MONTENEGRIN ACADEMY
OF SCIENCES AND ARTS

138

International Conference

TECHNOLOGY + SOCIETY ?→ FUTURE

2016

MONTENEGRIN ACADEMY OF SCIENCES AND ARTS

International Conference

TECHNOLOGY + SOCIETY $\xrightarrow{?}$ FUTURE

19–20 May 2016, Podgorica, Montenegro

Organized by
Montenegrin Academy of Sciences and Arts

In cooperation with
World Academy of Art and Science
European Academy of Sciences and Arts
The Global Round Table
European Federation of Academies of Sciences and Humanities (ALLEA)

MONTENEGRIN ACADEMY OF SCIENCES AND ARTS

Scientific Meetings
Volume 138

PROCEEDINGS

International Conference
TECHNOLOGY + SOCIETY $\xrightarrow{?}$ FUTURE

19–20 May 2016, Podgorica, Montenegro

Editor
Momir Đurović

Podgorica
2016

OPENING OF THE CONFERENCE

Momir ĐUROVIĆ
President, Montenegrin Academy of Sciences and Arts

CAN WE LIVE WITH TECHNOLOGY ADVANCE?

Your excellences ambassadors, your excellences ministers, very distinguished participants of the conference Technology + Society =? Future.

„Technology wants what life wants: Increasing efficiency; Increasing opportunity; Increasing emergence; Increasing complexity; Increasing diversity; Increasing specialization; Increasing-ubiquity; Increasing freedom; Increasing mutualism; Increasing beauty; Increasing sentience; Increasing structure; Increasing evolvability." (Kelly Kevin) Shaping the future in order to realize those goals that enable the establishment of a socially inclusive and environmentally healthy community is the fundamental challenge of human society.

Our own age is characterized by a deliberate fostering of technological change and by the growing social role of knowledge. The development and adoption of new technologies are changing individual and social values. There is only a „soft" determinism in the technology-society relationship, hence different societies can react differently to the same new possibilities. The rapid technological development of the past century — in biotechnology, information technology, nanotechnology and artificial intelligence — holds the promise to do the same for our current, post-industrial world. But what comes next, in a post-industrial world? Technology advances and growth may soon progress at a such fast rate, and perhaps a rate than is faster than our ability to deal with it.

Many stories, like one on communities the Oji-Cree, which were literally being killed by technological advances, offers an important massage to the human race. The problem with technological evolution is that it should be under our control but, unfortunately, we don't often make the best decisions. The most straightforward explanation for the lack of appreciation is that modern technologies are too complex to be understood by anyone but the experts.

Although the human have been accommodated to biological evolution, there is the principal difference between technological and biological evolution. Biological evolution is driven by survival of the fittest, and it favors organisms who are adapted to their environments. Technological evolution, for contrary, has a different motive force. It is self-evolution, and it is therefore driven by what we want, rather than to what is adaptive. In a market economy, it is even more complex. If we're not careful, our technological evolution will take us toward not a singularity but a sofalarity. That's a future defined not by an evolution toward superintelligence but by the absence of discomforts.

The developments in digital technology have been truly dramatic and their implications far-reaching. Intelligent Machines add further concerns. Neuroscientists, psychologists and researchers in the field of artificial intelligence come up with the term cognitive technology to describe how electronic devices and other tools can assist and influence humans' mental activities that may have profound effects on how we live. Medicine, energy, computation, weaponry, and basic materials may soon include nano-components. Nanotechnology could even change what it means to be human. The BINC technologies are likely to lead to big changes in societies. This could be as drastic as the differences between the Stone Age and the Bronze Age, or from agricultural society to the scientific age of industry. Inevitably, such a shift leads to changes in economic and political systems, national sovereignty, balances of power, the environment, the human condition, even religion. We are witnessing that economic, cultural and technical cooperation among nations is growing, resulting in increasing interdependence while creating both opportunities and challenges for the private and public sectors. But, the outcome will depend on how things are distributed — everyone can enjoy a life of luxurious leisure, or most people can end up miserably poor. So far, the trend seems to be toward the second option, with technology driving ever-increasing inequality.

Such technology „mega-trends" will greatly impact the society, giving opportunities for improving individuals lives and facilitating democratization and transparency. In the same time, these technologies present concerns about individuals privacy, data security and necessary adjustments for individuals, organizations, governments and the society in general. Furthermore they will not happen overnight, but are well on their way to reality and most of us don't realize it. This time the changes will take within a generation or so. With the right political, legal and economic structures and institutions in place, those changes can promise meaningful work, leisure time, prosperity and freedom for all. While society as a whole is not really cognizant of or prepared for the shifts to come, apathy and avarice conversely could seen this transition bringing our world into a new dark age, a dystopia controlled by a tiny elite, At the same time Political Systems also appear to be relying heavily on using technology, changing the way the economy or even society work, before the law can catch up.

Among many Hawking has made, too, a point about how increasingly advanced technology could potentially harm humanity believing „the development of full artificial intelligence [AI] could spell the end of the human race." Ray Kurzweil does not see humans and machines coexisting, though; he believes they will merge. Looking as science fiction he claims: Humans will integrate more and more technological devices into their body, a process that has already begun. The interface between biological and artificial parts will be broadened to a point where human consciousness can be downloaded into a powerful computer that simulates all aspects of a brain. When this happens, computers will also become conscious. According to Moore's Law, computer evolution will happen by much greater rate than that of natural evolution, thus computers will become more powerful than humans. Toffler has demonstrated that knowledge and technology are the two powerful determinants in facilitating changes in society, and thus bring the society to an unprecedented process of transformations to a new type of order. One can go on citating many well known scientists who expressed similar concerns.

Serious efforts are to be devoted to anticipate the consequences of technological developments. Thus, there might be need that technologies must undergo through strict selection procedures to evaluate the purpose of their innovations and applications in the society. Certainly, the research in some areas such as bio, nano and many more technologies cannot be stopped and should definitely continue, but certainly in a more controlled environment. It should become obligation that their results on society and our entire planet should be studied in details before a decision to commercialize and release them is made.

The conference is devoted to many questions related to the interaction of emerging technologies and society. Certainly answer are not so simple, obviously because we have not been jet adopted to the age in which knowledge and technologies, regardless produced by human or machine, are our destiny.

Those were some of issues why I had suggested to ALEEA, EASA, WAAS, and GRT to run the conference which has shown to be of a great interest, and no event in which all who wanted were accepted to participate. No dough, knowing many of participants at the conference that a light will be shed to some of still not fully understand questions among which there are many more than mentioned in this address.

Last but not least let me express to all of you welcome to Montenegro and to Montenegrin academy of Sciences and Arts. We are small country but long lasting even celebrating these days 1000 year having state, and 10 years since its independence was reestablished. Montenegrin academy is small but keeps organizing conferences in which top world intellectuals and thinkers participate. We will try, again, the best so you return here on the similar occasions next time, as you have done this time.

Thank you for attention!

Heitor GURGULINO DE SOUZA
President of the World Academy of Art and Science (WAAS)

OPENING REMARKS

Academician Momir Đurović, President, Montenegrin Academy of Sciences and Arts
Prof. Graham Cale, European Federation of Academies of Sciences and Humanities (ALLEA)
Prof. Felix Unger, President, European Academy of Sciences and Arts (EASA)
Dr. Gilbert Fayl, President, The Global Round Table (GRT)
Prof. Gordon McBean, President, International Council for Science (ICSU)
Mathieu Denis, Executive Director, International Social Science Council (ISSC)
Dr. Peter F. Mc Grath, Coordinator, The InterAcademy Partnership (IAP) including IAP for Science and IAP for Health
Felows of the World Academy of Art and Science (WAAS)
Distinguished Participants
Ladies and Gentlemen

It is a great pleasure and honor to address all of you this morning, on behalf of the World Academy of Art and Science (WAAS). First of all, I would like to express our warm congratulations and thanks to Academician Momir Durovic and his colleagues of the Montenegrin Academy of Sciences and Arts (MASA), for organizing this International Conference in Podgorica, under the patronage of H. E. Mr. Milo Dukanovic, Prime Minister of Montenegro. This time we will discuss quite an interesting and important theme: „Technology + Society >? Future". But I still recall that, just two years ago, President Momir brought us together here for another excellent Conference to discuss „The Transition to a New Society", the proceedings of which have already been published by MASA.

As a good scientist/technologist he is thinking ahead, in a future that is just around the corner and should be of deep concern for all of us. Indeed there are still many challenges ahead and more than ever, in my view, joint united action is and will be more and more necessary.

Technology was the key word of the „Fourth Industrial Revolution", as we witnessed in many discussions at the Davos Conference in the beginning of this year. Finally the United Nations arrived at a reasonable global Consensus, at the COP 21 held last December in Paris, pending of course, on „technological developments" to achieve global temperatures below 2 C (hopefully below 1,5 C in the next 50 years). And the General Assembly of the United Nations, in New York, in September last year, agreed on an important set of Sustainable Development Goals and Targets to be reached by 2030. Technology will also play a big role in achieving many of them.

So all of us should carefully look on the role of technology on society in our future.

Our own World Academy of Art and Science has jointly organized, with CERN (European Organization for Nuclear Research) at its headquarters in Geneva, last November 15th, a very important Conference entitled: „Science, Technology, Innovation and Social Responsibility" in which our Fellows and seven UN Agencies, located in Geneva have participated.

WAAS and CERN have expressed and I quote: „Today the rate of scientific and technological development dissemination and application far outpaces the capacity of society, institutions and individuals to adapt, contributing to increasing social imbalances, stress, upheavals, displacement and disruption. The challenge before humanity is to arrive at the most effective blend of governance and self-management to maximize both the freedom for scientific creativity and technological innovation and the welfare of present and future generations".

I don't have the time now to describe in more detail what CERN and WAAS are planning for the future, but I can say that among other of their traditional natural scientific endeavors (search for the boson of Higgs, e. g.) CERN is already developing a major Program, for the next decade, addressing the issues of innovation and social responsibility (involving young people, government and private business, e. g.) WAAS is working on a „New Paradigm for Sustainable Development" and on a „New Economic Theory", as well as through our WUC (World University Consortium), aiming to provide support for a „World Global University", an old dream of our founding fathers in the 1960's (almost impossible at that time, but certainly more feasible in this age of ICT'S — Information and Communication Technologies).

We have begun developing Courses in the IUC (Inter University Center) in Dubrovnik and next October 31 — November 4, one on „Social Power, Empowerment and Social Evolution will be offered, and you can

participate either as a Student or, as a Faculty, if you wish to. Also I should mention that WAAS publishes two Journals: „CADMUS" and „E-Eruditio", and both responsible for them — our Fellows Garry Jacobs and Winston Nagan, respectfully — are present in Podgorica. WAAS also publishes a periodical Newsletter. (Please see: www.worldacademy.org and: www.wunicon.org).

Looking to President Momir's basic theme for this Conference, I am quite sure that many of you, through your submitted papers will highlight technologies that will be developed, how they will be used and what will be their impact (positive and/or negative) in our societies. What will be their impact on climate change, for instance. Some are already predicting an explosion of the Internet of Things (loT) on consumers, businesses and governments. Studies have shown (Sweden) that the „Circular Economy" can cut carbon emissions by 70% by 2030. And my old friend Calestous Juma has written a book (that will be published next July 2016) with a title: „Innovation and its enemies" (Why People Resist New Technologies). I could cite many other technologies but time doens't allow me.

So, let me conclude, by thanking again our generous host and his team of collaborators for their great efforts, and our expecatation of a very successful Conference, in the name of our Trustees, our Executive Committee and our Fellows of the World Academy of Art and Science.

Graham D. CAIE
CBE, FRSE, FEA, FRSA
Member of ALLEA Board

WELCOME FROM ALLEA

Professor Caie thanked all those, and in particular the President of the Montenegrin Academy, who were involved in the preparation of this conference for making it so successful.

He brought the best wishes of the Board of ALLEA, the European Federation of Academies of Science and Humanities, of which the Montenegrin Academy is a member. This conference expertly reflects a core value of ALLEA, namely the essential links between, and co-dependence of, natural science, social science, technology, humanities and society. Such a conference occurs at a critical time for science and society, for example the need to plan for a sustainable future earth, and to promote human welfare throughout the world.

A word about ALLEA. ALLEA comprises 57 Academies of Sciences and Humanities from 40 countries in the Council of Europe region; that means countries outside the EU are members and some countries have more than one academy represented. Our President is Professor Günter Stock and the federation is based at the Berlin Brandenburg Academy of Sciences and Humanities. We have an annual General Assembly — this year in Vienna — at which all ALLEA activities are discussed, the working committees report and the President and Board are elected from amongst the ALLEA Members Academies, the Board being responsible for all operative ALLEA activities.

ALLEA membership is based on key criteria, such as interdisciplinary excellence" scientific autonomy, the academy‘s role in the national science system, and international collaborations. It aims to promote the exchange of information and experiences between Academies, to offer European science and society advice from its Member Academies, to strive for excellence in science and scholarship, and for high ethical standards in the conduct of research. ALLEA contributes to improving the framework conditions under which science and scholarship can excel, fosters independence from political, commercial and ideological interests, and works towards an understanding of Europe as a cultural and intellectual entity.

ALLEA provides independent, evidence-based advice to European policy and society, and does this partially by means of the newly created European Commission's Scientific Advice Mechanism (SAM). In this project ALLEA has joined forces with EASAC, FEM, Academia Europea, and Euro-CASE. In addition to the High Level Group assembled by the Commission and the Joint Research Centre in Brussels, this Consortium of five Associations has been identified as the most suitable source of independent, scientific advice for EU policy makers. We hope that this will improve the quality of EU policy making by providing timely scientific evidence to the EU, and creating more effective links between individual academies and networks of academies. In addition to requests from the EU for short term and long term advice, ALLEA and its partners in SAM will initiate science advice projects, based on our horizon scanning.,Advice, therefore, will be provided top down for policy makers, and bottom up on topics we consider policy makers should be aware of.

ALLEA co-organised meetings in the European Parliament on topics such a demography, societal inequalities and has co-organised the pairing of MEPs with researchers from our member academies.

Since its beginning ALLEA has provided analytical reports and studies, memoranda and statements, articles and essays on relevant scientific matters and reaches a wide range of decision-makers and stakeholders in the science policy arena. These include „Open Access to Scientific Publications", „On the Status of the Patent System of the European Union", „Going Digital: Creatiing Change in the Humanities", „On the Boundaries of Europe" and „A Survey and Analysis of Basic Social Science and Humanities Research in European Academies".

At the General Assembly we award the ALLEA Madame de Staël Prize for Cultural Values. Last year it was awarded to Professor Dame Helen Wallace of the British Academy by European Commissioner Carlos Moedas. This year in Vienna the prize was presented by Commissioner Johannes Hahn to the French philosopher Rémi Brague. The topic for this year's symposium at the General Assembly was *The Freedom of Scientific Research in the Face of Political and Societal Demands*.

ALLEA actively engages in the advancement of the European Research Area and in particular Horizon 2020, and has working groups on topics such as Digitisation and Research Infrastructures, Intellectual Property Rights and Open Access, Science and Ethics, Science Education, Social Sciences & Humanities and E-Humantiies. The Social Sciences & Humanities working group, for example, has made major progress, thanks to the British Academy, in embedding SSH in future H 2020 calls, evaluating the first years of H 2020, and in planning the future research programmes in a post-H 2020 Europe.

ALLEA is honoured to be part of this important International Conference and wishes all participants well in the coming days,

Felix UNGER
President of the European Academy of Sciences and Arts

WELCOME REMARKS

I would like to congratulate Academician Momir Djurović for organizing this important meeting and initiative. He has been organizing such important meetings for 15 years. Such events are very important for Montenegro, as they stimulate and create new ideas for the future of this country.

Before I came to Podgorica, I had met Academician Djurović twice in the last months First at the ALLEA-Meeting in Vienna and then at the Danube Academies Conference in Ljubljana, where we spoke of today's meeting. The title is representing a kind of equation, implying that our input adds up to the future. It is very well chosen as this equation is also a task for Academies. Presently, Academies are in transition. Therefore, it is always important to consider from where we are coming and where we are going.

The longstanding tradition of Academies began with Plato 2.500 years ago. He started in the garden of Akademikos in a narrative way gathering important people and discussing different topics as well as developing new ideas how to run a state. His Timaios gives a great deal of the main thoughts of this school which is of course based on the contact with Socrates and later on continued by Aristotle.

There was a break of nearly 1.000 years when Ficino started in the gardens of the Medici in a narrative way to develop ideas for the state. Boccaccio was also during this time and made it possible that young people met in the outskirts of Florence and survived the pestilence in Florence. Machiavelli was also very important during this time, giving instructions to the Prince of Florence in his booklet „Il Principe". The time for establishing academies was mature. Newton founded the Royal Society with the specific aim of being advisor to the King, giving advices based on evidence. This concept was taken over in Berlin and Paris, where Leibniz and Voltaire established similar concepts and understood their roles as advisors to their Kings too.

In the 20th century, the tasks of Academies started to change slightly. Research labs were founded which were not necessarily part of the core concept of an Academy, they are in competition to Universities. At the end of the 19th century the Kaiser-Wilhelm-Institute in Germany was founded. During the communist time research institutes at Academies as well as educational sites were very important in Eastern Europe. Academies started to become large entrepreneurs in the states. This was important to have a political control of the researchers.

Now the European Union again has the desire of advising politicians with the hope to influence policymakers in their decisions. I am always a little bit hesitant seeing this as a final goal. All what I have experienced is that politicians are rather resistant to advices, they decide not necessarily on evidence, they are deciding on plausibility. Decisions have to be translated to people, to their demands and finally to be re-elected. We have seen it recently with the topics pesticides and nuclear energy. I would like to make some critical remarks at this point: Scientists are sometimes difficult. I was told by some politicians that when meeting three scientists, they get to hear five opinions.

In the 21st century a new narrative has started. We called this project „Next Europe". Everybody is called upon to express their ideas and opinions for the future of Europe. We invited our 1.900 members, 2.300 friends and are compiling all inputs which will lead to a strategic concept how to transform all contributions in a final recommendation. The first public meetings are starting in fall 2016. The final results will be presented in the Giardini of Venice in 2018.

Why the Giardini? Because The Giardini represent the development of Academies, starting with a narrative of Plato in the garden. A garden can be interpreted as a metaphor, as an environment where people are walking, discussing, sharing experiences in all four dimensions (room and time). Mankind started in the Garden of Eden. Now we use the garden as a soil for new ideas, and the technique of communication in a garden is the „narrative".

Gilbert FAYL
President of The Global Round Table*

OPENING WORDS

I would like to congratulate Prof. Momir Djurovic, my good friend, for organising this conference at a critical moment in the European Union's history.

The Global Round Table is delighted to be among the organising partners. It is a fact that — Great powers rise and fall.

They rise for reasons of fortuitous circumstance, they crumble because they overlook or underestimate warning

signals. History has shown that neither economic- nor military might prevent civili sations from vanishing.

This is equally true for the European Union.

The EU has arrived at a crossroads and must decide on how to best meet the new challenges of the 21st Century, including the transition to a new global order, global migration and global terrorism.

The EU is witnessing an unimaginable human drama and facing a — in modern times — not-experienced monumental challenge of uncontrolled human migration from another cultural region. By early 2016, more than one million (maybe close to two) legal refugees and economic migrants are in- and on the route to Europe. The end of the migration flood isn't in sight as indicated by the subsequent ill ustration.

This dramatic development is stretching political cooperation, public opinion and resources to breaking point within the EU, and could have wide-ranging consequences for the European social fabric.

But the uncontrolled migration is just one of the challenges the EU is facing. The other key challenges include:

— The foundations of civili zations in the 21st Century is under attack by criminal forces from the Middle-East and Northern-Africa;

— The perceived post-Cold-War geo-political stabili ty is under threat; and

— The key challenges from the end of the 20th century remain — notable global warming and global financial volatili ty.

Regrettably, it must be acknowledged that current responses of European political leaders are temporary fixes.

European leaders must recognise that solutions to the monumental challenges will never be found in naïve humanitarianism nor political correctness or selfish economics. European leaders must remain faithful and steadfast to values that represent European society.

The situation is crying out for a realistic vision for the EU's future in the new World order followed by determined political leadership.

It is my hope that this conference will contribute with innovative ideas and implementable proposals to which I wish every success.

*

* The Global Round Table is a unique non-party political initiative with the aim to improve the level and quality of information available to economic- and political decision-makers. The secondary aim is to provide inspiration to civil society leaders and the young generation.

Its Protector and High Patron is H. E. Boutros Boutros-Ghali, UN Secretary General (1992–1996) and President of the International Panel on Democracy and Development. Its International Board include Nobel Peace Prize Laureate, former Heads of State, former Prime Ministers, former European Parliament Vice President, former European Commission Vice-President, former President of UNESCO General Conference, former President of World Academy of Art and Science.

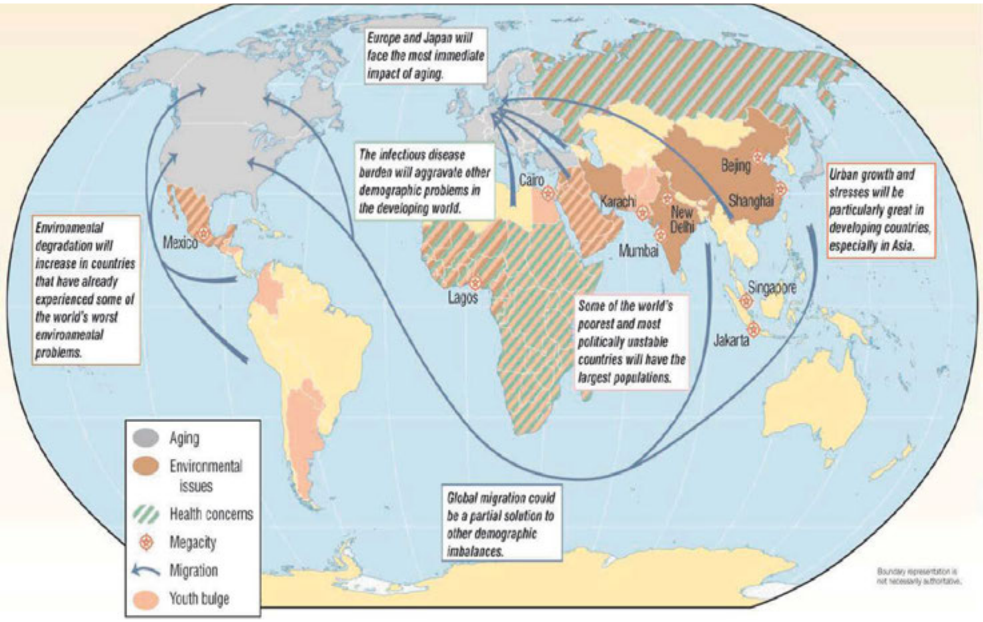


Illustration:
Snapshot of Global Demographic Trends at the turn of 20th to 21st Century.

Source:
https://www.cia.gov/library/reports/general-reports-/Demo_Trends_For_Web.pdf (July 2001)

Gordon A. McBEAN
President, International Council for Science

OPENING COMMENTS

On behalf of the International Council for Science (ICSU), I bring greetings to all the participants at this important International Conference on Technology and Society and their relationships with the Future. Seeing the future is an essential element in our role as scientists and it is necessary to bring together all aspects of science, technology and society in order to enable our forward projections. To do this, we need to bring together a very broad range of disciplinary scientists and to enable transdisciplinary science; in this, we are working very closely with the International Social Sciences Council (ISSC) and are pleased that they are also represented here. Thanks to the Montenegrin Academy of Sciences and Arts, one of the 122 National Members covering 142 countries, of the International Council for Science. We value greatly the input from our Members, from a national, multidisciplinary perspective, on priority areas for our future activities. This Conference is especially important in this broad context and also specifically for our Future Earth: Research for Global Sustainability. It is also important that the World Academy of Art and Science (WAAS), European Academy of Sciences and Arts (EASA), Global Round Table (GRT), and European Federation of National Academies of Sciences and Humanities (All European Academies-ALLEA) are also cooperating in this Conference. The interactions and synergies amongst our international organizations provide for the scientific inputs towards moving the global community ahead for the benefits of societies, all societies. A conference addressing issues of technology in all its aspects and the broad aspects of society is very important and I am very confident that this Confidence will contribute greatly in these aspects. Thank you for inviting me and I look forward to the presentations and discussions and continuing dialogue into the future.

Peter McGRATH
Coordinator, IAP

WELCOME ADDRESS

First, let me say that I am very pleased to be here — my first time in Montenegro.

I was due to come two years ago, but a torn shoulder ligament and subsequent operation meant that I couldn't travel.

Thank you also to Prof Djurovic, President of the Montenegrin Academy of Sciences, for the opportunity to address you all on behalf of IAP during this opening session.

I want to start by referring to the establishment of the InterAcademy Partnership, which was formally endorsed by the member academies of three international academy networks — IAP, IAC and IAMP — at the IAP General Assembly in Hermanus, South Africa, on 2 March this year.

This Partnership should now enable us and our member academies to receive greater visibility for our efforts as we work in a more coordinated manner under a single banner.

It also provides a strength as we go seeking funds for projects. Indeed, we already have three major ongoing projects.

Already active since a year ago, we have funding from the German government for a series of regional studies on 'Food and Nutrition Security and Agriculture'. The four regional reports will then be capped with a final global report — a model for future IAP activities that can build on efforts of individual academies and our affiliated regional networks.

Two other projects are just beginning to get under way. In the past few weeks, those of you representing IAP member academies should have received an invitation to nominate experts to guide the two projects: 'Harnessing SEM to address Africa's challenges' and 'Improving scientific input to global policymaking' — which will provide training and help build the capacities of academies to provide science advice to governments.

Indeed, immediately prior to the IAP General Assembly that I just mentioned the Academy of Science of South Africa (ASSAf) hosted the IAP Conference on Science Advice — perhaps our most successful yet, based on the quality of the speakers and the record number of academies in attendance.

One of the recommendations that emerged from Hermanus was that IAP should forge close links to the UN system — indeed that IAP and its member academies should be seen as „tools" for use by the UN rather than „stakeholders".

We are already acting on this, building on engagements such as with the UNISDR — as a member of the scientific community (led by ICSU) providing guiding the input of S&T into the implementation of the Sendai Agreement on disaster risk reduction — and the ongoing efforts of the IAP Biosecurity Working Group into the deliberations of the Biological and Toxin Weapons Convention.

And in these very days, IAP for Health (formerly IAMP) has convened a group of its Young Physician Leaders alumni at the World Health Assembly in Geneva — some of whom have been integrated into their national delegations. Likewise, on 22 May, a statement from the IAP for Health co-chairs will be read out at the opening of the UN Environment Assembly in Nairobi.

And we have a fantastic opportunity for further engagement as the UN Scientific Advisory Board will be meeting in Trieste next week — hosted by IAP along with the other international organizations based in Trieste: TWAS, ICTP and ICGEB.

These are examples of IAP engaging in science for policy — but we have also been working in the arena of policy for science. Most notably with partners ICSU, ISSC and TWAS, under the banner of Science International. The result of the first Science International meeting was the release of an accord on 'Open Data in a Big Data World'.

Again, academies and other organizations should have received an invitation to review the text of the accord and to consider endorsing it. If your academy has not yet done so — there is still time.

Now, coming back to the theme of this conference, 'Science + Technology = ? Future', the different topics that I have mentioned — plus synthetic biology, which I will speak on tomorrow, as well as others such as antimicrobial resistance, climate change, water management and sustainable energy — are all areas where the scientific community can have an influence and help model 'the future we want' — as per the resolution adopted by the UN General Assembly on 27 July 2012 and the stimulus for the Sustainable Development Goals (SDGs).

It is up to us as scientists, as academicians, and as a global network of academies, to ensure that the future we want is the one that actually arrives.

Let us work together to ensure that. — Thank you.

Milo ĐUKANOVIĆ
Prime minister of Montenegro

LETTER TO MR MOMIR ĐUROVIĆ PRESIDENT OF THE MONTENEGRIN ACADEMY OF SCIENCES AND ARTS

Dear Mr President of the CANU,

Due to the fact that I will not be in Montenegro, I am not in possibility to take part in the great international conference Technology + Society=?Future, organised by CANU under the auspices of the Government of Montenegro. This activity was also aimed at showing the respect towards this current, intriguing topic which preoccupies the modern world. Also, we wanted to show the respect towards the affirmed names of the European and the world's scientific minds that have shown appreciation to the Montenegrin Academy and Montenegro by attending the event. We especially appreciate the fact that this representative scientific event is organised in days when our state celebrates the first decade of its independence and renewal of it international recognition.

I certainly understand the dilemmas that you indicated in your invitation letter. Regardless of the fact that none of us today has the valid answers to them does not mean that we have to seek them on daily basis. Maybe the key is in reminding to the retrospective of the road passed. The development of the global society at the end of the last century was marked by the fast technological progress. The technology has become the key factor of the swift changes in all segments of the society. This swiftness precisely is the main characteristic of today's world which implies uncertainties, but also the hope for the better future. This is why the technological development and its impact to society and the future is a very inspiring subject. New findings in the world of science open the new development and application paths for the new technologies in the every-day life of a man. These are expected to improve the economic growth at the same time and to contribute to the wellbeing of people. Not to be fascinating but to contribute to the improvement of the quality of life and the overall progress of the society.

In order to understand the modern processes, the contemporary education is necessary above all. This is the only way that allows for keeping the pace with the development in science and technology and for understanding of its benefits for the individuals and the society as a whole. The education of the new generations of researchers and experts in science and technology is of the essential importance not only for understanding of the process but also for contribution to the modernisation of the technological development. The knowledge must be a base that is upgraded by the creativity and innovation, entrepreneurship spirit and the team work.

Our society needs the continuous enhancement of skills and knowledge in order to successfully plan and envisage the economic development trends which cherish the technology as a powerful and strong means of change for the better.

The state needs to have a role of a driver of the development processes in order to pave the roads towards a stronger application of new technologies with a view to smart growth and society development. I am pleased that the new generations have talent and show the interest for inclusion in the contemporary technological trends. According to the results achieved, we may hope that the future lies in sure hands. I find especially important that the scientific institutions such as the Academy, by communicating with the most relevant scientific addresses, create the conditions for keeping track with the contemporary global trends which helps us to consider our reality and anticipate the future that has already begun.

I believe that after this scientific gathering, we will be a step closer to finding the answers to this and other contemporary challenges.

I wish you a successful work, and a pleasant stay in Montenegro to the guests. I would like to extend the cordial regards to all participants of the international conference.

Key-note lecture

Loucas G. CHRISTOPHOROU
Academy of Athens

SCIENCE-BASED TECHNOLOGY AND SOCIETY

Abstract: in biomedicine and energy, and their possible impact on society and on man himself are discussed. The frontiers in biology and medicine will give humanity new powers to treat, prevent and cure diseases and to effect beneficial genetic modifications of plants and animals vital for society's future (for instance, increase of food production). Simultaneously, these same powers will give rise to new ethical and social issues and „fears of the worst kind". Indeed, some argue that emerging scientific and technological frontiers in biomedicine, will determine, in the non-too-distant future, the ultimate fate of humanity. Similarly, frontier science-based energy technology promises abundant, „clean" energy, intelligently conditioned to the needs of modern technology; energy will impact all future functions of society and its availability and affordability will be considered a human right. Simultaneously, energy production and use will continue to raise fundamental challenges and serious concerns about its adverse impact on the environment and climate change.

Undoubtedly, there will be many new future avenues to knowledge and its use and misuse, and hence enormous shared responsibility by both scientists and non-scientists. This responsibility must be grounded on basic human values and the mutual accommodation of science and society through enhanced dialogue and trust. In our view, the *ultimate future challenge of civilization will be the protection of humanity and the respect of human dignity.*

Key words: *science-based technological frontiers; biomedicine; energy; materials; dual impact on society*

SCIENCE-BASED TECHNOLOGICAL FRONTIERS AND THE DUAL ASPECTS OF THEIR IMPACT ON SOCIETY

Science and science-based technology have accelerated the pace of change and innovation and have unified the world; there is no „them" anymore; the boundaries of national civilizations and cultural-value-systems are being blurred. Science and science-based technology enabled the formation of societal infrastructures vital for the survival and well-being of humanity; they helped humanity achieve social justice, freedom and emancipation in many parts of the world and made possible the penetration and the breakup of the „iron curtains" of totalitarian states, liberating oppressed peoples.

Yet, injustice and suffering abide the world over, totalitarian states still enslave their people, and basic human needs for food, energy and shelter are still not satisfied for billions of people especially in the rural areas of impoverished countries. Terrorism and extremism still inflict pain and misery on a grand scale the world over, and uncontrolled capitalism and failed government policies lead to unprecedented world-wide economic crises setting humanity back on a slower pace, homogenizing people in their degradation. An unrestrained consumer society lives beyond its means and strains resources and the planet.

The *dual aspects of the impact of science-based technology on society and on man himself* will continue and can, in fact, be anticipated to intensify in the future. In this paper the impact of science-based technological frontiers is exemplified in three areas: (1) *Biology and medicine (foremost molecular genetics and molecular medicine) and biotechnology,* (2) *Energy (new sources, carriers and transformations of energy), and* (3) *New materials (nanomaterials and superconductors).*

1) BIOLOGY, MEDICINE AND BIOTECHNOLOGY

In the previous century, we have seen the merger of chemistry with physics and gradually the merger of biology with both physics and chemistry. By the end of the 20th century we have begun to see the gradual reduction of parts of medicine to atoms, molecules and genes, and the beginning of the remarkable explosion in molecular and genomic medicine, driven in part, by *bioinformatics* (the use of computers to rapidly scan and analyze the genomes of organisms). Basic elements of these emerging technologies are the next generation of genome sequencing, genetic engineering, and big-data driven medicine. In the manipulation of the very small lies new fundamental knowledge for understanding the behavior of the very large, which will undoubtedly lead to new technological frontiers in biology, medicine and biotechnology giving humanity new powers to treat, prevent and cure diseases, and to effect beneficial genetic modifications of plants and animals vital for society's future. Concomitantly, these same powers have the potential to change us: the way we are, the way we live, the way we think about ourselves, and the way we relate to the rest of life and nature. Indeed, some argue that emerging scientific and technological frontiers in biomedicine, will determine, in the non-too-distant future, the ultimate fate of humanity.

Examples of the new frontiers in these fields are the following:

— *Molecular and genetic roots of cancer.*The processes leading to the development of cancer are extraordinarily complex and there are many different types of cancer. If the uncontrolled growth of cells is caused by genetic abnormalities in cells, then hitting cancer at its molecular origin is of utmost importance. It is generally believed that in the near future it would be possible to cure many genetic diseases that are caused by the mutation of a single gene. In the case of cancer one is likely to be dealing *with multigene processes* [1, 2].

— *Stem cell technology.* Stem cells can change into any type of cell in the body, and embryonic stem cells retain this ability to re-grow any type of cell throughout their life. Stem cells have the potential to cure diseases such as diabetes, heart disease, Alzheimer's, and Parkinson's. They are, however, controversial and they raise ethical questions because an embryo has to be sacrificed to extract these cells.

— *Designer genes.* In time, it will be possible to go beyond just fixing „broken" genes to actually enhancing and improving them. Whether designer genes should be used to change the way we look, the way we feel, to make us healthier or something else, we are faced with profound ethical issues.

— *Germline gene modification.* Here one alters the genes of the sex cells and the resultant genes are passed on to the next generation. A frontier field, full of promise and peril, and replete with scientific, ethical and social concerns [3].

— *Synthetic biology.* This new field began to surface at the turn of the previous century; it has been described as „the application of science, technology and engineering to facilitate and accelerate the design, manufacture and/or modification of genetic materials in living organisms"; „to create life from non-living materials. to design living things that meet the specific needs and wishes of humans" [4]. Synthetic biology is defined as „the application of science and engineering to facilitate and accelerate the design, manufacturing and/or modification of genetic materials in living organisms" [5]. „Synthetic genomics" according to Cho and Belman [6] refers to the laboratory synthesis and assembly of genomes and their expression to produce viruses or cellular life forms. From its beginning, synthetic biology has been steeped in controversy regarding its potential for societal benefit or harm. Opinions vary from praising synthetic biology for „engineered future life" to how it could lead to the devaluing of life. Unquestionably, the ethical issues raised are monumental [7].

— *Epigenetics.* This emerging science „describes changes in the regulation of gene expression that can be passed on to a cell's progeny, but are not due to changes to the nucleotide sequence of the gene" [8]; they are epigenetic (non-genetic) modifications to the genome „that crucially determine which genes are expressed by which cell type, and when" [8].

— *Human genetics.* The genetic changes that help separate humans from chimps are likely to be profound despite the oft-repeated statistic that only ~ 1.2% of our DNA differs from that of chimps. A complete understanding of uniquely human traits will, however, include more than DNA [8, 9]; it takes much more than genes to make the human. The *sequencing of the human genome* gives humanity new powers to treat, prevent and cure disease. At the same time the new developments in biotechnology, genetic engineering and synthetic biology raise profound new ethical and social issues mainly caused by the possibility of crossing boundaries between species. What changes in man? Will, for instance, man proceed and create synthetic forms of life and should he concede rights to non-human animals? Is man, as many have prophesized [10], *en route* to the creation of a post-human society? And by „what standards and on whose authority?" might one rightfully ask?

— *Prosthetics.* Molecular and genomic medicine will profoundly impact the health care and delivery systems. Future robotic prosthetics which mimic what the human body does naturally are being envisioned, and nano-robots might become a reality and might alter society profoundly [2].

Genetic modifications of plants and animals. Genetically modified organisms (GMOs) have been applied to plant and animal food sources and genetically-modified foods (GMFs) are a reality. The benefits — real and potential — of transgenically-modified plants and animals include food supply, enhancement of nutrient security, targeted health such as diet-related chronic diseases, as well as improving herbicide or disease resistance, or drought tolerance, etc. Currently, commercialized GM crops include maize, soya beans, cotton, canola, squash, papaya, sugar beet, tomato and sweet pepper, which are grown primarily in North and South America, and South and East Asia. In efforts to boost agricultural productivity in the world's poor regions, attention has been drawn to Africa [11, 12]. Africa, many argue, needs to embrace technologies that enable production of more and better food, and GMOs may increase cereal production especially in Sub-Saharan Africa. However, coexisting with the benefits of genetic modification of plants and animals are known and unknown risks such as possible health risks and food safety, but also possible effects on the environment and socio-economic and ethical issues connected with control of agricultural biotechnologies and intellectual property rights [11–14]. Partly for these reasons, there still remains scepticism over GMFs and the issue still divides the EU [15]. In spite of these (and possibly other) concerns, humanity would likely take full benefit of the new age of molecular biology and biotechnology for food production and would explore further options involving highly polygenic traits [16]. In the fight against world hunger, another factor is of paramount significance, namely.

2) ENERGY (NEW SOURCES, NEW CARRIERS, AND NEW TRANSFORMATIONS OF ENERGY)

Frontier science-based energy technology promises abundant, „clean" energy, intelligently conditioned to meet the needs of modern technology; safer electrical energy from nuclear fission and abundant clean energy from controlled nuclear fusion; more efficient, cheaper and larger scale renewable energy sources with storable energy and fuels capabilities; transmission of large amounts of electrical energy over long distances [17].

Energy is and will continue to be critical for society. An incessant flow of energy is the basis of modern civilization and of life itself. Technology may be limited by not just the amount of available energy for its use, but also by the forms of available energy. For instance, technology today (information technology in particular) is dependent on the availability of energy in especially conditioned forms. New ways to access known forms of energy and new sources of energy will be sought, and new energy transformations and energy carriers will be searched for. What will succeed electricity as an energy carrier? Would *photons replace electrons as energy carriers?* And would a better understanding of the pathways of energy flow in biological systems lead to a better understanding of biological mechanisms and relevant technologies?

Energy is the key in achieving stability of the planet's climate. Energy production and use will continue to raise fundamental challenges and serious concerns regarding its adverse impact on the environment and climate change. The energy-climate era will thus continue unabated. Hence, up and until we obtain abundant „clean" energy, we need to slow-down the use of „unclean" energy and reduce our consumption of energy by conserving energy and by utilizing it more efficiently [17–19].

Energy raises moral issues as major factor of social well-being. Ethical questions are raised about the use of energy and about the access to energy. World poverty is essentially energy poverty; to eradicate poverty we must satisfy *the basic energy needs of poor people*. Countries where a large part of their population lives on less than $2 a day have little or no access to electricity [20]. Developed countries consume up to a thousand times more electricity per person per year than the underdeveloped. There is in fact a clear relationship between the consumption of electricity and the GDP of a country. The high-energy consumption by the developed countries today affords their citizens the greatest choice in human history; lack of energy means lack of choice. The future is thus clear: *Escape poverty through provision of energy and in particular electricity; access to affordable energy may be regarded a fundamental human right and a moral obligation of civilization* [17, 18].

Humanity must make its use of energy compatible with human survival, need and dignity, and its obligations to the planet. And because the consumption of electricity will continue its ascendant course, the challenge for the future remains the transition to carbon-free energy.

3) NEW MATERIALS

Frontier science-based technologies will rely heavily on new materials. Let us look, by way of example, at just two categories of materials: *nanomaterials and superconductors*. The potential uses of both types of materials are based on knowledge to handle atoms and molecules and to manipulate them in a targeted way, making use of structure-dependent atom-to-atom and molecule-to-molecule interaction and processing.

Nanomaterials are substances with dimensions less than ~100 nanometers (1 nanometer is one billionth of a meter). At these sizes, materials exhibit size-dependent properties. Nanomaterials are increasingly being used in bioscience, information science and technology, energy generation and storage, bio-physico-chemical processing and catalysis, diagnostic and therapeutic applications in medicine, and so on [21]. Nanomaterial research is rapidly expanding in the use of nanoparticles in medicine and cancer therapy, and nanomaterials and nano-devices are envisioned revolutionizing medicine whether through nano-machines or molecular robots.

Another most interesting application of nanomaterials is in the area of *nanophotonics,* the study of the interaction of light at the nanometer scale, which allows understanding of the flow of light at length scales far below the optical wavelength. As photons are „shrunk" to nanoscale dimensions ultimately approaching the scale of the wave function of electrons, fundamental new science is expected and important new technological advances are anticipated, for instance, dense integrated circuits and optical computing [22]. Nanomaterials are expected to impact light-based quantum technologies, which are driving forward the quantum information revolution [23]. Light plays a central role in these applications because it is the ideal medium for transmitting quantum information [24]. Quantum communications deal with the idea of transferring quantum states from one place to another. The underlying concept is that quantum states can share entanglement between several parties, and these correlations can encode information which is shared between the parties.

High-temperature superconductors. The development of high-temperature (T) superconductors will signal the „age of magnetism" and will impact technology most profoundly just as electricity and electromagnetism did in the previous century. The highest-temperature known superconducting materials are the cuprates, which have demonstrated superconductivity at atmospheric pressure at T as high as -135 °C (138 K) [25, 26]. A room-temperature superconductor is a material that would exhibit superconductivity at 0 °C. While this is not strictly room temperature (~20–25 °C) it is the T at which ice forms and can easily be reached and maintained. Finding a room T superconductor would allow creation of huge magnetic fields that require little power and would have enormous multifaceted technological significance; for instance, in high-speed rail systems and other means of transportation, in health systems, and in energy where they would enable „an *energy superhighway* by supplanting copper electrical conductors with a ceramic superconducting alternative that has higher capacity while eliminating losses that typically occur during transmission" [27].

Explosive new developments lay ahead also in many other areas such as *information technologies and the Internet*. Newness in future computing and in computers themselves would allow *abundant avenues to knowledge and its use and misuse*. We shall all be changed whether by ubiquitous computing (by bringing the computer into the world) or by virtual reality (by putting us into the world of the computer). Through the Internet, developing nations will be able to take a shortcut to the future, taking advantage of the information revolution to build on intellectual capital. *Information technology and the Internet* with all their wonderful benefits, could be easily misused (e. g., forgery, fraud), and we could all be drowned in „unfiltered information" and stripped of our personal privacy. More powerful computers and more fundamental advances in computational methods, taking advantage of new (superconducting) materials, would lead one to assume that in the future „everything would have a tiny chip in it, making it *intelligent*" and we would then, as Kaku writes [2], be living in „a world populated by robots that have humanlike characteristics!" Technology will drive ethics and not the other way around [28].

SOCIETY

1) SOCIETAL COMPLEXITY

Human society, history tells us, is moving toward higher levels of complexity: larger settlements supported by increasingly larger and more complicated infrastructures; more institutions, social needs and specialization; larger information and communications loads and more societal interconnections through an elaborate web of systems and technologies. Society increasingly becomes more organized, more socio-politically controlled, and more dependent on powerful technologies to support the services demanded by its population traditional needs and new habits such as the explosive growth in consumer, business and government e-services. The cost of maintaining this societal complexity is increasingly becoming more difficult to afford principally because it requires: (1) processing enormous amounts of energy and information in an increasingly less efficient manner, and (2) technological infrastructure which grows increasingly more complex and becomes more difficult to understand and to control. Societal complexity and its maintenance, it is argued [29], destabilizes society's institutions and diminishes their adaptive capacity; it makes society operationally fragile and vulnerable. Once complex societies become unable to support their complexity, they crumble and unavoidably they collapse; in the present age of globalization, *they may not collapse in isolation*. Yet, all indications are that present complex societies will become more complex in the future. They will thus require more efficient infrastructure, new technology, and new information processing and energy supply systems.

Another most crucial element for the sustainability of modern civilization is the balance between availability and consumption of resources. It is unlikely that technology alone will be sufficient for society to achieve this balance; society *has to tame consumerism* through *cultural change* and *adaptation*.

2) COMPLEXITY IN SCIENCE AND VALUES

In the future, new scientific concepts and constructs will be needed to enable better understanding of higher levels of abstraction in basic science and the emergence of large-scale behavior of highly complex systems. New mathematics will be needed for the modeling of complex systems and for characterizing the behavior and properties of biological entities with huge numbers of degrees of freedom.

The increase in societal complexity and the accompanied increases in communication, information exchange and human interactions are accompanied by changes in human behavior and the emergence of new types of human relations, which challenge traditional human values and ethics. For instance, the relations between individual persons have been profoundly affected by the degree of their mutual reciprocity. As human reciprocity weakens, so does the value of the „the golden rule". On the other hand, human problems and events become instantaneously panhuman, and ethics assumes new time- and space-characteristics. Will the spectrum over which value judgment is effected become too large for any value to be effectively applied? Is societal complexity a challenge to values?

Similarly, the ethics of energy and the environment transcends locality and demands responsible global action over space and time [30]. Adaptability, it has been said, is an asset for survival. Yet, paradoxically, the greatest threat to the quality of life is that the human species is so immensely adaptable that it can survive under utterly objectionable conditions. Healthy adaptation whether in governments, businesses, or social organizations and institutions needs innovation, and almost all innovations can cause both benefit and harm. And how would we adapt to machines interacting with each other as algorithms, with little human involvement?

As noted earlier in this paper, powerful new realities challenge ethics in a most fundamental way: *man is getting ready to modify and to remake himself and all the rest.* We are headed for actions beyond „all former ethics" and we may wonder if we would care about our former ethics and values and the things we were! Truly, then, we might ask: who has the right to experiment with the future of humanity?

3) SCIENCE, SCIENCE-BASED TECHNOLOGY, AND SOCIETAL VALUES

It is the mutual responsibility of scientists and society to curb the power of science to suppress and destruct, and to deploy scientists in this process. Since WWII, the frontiers of science and technology have increasingly become the frontiers of weaponry. Science and scientists are unquestionably responsible for the dangerous nature of modern weapons [31] — without modern science such weapons would not be possible. There is thus a pressing need for radical scientific change, a need for a paradigm shift in the functions of modern scientists. Science needs to reassess its deep involvement with the machinery of war [32].

*It is the mutual responsibility of scientists and society to predict, prevent and manage the risk against the idea of man associated with the progress of science.*There will be immense future challenges to science and human values arising from the influence of science and scientific technology on man and his image.

As it has been argued earlier [33], the road from *human to animal* has become wide open with the systematic insertion of human genes into animals, to beings who share human and animal cells and are potentially new forms of life, *chimeras.* Several such efforts are under way in a number of countries. How „human beings" are the chimeras made with human stem cells? At what point in the process animal beings with consciousness are being created? Does the road to better health through chimeras constitute the next step in the further diminution of man? Difficult questions challenging science and values alike.

Earlier in this paper, reference was made to *synthetic biology* as its purpose is to artificially design new biological and biochemical systems („genetic material parts"), that could then be placed in living cells and their behaviour and new functions be studied. This knowledge is sought in order to design synthetic systems, which define the recipient organism's central genetic features and allow the artificial intervention in the basic operational mechanisms of life and the feasibility of creating „artificial life". Thus, synthetic biology becomes potentially capable to design with computers and compose with biochemical methods artificial genomes, to import them at will in the cells of organisms and to bring in their genome any changes sought by the designer researcher (or his employer); it creates *semi-synthetic„chimeric" cells, and opens the way for artificial life.* The questions raised are many and fundamental. What information will be „written" in the synthetic DNA that will be *infused* into the cells? Who will intervene and plan artificially the operation of the organisms' cells? Who (and how) will prevent the design of genomes for the creation of dangerous synthetic forms of life? These are essential questions and great challenges to science and values.

It is the mutual responsibility of scientists and society to require that the application of scientific knowledge is compatible with the values of society. For this, scientists and society must achieve accommodation between their mutual value systems, enhance their mutual trust, and shift from confrontation to complementary acceptance. Obviously, the morality of modern man cannot be based on science, but neither can it be separated from it, nor can science claim to be amoral. Science and science-based technology have added new roles for knowledge in ethics. It is furthermore essential for society to recognize that virtually every major issue confronting it has a science and technology component requiring public understanding. This requirement will be magnified in the future. It is thus necessary for society to appreciate the value of freedom in the execution of scientific research and to secure conditions for science to maintain its integrity and thus diminish its dark side.

4) THE SCIENTIST AS POLICY ADVISOR AND AS ADVOCATE

Today, enormous new scientific knowledge is generated across all fields of science, which is important for human well-being; this powerful scientific knowledge is easily accessible and can be quickly put into practical use. Thus, the view is prevalent that scientists have a responsibility to advise governments, decision makers, and the public of the possible benefits and risks of new scientific knowledge and technology, and to help them choose wisely between available options. There is a need to develop ways for „Science for Policy" activities, which will make possible the input of scientific evidence into the decision making process and aid the resolution of social issues and claims [34]. For instance,– *To aid society and decision makers in crises with scientific dimensions* (e. g., earthquakes, tsunamis, hurricanes, floods, volcanic ash clouds, terrorism, etc.)

— *To clarify scientific claims on important controversial scientific-technological issues where answers are still not clear and claims not fully trusted* (e. g., GM crops, fracking, food safety and security, climate change, etc.)

— *To delineate proposed claims for or against a given issue* (help avoid interpretation of scientific facts beyond the truth they contain).

— *To choose wisely the mechanisms from which advice is gotten.* Today, it seems that everyone wants to have scientific advice (especially the government) and everyone wants to give scientific advice, foremost to the government! Thus, debates over structures and procedures necessary for sound scientific advice abound. Unquestionably, society needs broad-based, open, evidence-gathering mechanisms to act. Five structures commonly used are: *individual scientists, chief scientific advisors, advisory councils, advisory committees, organizations of national academies.* There has actually been a proliferation of Groups of Science Academies [International Council for Science (ICSU), InterAcademy Panel (IAP), InterAcademy Medical Panel (IAMP), Federation of European Academies of Medicine (FEAM), European Academies' Science Advisory Council (EASAC), All European Academies (ALLEA), European Council of Applied Sciences, Technology and Engineering (Euro-

CASE), Academia Europaea (AE), and others] offering „independent" and „competent" scientific advice to governments and national and international organizations, which often moderates extreme views on key issues and balances advocacy.

— *To delineate the role of the scientist as a policy advisor and as an advocate.* The views of scientists (whether acting alone or as members of academies/organizations/committees) are respected because they are objective and independent experts in the particular field advice is sought, but when they act as advocates they are likely to be in conflict with the professional norms of science. Advocacy by scientists themselves on behalf of any issue be it the environment, global warming, shale gas extraction, GMFs, stem cells, or synthetic biology, may be a real or perceived attempt to affect the opinions of the general public or certain groups of population, or the decision making of politicians, legislators and governments. And yet scientific advice almost always contains shades of personal opinion not entirely scientific, and in many instances the available scientific knowledge is incomplete, trans-scientific [30, 35].

Clearly we are witnessing new paradigm shifts as to the role of scientists and their scientific societies.

GAZING AT THE FUTURE

When modern man gazes at the future he is heavily troubled; many questions torment him:

— Will humanity preserve and will science and science-based technology respect man?

— Will science become an integral part of civilization and will man be able to respond to the ethical issues raised by the progress of science and the needs of society?

— Will society protect the universal values of civilization and will it be able to reconcile the values of science, local cultures, and religions?

— Will civilization provide to future generations the necessary commons: energy, water, food, materials, health, etc., and will societies and nations share resources with all humanity?

— Will man be led to a superior civilization or will the complex globalized society collapse irretrievably under the weight of its problems?

Or, will man change to such a degree, that all these questions and many others, be no longer meaningful?

Obviously the past constrains the future because the future is prepared on the basis of the knowledge of the past. The future however *challenges* because it is unknown and because it repeatedly contradicts the predictions of the past. And if the future is accompanied by the memories of the fears of the past, the future is desired because of the hope it promises!

I therefore believe in a promising future grounded in science and human values and the ability of future generations to recognize the value of complementarity. In this promising future, *the ultimate challenge of civilization will, in my view, be the protection of humanity and the respect for human dignity.*

REFERENCES

[1] It is conjectured (Ref. [2], pp. 152–157) that cancer fundamentally involves mutations in four or more genes, and that the fact that it takes a sequence of four or more defective genes to cause cancer probably explains why it often kills decades after an original incident (e. g., radiation exposure).
[2] Michio Kaku, *Physics of the Future*, Anchor Books, New York, 2012.
[3] Nicolas Wade, The New York Times, March 19, 2015.
[4] EASAC, *Synthetic Biology: An Introduction*, January 2011.
[5] R. Breitling, E. Takano and T. S. Gardner, Science 347 (9 January 2015, Editorial), p. 107; http://ec.europa.eu/health/consultations/index_en.htm
[6] M. K. Cho and D. A. Belman, Science 329 (2 July 2010), pp. 38–39.
[7] There is an extensive bibliography on these issues (for example, in *Science, Nature, Proc. of the National Academy of Sciences, USA*). See also M. Schmidt, A. Kelle, A. Ganguli-Mitra and H. de Vriend (Eds.), *Synthetic Biology — The technoscience and its societal consequences,* Springer 2009; EASAC, *Realising European potential in synthetic biology: scientific opportunities and good governance,* December 2010, ISBN 978–3-8047–2866–0; E. Parens, J. Johnson, and J. Moses, *Ethical Issues in Synthetic Biology — An overview of the debates,* Woodrow Wilson International Center for Scholars, June 2009; S. Joyce et al., *Synthetic Biology*, The National Academies Press, Washington, D. C., 2013, ISBN 978–0-309–22583–0; EASAC, *Synthetic Biology: An Introduction*, January 2011; Volker ter Meulen, Nature 509 (08 May 2014), p. 135; Jennifer Sills, Science 348 (17 April 2015), p. 296.
[8] Nature-Editorial 518, 273 (19 February 2015); www. nature. com/encode/category/research-papers
[9] F. S. Collins, *The Language of God*, Free Press, New York, 2006.
[10] F. J. Dyson, *Infinite in All Directions*, Perennial, New York, 2004; M. Rees, in J. Brockman (Ed.), *Science in the Age of Certainty*, HarperCollins Publishers, New York, 2006.
[11] Uma Lele, Science 326 (26 March 2010), p. 1554.
[12] Brian Heap and David Bennett (Eds.), *Insights — Africa's future… can biosciences contribute?* Lavenham Press, U. K., 2013.
[13] EASAC policy report 21, *Planting the future: opportunities and challenges for using crop genetic improvement technologies for sustainable agriculture*, June 2013, ISBN: 978–3-8047–3181–3.
[14] http://www.csa.com/discoveryguides/gmfood/overview.php
[15] Cynthia Kroet 12. 06. 2014 ENVIRONMENT
[16] H. C. J. Godfray et al. Science 327 (12 February 2010), pp. 812–817.
[17] Loucas G. Christophorou, *Energy and Civilization*, Academy of Athens, Athens, 2011 (ISBN: 978–960–404–216–6).
[18] Loucas G. Christophorou, *Energy, Environment and Modern Civilization*, Proceedings of the International Conference on „Transition to a New Society", Montenegrin Academy of Sciences and Arts, 2014, pp. 257–269.
[19] EASAC policy report 22, *Trends in extreme weather events in Europe: implications for national and European Union adaptation strategies*, November 2013, ISBN: 978–3-8047–3239–1; *Climate Change, Evidence & Causes*, The Royal Society and the US National Academy of Sciences Publication, 2014 (see also http: //nas-sites. org/americasclimatechoice/ http: //royalsociety. org/policy/climate-change/).
[20] International Energy Agency (IEA), *Energy Poverty-How to make modern energy access universal?* OECD/IEA, 2010; The World Bank 2011, *One Goal, Two Paths: Achieving*

Universal Access to Modern Energy in East Asia and the Pacific, The World Bank, Washington, D. C. 2011 (ISBN 978–0-8213–8837–2).
[21] Joint EASAC-JRC Report, September 2011 (EASAC Policy Report No. 15), „Impact of Engineered *Nanomaterials* on Health: Considerations for Benefit-Risk Assessment".
[22] A. F. Koenderink et al. Science 348 (1 May 2015), p. 516–521.
[23] I. A. Walmsley, Science 348 (1 May 2015), pp. 525–530.
[24] M. Raymer and K. Srinivasan, Physics Today, November 2012, pp. 32–37.
[25] https://en.wikipedia.org/wiki/High-temperature_superconductivity
[26] In 2015, hydrogen sulfite under extremely high pressure (~ 150 gigapascals) was found to undergo superconducting transition at ~ 203 K (-70 oC) [25]; E. Cartlidge, Nature 524 (20 August 2015), p. 277.
[27] www.oe.energy.gov
[28] Freeman J. Dyson, *The Sun, the Genome, and the Internet*, The New York Public Library, Oxford University Press 1999, p. 60.
[29] See, for example, Joseph A. Tainter, *The Collapse of Complex Societies,* Cambridge University Press, Cambridge, 1988; Robert M. May, *Stability and Complexity in Model Ecosystems*, Princeton University Press, 2001.
[30] Loucas G. Christophorou, *Place of Science in a World of Values and Facts,* Kluwer Academic/Plenum Press, New York, 2001.
[31] Recent reports (International New York Times, January 13, 2016) that the US shifts to smaller, less powerful nuclear bombs which have more precise targeting capabilities, could make nuclear weapons more tempting to use.
[32] Loucas G. Christophorou, *„Scientists and Society: Needs and Responsibilities",* Rendiconti Lincei, Vol. 23, Supplement 1, September 2012, pp. S 23-S 27.
[33] Loucas G. Christophorou, *The Inductive Method of Physical Science (from Molecules to Man?),* Proceedings of the Academy of Athens, Vol. 82 A', 2007, pp. 5–30.
[34] James Wilsdon and Robert Doubleday (Eds.), *Future directions for scientific advice in Europe,* Published by the Centre for Science and Policy, April 2015, Cambridge, ISBN: 978–0-9932818–0-8.
[35] A. M. Weinberg, Minerva 10, April 1972, p. 209; Science 177 (21 July 1972), p. 211.

Gordon McBEAN*

SCIENCE AND TECHNOLOGY FOR A SUSTAINABLE FUTURE EARTH

Abstract: Climate change, disaster risk reduction, poverty eradication, social and economic sustainable development are interconnected issues that must be addressed in the development of policy. In 2015, governments agreed on goals and targets and a key issue is how can science best provide the inputs to these policy processes and more importantly to help governments and people address the issues? The Programme Future Earth: Research for Global Sustainability has as its goal: „To provide the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability". Future Earth and the World Climate Research Programme are linked, through the International Council for Science (ICSU), to the Integrated Research on Disaster Risk and Urban Health and Wellbeing Programmes to collectively address the challenges of bringing together interdisciplinary and transdisciplinary teams of scientists to undertake transformative research leading to outcomes that make a difference for global sustainability.

Key words: *climate change, disaster risk reduction, urban environment, sustainable development, science for policy, Future Earth*

INTRODUCTION

As we look ahead to the future, there are many science, technology and society policy issues that need to be considered. These include: poverty; food, health; security in the broad sense of the word; cities and, in general, urban issues; migration, both voluntary and involuntary; biodiversity; sustainable development on local to global scales and over decades to potentially millennia; disaster risk reduction and climate change. The year 2015 was a crucial year for the international policy agenda with the Third UN World Conference on Disaster Risk Reduction (WCDRR) and the ensuing Sendai Framework on Disaster Risk Reduction [1], United Na-

* President, International Council for Science,
Co-Chair, Governing Council, Future Earth,
Western University, London, Canada

tions Sustainable Development Summit and ensuing Agenda 2030 and Sustainable Development Goals (SDGs) [2], COP-21 of the UN Framework Convention on Climate Change and its Paris Climate Agreement [3] and the International Conference on Financing for Development [4]. To address these issues, there is need for integrated information on these topics and related issues. As we look ahead for the next decades, there is need for recognizing the responsibilities of global science to contribute to post-2015 frameworks, including the Sendai Framework, Agenda 2030, Paris Climate Agreement and the upcoming urban agenda at Habitat III Conference. It is important to note the 17th of the Sustainable Development Goals: *Strengthen the means of implementation and revitalize the global partnership for sustainable development*. To achieve these goals and targets it is important to develop fully global science capacity so that science benefits of all societies and „leaves no scientists behind". Recognizing the theme of this Conference, it is imperative to develop the abilities to project ahead technologies and societal changes to „*see the future*" for Sustainable Development.

SUSTAINABLE DEVELOPMENT

Sustainable Development [5] is defined as: „*Humanity has the ability to make development sustainable — to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*". A principal key part of the sustainable development is the linking of social, economic, technology, science and environmental issues and connecting the future with the present. It essentially leads to science-informed decision making. This clearly relates to the theme of this conference of „*Technology + Society =? Future*". There are major issues of sciences and policy in how to „*see the future*". The fundamental concept of the Science and Technology in Society Forum [6], held annually in Kyoto, Japan, is: „*The explosive progress of science and technology up to the 20th century brought prosperity and enriched the quality of life for much of mankind. However, the advance of science and technology raises important ethical, safety and environmental issues: possible negative applications are threatening mankind's own future. Since progress in science and technology is expected to accelerate and will be necessary for sustainable human development in the 21st century, wisdom must be exercised to keep it under proper control. In that sense, the most pressing problems we face today include harmonizing economic development with global warming; preventing terrorism; controlling infectious diseases; and assessing the potential health benefits and ethical factors relating to cloning technology. International efforts to address these problems are needed now more than ever. This is really what symbolizes the „lights and shadows of science and technology." Opportunities need to be taken, but the risks must also be controlled. Health, meeting energy needs, and many other aspects of human welfare are dependent on continued progress in science and technology.*" The sense of the „*lights and shadows of science and technology*" is very important and an important challenge is identifying in advance both the lights and shadows.

The Global Risks Report 2016 [7] is published by the World Economic Forum, within the framework of The Global Competitiveness and Risks Team and is based on information obtained from experts around the world. Global risk is an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years. Risks are ranked based on impacts, from low to high, and likelihood, also low to high. The highest likely risk was judged to be „*Large-scale involuntary migration*" with „*Extreme Weather Events*" next. The highest impact risks were: „*Failure of climate change mitigation and adaptation*" with „*Water crises*" next. „*Large-scale involuntary migration*" was the next highest in terms of impact. From the overall point of view of high impact, high likelihood risks, the environmentally related issues of failure of climate change mitigation and adaptation, water crises and extreme weather events are very important risks. Large-scale involuntary migration also links to environmental issues as well as other issues is also very important. The Global Risks Report 2016 draws attention to ways that global risks could evolve and interact in the next decade. The report notes that the year 2016 marks a forceful departure from past findings, because risks that they have been warning of over the past decade are starting to manifest. *Warming climate is likely to raise this year's temperature to 1° Celsius above the pre-industrial era* is one issue among several and the *Report calls for action to build resilience — the „resilience imperative*" — and identifies practical examples of how it could be done.

The roles of science and technology policy and application need to be to reduce the Impacts and the Likelihoods through better „solutions" to the risk issues and, importantly, to examine and activate in a positive way the societal roles. For this, it is necessary for the global communities to better communicate and globally connect.

SEEING THE FUTURE — PREDICTION

Prediction is used across the natural, environmental, social and economic sciences [8]. The Oxford Dictionary defines the verb to predict as to „*foretell, prophesy*". The noun forecast is defined as: „*conjectural estimate of something future, especially, of coming weather*". Conjecture is the „*formation of opinion on incomplete grounds*". We can use the definition [9] „*Prediction is a statement or claim that a particular event will occur in the future. Narrowing the sense of prediction it may be added that the place and time of event are known as well.*"

The sense of estimate, future and incomplete information is certainly consistent with the sense of prediction of natural and human systems. Prediction is the process of looking ahead on the basis of incomplete knowledge of the present and with incomplete understanding of how the system works; the process is not simple. For some natural science issues, such as the tides and related lunar orbits, there are laws of physics that relate the present state to the future state. When we move to weather prediction, the relationships are more complicated with the additional uncertainty in defining the present state. Projecting climate over the next century not only includes the uncertainties in the present state and the natural scientific relationships, but, more importantly actually, the actions that societies will or will not take to reduce their interference with the climate system through emis-

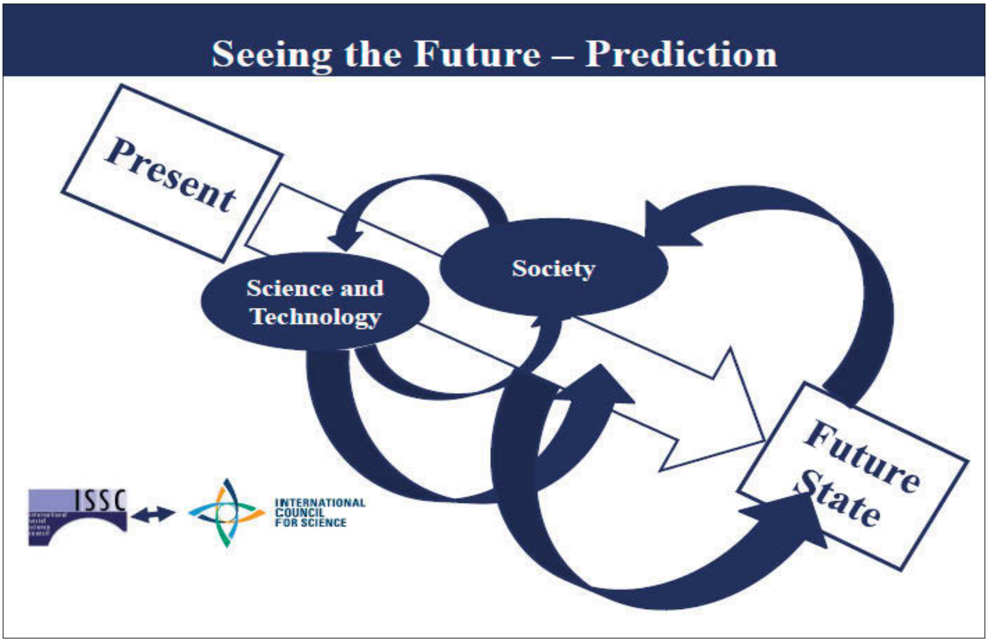


Figure 1: Prediction — „seeing" the future state from the present

sions of greenhouse gases and the changes in the conditions of the planetary surface, as examples.

As schematically shown in Figure 1, projections or predictions of future states require understanding and incorporating the implications of science and technology and society in iterative ways, recognizing that changes in technology result in changes in society and vice versa. Further, as the future state becomes clearer for a specific projection based on the „best" estimates of technological and societal changes, these may „feedback' into the societal response, resulting in the modifications to the prediction of the future state. A fundamental role of the science and technology community is to work closely with the social science community to enable the prediction of future states through an integrated, continuously iterative process of refinement to reduce uncertainty and provide the „best" estimates of futures states as well as clarification of the assumptions inherent in the prediction such that the societal processes can, when possible and appropriate, modify societal changes.

INTERNATIONAL COUNCIL FOR SCIENCE

The International Council for Science (ICSU) [10] is a leading non-governmental science organization that was created in 1931. The Council now has 120 National Members and 31 Unions or Associations of scientists by discipline. The scope of these disciplines include math, physics, chemistry, geology, biology, anthropology, sociology and the philosophy of science. The Mission of the International Council for Science (ICSU) is *„to strengthen international science for the benefit of society*", for all societies. The vision of the Council is for a world where excellence in science (all sciences) is effectively translated into policy making and socio-economic development, with universal and equitable access to scientific data and information, where all countries have scientific capacity, enabling the generation of new knowledge and nations can establish their own development pathways in a sustainable manner. The Council's key priorities and associated activities are: Science for Policy (and policy for science*);* Universality of Science with the freedom to do science while recognizing the responsibilities of science and scientists; and International Research Collaboration.

INTERNATIONAL RESEARCH COLLABORATION

The International Council for Science (ICSU) is very involved in initiating, organizing and leading international research collaboration, often partnering with other governmental and non-governmental organizations. The International Geophysical Year (IGY) [11] of 1957 is an important early example. During the IGY, Sputnik was launched opening a new mode of „see our planet" and the systematic measurements of carbon dioxide and ozone, as two important atmospheric constituents, were initiated. Without these measurements, society would not now be able to document the changes in the stratospheric ozone layer and the greenhouse effect and project ahead the changes that are now being addressed through the Montreal Protocol [12] and the Climate Convention [13]. Recognizing the increasing societal concerns about the climate system, the International Council for Science (ICSU) and the World Meteorological Organization (WMO) joined in 1980 to create the World Climate Research Programme (WCRP) [14] with the scientific objectives: to determine: *the predictability of climate; and the effect of human activities on climate*. The underlined word, predictability and human activities — societal — link closely to the theme of this Conference. The Intergovernmental Oceanographic Commission of the UN Educational, Scientific and Cultural Organization (UNESCO) became a co-sponsor in 1992, to most effectively connect the global oceanographic community to the WCRP. By the mid-1980's, the level of international concern regarding climate change and broader issues of global environmental change, plus the discussions on sustainable development, led the International Council for Science (ICSU) to initiate the global change program, International Geosphere-Biosphere Programme (IGBP) [15] to: *study earth system science and to help guide society onto a sustainable pathway during rapid global change*. Again note the connections with Conference themes. With the increasing global concern about the climate system and possible human-caused climate change, the Intergovernmental Panel on Climate Change (IPCC) [16] was created in 1988, under the sponsorship of the World Meteorological Organization and the UN Environment Programme (UNEP) in order to: (i) assess available scientific information on climate change, (ii) assess the environmental and socio-economic impacts of climate change, and (iii) formulate response strategies. The First Assessment Report was prepared in 1990 for presentation to the 2 nd World Climate Conference which, in turn, fed the information into the creation of the UN Framework Convention on Climate Change (1992) at the Earth Summit in Rio in 1992. The 2nd IPCC Assessment Report was completed in 1995 to provide an assessment for the Kyoto Protocol in 1997. Over the years, the scientific programs planned and coordinated by the WCRP and the IGBP have been the major source of scientific results for the IPCC assessments.

In 1992, the International Council for Science (ICSU), with one of its unions, the International Union of Biological Sciences, and the ICSU Scientific Committee on Problems of the Environment, with UNESCO, recognizing the concerns about the state of biodiversity on the planet, created the program DIVERSITAS [17], as an integrative biodiversity science, that links biological, ecological and social disciplines to address the complex scientific questions posed by the loss in biodiversity and ecosystem services and to offer science-based solutions to this crisis. In 2011, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [18] was created as the intergovernmental body to assess the state of biodiversity and of the ecosystem services it provides to society, in response to requests from decision makers. IPBES is placed under the auspices of four United Nations entities: UNEP, UNESCO, FAO and UNDP and administered by UNEP. DIVERSITAS became one of its major supplier of scientific information. The International Human Dimensions Programme on Global Environmental Change (IHDP) [19] was established in 1996 by its two scientific sponsors, the International Council for Science (ICSU) and the International Social Science Council (ISSC). IHDP was an international, non-governmental, interdisciplinary research programme addressing the coupled human-natural system in the context of global environmental change (GEC). It fostered high quality research aimed at describing, analysing and understanding the human dimensions of GEC. Human dimensions are the ways in which individuals and societies contribute to global environmental change, are influenced by global environmental change and mitigate and adapt to global environmental change.

Recognizing the needs for research capacity enhancement in Africa and Asia, Global Change START [20] was launched in 1992 under the aegis of the International Council for Science (ICSU) and its four international global change science programs as the capacity building arm of the global change programs' work in Africa and Asia-Pacific.

The impacts of natural hazards continue to increase around the world with hundreds of thousands of people killed and millions injured, affected, or displaced each year because of disasters, and the amount of property damage has been doubling about every seven years over the past 40 years. To address the shortfalls in current research on how science is used to shape social and political decision-making in the context of hazards and disasters, the International Council for Science (ICSU) initiated the Integrated Research on Disaster Risk (IRDR) Programme [21]. The IRDR mission is to develop trans-disciplinary, multi-sectorial alliances for in-depth, practical disaster risk reduction research studies, and the implementation of effective evidence-based disaster risk policies and practices. The IRDR Programme objectives are: 1) Characterization of hazards, vulnerability and risk; 2) Understanding decision-making in complex and changing risk contexts; and 3) Reducing risk and curbing losses through knowledge-based actions. Attainment of these objectives through successful projects will lead to a better understanding of hazards, vulnerability and risk; an enhanced capacity to model and project risk into the future; better understanding of decision-making choices that lead to risk plus how they may be influenced; and how this knowledge can better guide disaster risk reduction. The IRDR Programme is now co-sponsored by the International Council for Science (ICSU), the International Social Sciences Council (ISSC) [22] and the UN Office for Disaster Risk Reduction (UNISDR, International Strategy on Disaster Reduction) [23].

With the increasing growth of populations in cities and the accompanying health issues, the International Council for Science (ICSU), in partnership with the UNU International Institute for Global Health and the Inter-Academy Medical Panel (IAMP) created the Health and Wellbeing in the Changing Urban Environment: a Systems Analysis Approach Programme [24] to promote systems approaches to understanding health and wellbeing in urban settings by understanding the functioning of the urban system as a whole. The systems approaches involves one or more of the following elements: 1) development of new conceptual models that incorporate dynamic relations; 2) use of systems tools and formal simulation models; and 3) integration of various sources and types of data including spatial, visual, quantitative and qualitative data. The overarching vision for the ICSU-IAMP-UNU Urban Health and Wellbeing Programme is the development of aspired levels of wellbeing for people living in healthy cities.

FUTURE EARTH: RESEARCH FOR GLOBAL SUSTAINABILITY

Future Earth: Research for Global Sustainability [25] is a major international research platform with the Goal: „To provide the knowledge required for societies in the world to face risks posed by global environmental change and to seize opportunities in a transition to global sustainability". Future Earth brings together and, in partnership with existing programmes on global environmental change, coordinated new, interdisciplinary approaches to research on three themes: Dynamic Planet; Global Sustainable Development; and Transformations towards Sustainability. DIVERSITAS, the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme (IHDP) have been merged into Future Earth and the World Climate Research Programme (WCRP) is a partner. Partnerships with START and other programs are also being undertaken.

Future Earth is a platform for international engagement to ensure that knowledge is generated in partnership with society and users of science and will bring together scientists of all disciplines, natural and social, as well as engineering, the humanities and law. The governance structure of Future Earth embraces the concepts of co-design and co-production of science with relevant stakeholders across a wide range of sectors.

Future Earth is led by a Governing Council and supported by two advisory bodies: a Science Committee and an Engagement Committee. The Governing Council of Future Earth is composed of the International Council for Science (ICSU), the International Social Science Council (ISSC), the Belmont Forum of funding agencies, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), the United Nations University (UNU), World Meteorological Organization, Sustainable Development Solutions Network (SDSN) [26] and the STS Forum. The Future Earth Engagement Committee is a strategic advisory group, comprising thought-leaders from stakeholder groups including business, policy and civil society. Working together with the Future Earth Science Committee and the Secretariat, its primary purpose is to foster in-depth and innovative interactions between science and society. The Engagement Committee provides leadership and creative thinking on how to bridge the gap between knowledge and solutions for sustainable development. Through their joint actions the research program of Future Earth is developed to co-design the themes, priorities and approaches with the stakeholder community so that the co-produced knowledge, technologies and approaches with better address societal needs.

In the context of this Conference, the combined approach of identification of the technological and societal needs and challenges, with modifications and adjustments in the conduct of the program is to lead to futures for society and technology that better correspond to our science-informed choices. The key question that Future Earth and its partnering programs, including Integrated Research on Disaster Risk and Urban Health and Wellbeing Programme, need to address is: *How can we develop the integrated, equitable, societal, science and technology approaches for the „right" future?*

SCIENCE FOR POLICY AND POLICY FOR SCIENCE

An important area of action for the International Council for Science (ICSU) is Science for Policy, which includes the international research programs described above, and policy for science. In the global policy arena, there are the intersecting issues of climate change, disaster risk reduction and sustainable development and their applications for cities, energy, resilience, health, populations and security. As shown schematically in Figure 2, there is the need to bring the integrated science together for policy so that the issues of technology and society can be addressed for the benefits of future societies. There is also the need to address fully global science capacity so that science benefits of all societies and „*leave no scientists behind*". A related issue is big science and open data, which will be discussed further below.

To enhance the connections between science and policy, the International Council for Science (ICSU) and Professor Sir Peter Gluckman, the Chief Science Advisor to the Prime Minister of New Zealand, created the International Network of Government Sciences Advice (INGSA)[27]. The INGSA provides a forum for policy makers, practitioners, academies, and academics to share experience, build capacity and develop theoretical and practical approaches to the use of scientific evidence in informing policy at all levels of government. INGSA is a collaborative platform for policy exchange, capacity building and research across diverse science advisory organizations and national systems. The network aims to enhance the

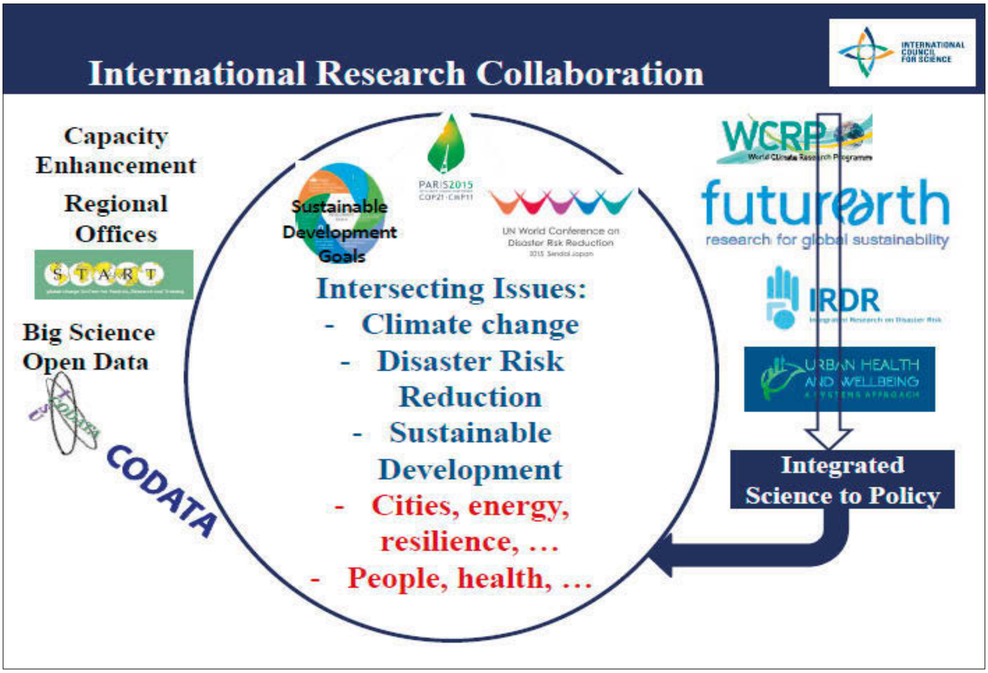


Figure 2: Intersecting issues and the need for integrated science to policy

global science-policy interface and improve the user of evidence based policy formation at both national and transnational levels through workshops and fora. The first meeting was held in Auckland associated with the 2014 General Assembly of ICSU and now involves hundreds of science advisers around the globe. Professor Gluckman is Chair of INGSA. Both major events, at least biannually, and regional events are held.

Another science-policy issue is „big" science and open data. In 2015 the International Council for Science (ICSU) initiated 'Science International' as a new series of action-oriented meetings bringing together major international science bodies: International Council for Science (ICSU); the International Social Science Council (ISSC); The World Academy of Sciences for the advancement of science in developing countries (TWAS) [28]; and the InterAcademy Partnership (IAP) [29]. The initial issue for joint consideration was that of big data and open science. An International Accord, Open Data in a Big Data World [30], was created and has now close to 100 endorsements from academies and other international organisations. The Accord is an example of international science, the global voice of science, addressing issues of policy for science. The Accord presents information on the opportunities and challenges of the data revolution as predominant issues for global science policy and some fundamental principles. It presents the distinctive voice of the scientific community. It was agreed that fundamental pre-requisites are rigour of scientific inquiry and maximising public benefit, in both developed and developing countries. It is important to promote discussion and adoption of principles like these and have their endorsement by bodies of science at national and international levels.

CONCLUSIONS

This paper has discussed the building on technology and science, including social sciences, to „see society's future" and through collective actions to have the „future we want". It has focussed on the role of the International Council for Science (ICSU) as a key, leading international non-governmental organization that works with many partners to achieve these common goals. We look forward to working together for the benefit of all societies.

ACKNOWLEDGEMENT

Thanks to my colleagues in the International Council for Science (ICSU) and around the world for the initiatives and leadership for international science.

REFERENCES

[1] Sendai Framework for Disaster Risk Reduction 2015–2030 — UNISDR; *www.unisdr.org/we/inform/publications/43291*
[2] Sustainable Development Goals; *https://sustainabledevelopment.un.org/?menu=1300.SDG/Agenda 2030; „Transforming our world: the 2030 Agenda for Sustainable Development „http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E*
[3] Paris Agreement, UNFCCC; *https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf*
[4] Third International Conference on Financing for Development, http://www.un.org/ga/search/view_doc.asp?symbol=A/CONF. 227/20
[5] World Commission on Environment and Development, 1987 *www.un-documents.net/our-common-future.pdf*
[6] Science and Technology in Society Forum http://www.stsforum.org/?lang=en
[7] The Global Risks Report 2016, 11th Edition, World Economic Forum within the framework of The Global Competitiveness and Risks Team. http://wef.ch/risks2016
[8] McBean, Gordon A., 2008: „Role of Prediction in Sustainable Development and Disaster Management", in: Brauch, Hans Günter; Oswald Spring, Úrsula; Mesjasz, Czeslaw; Grin, John; Dunay, Pal; Behera, Navnita Chadha; Chourou, Béchir; Kameri-Mbote, Patricia; Liotta, P. H. (Eds.): *Globalization and Environmental Challenges: Reconceptualizing Security in the 21st Century.* Hexagon Series on Human and Environmental Security and Peace, vol. 3 (Berlin — Heidelberg — New York: Springer-Verlag): 929–938.
[9] Mesjasz, Czeslaw, 2005: „Prediction in Security, Theory and Policy", Paper presented at the First World International Studies Conference at Bilgi University, Istanbul, Turkey, 24- 27 August.
[10] http://www.icsu.org/
[11] http://www.icsu.org/publications/about-icsu/the-international-council-for-science-and-climate-change-2015/the-international-council-for-science-and-climate-change-2015–1
[12] http://ozone.unep.org/en/treaties-and-decisions/montreal-protocol-substances-deplete-ozone-layer
[13] http://unfccc.int/essential_background/convention/items/2627.php

[14] http://www.wcrp-climate.org/
[15] http://www.igbp.net/
[16] http://www.ipcc.ch/
[17] http://www.diversitas-international.org/
[18] http://www.ipbes.net/about-us
[19] http://www.icsu.org/what-we-do/past-interdisciplinary-bodies/hdp
[20] http://start.org/programs
[21] http://www.irdrinternational.org/
[22] http://www.worldsocialscience.org/
[23] https://www.unisdr.org/
[24] http://urbanhealth.cn/
[25] http://www.futureearth.org/
[26] http://unsdsn.org/
[27] http://www.ingsa.org/
[28] http://twas.org/
[29] http://www.interacademies.org/ The InterAcademy Partnership is an umbrella organization that brings together IAP — the global network of science academies, the Inter Academy Medical Panel (IAMP), and the InterAcademy Council (IAC).
[30] http: //www.icsu.org/science-international/accord/accord?searchterm=Big+data

Miroslav VESKOVIĆ*

REINVENTING TOGETHER SOCIETY, ECONOMY AND SCIENCE**

Abstract: The great challenges of our time in environment (climate change and environmental sustainability…), science (Science 2.0, the data revolution…), society (demography, migrations, inequality, communication, internet of everything…) and economy (employability, open innovations, circular economy…) cannot be understood and tackled by any one academic field alone. The problems we are facing are large-scale socio-technical problems of such immensity, complexity, and urgency that to neglect a single aspect could be very "costly". But the future is not predefined, it very much depends upon the policies taken. EU policymakers are increasingly confronted with a wide array of problems. They often need their decisions to be informed by the best available science from across disciplines as these challenges no longer arrive in neat discipline-shaped boxes. The mission of the Directorate General Joint Research Centre as the Commission's in-house science service and *honest broker* is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Key words: *future trends, key technologies, data revolution, disruptive new technologies or events, evidence-informed policy-making, knowledge management, Directorate General Joint Research Centre*

INTRODUCTION

The history of Earth as well as the history of human society is a combination of slow evolutionary processes and disruptive events. But our world will change more this century than during any other time in human history. Change will happen faster than ever before. It will also affect more people than ever before. [1] The 21st century could be our best century ever, or our worst. The outcome will depend on our abili ty to understand and harness the extraordinary opportunities as well

* European Commission; Joint Research Centre; International, Interinstitutional and Stakeholder Relations Unit; On leave of absence from University of Novi Sad, Serbia

** Jean Staune: *Les clés du futur. Réinventer ensemble la société, l'économie et la science*, Plon, 2015 as manage the unprecedented uncertainties and risks. While the future is full of opportunity arising from the extraordinary advances of recent decades, it is also highly uncertain and characterised by growing systemic risks. The changes created by globalization, demographics, technology, economic growth, systemic risk, and governance should serve as a guide to 21st century businesses, investors, and governments. The scale of the opportunities and risks require more attention in the future and a more far-sighted attitude.

FUTURE TRENDS

Analysis of future trends, whether derived from extrapolations, simulations, projections or scenarios, can provide important insights for the future. They can offer support and guidance for decision makers and investors, and forewarn policy makers, the business community, researchers and society more generally to important upcoming issues. Interpretation of future trends, however, always needs to be done with care: they do not foresee the future, they merely indicate how the future might evolve under certain conditions and in a given subject area. A somewhat fuller picture of possible futures can be assembled by bringing together numerous trends from different subject areas. This can strengthen the basis for developing narratives, which in turn can enrich our view of where the world is heading and what challenges and opportunities may lay on or beyond the longer-term horizon.

In reality, our future is being shaped by a multitude of powerful, highly complex and interconnected forces and any attempt to peer into the future seems destined merely to enhance our sense of uncertainty. Yet, seen over a time horizon of one or two decades, some of the big trends we see unfolding before us are in fact quite slow-moving. These are megatrends — large-scale social, economic, political, environmental or technological changes that are slow to form but which, once they have taken root, exercise a thorough and lasting influence on many if not most human activities, processes and perceptions.

What often tends to shake that confidence, at least temporarily, are *disruptive* events. They come in a multitude of forms

— from global financial crashes and pandemics to wars and sudden waves of immigration and from continental-scale natural disasters to sudden shifts in population fertility. Such events are difficult to build into trend projections, and so are often treated in foresight exercises as “wild cards”. Potentially disruptive scientific and technological innovations, on the other hand, frequently find a place in forward trend studies, not least because they often occur as an extension of or as a marked departure from existing science and technology trends. Ultimately, it is how megatrends and disruptive trends — especially in the field of science and technology — interact that will set the scene for the coming decades. It is for gov- ernments, business, researchers and citizens in general to reflect on what the interplay of such trends means in terms of opportunities to be grabbed and challenges to be met. [2]

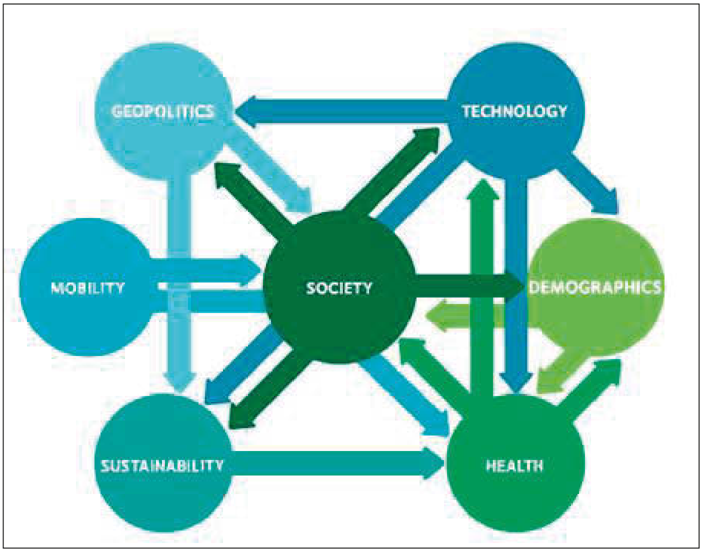


Figure 1. Global megatrends in the 21st century (Source: Oxford Martin Commission for Future Generations [3])

As identified by Oxford Martin Commission for Future Generations: Challenges or interacting megatrends that are expected to have significant socio-economic impacts over the next 10-20 years and beyond are:

The European Strategy and Policy Analysis System (ESPAS) project in its aim to help the European Union (EU) to identify the main global trends, assess their implications and review the resulting challenges and policy options, published the document Global Trends to 2030: Can the EU meet the challenges ahead? [4]

Those challenges pose questions like: How to make growth and development more sustainable and inclusive? How can different stakeholders (businesses, institutions and governments) contribute to more inclusive and sustainable growth? How to ensure enough food, energy, water and biodiversity? How public health infrastructure and processes would be able respond to the needs of all? Whether power transitions would be the basis for new forms of collaboration?

These challenges cannot be understood and tackled by any one academic field alone. So no one sector of society can make our sustainable dreams come true—not science, government, business, industry, civil society, academia, or the arts. All sectors need to share their concerns and perspective about these issues to ensure the best possible outcomes.

TECHNOLOGY AS A SOLUTION (?)

A dramatic megatrend of the last half-century has been the pace of technological change. Very often we turn to *technology* as a solution. Nearly every country—from low to high income—has been convinced that it must engage on a world-class level in science and technology to become more innovative in a highly competitive and interconnected world. They also have taken into account the understanding that *human capital development* through scientific research is one the essential elements of innovation success and technological advancement.

EU is strongly supporting Key Enabling Technologies (KETs) and Future and Emerging Technologies (FETs). Key Enabling Technologies (KETs) are investments and technologies that will allow European industries to retain competitiveness and capitalise on new markets. The Industrial Technologies Programme (NMP) focuses on four KETs: nanotechnologies, advanced materials, and advanced manufacturing and processing (production technologies) and biotechnology. The Future & Emerging Technologies (FET) programme invests in transformative frontier research and innovation with a high potential impact on technology, to benefit our economy and society. FET Open supports the early-stages of the science and technology research and innovation around new ideas towards radically new future technologies. It also funds coordination and support actions for such high-risk forward looking research to prosper in Europe. [5]

This should continue and public and business investment into integrated research and development and long-term systems approaches uniting food, energy, water and land use and biodiversity preservation need to increase considerably. A consideration of possible pathways to tackle new challenges requires an awareness that technology is deeply embedded in existing institutional and societal structures. To some extent, this can act as a barrier to more sustainable innovation, and favour incumbent technologies against newcomers or more radical interventions. Stimulating new technologies that offer alternatives to existing resource-intensive "locked-in" technologies (scholars point to our current carbon based energy and transportation systems as evidence of "technological lock-in", reinforced by regulatory and incentive structures with substantial environmental consequences), and measuring available potential of renewable energy would make a significant contribution.

The Digital Technology Revolution, in the second half of 20th century enabled the Data Revolution [6] and marked the beginning of the Information Age. New technologies are leading to an exponential increase in the volume and types of data available, creating unprecedented possibilities for informing and transforming society and protecting the environment. Governments, companies, researchers and citizen groups are in a restlessness of experimentation, innovation and adaptation to the new world of data, a world in which data are bigger, faster and more detailed than ever before. Digital technologies—the internet, mobile phones, and all the other tools to collect, store, analyse, and share information digitally—have spread quickly. The number of internet users has more than tripled in a decade—from 1 billi on in 2005 to an estimated 3.2 billi on at the end of 2015. This means that businesses, people, and governments are more connected than ever before. The digital revolution has brought immediate private benefits—easier communication and information, greater convenience, free digital products, and new forms of leisure. It has also created a profound sense of social connectedness and global community. But have massive investments in information and communication technologies generated faster growth, more jobs, and better services for everybody? [7] One of

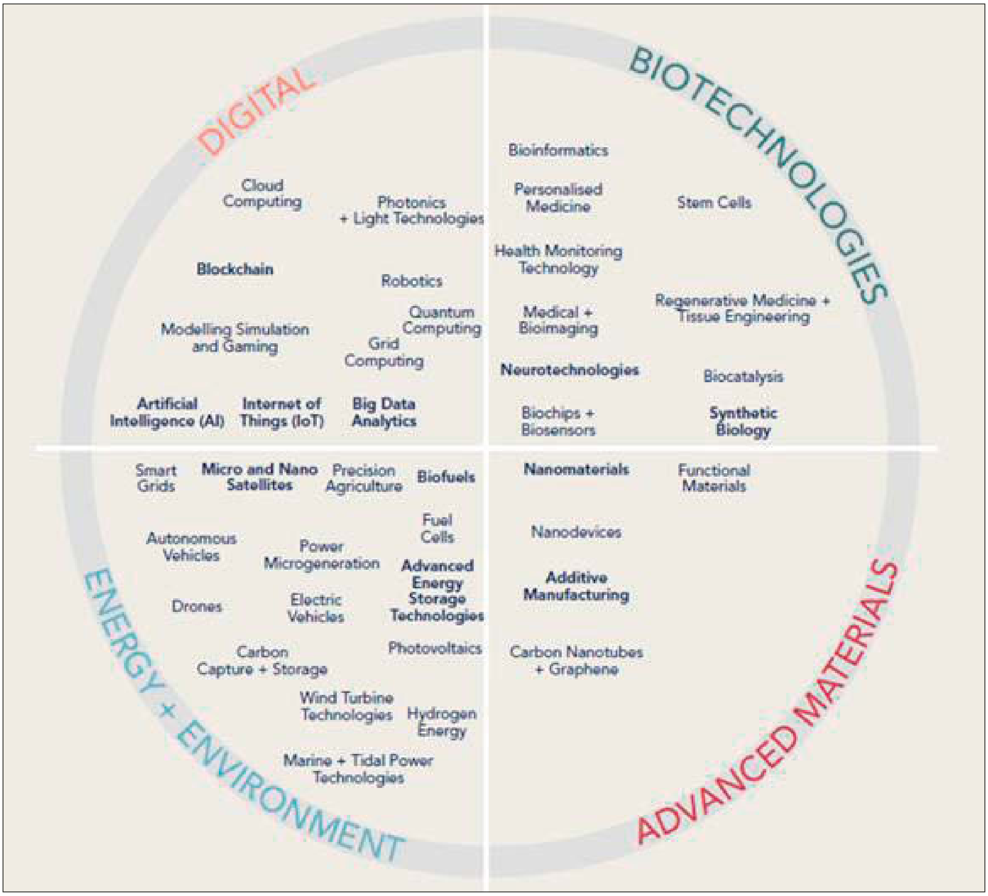


Figure 2. Forty key technologies for the future (Source OECD [2])

the strongest trends for the 21st century may be the ascent of the emerging middle class. According to a paper by Homi Kharas [8] the emerging middle class could almost double by 2020 and triple by 2030. Based on the rapid growth, scholars expect the global middle class to be the driving force for sustainable development. This assumption, however, is contested and *technological unemployment* is discussed [9].

Computing power has been doubling almost every 18 months. This appears likely to continue for at least the next decade or two, and will continue to revolutionise the way we lead our lives and the way societies are governed. Such is its reach and nascent speed, the World Wide Web has been declared "the most powerful force for globalisation, democratisation, economic growth, and education in history". The information revolution has penetrated our lives in ways not entirely understood, and created a faster, smarter, "more personal and participatory" world.

On the other hand, new information technologies are reaching the world's poor much faster than food and toilets. A recent UN report suggested six billi on people have access to mobile phones, while only 4.5 billi on have access to working toilets. More households in developing countries own a mobile phone than have access to electricity or clean water, and nearly 70 percent of the bottom fifth of the population in developing countries own a mobile phone. There are around one billi on mobile phones in both China and India. Africa is home to twice as many mobile phones as the United

States and is the most advanced continent when it comes to "mobile money". Developing countries accounted for 80 percent of new mobile subscriptions in 2011, with the number of Internet users doubling over a four year period. Technology offers great potential to enhance education opportunities, dramatically improve health outcomes, promote free speech and democracy, and offer greater access to global markets.

The Internet is the key driver of global connectivity and opportunity, but different bandwidth speeds, limited access, and contrasting levels of openness can mean that the Internet aggravate rather than offsets inequality. The WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights commits developed countries to providing incentives to the private sector for technology transfer to developing countries, but implementation remains weak. Once online, the inequalities persist.

The technology-enabled shifts, at their core, are potentially providing two things: (1) digital connectivity for everyone to everything, anywhere and at anytime; and (2) the tools for analysing and using digital data in new ways.

By 2020, there are expected to be four billi on people online, 31 billi on connected devices, 450 billi on online interactions performed per day, and up to 50 trillion gigabytes of data. The notion of the cyber world as a separate "space" is increasingly redundant as technology becomes omnipresent and we become more dependent through our business

models, our working and social practices, and in the delivery of key services. Digital technologies hold great promise. The growing maturity and convergence of digital technologies are likely to have far-reaching impacts on productivity, income distribution, well-being and the environment by 2030. Firms will be predominantly digitalised, enabling product design, manufacturing and delivery processes to be highly integrated and efficient. Additive manufacturing technologies will allow certain products to be tailored to specific user needs using computer-assisted drawing software. The Internet of Things, big data analytics, artificial intelli gence and machine learning tools will enable the emergence of smart machines that will be increasingly adjustable through sensor technologies, cheap computing power and the real-time use of algorithms. These impacts will however vary across industries, countries and sections of the workforce.

But this is all somewhat predictable. Similar importance is the potential of truly disruptive new technologies or events like quantum computing, artificial intelli gence or disruptive cyber crises in society in coming decades. [10] Whilst technological advances have revolutionised our lives, and offer profound possibilities for tackling challenges, they also maximise vulnerability. Our everyday li fe is highly dependent upon different *Critical Infrastructures* and their information networks: internet, smart grids (electricity, oil, gas), road — rail — air transport, flight control, water, environment, food, health care, financial systems… Individual hackers now have the capacity to damage public and private services, or cause widespread destruction through the deliberate or unintentional spread of misleading information. Risk management processes is becoming more and more important. It should be protecting the organizations and their abili ties to perform their missions, thus reducing the vulnerabilities of Critical Infrastructures and increasing their resilience.[1] [11]

All of these massive changes underline that technology not only provides solutions but also brings its own set of challenges. Even in 1955 John von Neumann asked: Can we survive technology? and stated [12]: “Technological evolution is still accelerating. Technologies are always constructive and beneficial, directly or indirectly. Yet their consequences tend to increase instabili ty–a point that will get closer attention after we have had a look at certain aspects of continuing technological evolution…All experience shows that even smaller technological changes than those now in the cards profoundly transform political and social relationships.”

THE FUTURE IS NOT PREDEFINED, IT VERY MUCH DEPENDS UPON THE POLICIES TAKEN

Now in the 21st century we are beginning to understand the natural world to such an extent that we can manipulate it to our own ends. But we have to understand also that climate change produces controversy in established ways of understanding the human place in nature. For the first time in human history our activities are influencing the biosphere in a such a (dramatic) way to be able to shift the course of its evolvement.

The lesson mankind should learn is that technology alone can’t solve problems — it’s most effective when it’s paired with capable underlying human forces. But after ages of designing technologies for humanitarian causes, we must conclude that no technology, however dazzling, could cause social change on its own. I t is human wisdom, not machines, that move our world forward.

Technology advances will continue to change the ways in which people live and interact with each other and their governments. Governments and societies will deal with complex, interconnected issues like data security, intellectual property rights, automation, privacy and identity concerns, and job displacement. Technol-

[1] DG Joint Research Centre (JRC) is one of the Directorate Generals of the European Commission. One of its seven Scientific Institutes the IPSC Institute for the Protection and Security of the Citizen in Ispra-Italy. The scientific research areas of IPSC include the area of Safety and Security. Among other things, specific area of its expertise is critical infrastructure protection, cyber security, global safety and security, nuclear safety, security for privacy and data protection, surveillance and transport safety and security. The power grid, the transport network and information and communication systems are among the so-called “critical infrastructures”, which are essential to maintain vital societal functions. Damage or destruction of critical infrastructures by natural disasters, terrorism and criminal activity may have negative consequences for the security of the EU and the well -being of its citizens.

ogy advantages once held by developed states and large corporations will continue to devolve rapidly to all states and non-state actors alike.

The choices of people—along with governments, organizations, and elites—will shape the 21st century and challenge many 20th century ways of li fe. The future can therefore evolve in different directions, which can be shaped to some extent by the actions of various players and the decisions taken today.

For policy responses to address all the pressing current global challenges, especially when these are seen separately from one another, is clearly a demanding task. Institutions face greater complexity and difficulty in providing solutions in due time if the policy focus extends beyond the challenges that societies face today, seeking to anticipate future challenges and transform them into opportunities. Policy problems no longer arrive in neat, isolated boxes but increasingly inter- connect, presenting themselves as "system" problems. At the same time, the explosion of new scientific knowledge, information and data, including big data, means that policymakers face a problem of abundance, rather than scarcity of information.

While complexity and uncertainty are growing and a lot of developments cannot be predicted as such, a stronger anticipation culture would strengthen preparedness and resilience of our societies.

EVIDENCE-INFORM ED POLICY-MAKING

Policymakers are increasingly confronted with a wide array of problems, such as climate change, economic inequality, ageing populations, energy and food security, and water scarcity. They often need their decisions to be *informed* by the best available science from across disciplines as these challenges no longer arrive in clean-cut discipline-shaped boxes. This is crucial because the wrong policy can result in grave economic and social costs, and erode trust in governing institutions.

The good news is that never before in human history has so much scientific information been produced and it has never been so easily accessible. We now have a better understanding of our planet, our economy, our society and of ourselves than any other time in history. With all this, we face the challenge of mobilizing these accelerating trends of scientific enterprise, knowledge, mobility and international co-operation to inform policy and take the world on a more sustainable path. (At the same time science itself and the way that scientific knowledge is being produced, distributed or transferred is undergoing change due to new technologies. One has also to seriously consider the quality of the scientific data and information being produced. There is a multiplicity of actors, with scientists no longer only based in universities or research institutes; citizens are now also actors in scientific evidences production.)

However, the process of translating this scientific information into policy relevant evidence is not simple. The science- policy interface is a very specific field with its own framework requiring specific approaches. The supply and demand for scientific evidence will be best handled by bringing policy and science as close as possible. Scientists need to be an accepted (and trusted) part of the policy cycle, regularly consulted at different stages of the policy cycle, from the initial discussions about potential new policy through to the ex-post assessment of the policy impact. Scientists could then provide their input in formal reports, but also in informal discussions as policy is developed. Format of the evidences presented is very important in order to provide policymakers with concise and visually obvious input so that they can quickly understand the main messages arising from the scientific evidence. Scientific evidence should be provided in a timely manner and usually as early as possible in the policy cycle, before important policy positions are taken. [13]

The problems policymakers are generally facing are large-scale socio-technical problems of such immensity, complexity, and urgency that to neglect a single aspect could be very "costly". These are not just problems per se, but problems with all the associated factors and concepts they encompass. These problems commonly cause different behaviour in different people. Narrowly focused, single-disciplinary science alone (usually hard science, forgetting importance of social sciences and humanities) cannot adequately underpin policies and solutions to resolve those challenges. For science to play a decisive role in addressing these problems in their full complexity, one must focus efforts toward multi-scale, integrated, interdisciplinary approaches that consider social, economic, and environmental aspects, that look between and beyond borders and sectors, and that identify feedbacks or the advantages of a policy or management decision, before it is made.

This is the area which is occupied by the *Directorate General* (DG) *Joint Research Centre* (JRC) of the European Commission [14]. As the Commission's *inhouse science service,* the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Its work has a direct impact on the lives of citizens by contributing with its research outcomes to a healthy and safe environment, secure energy supplies, sustainable mobility and consumer health and safety. As the *honest broker*, the JRC tries to identify and overcome biases, to present what is known, what is not known, what is the scientific consensus, what are the implications for policy and action and the trade-offs of various options.

DG JRC draws on over 50 years of scientific work experience and continually builds its expertise based on its seven scientific institutes, which host specialist laboratories and unique research facili ties. They are located in Belgium (Brussels and Geel), Germany, Italy, the Netherlands and Spain. While most of its scientific work serves the policy Directorates-General (DG) of the European Commission, the DG JRC addresses key societal challenges while stimulating innovation and developing new methods, tools and standards. We share know-how with the Member States, the scientific community and international partners. DG JRC collaborates with over a thousand organisations worldwide whose scientists have access to many DG JRC facili ties through various collaboration agreements.

DG JRC enhances the development of 'better regulation' tools, in particular to contribute to high quality impact assessments of policy proposals and policy options, and promote their application at EU and Member State level. It also provides scientific and methodological support to the impact assessment process. DG JRC strengthens its modelling capacity. This includes further development of sectorial models and their links to or integration with cross-sectorial analysis and sensitivity analysis. DG JRC continues its work on ensuring the consistent use of data and assumptions in its modelling across different policies, and the use of shared baseline scenarios.

Of course, the reality is that in a democracy, policy formation and political decision-making are and should be based on more than scientific advice alone. Science alone cannot decide whether or not a society should accept a particular trade-off between economic growth and environmental protection. But science can and should certainly inform the choices that society makes. But one place where science can play a much greater role and particularly assist the policy maker, and indeed the politician, is in developing greater insights and evidence about how citizens and users of services might respond to any particular option. There are many facets to how this can be achieved including behavioural insights and the use of controlled trials and so forth.

KNOWLEDGE MANAGEMENT

In his book Megatrends (where the shift from the industrial society to the information society was envisaged) published in 1982, John Naisbitt stated: “We are drowning in information and starved for knowledge”. Indeed information and information resources are exponentially increasing and it is now a universally recognised true, again talking with Naisbitt’s words, that unorganised information is no longer a resource, but an enemy to knowledge building.

Every stakeholder comes armed with their own knowledge, making it harder to detect the “signal” in the “noise”. Science is also increasingly suffering from fragmentation and hyper-specialisation, as disciplines become ever more focused at the time when policy-makers need multi and inter-disciplinary advice. The socio-biologist E.O. Wilson summed up this situation: “We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely.”

As a response to the changing nature of both the supply and demand for knowledge for policy DG JRC is organising Knowledge and Competence Centres in certain priority policy areas, the central part of its knowledge management system. [15] In these areas, they should ensure that DG JRC provides more timely, important and useful knowledge but also that it achieves real impact on the policy process. Their key role will be to better coordinate the supply of knowledge and also the demand. Due to changing nature of relations between science and policy, collaboration between scientists from different disciplines and policymakers from different Directorate Generals (DGs) in co-creating policy questions and research answers, is needed. Knowledge and Competence Centres will be virtual entities, bringing together experts and knowledge from different locations inside and outside the Commission. They will facilitate knowledge management across DGs and will put in place new collaborative working methods. They will develop core knowledge management skills — systemic reviews, meta-analysis, data visualisation, web design, data analytics, infographics and management of communities of practice. They will also put this knowledge into context and make it comparable and easily accessible. Their job will be to inform policy makers, in a transparent, tailored and independent manner, about the status and findings of the latest scientific evidence. Where there are legitimate disagreements in the scientific community, these will be clearly presented. The Knowledge Centres will not overstate what is known; they will fully acknowledge scientific limits and uncertainties.

While scientific evidences are plentiful, gaps do, of course, still exist. The Knowledge Centres will be able to map these gaps. They can then be fil led by DG JRC, if it is best placed to do so. If DG JRC does not have the knowledge, it should be connected to the best available person or body, so that it "knows who" as well as "knows what", which is the essence of knowledge management. Knowledge centres will create, collate, validate and structure internal and external scientific

knowledge for a specific policy field or across policy fields. Pilots will be set up for territorial policies and disaster ri sk management in collaboration with the relevant DGs. Competence centres will bring together analytical expertise such as modelling or data mining which are independent of theme, and can be applied across policy areas. The Centres will become the "synthesisers" referred to E.O. Wilson.

DG JRC would hope that the knowledge centres also take care of the preservation of knowledge in the respective priority areas of DG JRC in the form of constructing added-value resources (ready-to-use information evaluated and selected by experts) or group them as appropriate for their use by stakeholders, which could also be available to the general public. The Centres should therefore become the place both for policy questions and policy answers, a one stop shop where the most important questions and answers can be identified by the best policymakers and scientists from inside the European Commission but also ultimately around the world. DG JRC will launch three pilot Competence Centres: a Competence Centre on Composite Indicators, a Competence Centre on Microeconomic Evaluation and a Competence Centre on Modelling. While they operate in a similar way, Knowledge Centres are organised around a specific policy challenge, while Competence Centres are organised around a cross-cutting policy tool. This approach is also more likely to enhance the impact of evidence on policymaking. Closer engagement between policymakers and scientists means scientists are better able to provide useful, timely advice and policymakers are better aware upstream of emerging issues.

DG JRC also carries out high quality exploratory research to develop in-house the skills and knowledge necessary to better anticipate the science needed for EU policymaking. Exploratory research accounts for approximately 5 % of DG JRC's scientific activities and is integrated throughout the work programme.

DG JRC also continues to develop its capacity to monitor significant upcoming trends through horizon scanning, anticipate societal challenges and their impacts on policy, analyse complex problems with a system thinking approach and identify forward-looking solutions through foresight processes. DG JRC's competences in relation to socioeconomic research and behavioural sciences will be further developed. [16] DG JRC recently has established the EU Policy Lab as a collaborative and experimental space for innovative policy-making. [17] It is both a physical space and a way of working that combines foresight, behavioural insights, design thinking to explore, connect and find solutions for better policies. By accessing diverse areas of knowledge, EU Policy Lab strives to co-create, test and prototype ideas to address complex social problems and to enable collective change (citizens science, fab labs, sharing economy…[18]).The lab setting facili tates collaboration between policy-makers and society in order to place people [19] more at the centre of policy making.

CONCLUSIONS

Abraham Lincoln and countless others have articulated some variation of the quote: "The best way to predict your future is to create it." This statement is even more true today, when the world is a whole lot less predictable than it was.

As the world embarks on an ambitious project to meet new Sustainable Development Goals (SDGs), governing requires a dual vision: a commitment to address current needs and to build the foundations for vibrant generations in the decades ahead. So creating future means adopting forward-looking policies today and taking innovative actions. But taking a longer view is no panacea; striking a sustainable balance between short-term and long-term interests is key.

Given extraordinary advances in knowledge (information) and scientific understanding, today we are more aware than ever of the implications of our actions on future generations, not least in areas like climate change. This requires more and more science informed policy making but also better understanding of science-policy interaction. Indeed, the science/policy interface should perhaps be seen as a specific field or discipline in itself, requiring a particular set of methodologies and skill s.

So, DG JRC, in its strategic orientation, is positioning itself and rethinking its organisation, to be able to fulfil its task. It constantly interacts with policy makers in more diverse way and with multiple starting points, providing integrated (in the right form and format), timely and trustworthy information and knowledge management based on multiple perspectives which can lead to better decision-making and real-time citizen feedback.

REFERENCES

[1] Ian Goldin with contributions from Andrew Pitt and Citi Research: FUTURE OPPORTUNITIES, FUTURE SHOCKS, Key Trends Shaping the Global Economy and Society, October 2014, Oxford Martin School and CITY GPS

[2] Danish Agency for Science, Technology and Innovation: AN OECD HORIZON SCAN OF MEGATRENDS AND TECHNOLOGY TRENDS IN THE CONTEXT OF FUTURE RESEARCH POLICY, 2016

[3] The Report of the Oxford Martin Commission for Future Generations: NOW FOR THE LONG TERM, October 2013, Oxford Martin School

[4] http://europa.eu/espas/pdf/espas-report-2015.pdf

[5] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/fet-open. https://ec.europa.eu/programmes/horizon2020/en/area/key-enabling-technologies
[6] UN Data Revolution Report: A WORLD THAT COUNTS, 2014 (see http://www.undatarevolution.org/report/ Report prepared at the request of the United Nations Secretary-General, by the Independent Expert Advisory Group on a Data Revolution for Sustainable Development, November 2014
[7] World Development Report 2016: DIGITAL DIVIDENDS. Washington, DC: World Bank. doi:10.1596/978-1-4648- 0671-1. License: Creative Commons Attribution CC BY 3.0 IGO
[8] Homi Kharas: THE EMERGING MIDDLE CLASS IN DEVELOPING COUNTRIES, OECD Development Centre Working Paper No.285 (2010)
[9] Carl Benedikt Frey and Michael A. Osborne (2013-09-17). "THE FUTURE OF EMPLOYMENT: HOW SUSCEPTIBLE ARE JOBS TO COMPUTERISATION" (PDF). Oxford University, Oxford Martin School.
[10] Aymard de Touzalin (European Commission), Charles Marcus (University of Copenhagen), Freeke Heijman (NL ministry for economic affairs), Ignacio Cirac (Max-Planck Institute for Quantum Optics), Richard Murray (Innovate UK) and Tommaso Calarco (IQST Centre, Ulm): QUANTUM MANIFESTO A New Era of Technology Draft — March 2016,
[11] Dr Aikaterini Poustourli, Dr. Naouma Kourti STANDARDS FOR CRITICAL INFRASTRUCTURE PROTECTION (CIP) — The contribution of ERNCIP EURAS 2014 conference 8-10 September (European Academy for Standardisation) Belgrade, Serbia
[12] John von Neumann: "CAN WE SURVIVE TECHNOLOGY?" *Fortune , 1955*
[13] Vladimír Šucha: "FIVE PLUS FOUR INGREDIENTS FOR THE EFFECTIVE USE OF SCIENCE TO INFORM POLICY" Speech given by, Director General of the European Commission Directorate General Joint Research Centre at World Science Forum, Budapest, Hungary, 6th November 2015
[14] https://ec.europa.eu/jrc/
[15] European Commission Directorate General Joint Research Centre Strategy 2030
[16] Joana Sousa Lourenço, Emanuele Ciriolo, Sara Rafael Almeida, and Xavier Troussard: BEHAVIOURAL INSIGHTS APPLIED TO POLICY European Report 2016. EUR 27726 EN; doi:10.2760/903938
[17] http://blogs.ec.europa.eu/eupolicylab/
[18] Alan Irwin (Copenhagen Business School, DK) talk on Citizen Science and Scientific Citizenship at the Joint Research Centre as part of the STS "Contro Corrente" series of seminars, 15 October 2015; https://povesham.wordpress.com/2016/02/02/alan-irwin-talk-on-citizen-science-and-scientific-citizenship-jrc-october- 2015/
[19] Waag society, Institute for art, science and technology: A MANIFESTO FOR SMART CITIZENS, http://waag.org/en/blog/manifesto-smart-citizens

Tadej BAJD[*]

SCIENCE AND TECHNOLOGY ISSUES THROUGH THE DEVELOPMENT OF ROBOTICS

Abstract: Contemporary robotics is a branch of science studying the intelligent systems whose main characteristic property is movement. Such systems can be divided into industrial robot manipulators, mobile robots, man-machine systems and biologically conceived robots. Special attention is paid to development of robot cells with human operators, robotic education games for children, rehabilitation robotics, and research in humanoid robotics.

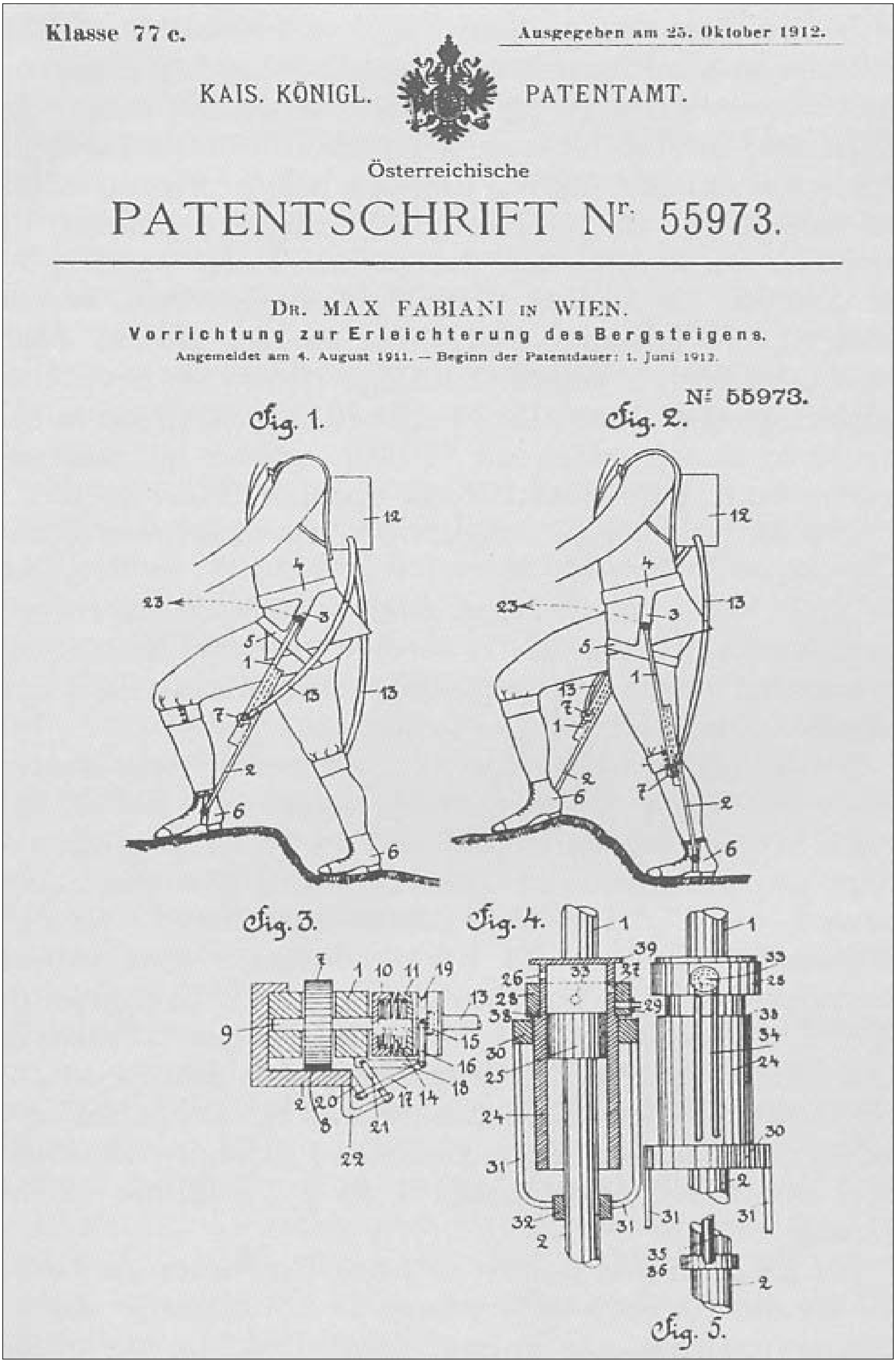
Along with robotic developments, the following science and technology issues are discussed: establishment of small, high technology and family enterprises, the needs for informal education in engineering, roboethics, the importance of proper science evaluation and research based innovation. The education of robotics in parallel with internationalization of universities is also presented.

Key words: *industrial robotics, rehabilitation robotics, humanoid robotics, education in robotics*

INTRODUCTION

The word „robot" does not originate from a science or engineering vocabulary. It was first used in the Czech drama R. U. R. (Rossum's Universal Robots) written by Karel Čapek and was first played in Prague in 1921 (the word itself was invented by his brother Josef) [1]. In the drama the „robot" is an artificial human being which is a brilliant worker, deprived of all unnecessary qualities: feelings, creativity and capacity for feeling pain. In the prologue of the drama the following „definition" of robots is given: *Robots are not people (Roboti nejsou lidé). They are mechanically more perfect than we are, they have an astounding intellectual capacity, but they have no soul. The creation of an engineer is technically more refined than the product of nature.* The Slovenian translation of the drama was published in the same year as the Czech original [2].

[*] President, Slovenian Academy of Sciences and Arts; Faculty of Electrical Engineering, University of Ljubljana, Slovenia



Klasse 77 c. Ausgegeben am 25. Oktober 1912.

KAIS. KÖNIGL. PATENTAMT.

Österreichische

PATENTSCHRIFT N^r. 55973.

DR. MAX FABIANI IN WIEN.

Vorrichtung zur Erleichterung des Bergsteigens.

Angemeldet am 4. August 1911. — Beginn der Patentdauer: 1. Juni 1912.

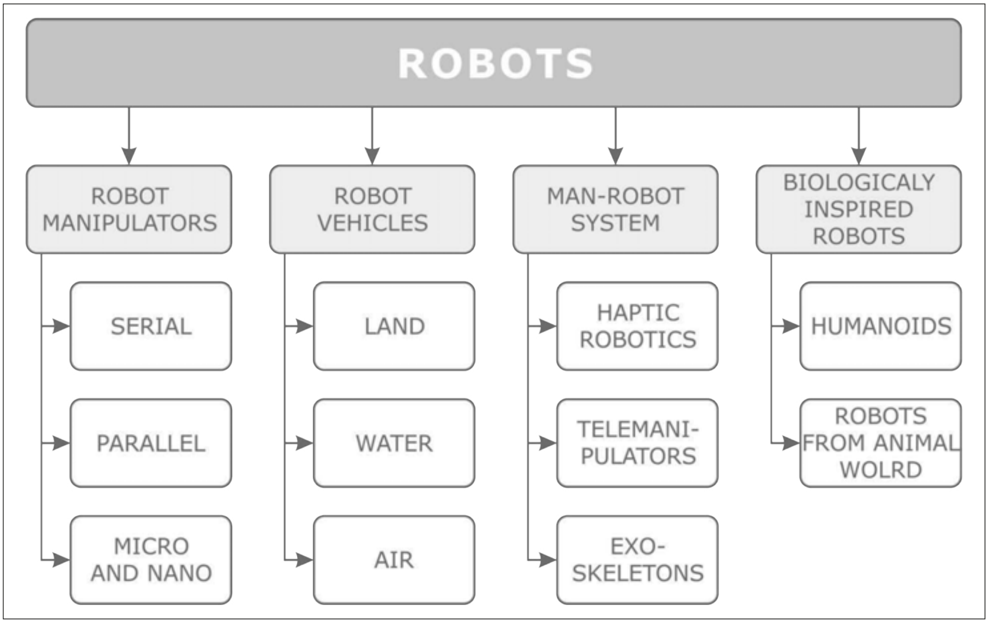
Picture 1. Fabiani's patent application

The patent application for an exoskeleton robot can be considered as an early achievement of Slovenian robotics (Picture 1). The aim of this robot device was to augment the movements of a person executing a task where forces, higher than those provided by human body, are required. Slovenian architect Max Fabiani, author of prominent buildings in Ljubljana, Vienna and Trieste, applied for and received the patent for his „device facilitating climbing to the mountains" already in 1912 before the word „robot" was invented. The proposed system, based on telescopic joints and pneumatic actuators, was, however, never realized. "

An important initiative for development of robotics in Slovenia was the meeting „Movement in Man and Machine" which was in 1982 organized by Slovenian Academy of Sciences and Arts. The participants of the meeting were the most eminent American and Yugoslav roboticists and biomedical engineers. Special attention was given to the analysis and comparison of movements assessed in human extremities, prosthetic devices and robot mechanisms. Of special theoretical importance was the lecture by Professor Richard Paul from the University of Pennsylvania on singularities of robot inverse models. Professor Paul published in 1981 the textbook [3] which significantly influenced teaching of robotics at the University of Ljubljana. Equally memorable was the lecture by Professor Bernard Roth from Stanford University discussing kinematic problems of robot fingers, arms and legs.

Professor Roth, the author of famous book on kinematics [4], has later many times paid a visit to Slovenia. The reason for his visits were the symposia „Advances in Robot Kinematics" initiated by Professor Jadran Lenarčič. The biannual symposia represent a central international event bringing together the researchers specialized in robot kinematics from all over the world. The first symposium was organized in Ljubljana in 1988. The symposium is always accompanied by a book which was initially published by Kluwer and later by Springer publisher. Until now 12 books have been published representing the important source of scientific literature in robot kinematics.

Contemporary robotics is a branch of science studying the intelligent systems whose main characteristic property is movement. Such systems can be divided into four larger groups: industrial robot manipulators, mobile robots, man-robot systems, and biologically inspired robots (Picture 2). The most frequent industrial robot manipulators are serial chains consisting of robot segments connected through the robot joints. More and more frequently used are parallel robots where segments are connected in parallel. In the areas of biotechnology and new materials micro and nanorobots are used manipulating with molecules and particles. Autonomous robot vehicles can be found in land, water and air. Man-robot systems are of special interest in medical environment. Haptic robots and exoskeletons are in combination with virtual environments used in rehabilitation, while telemanipulators are applied in surgery. Biologically inspired robots can be divided into humanoids and robots from the animal world (robotic snakes, fishes, quadrupeds, six- and eight leg walking robots). Humanoid robots are capable of biped locomotion. With further development of robot vision and recognition methods, we can expect that the humanoid robots will soon become close partners in our everyday environment.

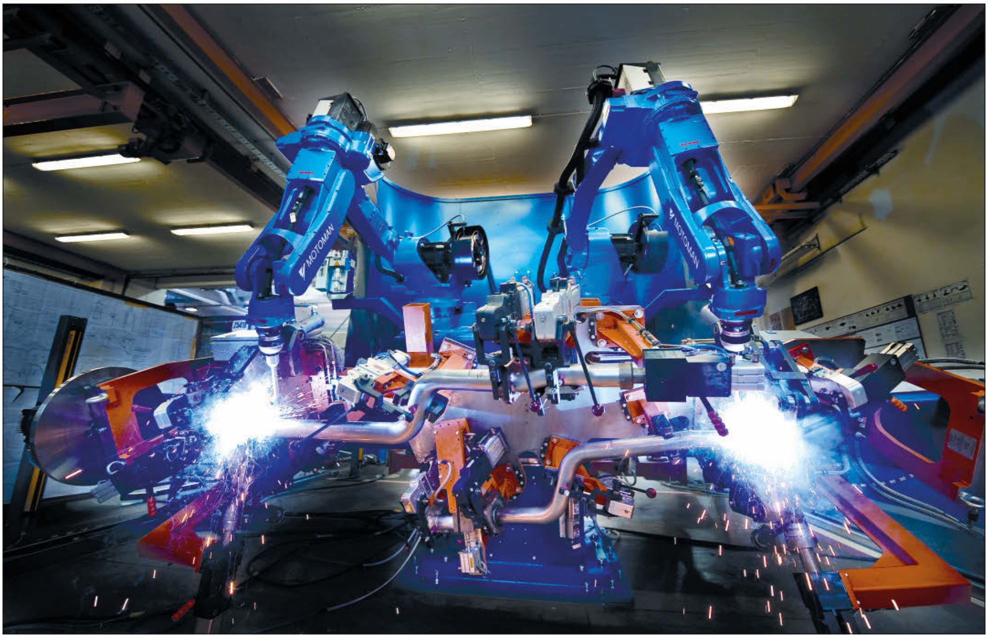


Picture 2. Classification of robots

ROBOT MANIPULATORS

First industrial robot manipulators appear in late fifties of the past century when US inventors proposed a „programmable mechanical manipulator" representing the basis for the first industrial robot „Unimate". Slovenian robotics started in late seventies by developing industrial robot manipulators of various structures (anthropomorphic, cylindrical, cartesian) and with different actuation modes. The robots were developed by the researchers of J. Stefan Institute and Universities of Ljubljana and Maribor. In small series they were produced by several Slovenian companies. Soon it became clear that for a small environment such as Slovenia it is economically more efficient to develop robotic manufacturing cells based on the robots produced mostly in other European and Asian countries. A robot cell consists of one or several robots, workstations, storage buffers, transport systems and numerically controlled machines. An example of a robot cell with two laser welding robots is shown in Picture 3. For safety reasons the today's robot cells are surrounded by a wire curtain. The advanced robot cells, however, are based on robot mechanisms that are not any more dangerous for human operator. The novel robot mechanisms are lightweight, made from new materials, and based on control systems, which make the robot compliant when in contact with either environment or worker. These modern robot cells are based on cooperation of a robot with human operator.

The industrial robot manipulators are replacing human operators in hard, monotonous, and dangerous tasks which often take place in unsuitable and unhealthy



Picture 3. Welding robot cell

environment. The industrial robots are reprogrammable and multipurpose. These properties make them interesting for use in various industrial processes such as welding, spray painting, palletizing and in assembly lines. In the world, there are over 1,500.000 industrial robots. Slovenia can be considered as an above average robotized European country with over 1.500 robots.

The development of robot cells is an activity appropriate for small and medium size enterprises. In the last decades, a series of such firms were established in Slovenia. They are introducing various European or Japanese robots into different industrial processes. Such firms are among others Yaskawa Slovenia, ABB Slovenia, Dax Electronic Systems, Fanuc Robotics, Domel, to name a few. Even small family businesses stand out in development of robot cells.

Here it should be also mentioned that in Slovenia the research and development departments in industry are in general half as strong as in more advanced European countries, e. g. neighboring Austria, and by four times weaker than e. g. in Finland. This deficit is to some extent overcome by the cooperation with the academic sphere and even more through the easily adaptable small enterprises. Nevertheless, for future prosperity our economy needs more engineers in their development departments. Also the reputation of Slovenian engineer must be increased by incorporating engineers in all levels of decision making in economy and environmental, societal and political administration.

ROBOT VEHICLES

Robot vehicles can be divided into three groups: mobile, underwater and flying robots. The mobile robotic systems are predominantly autonomous vehicles with wheels. These can be robotic vacuum cleaners, autonomous lawn mowers, intelligent guides through department stores or museums, attendants in clinical centers, space rovers, or autonomous cars. The underwater robots usually have the shape of smaller autonomous submarines. Often they are equipped with a robotic arm. They are applied in research of oceans, sea floor, ship wrecks or as attendants on oil platforms. Flying robots are smaller autonomous aerial vehicles usually applied for military reconnaissance missions.

It is interesting to note that all three types of robot vehicles are extensively used also for educational purposes. Students of University of Ljubljana are well known for their successful games of robot football. Here, the players are small cubic mobile robots with two active wheels. The microprocessor inside the robot is wirelessly connected to a computer. A camera above the playground recognizes the positions of the robots and the ball. The most important part of the robotic football is the strategy of the game which is preprogrammed and runs on the computer. The students of University of Maribor are known for their international successes in robotic rescue game. Here, we are dealing with simulation of circumstances that occur in a house demolished by an earthquake. The scene is represented by two floor labyrinth with several rooms. A tracked mobile robot equipped with a gripper is riding over various obstacles, while transporting the „victims" of the accident.

The professors of technical faculties and art academy at the University of Ljubljana have brought together their students at the practical work. This was an exceptional project opening the paradigm of interdisciplinary study, in this case combining media arts and science. Through the use of computer vision, virtual environments, kinesthetic assessments, and various robots they have begun to open an intermediate space for dialogue to ask questions about the essence of the scientific in art and artistic in science. The projects were transferred from laboratories to galleries and other public venues. Picture 4 shows a small mobile robot positioning by the use of the robot arm the objects on various places on the floor. In the so called „imitation game" the robot is copying the movements of a visitor of the gallery performing the same task. After a while it is not clear whether robot is copying human or human is copying robot.

The students of the secondary school Gymnasium Vič in Ljubljana developed a research submarine named Calypso. During the project work outside their regulary school hours they gained considerable knowledge on how to design the hydrodynamic shell of the submarine, how to select the appropriate actuators and microprocessors and preprogram the movements of the underwater robotic vehicle. The submarine Calypso was already deployed into the depths of the Slovenian sea. The quadcopters are relatively inexpensive flying robots and are very appropriate for various educative purposes. The quadcopters are equipped with gyroscopes, accelerometers, cameras and wirelessly connected to a stationary computer. In an in-

Picture 4. Mobile robot with a robotic arm involved in an artistic project

teresting student project the quadcopter was used to collect the seeds from the top of the high pines.

Informal education in engineering is of utmost importance. In grammar and secondary schools the teaching of technical subjects is underestimated in Slovenia. Because of financial requirements the technical contents are often simplified in the grammar schools, while students in general secondary schools (so called gymnasia) do not even hear the words such as engineering and technology. As a result the number of graduates from technical faculties is below the European average and Slovenia is lacking the sufficient population of engineers necessary to increase the competitiveness of its industry.

MAN-ROBOT SYSTEMS

Rehabilitation robots play an important role in the group of man-robot systems. They can be either haptic robots or exoskeletons. Haptic robots provide the user with the feeling of touch, limited motion, compliance, friction, and texture in virtual environment. Small haptic robots are usually used for assessment and evaluation of movements of upper extremities in paralyzed persons. Stronger haptic systems can hold the wrist of a paralyzed person and guide the arm end-point along the desired path which is shown to the subject in virtual environment presented on the computer screen. The haptic robot exerts two types of the forces to the subject's wrist. When the patient is unable to perform a movement along the path shown to him in the virtual environment, the robot pushes the wrist along the required trajectory and helps the patient to accomplish the task. The robot is helping only to the extent necessary for the patient to reach the goal point. When pa-

Picture 5. Robot in rehabilitation of upper extremity

tient's paralyzed extremity travels away from the planned curve, the robot pushes the wrist to the vicinity of the required trajectory. Similar therapeutic robotic exercise can be performed also by the use of exoskeletons. Exoskeletons are active mechanisms, which are attached to human upper or lower extremities. The upper extremity exoskeleton ARMIN with seven degrees of freedom (four in shoulder, one in elbow and two in wrist) developed by ETH Zürich in collaboration with University of Ljubljana is presented in Picture 5 [5].

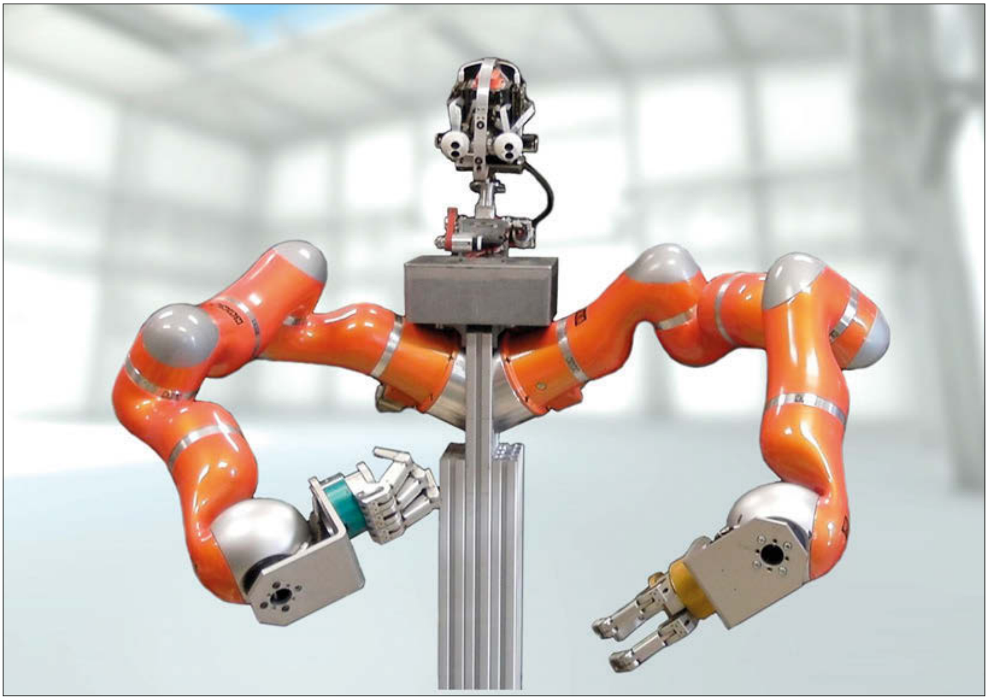
Rehabilitation robotics is a relatively new research area and is most appropriate to create new rehabilitative devices or new therapeutic procedures. Unfortunately, the Slovenian research evaluation system is in general not very much in favor of innovations. The Slovenian research system was in the year 2012 criticized by the OECD by the following statement [6]: *As the evaluation of the academic research work is almost exclusively based on bibliometric methods, this is not an incentive for the researchers from the universities and institutes to collaborate with industry in an innovation process.* With regard to the number of scientific publications, Slovenia is on excellent 7th place in Europe. On the other side Slovenia is below European average in patenting.

As similar situation can be found also in several other European countries, the word „*innovation*" will have to play an ever more important role. Here, as scientists we are predominantly interested into the „*research-based innovation*". It can be an accomplishment of either applied or basic research. It is important that it meets the expectations of society and is internationally competitive and economically promising in order to persuade political and economic leaders. The research-based innovation is often ill defined. Therefore, the European organization Science Europe proposed the following definition [7]: *Research-based innovation is an attempt to change something already established by introducing new services, products or processes to companies, governments or civil society actors, relying on knowledge that was not previously used in this area and that has been acquired through conducting research*. Research-based innovation is in Slovenia not adequately appreciated in the research environment itself and does not meet the expectations of society and of political and economic leaders. The situation can be improved by changing the evaluation practices of the research results. The research evaluation should not be based only on the knowledge published in peer-reviewed journals, but should take into account also knowledge produced in non-traditional forms, such as patents, prototypes, data, software, and other relevant knowledge.

BIOLOGICALLY INSPIRED ROBOTS

Humanoid robots are by far the most advanced robot systems in the group of the biologically inspired robots. Humanoid robots are adapted to live and work in human environment. The most noticeable property of humanoid robots is their ability of bipedal walking. They walk either with statically stable or dynamically stable gait, they can balance while standing on a single leg, they move in accordance with human co-worker, they can even run. Today's problems of humanoid robotics are related to artificial vision, perception and analysis of environment, natural language processing, human interaction, cognitive systems, machine learning and behaviors. In Slovenia the researchers of J. Stefan Institute are developing robots who learn about their own behavior from human demonstration (Picture 6). The robots are learning also from the experience, while replicating natural processes, such as trial-and-error and learning by doing, similar to that of a small child [8]. It this way the humanoid robot gains a certain degree of autonomy which further means that humanoid robots can behave in some situations in a way that is unpredictable to their human designers.

Humanoid robots are coming into our homes and are becoming our partners. They will soon be companions to the elderly and children, assistants to nurses, physicians, firemen, and workers. There is a rising need to embodying ethics into a robot. This new emerging ethics is called roboethics. *Roboethics is an applied ethics whose objective is to develop scientific/cultural/technical tools that can be shared by different social groups and beliefs. These tools aim to promote and encourage the development of robotics for the advancement of human society and individuals, and to help preventing its misuse against humankind* [9]. The outstanding novelist Isaac Asimov already in 1942 formulated his famous three laws of robotics. Later on, in 1983, he added the fourth law, known as the zeroth law: *No robot may harm humanity, or through inaction, allow humanity to come in harm*. New generation of humanoid robots will be partners that coexist with human beings, who assist human beings both physically and psychologically and will contribute to the realization of a safe and peaceful society. They will be potentially more ethical than humans.



Picture 6 Experimental humanoid robot

CONCLUSIONS

Let us devote the concluding remarks to the education issues. The history of education in robotics has at University of Ljubljana over 30-years long history. The first Slovenian robotics textbook was published in 1985, only four years after the first US textbook [3]. Today the Slovenian professors can proudly present themselves by a series of textbooks written both in Slovenian and English language. Their English textbooks were published by respectable international publisher Springer [10–14]. The textbook *Robotics* (Picture 7) is characterized by simple and original treatment of rather complex areas of kinematics, dynamics and control of the robot systems. American magazine *Choice* placed *Robotics* among the best academic books in the year 2010. The robotic textbooks can be reached from the web.

Internationalization of the universities is an important issue in Slovenia which has been an independent state for only 25 years. Slovenians developed their identity based on their language. The language is the value which connects Slovenians for one and a half millennium. It is therefore not difficult to understand that the teaching language in four Slovenian universities is more or less exclusively the Slovenian language. Single English courses are with difficulty entering the university teaching programs. On the other side, Slovenian universities would like to attract more international students and professors which is not only a profit but also a honor for an university. An important step in the process of internationalization of the uni-

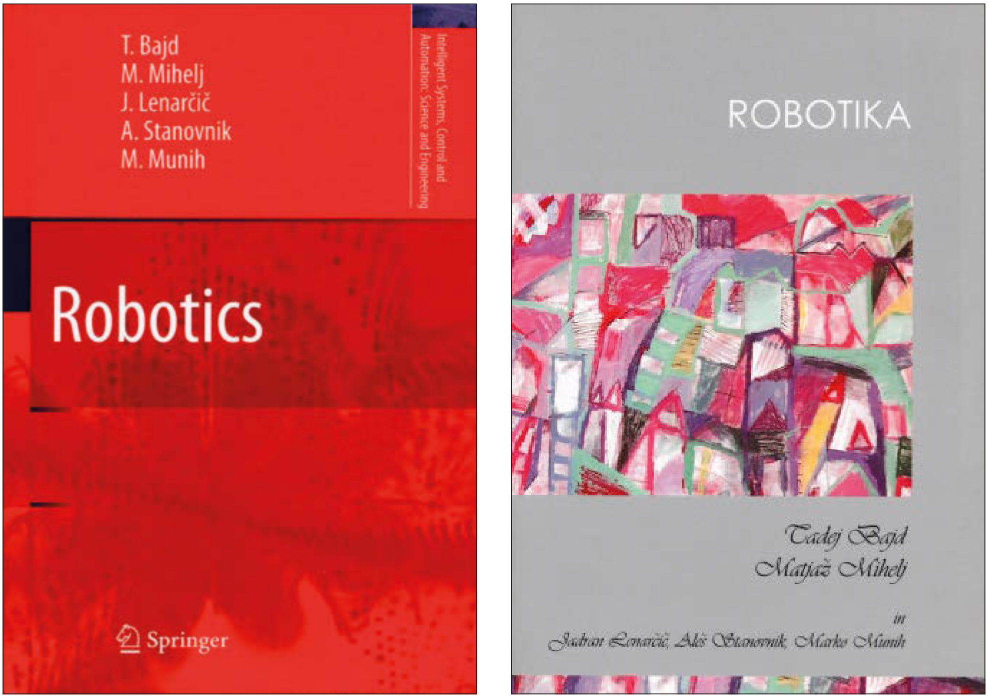


Fig. 7. Slovenian and English edition of the textbook *Robotics*

versities is in preparation of the teaching material, i. e. textbooks, lecture notes, video lectures and transparencies, both in Slovenian and English language. This is not such a difficult task with ever more extensive use of e-learning. This approach can calm those who are afraid that the Slovenian language can soon become the so called „3 F language" only used by family, friends and folk songs.

REFERENCES

[1] K. Čapek: „R. U. R Rossum's Universal Robots" *Penguin Books, 2004.*
[2] K. Čapek: „R. U. R Rossum's Universal Robots", *Zvezna tiskarna, 1921.*
[3] R. Paul: „Robot Manipulators: Mathematics, Programming and Control" *MIT Press, 1981.*
[4] O. Bottema and B. Roth: „Theoretical Kinematics" *Dover Publications, 1979.*
[5] M. Mihelj, T. Nef, R. Riener: „A novel paradigm for patient-cooperative control of upper limb rehabilitation robots" *Advanced Robotics, vol. 21. No 8. 2007. p. 843–867.*
[6] OECD: „OECD Reviews of Innovation Policy: Slovenia 2012" *OECD Publishing, 2012.*
[7] Science Europe: „Empowering Researchers to Provide Societal Value" *Engineering and Technical Sciences Committee Opinion Paper, 2015.*
[8] A. Ude, A. Gams, T. Asfour, J. Morimoto: „Task-specific generalization of discrete and periodic dynamic movement primitives" *IEEE transactions on robotics, vol. 26. No. 5. 2010. p. 800–815.*

[9] B. Siciliano and O. Khatib (Eds.): „Springer Handbook on Robotics” *Springer, 2008.*
[10] T. Bajd T, M. Mihelj, J. Lenarčič, A. Stanovnik, M. Munih: „Robotics” *Springer 2010.*
[11] T. Bajd, M. Mihelj, M. Munih: „Introduction to Robotics” *Springer, 2013.*
[12] M. Mihelj and J. Podobnik: „Haptics for Virtual Reality and Teleoperation” *Springer, 2012.*
[13] M. Mihelj, D. Novak, S. Beguš: „Virtual Reality Technology and Applications” *Springer, 2014.*
[14] J. Lenarčič, T. Bajd, M. M. Stanišić: „Robot Mechanisms” *Springer, 2013.*

Alexander LIKHOTAL*

SCIENCE AND PROGRESS

Is it progress if a cannibal uses a fork?

Stanislaw J. Lec

Science has become a part of almost every aspect of our life and takes justified credit for the progress. However the fundamental myth of progress — that it produces a steady betterment of life — is crumbling before our eyes. The experience of the twentieth century, with its civil and world wars, Gulags and Holocaust, was too tragic to support a continued belief in a kind of granted optimism of world history.

Unfortunately science development is distorted by our modern social organisation and economic system. Our society is possessed by money, consumption, and economic growth. In this model even science becomes an obedient servant of the system.

Science allows us to do more, but it doesn't tell us whether doing more is right or wrong. Therefore, with scientific advance, we need greater ethical vision; better judgment; and stronger analysis of how to use knowledge for good not ill. It was in the 19th century when idols of positivism pushed people to adjust ethics to the standards of science. Today, it is more appropriate to talk about the ethical control of the progress and results of scientific discoveries.

And it is not about making science a scapegoat for misuses of its advances. It is not science, but ignorance that is to be blamed. So education, new universal education is critical, and not just for those who expect to practice science but for everyone who lives in the modern world and especially — political leaders.

This will require a rapid transition to a different model of development, which not only takes into account the interests of short-term growth, but provides the opportunity for sustainable and inclusive development. Change may be frightening, but it is inevitable. And, in fact, it provides an opportunity to improve our instruments, our strategies, and… possibly ourselves. The wave of technological change

* President, Green Cross International, Switzerland; Trustee of WAAS

is far from its peak. We should be excited and filled with hope — by where it could take us, of course, only if we chart the course properly.

We live in a golden age of technological, medical, scientific and social progress. Just look at our gadgets! Twenty years ago, the internet was a geeks thing. Now we can't imagine life without it. We are on the verge of medical breakthroughs that would have seemed like magic only half a century ago: cloned organs, stem-cell therapies to repair our very DNA. Even now, life expectancy in some rich countries is growing by five hours a day. A day! Surely if not immortality, then something very close to it, is just around the corner…

Science has become a part of almost every aspect of our lives and takes justified credit for the great strides of His Majesty the Progress. And yet somehow, this does not feed our enthusiasm.

The fundamental myth of progress — that it produces a steady betterment of life — is crumbling before our eyes. The experience of the twentieth century, with its civil and world wars, Gulags and Holocaust, was too tragic to support a continued belief in a kind of granted optimism of world history. Today, IS and the refugee's drama, to say nothing about growing list of existential threats from climate change to hybrid/proxy wars erupting in many parts of the world do not add up to an optimistic picture.

As Stephen Hawking rightly argues: the human race faces one of its most dangerous centuries yet as progress in science and technology becomes an ever-greater threat to our existence. „We are not going to stop making progress, or reverse it, so we must recognize the dangers and control them," he warns.

Here, it seems pertinent to ask the paradoxical and provocative question: why during the last hundred years, the idea of progress has transmuted from the idea of almost a „salvation" into a dangerous factor, fraught with wars, almost ceaseless violence and existential threats to humanity?

I am not doubting scientific progress. But I do wonder about how science development has been distorted by our modern social organisation and economic system. I wonder whether real progress could have been much more impressive and tangible. I am thinking of the goals and definitions of progress.

What is progress?

Different dictionaries state that progress is a forward or onward movement towards an objective or a goal. The concept was introduced by Enlightenment as a secularization of the Christian idea of the 8th day. Christianity believed that human development (understood as spiritual growth), routed in human ontological freedom, was the purpose of history. Most clearly this idea was expressed by Hegel: „The introduction and pervasion of the principle of freedom in secular relationships is a time-consuming process, which constitutes the history". The goal of progress was well formulated in the 19th century by Russian thinker Chernyshevsky, who said that the progress — is the desire to „raise a man into human dignity", and „without freedom a man can not be a man". Thus human being was considered as not a perfect and complete entity, but something that always remains in formation. Consequentially progress was understood as an endless human ascension on the road of self improvement.

The twentieth century, driven by neo-liberalism and post-modernist transition, has horrendously distorted the very notion of progress. The idea of freedom as the foundation of progress was replaced by the idea of happiness — a fuzzy concept that could mean many different things to many people. The United Nations even declared the International Day of Happiness (20 March) to recognise „the relevance of happiness and well-being as universal goals." Predictably this idea has ultimately evolved into the hedonistic trend of seeking pleasant and avoiding unpleasant experiences — building a sort of heaven on earth based on improvement not of a human being but its living standards. However, since scientific and technological development (which has always been inalienable part of progress) successfully continued, it seemed that progress was underway. It remained largely unnoticed that the idea of freedom, without which the very notion of progress becomes void, had been gradually abandoned.

Recently UNESCO proudly reported: most countries, regardless of their level of income, now see science and innovation as key to fostering sustainable economic growth and furthering their development. But do you notice the double-meaning of that statement? In fact, there is a stark difference between science and innovation. While science implies investing money in research, innovation, though, is often simply the conversion of research into money…

Striving to fulfil the ever-growing appetites for joy and happiness, progress today is reduced largely to consumer-driven, often banal improvements in technology. Sure, our phones are great, but that's not the same as being able to send a man into the outer space, to fly across the Atlantic in eight hours or eliminating smallpox and other quantum leaps of the post-war Golden Quarter. As the US technologist Peter Thiel once put it: „We wanted flying cars, we got 140 characters" (on Tweeter).

If it were not for distorted frameworks, we could be living in a world where cancer and Alzheimer were treatable, where clean power had ended the threat of climate change, where the brilliance of genetics was used to bring the benefits of cheap and healthy food to the bottom billion, and where poverty would have been a thing of the past.

It feels bitter to think in the year of the 55th anniversary of Yuri Gagarin's first space flight, that after the century of fateful scientific breakthroughs the twenty-first century — at least its beginning — turned out to be a tremendous setback when archaism and the darkest superstitions are reborn into the modern world where 21st century technology helps spread images of barbaric decapitations in front of the cameras, and wars have become inalienable elements of „hybrid" peace.

And it is not about making science a scapegoat for misuses of its advances. It is not science, but ignorance that is to be blamed for both — misusing and hampering it.

However, the XXI century made one thing clear: the scientific endeavour is as much about us as it is for us.

We have to realize that science allows us to do more, but it doesn't tell us whether doing more is right or wrong. Science can only tell us what exists and not where we should head.

Goal setting is the function of values acquired in the course of history. This is why values are not „superfluous resource" but basic intangible assets of the civilization. Technically equipped, but morally flawed attempts to shape the future, risk turning into disastrous defeats that go beyond just restitution of the past (we see it already around us — rebirth of nationalism, the barbarisation of populations, demise and flagrant violations of international law, the dehumanising effects of pop culture).

Therefore, along with accelerating scientific advances, we need greater ethical vision; better judgment; and stronger analysis of how to use knowledge for good not ill.

Of course, all this does not mean that we should reject rationalism. Simply there are other dimensions to humanity that must be respected along with rationalism. Many areas of life are simply too non-physical to be satisfactorily addressed by science. Love, hate, relationships, poetry, art, music, literature, and spirituality are all outside the realm of science. Any problems that arise in these areas cannot be resolved by science.

To suppress and ignore these dimensions prevents even rationality from functioning properly. As Werner Heisenberg explained this in his philosophical work „The part and the whole": „Science is made by man. This is a natural fact that is easily overlooked; another reminder of it can help reduce the regrettable gap between the two cultures — arts and humanities and science and technology „. Both emotions and morality must work alongside rationalism as parts of the living totality that is human existence.

I am not promoting the merger of science and arts. Good art and good science necessarily require high degrees of specialization. After all, there will always be things that anyone understands, but can not explain: for example, any idiot sees that the ball is not a bagel, but you have to be Poincaré to see the problem here, and Perelman to solve it.

However, was it a coincidence that Einstein, Heisenberg, Gödel — the three geniuses who have propelled modern science from determinist universality based concept of material world into the age of complexity, relativity and uncertainty — had excellent philosophical and/or musical education? Was it a coincidence that Leibniz was a writer and a philosopher while Gauß and Fermi were renown philologists? Is it also a coincident that over 75% of sciences Nobel laureates have expansive knowledge in humanities and have been proficient in music or literature?

How many coincidences are needed to recognise the regularity?

Has anyone really looked for connections between culture, mathematics, and science? How about intuition and reason? It was 300 years before Einstein that Shakespeare intuitively guessed about relativity of time in his 77 sonnet. 100 years later Bach's fugues provided a musical model of the modern concept of Universe. It took centuries until Einstein — who, by the way, used to say „I often think in music" — has shown us how it all connects and turned the divine revelation into a scientific discovery.

Einstein directly warned about detrimental effects of science dehumanisation in 1946: „I think the root causes of a frightening world's ethical degradation are mechanization and dehumanization of our lives. This is a fatal side effect of the development of scientific and technical thinking. It is our fault! I do not see a way out from this plight. A man cools down faster that the planet on which he lives."

Therefore, the road to real progress, as Freud and Einstein agreed, must begin here with us, in our own attitudes. And no trip to Mars — a dream which, thanks God, now seems to be reborn — will not make us any smarter or more tolerant and human. We need to do something with ourselves and understand something about ourselves…

I think this was exactly what Nikola Tesla meant when he argued: „The day science begins to study non-physical phenomena, it will make more progress in one decade than in all the previous centuries of its existence."

This will require a new type of universal education and not just for those who expect to practice science but for everyone who lives in the modern world. We need it because education is a tool providing catalysts for important, sustainable change in our society. We need it to help youth to chart course. We cannot just train them to „succeed" in the current system — that is not a real education. We must inculcate in them a broader world vision and a greater capacity for critical thinking. Political leaders, in particular, badly need to be exposed to scientific vision. The mind, once stretched by a new idea, never reverts to its original dimensions.

It is easy to dismiss the suggestion that science driven technology can save the day. After all, technological advance also requires good governance, market forces, effective universities, and more. Politics will still play its role.

Nevertheless, it's time to recognize that governments are ill-equipped to understand the science determinants, sophisticated technological challenges and opportunities facing the world, and that new instruments are needed to ensure that science and technology are adequately applied to address a wide range of increasingly urgent global problems and not just to make our smart phones batteries last longer (which personally I would not mind at all).

This new universal education should enable us to master the cultural riches accumulated by humanity. And only then high culture multiplied by the achievements of scientific thought, interacting, enriching and feeding one another, will guarantee the real, human centred progress.

Ultimately we need a rapid transition to a different model of development, which not only takes into account the interests of short-term growth, but provides the opportunity for sustainable and inclusive development and returns meaning to the lives of individuals.

Change may be frightening, but it is inevitable. And, in fact, it provides an opportunity to improve our instruments, our strategies, and… ourselves. The wave of technological change is far from its peak. We should be excited and filled with hope — by where it could take us, of course, only if we chart our maps properly…

On Christmas day in 1989 conducting Beethoven's famous and mysterious Ninth Symphony, known as Ode to Joy to celebrate the fall of the Berlin Wall, Leonard Bernstein has replaced „Freude" („Joy") with „Freiheit" („Freedom"), allegedly reverting to the original title of Schiller's poem that he had had to change to avoid censor's recriminations. I am still wondering, was it the great Maestro's brilliant situational improvisation to symbolize many Germans jubilation of the retrieval of the divine gift of freedom? Or was it the prophetic Omen — „the writing on the wall" — reminding us that freedom is the humanity's historic invariant, abandoning which can not remain without consequences.

In any case I hope that the last century of great scientific discoveries will be followed again by the Age of Enlightenment — one that will illuminate the progress of Humanity.

Alberto ZUCCONI*

WHAT KIND OF EDUCATION IS NEEDED TO NAVIGATE THE FOURTH INDUSTRIAL REVOLUTION?

Abstract: The fourth industrial revolution is going to bring great and rapid changes, the negative effects will be greater than the benefits if we do not plan and manage effectively this revolution. Understanding the complex processes in motion is crucial as well as developing effective tools for governance. We can manage wisely this revolution, increase the positive effects, reduce and mitigate the negative ones if we make it person and people centered and sustainable. We need to make available for everybody scientific and emotional compasses. An effective person-centered education will be needed to navigate the rippling currents of change.

Interdisciplinarity, Intersectorially, Sociology of knowledge, Facilitators of change, Effective tools, Resilience, Sustainability, Person Centered Education. Person and People Centered Approaches.

INTRODUCTION

We are entering the so called 4th industrial revolution and the impact is going to be all pervasive and of much bigger magnitude than the previous industrial revolution. The incoming changes, approaching at an accelerating speed will be impacting everything and everybody and will be blurring the lines between the physical, digital, and biological spheres, they will affect all the bio-psycho-social dimensions, our narratives and even what it means to be human.

If not planned effectively and farsighted the results could be very problematic for all life forms on Earth.

If we manage the 4th industrial revolution with the same blindness and forms of denial with which we managed the 3rd and the 2nd revolutions, the negative the effects will be exponential. But we are not impotent, we can manage wisely this revolution, increase the positive effects and mitigate the negative ones since Tecne is designed, made, and managed by human beings. What will be the outcomes of the

* President, Person Centered Approach Institute (IACP), General Secretary of the World University Consortium (WUC), Treasurer World Academy of Art and Science (WAAS)

fourth industrial revolution for human and natural capital will not be determined by some mysterious evils, but as in the past by human beings.

We cannot be naïve and just hope that technology will automatically improve our lives and better satisfy our needs; new and effective tools for understanding and governing such epochal changes are needed as well as facilitating awareness in all the stakeholders about the dangers and opportunities offered by the incoming changes.

Effective education is going to be crucial, the fourth industrial revolution could be an unprecedented success if we will be able to manage the complex processes of this revolution and at the same time intentionally and effectively assure that each innovation, not only brings change but will also foster a more humane, sustainable and prosperous future for all. For effective governance we need effective tools, one needed tool is a clear understanding of the crucial role played by the processes by which we humans construe the experience of ourselves, of others and other of life forms. In other words we think we live in reality but we live in a socially construed consensus reality; ignoring that may create for us crucial blind spots and diminish our coping capacities and resilience.

Another tool needed is more effective metrics than the ones we presently use to measure reality and what we call profit, productivity, good education etc. To win these challenges effective and person & people centered education will play a crucial role.

THE PROBLEMS WE MUST FACE

The trouble with our times is that the
future is not what it used to be.

Paul Valéry

There is a large amount of scientific evidence that our present relationship with ourselves, others and the planet we live in is the main variable influencing all life forms and the planet itself, a dramatic epochal change referred to by scientists as the Anthropocene (Crutzen and Stoermer, 2000).

The human population's exponential increase favored by the first, second and third industrial revolutions in numbers, production and consumption behaviors has produced such dramatic and exorbitant costs to ourselves and all the lifeforms. The number of people on the planet is set to rise to 9.7 billion in 2050 with 2 billion aged over 60. (United Nations Department of Economic and Social Affairs, Population Division, 2015).

According to the last The Living Planet Report, the problems are getting worse as populations and consumption keep growing faster than technology finds new ways of expanding what can be produced from the natural world. This had led the report to predict that by 2030, if nothing changes, mankind would need two planets to sustain its lifestyle.

The WHO reminds us that the destruction and pollution of the environment has dire consequences for people's' health; globally, 23% of all deaths are estimated to be attributable to the environment, and 22% of disability-adjusted life years (DALYs). In total, the number of deaths linked to the environment amounts to 12.6 million per year (based on 2012 data). This burden could be lessened significantly by reducing risks (WHO 2016 a).

There are also other kinds of mounting problems around the world and in particular in the most prosperous countries. Paradoxically, on one side we have since the second world war an exponential increase in the availability of material goods, services and connectivity, on the other a significant increase of the number of people that feel disconnected, are depressed or burdened by narcissism, consumerism, self-exploitation and lack of meaning (Han, 2014).

There is evidence that depression predisposes people to myocardial infarction and diabetes, both of which conversely increase the likelihood of depression. Many risk factors such as low socioeconomic status, alcohol abuse and stress are common to both mental disorders and other non-communicable diseases. There is also substantial concurrence of mental disorders and substance use disorders. Taken together, mental, neurological and substance use disorders exact a high toll, accounting for 13% of the total global burden of disease in the year 2004. Depression alone accounts for 4.3% of the global burden of disease and is among the largest single causes of disability worldwide, 11 % of all years lived with disability globally, particularly for women. The economic consequences of these health losses are equally large (WHO, 2013).

The World Health Organization remind us that every year more than 800 000 people take their own life and there are many more people who attempt suicide. Every suicide is a tragedy that affects families, communities and entire countries. Suicide occurs throughout the lifespan and was the second leading cause of death among 15–29-year-olds globally in 2012. The number of suicides increase in moments of crisis with a breakdown in the ability to deal with life stresses, such as financial problems, relationship break-up or chronic pain and illness. In addition, experiencing conflict, disaster, violence, abuse, or loss and a sense of isolation are strongly associated with suicidal behavior. Suicide rates are also high amongst vulnerable groups who experience discrimination, such as refugees and migrants; indigenous peoples; LGBTI persons; and prisoners (WHO 2016 b).

To make things worse the combining effects of climate change, the acidification of the oceans, the desertification of large parts of the planet, the increasing deforestation, the increasing destruction of biodiversity, interact with other explosive realities. There are still enormous numbers of people suffering from hunger, ill health, wars, terrorism, violence, unequal access to resources and opportunities, racism and many forms of discrimination and injustice. Many people are forced to live their homes and countries by warfare and ethnic or religious fanaticism enlarging the growing numbers of refugees and migrants that in an escalating spiral are the innocent targets of the fears and bigotry of some citizens of the nations where they seek refuge.

A mounting number of scientist warn us that we, are fast reaching a tipping point where mitigation and /or reversal of trends will be not be within our reach if we do not act promptly and effectively (IPCC, 2007, 2012, 2014).

The fourth industrial revolution could help us to exit from this human-produced quagmire, but only if we will capable of effective planning and governance.

For sure the fourth industrial revolution will create new problems. It is estimated that massive unemployment of unskilled labor and disappearance of some jobs becoming automated by computerized machines will be one of the effects of the changes looming ahead that we will need to deal with: It is estimated that in the next 10–20 years the number of jobs threatened by new technologies will be around 47% of the total in the United States and between 40% and 60%. in Europe (Degryse, 2016).

Rising inequalities is another; according to Credit Suisse's Global Wealth Report 2015, the richest 1% of the population now owns half of all household wealth. Oxfam's new report states that 62 individuals control more assets than the poorer half of the world's population. Researchers such as Richard Wilkinson and Kate Pickett have found that unequal societies tend to be more violent, have higher numbers of people in prison, experience greater levels of mental illness and have lower life expectancies and lower levels of trust. These inequalities will create even more fears and backlash against change. The rising of interconnectedness will bring rising dangers on security, cyber terrorism and like in an Orwell scenario, all these smart machines and smart customized services, if we do not plan wisely the internet of Things (IoT) and smart machines to not only smart, but also people centered, the cyber revolution may deprive us of our right to privacy, creating an all-encompassing planetary Big Brother' effect.

WHAT TO DO?

We can do several things for planning and governing the fourth industrial revolution in a people centered and sustainable way; they all have a common denominator: to ensure that the planned changes are person, people and community centered and sustainable. It is imperative to identify the barriers to achieve these goals and work effectively to identify, remove or reduce them (Norgaard, 2011); (Zucconi, 2013).

Some of the variables that will effectively foster a more humane and sustainable future for social and natural capital:

— More awareness
— More empathy
— More capacity for respecting oneself, others and the world
— More responsibility (in the sense of the ability to respond)

Since reality is socially construed in order to have a fourth industrial revolution that will protect and promote human and natural capital, we need to educate everybody to give their contribution to reach that goal.

CREATE AND APPLY EFFECTIVE METRICS AND TOOLS TO PROMOTE SUSTAINABLE CHANGE

Our relationship with ourselves, others and the world is an important determinant of our mental, physical, and social health. People and societies that are alienated from parts of themselves, relate to others and the planet in alienated and distorted ways.

At present, the way profit is calculated in a mechanistic reductionist way, the so called „bottom line", at the national level is the GNP whose standards completely ignore the destruction of human and natural capital. With a more realistic and sustainable approach there are at least 3 variables that account for the so called Triple Bottom Line (TBL) that measure economic, ecological and social results. The Quadruple Bottom Line (QBL) also takes into consideration the cultural aspects, including governance. (Zucconi, 2013).

Recently an Inclusive Wealth Index (IWI) has been formulated, it has a broader way of measuring natural capital, such as forests, produced capital, such as roads and factories; and human capital, including levels of education, knowledge, and creativity. The preliminary findings indicate that it is possible to trace the changes of the components of wealth by country and link these to economic growth, underlying the impact of declines or increases in natural capital as an economic productive base (UNU-IHDP, 2012). Effective economic growth can be attained only through ecologically conscious green or blue economies (Pauli, 2010). We need to apply effective metrics and in need we can create new ones. We need to use in all the future planning and project management some effective human capital and environment impact assessments scales, or use tools already available like the Health Impact Assessment (HIA) to measure and make predictions of health consequences (WHO 2016 a). If such assessments are performed at the planning stage we can have projects with a sustainability, people-centeredness, quality, vulnerability and resilience focus.

USE SCIENTIFICALLY VALIDATED PEOPLE-CENTERED TOOLS

The Person-Centered Approach is a scientifically proven effective way to create solutions on a win-win basis. The Person-Centered Approach is a systemic, holistic approach applied successfully on all the helping relationships and in interpersonal relationships including conflict resolution. This approach focuses on health not on illness, on capacities rather than on limitations; empowers and promotes well-being and resilience by facilitating the development of the potentialities of individuals, groups and organizations, helps people to grow and take responsibility for what they do rather than fostering dependency.

The Person Centered Planning (PCP), a scientifically sound and process-oriented approach to empowering people. It focuses on the people and their needs by putting them in charge of defining the direction for their lives.

The People Centered Approach (PCA), a scientifically validated, interdisciplinary and intersectorial approach designed to be employed on large scale projects focused on fostering the maximum level of effectiveness in protecting and promoting human ecologies and natural ecosystems and promoting sustainable change. The People Centered Approach (PCA) is a values oriented approach based on Equal Rights, deep respect of all form of life, cultures and traditions. The PCA promotes empathic understanding, mutual respect and effective communication and collaboration among different stakeholders with actions of empowerment & resilience.

IDENTIFY THE BARRIERS TO SUSTAINABLE PERSON CENTERED CHANGE

Notwithstanding the seriousness of the threats, and the urgency to deal with them, many obstacles remain in the way of effective, community, national and international governance. The lack of awareness of the magnitude of the problems and the changes needed in the behaviors of all the stakeholders to manage the serious mounting challenges facing humanity is in part due to barriers of a sociological and psychological nature that impede effective coordinated actions of the various stakeholders. The underlying mechanism at work in the promotion or resistance to change or the denial of threats like climate warming vary from culture to culture: how reality is socially construed and how individuals and organizations construe their experiences and narratives is relevant for the understanding of the promotion of change needed to promote sustainable governance as well how to deal effectively with the barriers to change.

REALITY

Reality isn't what it used to be

Walter Truett Anderson (1990)

In the age of globalization and of growing complexity, in order to meet the challenges of our present and future we need new and effective ways to facilitate the capacity of awareness & integration of our ways of knowing and of behaving. We need to foster a new socio-psychological literacy for billions of people; a socio-psychological compass, a needed holistic/systemic way of being in relationship with ourselves, others and the planet, to enable us to navigate in the rippling currents of change.

Nowadays decision makers and experts still seem not to take notice in their blueprints for governance of how individuals, communities, societies and cultures are fully immersed in the ways they call and perceive as reality, that in effect is not quite what they intend — reality as an objective fact- What they call reality is the way individuals construe their experiences of the so called reality at the personal and societal levels.

The ways individuals and communities construe their experiences can be very useful in helping them coping effectively with their circumstances only if they have a clear understanding of how problems are generated and how they can be resolved or mitigated.

As the history of humankind amply shows, the construction of experience mistakenly taken for objective reality can, with the best intentions, create destructive boomerang effects, immense sufferings and even the downfall of some empires and civilizations.

The way we still use some dysfunctional metrics to measure growth is one of the many examples on how we can make ourselves blind to the obvious: We can still read in the daily news that the economy is growing even when society is bent in effectively destroying its human and natural capital, impacting negatively present and future generations and behaving like a cancerous growth does in a living organism.

Understanding why the drawing national borders with a ruler might look neat in a map of post-colonial nations but that blindness will provoke chaos and immense suffering for generations and spread in larger areas as the present social pandemic of violence seems to indicate. Only blindness can explain the recent behaviors that some of the most advanced nations have adopted in Iraq, Syria, Libya, the Middle East. Only blindness can explain the lack of preparation for the consequences from the dislocation of immense numbers of people running for life away from their war torn countries that risk their lives to have a chance in more safe and prosperous countries that in turn witness a rise in fear insecurity, that generate the rise of populist politics, racism and violence.

„The world of everyday life is not only taken for granted as reality by ordinary members of society in the subjectively meaningful conduct of their lives. It is a world originated in their thought and actions, and is maintained as real by these."

Berger & Luckmann, 1966, page 19

What is perceived as real varies from society to society and is produced, transmitted and conserved through social processes. Our perception of reality is largely modeled from beliefs and assumptions that are typical of the society and culture in which we belong. What we know, what we consider true and right, the behaviors we adopt, all are influenced by the social/cultural environment in which we live. This process happens through the internalization of a „reality" that occurs during the socialization process.

We need new and effective ways of coping with our rapidly changing realities. A way to become aware on how we construe our experiences of what we call reality: the relationship with ourselves, the others, the world. We need to foster at every level of society awareness of the social construction of reality, of our powers and responsibilities for the present a future of humankind & the whole planet (Anderson, 1990, 1997, 2016).

Socio-cultural and personal constructs are the ways communities and individuals construe their experiences at the emotional and cognitive level. The social and personal constructs are interacting and influencing all the time the social and individual dimensions.

Some of the variables influencing us are:

— Our relationships with significant others parents, siblings etc), by the roles that they give us and the by the ways of being (constructs) we introject and become part of our personality, influencing the ways on how we relate with ourselves, others and the world.

— The social environment through the imposition of societal norms.

— The narratives we absorbed from kids fables, cartoons, movies, TV, social media, popular heroes.

— The formal and informal education we receive

For all the above reasons we need to educate everybody to understand the social and individual processes that are at the base of the construction of the narratives we call reality. That what we call reality is a consensus reality and is largely shaped by our beliefs. If our socially construed and personally construed beliefs are made conscious and their values explicit we can examine them and verify if some of our beliefs are obsolete or dysfunctional, so we can update and change dysfunctional ways of thinking and feeling with more functional ones; a process that is characteristic of fully functioning persons (Rogers, 1965).

EFFECTIVE EDUCATION

No other institution in the world is as powerful in shaping our future, since with the educational process much of the social construction of reality occurs. Education is where the minds of the new generation are shaped about what is real.

(Dewey, 1897, 1924); (Rogers, 1969,1983); (Freire, 1970); (Foucault, 1980); (Zimring, 1994); (Morin, 2001,2007 a, 2007 b).

Francis Bacon, said that knowledge is power, most people will agree with that, but is not automatically self-evident that that to have faulty knowledge is to lose power, a form of socially inflicted harm. Present education stifles our natural learning abilities.

All lifeforms survival depends of effective and rapid learning how to adapt their behaviours to environmental changes. We need to retool and upgrade all levels of education. Formal and informal education at any level need to offer people the knowledge, skills and attitudes that will enable them to become effective facilitators of change.

This new education needs to be people centered and empower people to be in contact with themselves, others and the world in which they live with the natural qualities of respect and empathy (Vincow, Gershon. 1997); (Lambert & McCombs; 1997); (Catalano & Catalano 1999); (Thorkildsen, 2011); (Zucconi, 2013); (Costa, 2014);

If I am able to be in relate to myself with respect and empathy, then is much more easier and natural to relate to other human beings even those with different beliefs and customs with respect and empathy. This is not mere wishful thinking there is ample scientific evidence accumulated that shows that people able to relate with respect and empathy to themselves not only are they able to have relationships with other human beings with respect and empathy but they are going to perceive life around them, to attune themselves empathically with all the life forms. This way of being is not exceptional, is just typical of mentally healthy human beings. (Rogers, 1969, 1977,1983); (Zucconi 2013). (Silani, Zucconi, Lamm, 2013).

Unfortunately centuries of spreading alienation have made lack of contact and chronic reification „normal". Those alienated individuals that relate to themselves, others and the word, like something that can be turned in a commodity and sold for monetary gain are considered smart and successful. The results are irresponsible environmental exploitation, social injustice and the destruction of our planet.

Is encouraging to see what Pope Francis is saying in his encyclical *Laudato Si'*, an effective call to an 'ecological conversion', of every good christian, a person that in his/her feelings and behaviors respects all the different human beings and all the living creatures. If spiritual, political leaders, and opinion makers will give a congruent message of respect and empathy with all the life forms, this common calling would be an excellent teaching and such motivational narratives would have significant positive results.

Our success will depend on how we organize learning, since learning is for our species the empowering and adaptive way to accelerated change. Human educational activities and organizations may represent the most important way for humans to promote our own survival and to save our planet. The World Academy of Art and Science (WAAS) has launched a project with other sister institutions called World University Consortium (WUC) to create a space open to all the stakeholders to brainstorm and retool education to serve people' urgent needs to better cope with the present emergencies (www.wuc.org).

Effective people centered education is needed to create more aware and resilient citizens who will integrate knowledge, promote collective wisdom, build a sustainable society, in which duties and responsibilities are equally important as rights and opportunities.

Promoting change cannot be done in a mechanistic reductionist way as Jasanoff, (2011) reminds us, different civic epistemologies shape different responses to the anthropogenic changes (Norgaard, 2011): the construction of public knowledge varies from culture to culture and from community to community, different epistemologies and different hermeneutics need to be kept in mind in the promotion of change because what may work in a community is not automatically effective in another.

In order to be effective the new paradigm of education shall avoid becoming a one way worldview, as it is important to protect the biodiversity it is important as well to protect the human creativity and the plurality of narratives and cultures, all united in their common goal and effort to protect and respect all life forms.

REFERENCES

[1] Anderson, W. T. (1990). *Reality isn't what it used to be*. San Francisco: Harper & Row.

[2] Anderson, W. T. (1997). *The future of the self.* New York: Tarcher/Putnam.

[3] Anderson, W. T. (2016). *The Bionic Garden*. World Academy of Art and Science Press. Sonoma, CA.

[4] Berger, P. L. & Luckmann, T. (1966). The social construction of reality. New York: Doubleday.

[5] Catalano, George D., and Karen Catalano. 1999. „Transformation: From Teacher-Centered to Student-Centered Engineering Education." Journal of Engineering Education 88 (1). Wiley-Blackwell: 59–64. doi: 10.1002/j. 2168–9830.1999. tb 00412. x.

[6] Costa, Manuel João. 2014. „Self-Organized Learning Environments and the Future of Student-Centered Education." Biochemistry and Molecular Biology Education 42 (2). Wiley-Blackwell: 160–61. doi: 10.1002/bmb. 20781.
[7] Crutzen, P. and Stoermer, E. FThe „Anthropocene", IGBP Newsletter 41, 12. (2000).
[8] Christophe Degryse, D. (2016). Impacts sociaux de la digitalisation de l'économie, Working Paper 2016.02. Institut syndical européen (ETUI).
[9] Dewey, J. (1897). My pedagogic creed. The School Journal. LIV, 4. 77–80. pg. 77.
[10] Dewey, J. (1924). *Democracy and Education*. New York: MacMillan.
[11] Ekstrom, A. J; Moser, C. S and Margaret Torn, M. (2011). Barriers to Climate Change Adaptation: A Diagnostic Framework. California Energy Commission. Publication Number: CEC-500–2011–004.
[12] Foucault, M. (1980). *Power/Knowledge: Selected interviews and other writings, 1972–1977.* New York: Pantheon.
[13] Freire, P. (1970). *Pedagogy of the Oppressed*. Transl. M. Ramos. First published 1968. New York: Bloomsbury.
[14] Gershon; V. (1997). „The Student-Centered Research University." Innovative Higher Education 21 (3). Springer Science + Business Media: 165–78. doi: 10.1007/bf 01243714.
[15] Han, Byung-Chul (2014). Psychopolitik: Neoliberalismus und die neuen Machttechniken (Essay Collection). S. Fischer Verlag Frankfurt.
[16] Jasanoff, S. 2011. Climate Science and National Civic Epistemologies, in: The OxfordHandbook of Climate Change and Society Edited by John S. Dryzek, Richard B. Norgaard and David Schlosberg.
[17] Lambert, M. N.; McCombs; B. (1997). How Students Learn: Reforming Schools through Learner-Centered Education. Washington, DC: American Psychological Association.
[18] Morin, E. (2001). Seven complex lessons in education for the future. Paris: UNESCO. 31
[19] Morin, E. (2007 a). On Complexity. Cresskill, NJ: Hampton Press.
[20] Morin, E. (2007 b). Restricted complexity, general complexity. In C. Gershenson, D. Aerts & B. Edmonds (Eds.), Worldviews, science, and us: Philosophy and complexity. New York: World Scientific Publishing Company.
[21] Norgaard, K. M. (2011). Living in Denial: Climate Change, Emotions and Everyday Life. Cambridge, MA: MIT Press.
[22] Pauli, A. G. (2010). The blue economy: 10 years, 100 innovations, 100 million jobs /Paradigm Publications, Taos, New Mexico, USA.
[23] Rogers, C. R. (1965). A humanistic Conception of Man. In: Farson, R. (ed). *Science and Human Affairs*. Palo Alto.: Science and Behavior Books.
[24] Rogers, C. R. (1969). Freedom to learn: a view of what education might become. Columbus, OH, Charles E. Merrill.
[25] Rogers, C. R. (1980). Do we need „a" reality? In A way of Being. Boston: Houghton Mifflin
[26] Rogers, C. R. (1983). Freedom to learn for the 80 s. Columbus, OH, Charles E. Merrill.

[27] Rogers, C. R. (1977) Carl Rogers on personal power. N. Y. Delacorte Press.
[28] Thorkildsen, A. T. (2011). „Education as a Person-Centered Process." PsycCRITIQUES 56 (30). American Psychological Association (APA). doi: 10.1037/a 0024227.
[29] UNU-IHDP and UNEP (2012). Inclusive Wealth Report 2012. Measuring progress toward sustainability. Cambridge: Cambridge University Press.
[30] United Nations, (2015). U. N. Department of Economic and Social Affairs, Population Division, World Population Prospect, Revision 2015.
[31] (WHO, 2013). Mental health action plan 2013–2020. World Health Organization, Geneva, Switzerland.
[32] (WHO, 2016 a). Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks / Annette Prüss-Üstün … [et al]. World Health Organization, Geneva, Switzerland.
[33] (WHO, 2016 b). Suicide Fact sheet 398, Reviewed April 2016. http: //www. who. int/mediacentre/factsheets/fs 398/en/retrived June 24th, 2016.
[34] Zimring, F. (1994): Carl Rogers on Education. *Prospects: the quarterly review of comparative education, Paris, UNESCO: International Bureau of Education, vol. XXIV, no. 3/4, 1994, p. 411–22.*
[35] Zucconi, A. & Leka, S. & Jain, A. (2007). Supporting the older workforce. A guide for organizations. Institute of Work, Health & Organizations, University of Nottingham, Nottingham, U. K.
[36] Zucconi, A. (2008). Effective Helping Relationships: Focus on illness or on health and well being? In B. Lewitt (Ed.). *Reflections of Human Potential: The Person Centered Approach as a positive psychology*. PCC Books, U. K.
[37] Zucconi, A (2011) The Politics of the helping relationships: Carl Rogers contributions. Journal of the World Association for Person- Centered Psychotherapy and Counseling, Volume, 10 N. 1, March 2011. pp. 2–10.
[38] Zucconi, A. (2013). The Psychology of Denial: Forms of Self-Inflicted Blindness in the Anthropocene Era In: Serageldin, I. & Mohammed, Y. Eds. New Life Sciences: Linking Science to Society. BioVisionAlexandria 2012. Alexandria, Egypt: Bibliotheca Alexandrina, Alexandria, Egypt

Agni VLAVIANOS ARVANITIS*

BIOPOLICY — BUILDING A VISION OF HOPE AND TECHNOLOGY AS THE TOOLS FOR FUTURE SOCIETY

Abstract: In order to accelerate cooperative climate action, leadership in the 21st century irrevocably needs to take on a new role, identifying the mitigation of global warming as a moral imperative for future generations. Time is running out, and the urgency of addressing the implications of a catastrophic shift in the global climate system is made obvious every second. To respond to this challenge, the world has to act forcefully and quickly to ensure a climate-resilient and sustainable future.

Science and technology offer unlimited solutions in building resilience to climate change. We just need to take action. The „bio-assessment" of technology and the cooperation of *techne* — the arts — and technology can provide the momentum necessary to free our vision and imagination so we can address urgent global problems with a view to saving *bios*, all life on our planet.

To shape tomorrow's sustainable world, a life-supporting paradigm needs to be placed at the core of technology, policy and education, and to form the basis of thinking and action for every citizen. Biopolicy with climate change mitigation at the heart of decision-making can help to advance technological innovation for the benefit of the environment and shape the next generations of world changing leaders by building a vision of hope.

Key words: *climate change, biopolicy, bio-assessment of technology, technological innovation, sustainable future, renaissance of values*

BIOPOLICY — ENCOURAGING A CLIMATE RESILIENT SOCIETY

Technology has always served as *a revelation of the truth*. Its ramifications have a huge effect on society, one that we are only now beginning to grasp as we unravel the mysteries of the *macrocosmos*, the *cosmos*, and the *microcosmos*. These new dimensions increase society's possibilities for growth and knowledge, but also lead to unprecedented challenges. Are we the new *Phaethon, galloping towards our own*

* President and Founder, Biopolitics International Organisation, Athens, Greece; Fellow, World Academy of Art and Science

destruction by the burning sun, or can we use the *light of wisdom and progress to build the knowledge* we need for a more *resilient and sustainable future?*

Neutron or galaxy

Galaxy or galaxies
are small dimensions
not infinity

Neutrons are small
very small
not infinity

And what am I
a neutron to the galaxy
or a galaxy to the neutron?

A. Vlavianos Arvanitis, 1983

The choices and opportunities offered by technology are endless. The potential has always been there, but now we also possess the tools to understand it, which *creates enormous ethical responsibilities.* With the geometric progress of ICT, everything is moving faster than we could ever imagine. The internet revolution has a *profound effect on the way we think, work and live,* creating a *knowledge-driven economy* with an ever-increasing proliferation of information in both scale and scope. This staggering progress also poses new dangers and *threats for — all life on our planet* — as the technology exists to destroy life on Earth within seconds. *Lack of perspective and vision* in the application of progress can cause irreparable damage. This shortsightedness is evident in divide-and-rule policies, where differences are considered a threat and neighbors are declared enemies. Instead of viewing diversity as a menace, we need to consider it an enrichment, and *technology should be deployed as a means of saving life globally.*

The challenge to protect bios is the *core of „biopolicy" — policy with the environment at the heart of decision-making.* Unfortunately, precious time is lost and climate change mitigation is becoming an increasingly difficult task, as our ability to keep up with environmental destruction is fast outpaced. The recent decisions at the *COP 21 meeting in Paris* are, however, *encouraging,* as *world leaders agreed on a common target* for a global climate agenda. Successfully addressing the economic, environmental, and above all, the crisis in leadership, needs this *positive vision in order to unite world leaders in a joint cause.*

COMBINING AND TECHNOLOGY

Devising a comprehensive solution to climate change tests our social, political and economic institutions beyond their current capacities. The *impacts of climate* *change will reach deeper and deeper into human society over the coming decades*, forcing the development of policies to reduce environmental dangers. Searching for and *developing better, cleaner and safer technologies* requires challenging the way we *think about the entire basis of modern society.*

It is evident that the *models of the past are not adequate* to help us deal with today's expanding challenges. A coordinated and collaborative approach, effectively *combining all stakeholders,* is essential in order to limit the effects of uncontrolled growth on society and the environment and *catalyze change. Ethical guidelines,* such as the *Hippocratic Oath* in medicine, need to be developed in every profession. If we comprehend that these inspirational dynamics have to include the *cooperation of — the arts — and technology,* we can create a vision of mutual understanding for all the positive forces to *combine, interact and contribute to climate change mitigation*.

The *role of the arts* is vital in this context, as their active engagement can lead to an *enhanced intellectual and emotional awareness about climate change.* Artistic expression has the potential to *transcend the boundaries of the cosmos* and help us to be inspired by *the marvel of the microcosmos, the world of cells and molecules.* A worldwide *creative arts competition in nanotechnology* can enhance this potential by pioneering new forms of artistic practice in any field or cross-disciplinary activity. This intersection of *techne* and technology in the struggle to reverse current trends and restore the balance of life with the environment *rests on the participation of every individual,* whether governance expert, academic, thought leader, business executive, worker or student.

BIO-ASSESSMENT OF TECHNOLOGY

The struggle to solve the climate change problem indicates that there is a pressing need for ethical guidance which is not satisfied simply by applying conventional approaches to the complex and novel problems of the 21st century. *Breakthroughs in science and technology have greatly facilitated better living conditions,* increasing the standard of living worldwide. On the other hand, consequences such as water and air pollution, deforestation, large-scale farming, as well as developments like cloning and gene-manipulated food, have caused *grave fears for the future of humankind and for the continuity of bios.*

The implementation of mitigation and adaptation strategies requires a range of different disciplines and skills, and, in particular, *imagination and innovation. Technology expands human potential,* yet it can have disastrous consequences if it proceeds without concern for its environmental impact. Uncontrolled progress has opened a *Pandora's Box* of environmental destruction, but we also depend on technology for our transition to a climate smart economy. The *„bio-assessment of technology,"* as promoted by B. I. O. for the last thirty years, involves *dialogue* and the re-evaluation of priorities in order to support development that respects and helps bios. Based on a *thesis, antithesis, and synthesis of new ethics and values,* the goal is to achieve economic and technological progress that improve our interaction with the environment and protect all forms of life on our planet.

The bio-assessment of technology serves as the *vehicle to transform scientific and economic progress into cleaner and sustainable endeavors.* In this context, the bio-assessment of technology encourages climate-smart development, comprising, *renewable energy, climate change adaptation, fair trade, green jobs and corporate social responsibility.*

The progress of technology is rapid, necessitating new ways of administration and experimentation. A global *center for the bio-assessment of technology,* where *specialists can convene year round* to deliberate and share ideas, would better equip governments and policymakers with the needed guidance and vision to develop and implement strategies that *combat the effects of climate change at all scales of society.*

INNOVATION FROM BIOS FOR A FUTURE SOCIETY OF HOPE

Human history can be traced back a few thousand years only. The history of life, however, extends for hundreds of millions of years. *Life has been tested in unlimited varieties* and the most viable species have survived through the powerful selection of evolution. Living systems and natural processes are therefore ideal models for *technological innovation that supports the environment and all life on our planet.*

The *awe-inspiring process of evolution*, from the first anaerobic bacteria to the incredible biodiversity we see today, has involved billions of years. If we compare the evolution of life on Earth to a twenty-four hour day, the presence of humans has occurred in the very last fragment of a second.

The *amazing mechanisms of photosynthesis transformed the potential for life.* Once the first aquatic photosynthetic organisms appeared, free oxygen entered the atmosphere. It combined with oxygen molecules forming the ozone layer, which changed the conditions of natural selection for all organisms on our planet and allowed the radiation of life on land.

Today, as we delve into the *quest for new alternatives,* we must consider the *perfect efficiency of the cell,* one of the best examples of community survival, as evidenced by the compartmentalization and cooperation among its separate structures. Under the cryptographic code control of the nucleus, many organelles, enzymes and complex metabolites suspended in the cell's cytoplasm function with the greatest harmony in order to maintain a stable environment. Ribosomes interpret the genetic code and synthesize proteins by binding amino acids together. Mitochondria, the cellular power plants, burn fuel in dozens of small steps and produce energy with virtually no loss. Chloroplasts, the solar battery system of plant cells, convert sunlight into food and energy, and release oxygen into the environment. Perhaps *technology in the 21^{st} century can draw inspiration from these fundamental biophysical principles* and replace the uncontrolled „burning" of energy sources with *efficient instruments such as those prevalent for millions of years in the evolution of life.*

Innovation is key in order to inspire progress. Investment in the use of climate friendly technology can facilitate the *transition to a development path* that addresses *climate change efficiently and effectively.* Buildings that not only conserve energy but power their own requirements through *renewable energy sources*, could transform urban centers so that they can get the most out of the land, water and energy they actually use. The production of food with a minimum use of resources *limits the pressure on the environment* and makes food affordable for the poor. The preservation of seed genetic resources *ensures food security,* as well as better quality and output in food production. As promoted by *B. I. O. since 1985, local Genetic Banks* can *protect endemic biodiversity* through seed conservation and seed exchanges among farming communities, while also supporting sustainable farming systems. Technology for the protection of marine resources *preserves the integrity of ocean ecosystem services* and can help to restore the CO_2 absorbing capacity of the oceans, currently compromised by acidification. Biotechnology and nanotechnology are *engineering amazing new solutions* for climate change mitigation in fields such as clean energy and production, which can decrease the rate of global warming. The *more diversity, the more options* will be available *to respond to changing conditions* and *adapt to future challenges.*

BIO-EDUCATION — THE ROLE OF THE INTERNATIONAL UNIVERSITY FOR THE BIO-ENVIRONMENT

Education is a powerful tool for the *welfare of present and future generations.* It can help to achieve an inclusive approach to climate change mitigation by instilling *environmental values and ethics* in all academic disciplines and professional initiatives. This aim spurred the creation of the International University for the Bio-Environment (I. U. B. E.), which B. I. O. launched in 1990. The I. U. B. E. seeks to vaccinate every human endeavor with a love and appreciation of bios, imparting this message to students, professionals and decision-makers around the world. It also seeks to *promote a new concept of „profit,"* comprising the environment, culture and quality of life, as well as a unifying *bioculture, where science and the arts, can catalyze a climate-resilient society.*

Fighting the trend towards over-specialization, the I. U. B. E. seeks to *open up all areas of study and training to climate-smart development.* This is being implemented to a great extent through a highly successful e-learning program, which has been running with participation from 130 countries in order to sensitize people everywhere on matters such as *reversing unemployment, creating „biopolies" — cities with zero pollution* — using *green* technology in *energy and transport*, addressing *access and equity* issues for *people with disabilities*, and producing *safe and sufficient food*. The wealth of *educational material and resources* placed online and the breadth of topics offered by the program provide participants with the *freedom to cross boundaries* and to discover intellectual and *creative thinking processes spanning several academic disciplines* and featuring bios as a common point of reference. Courses are continuously updated to create new opportunities for green jobs and skills.

Also in the context of bio-education, B. I. O. has launched the *Youth Bios Olympiads,* which are being held annually in St. Petersburg since 1995, with the participation of thousands of school children and young adults from several countries. The Youth Bios Olympiads inspire the young to *embrace synergy, cooperation, and* *peace promoting values,* while promoting cultural development that enhances the understanding of the urgency of protecting all life on our planet. The ultimate goal is to *strengthen education and learning for all members of society,* so that all available resources are utilized with local and global development in mind. This is an *ongoing process* that contributes not only to individual wellbeing, but gives *economic results and benefits all stakeholders.*

INSPIRING A RENAISSANCE OF VALUES IN AN ERA OF METACAPITALISM

Unlimited arrogance and greed are leading us to destruction, even though the stunning progress of science and technology is providing choices to correct social imbalances, conflict, and disruption. Our lack of vision has resulted in massive disasters and catastrophes, but maybe the common threat of climate change can provide the opportunity for joint action, allowing *biodiplomacy — international cooperation in environmental protection* — to flourish. *Differences* in biodiversity, culture, religion, philosophy, are the *wealth of humanity.* In the whole cosmic scheme, on the scale of space and time, Earth is the only planet we know of where life exists. We should *deploy technology to protect environmental resources, and to build peace and mutual understanding.* We have to cease viewing our neighbor as the enemy, and *join forces in the war against climate change.*

If science and technology focus on our interdependence with each other and with all forms of life, society will be able to exit the crisis in values and move into a *„New Renaissance."* People, governments and organizations everywhere can mobilize a *new vision* in leadership. A vision bypassing the desire for enormous economic and political power, for the benefit of a long-range commitment to save life on our planet. Awakening this urgency for *inspired leadership* can help to defend society against the challenges of today while *making the most out of the opportunities of tomorrow.*

It is high time we moved into a *period of metacapitalism.* The goal is not to threaten vested interests but to inspire and mobilize change. *Shifting from stagnant and bureaucratic patterns to an era of inspiration* relies to a great extent on motivating the *1% of the population who hold 50% of the world's wealth* to make a *voluntary commitment* to invest in securing the continuity of the unique gift of life, an investment with staying power that will be *appreciated for millennia.*

CONCLUSION

In our unprecedented drive for economic power, we have forgotten the value of a *vision of hope and mutual understanding.* Despite decades of investigation, we know of no other planet in the universe where life exists. This makes it all the more urgent to elicit a global commitment to protect the continuity of bios.

Times of crisis can also become opportunities, spurring the search for the proper perspectives for enlightened leadership in every sector. *Biopolicy catalyzes tools and guidelines* for the promotion of *dynamic relations* between the environment, society and policy, and inspires people everywhere to take urgent and concerted action to mitigate climate change and save life on our planet.

Bioculture can motivate us to deepen our culture of innovation and entrepreneurship through the application of new knowledge and the development of new thinking and action. By *mobilizing an educational and cultural commitment,* bioculture can encourage science and technology to bring benefit to society. Literature and the arts can be an enlightening force in this effort, supporting mutual enrichment and helping us to view our differences as a source of inspiration provided by bios. *and technology offer countless solutions* to our current problems. We just need to take action. *The choices are infinite:* renewable energy, ocean clean-up, environmental technologies, food security, health, education, zero-emission cities, better living conditions for all. Investing in sustainable technologies can integrate the recovery of the world economy with efforts to limit climate change and reaffirm the *positive link* between *climate resilient development* and our survival on this planet. To be successful in this effort, we must draw inspiration from the miracle of life, as it is our *ability to be inspired that will turn the tides and make a difference.*

Life on Earth

Thirsty the soil soaking polluted water
Blood of the innocent colors the flowers

Enough, whisper the leaves
Enough, cry the threatened animals
Enough, speaks the wave caressing the shore with wisdom

Life is harmony, a link for us all
Send messages of love not hatred
Share in the joy
Call out for peace

A. Vlavianos Arvanitis, 2007

REFERENCES

[1] Vlavianos Arvanitis A. (1985) Biopolitics — Dimensions of Biology. Biopolitics International Organisation, Athens, 16 pp.
[2] Vlavianos Arvanitis A. (1989) Biopolitics. The Bios Theory. In: A. Vlavianos Arvanitis (ed.) Biopolitics — The Bio-Environment II. Biopolitics International Organisation, Athens, pp. 17–31
[3] Vlavianos Arvanitis A. (ed.) (1990) Biopolitics — the bio-environment III. International University for the Bio-Environment. B. I. O., Athens, 683 pp.
[4] Vlavianos Arvanitis A. (1992) Reversing the crisis of values. In: A. Vlavianos Arvanitis, R. Keles (eds.). Biopolitics — the bio-environment IV, Biopolitics International Organisation, Athens, pp. 18–28

[5] Vlavianos Arvanitis A. (1995) Biopolitics — bio-culture and business opportunities. In: A. Vlavianos Arvanitis (ed.) Business Strategy for the Bio-Environment II. A Symposium at the Harvard Club of New York City. Biopolitics International Organisation, Athens, pp. 7–19
[6] Vlavianos Arvanitis A. (1996) Biopolitics: a new dimension of the concept of profit. In: A. Vlavianos Arvanitis (ed.) Business Strategy for the Bio-Environment III. Biopolitics International Organisation, Athens, pp. 14
[7] Vlavianos Arvanitis A. (1996) The bio-environment — bio-culture — bio-peace for the next millennium. In: Biopolitics — the bio-environment Vol. V A. Vlavianos Arvanitis (ed.) B. I. O., Athens, 1996, pp. 51–66
[8] Bio-Environment — A New Renaissance in Business (2000) B. I. O. Conference on development and the environment, Athens, 2000, BioNews #22, April 2000
[9] Vlavianos Arvanitis A. (ed.) (2001) Biopolitics — the bio-environment VIII Resolving the environmental crisis — the need for an International Court of the Environment, B. I. O. International Conference, Athens, 41–150 pp.
[10] Vlavianos Arvanitis A. (2002) Bio-Ethics. In: Bio-Syllabus for European Environmental Education, B. I. O., Athens, pp. 269–306
[11] Vlavianos Arvanitis A. (2002) Bio-Economics. In: Bio-Syllabus for European Environmental Education. B. I. O., Athens, pp. 101–106
[12] Vlavianos Arvanitis A. (2007) Biopolicy — an effort to reverse the crisis in values. Proceedings from the the bioethics conference on „Judging Values," Karlsruhe, Germany
[13] Vlavianos Arvanitis A. (2011) Biopolicy — Ethical Responsibilities for Rio + 20, at the VII World Conference on Bioethics, Gijon, Spain
[14] Vlavianos Arvanitis A. (2013) Green Salary, Reversing Unemployment in a Changing Climate, B. I. O., Athens 272 pp.
[15] Vlavianos Arvanitis A. (2015) Biopolicy — the bioethics of climate change mitigation. B. I. O., Athens, 80 pp.

Jüri ENGELBRECHT*

COMPLEX SOCIETY AND VALUES

Abstract: Contemporary society is a highly complex system which involves many constituents starting from alliances and states to individual persons. Like in other complex systems (physics, biology, etc), the links between constituents and the corresponding interactions along them determine the behaviour of a system as a whole. In physical systems such interactions are determined by physical laws, in social systems, however, the properties of links and the characteristics of interactions are not so clearly determined. In this case one should interpret these characteristics not only by certain material quantities but also by values which generate behaviour of the society. A short analysis of values in society is presented together with some examples.

Key words: *complexity, society, values*

INTRODUCTION

Complexity is an important notion not only in natural sciences but also in society. In a nutshell, complex systems are composed of a very large number of different constituents (elements) which interact with each other (mostly) nonlinearly. As a consequence, one cannot characterize a complex system by studying the behaviour of its constituents only because due to interactions the full system behaves in a manner which is not deduced simply by summing up the behaviours of its constituents. The contemporary studies of complexity started from ideas of L. von Bertalanffy and N. Wiener in mid-20th century in systems theory and cybernetics and then got a full swing in the second half of the 20th century in studies of chaos theory, self-organization, networks, multi-agent modelling, etc. The vast literature (see for example [1–8]) deals mostly with natural sciences. One should stress some basic ideas emphasized in these studies:

* Estonian Academy of Sciences and WAAS

One of the most highly developed skills in contemporary Western civilization is dissection: the split-up of problems into their smallest possible components. We are good at it. So good, we often forget to put the pieces back together again.

A. Toffler (1984) [9]

Complexity science offers a way of going beyond the limits of reductionism, because it understands that much of the world is not machine-like and comprehensible through a cataloging of its parts; but consists instead mostly organic and holistic systems that are difficult to comprehend by traditional scientific analysis.

R. Lewin (1993) [10]

With new terminology applied in different fields of knowledge, one should be careful because the notions could be understood differently. Take for example Humpty-Dumpty's attitude from Lewis Carroll („Through the Looking Glass"). Alice asked him „whether you can make words mean so many different things?" The answer was, „the question is, which is to be master — that's all". Here we follow notions from the analysis of physical systems and leave aside notions like algorithmic complexity, computational complexity, etc. Given the lessons from the analysis of such systems, the further attention in this essay will be turned towards complex society. Indeed, contemporary society is a highly complex system which involves many constituents starting from alliances and states to individuals — all entangled into a whole. Without any doubt, the complex social systems are a part of a complex world like described in an excellent collection of essays „Philosophy of Complex Systems" [11]. A special analysis of social systems from the complexity viewpoint is given in [12]. However, as far as in physical, biological, etc complex systems the interactions between the constituents can be described by quantitative links based on physical/physiological measures, in social systems the situation is much more complicated [13]. Yes, one can collect data from opinion polls, create databases of indices, characterize the structures (networks, etc but as a matter of fact, the qualitative measures which are of special importance in societies, are hard be characterized. In very general terms, one can call these qualitative measures as values. In this essay the discussion will be centred on values in complex societies.

In Section 2 the main lessons from the analysis of physical systems are described. The next Section 3 deals with values from the general viewpoint and further, in Section 4, the problem of values in societies is discussed. Some examples which could cast more light on these discussions are presented in Section 5. Finally, Section 6 is devoted to some conclusions.

COMPLEXITY OF PHYSICAL SYSTEMS

1) PHENOMENA

The signatures of complexity in physical systems are described in many monographs, see for example [6,7]). Starting from simple nonlinear cases, many important phenomena characterize the life in complex systems and much can be learned from them. It is even surprising that very simple nonlinear systems like the logistic equation or the three body system display rich dynamics that help in understanding more complicated cases. Even more, the simple sandpile dynamics [4] can open door for understanding earthquakes, traffic jams and economy.

First, some words about nonlinearity. In simple words it means that the rule of proportionality does not work and the links between inputs and outcomes are described by nonlinear rules. That means also that summing the influence of interactions is much more complicated than simple summing. Although known long time ago:

> *The whole is more than the sum of its parts.*
>
> Aristotle, Metaphysica

the full understanding of the importance of being nonlinear is the result of, let us say, the last half a century [14].

What follows is a brief survey of main effects which are important for understanding complexity.

(i) non-additivity and nonlinear interactions. This is the source for chaotic motions and typical for many physical systems modelled by mappings or differential equations. A typical example of a nonlinear interaction is the gravitational force between different masses. The three-body system (Sun, Earth, Moon) analyzed by H. Poincaré already more than a century ago has revealed the ideas of possible instabilities. Another iconic example is the Lorenz attractor describing simplified atmospheric motion using the system of three nonlinear differential equations.

(ii) deterministic unpredictability. The behaviour of deterministic nonlinear systems may not be predicted and lead to the chaotic regimes of motion. A typical example is a simple logistic equation (mapping) derived for calculation of changes in the number of species. The weather is described by nonlinear Navier-Stokes equations that again do not permit the accurate forecasts for longer periods.

(iii) sensitivity to initial conditions. Small changes in initial conditions for a dynamical nonlinear process may lead to large changes of the resulting quantities in the course of time. This phenomenon within the framework of a nonlinear simple model was discovered by Lorenz although Maxwell has already hinted to such a possibility in the 19^{th} century and Poincaré in the beginning of the 20^{th} century. As far as the accuracy of physical quantities is limited in their value, there exists a so-called predictability horizon [15] because for example one simply cannot determine the temperature distributions needed for long-term weather forecasts with the accuracy of many digits after comma.

(iv) there are several typical phenomena characterizing the behaviour of nonlinear systems like bifurcations when the new solutions emerge after small changes of control parameters, emergence when new patterns arise, attractors where the solutions are attracted to a certain space of variables (phase space), multiple equilibria which are characterized by several (co-existing) attractors, thresholds which mark the borders between the various states, coherent states where effects are balanced, etc.

(v) despite the variety of chaotic motions there are several rules which govern the processes: period doubling and Feigenbaum numbers, power laws, self-similarity, fractality of attractors, etc and also a number of methods which allow to analyse the processes: Melnikov method, renormalization method, determination of the Kolmogorov entropy and Lyapunov exponents for determining the scale of chaotic motions, etc.

Above is only a short-list of phenomena and methods in the nonlinear world. For more information one should consult the „Encyclopedia of Nonlinear Science" [16]. One should also stress the following. The usual understanding (common sense) is that nonlinear models are just a little bit corrected linear models. The world around us, however, is deeply nonlinear and the linear models, as a rule, are simplifications. Yes, in many cases simplifications work but essential effects are nonlinear. Next, the nonlinear physical problems are intensively studied and the ideas and methods can be used also in other fields, at least in the metaphoric sense bearing in mind that models in other fields might be more complicated and the characters of interactions are not so well described like in physical systems.

2) STRUCTURES

Here we explain briefly the main structural cornerstones of complex world and processes — fractals and networks.

The word „fractal" is coined by B. B. Mandelbrot [17] using Latin „frāctus" (broken or fractured) for describing irregular non-differentiable structures. The famous Mandelbrot fractal is generated by a quadratic mapping in the complex plane and possesses a wonderful property — self-similarity. In simple words, under various degrees of amplification (zooming) each small part of this fractal replicates the structure of the whole. It means that such objects are scale-invariant and in addition are characterized by non-integer (fractional) dimensions. The fractal geometry [18] is based on the idea of using feedback procedures that is simple repetitive rules for constructing very complicated structures. The iconic fractals named after Mandelbrot, Koch, Sierpinski, Cantor, Barnsley etc display explicitly the properties of fractals. The fields of usage fractals for describing physical phenomena cover a wide area of nature and technology: from coastlines to crystals, from describing attractors in phase spaces to Brownian motion, from fractals in biology to structure of time-series of financial markets, from characteristics of seismic activity to music, from mountain ranges and structure of lightning to heart rate, etc.

The lesson to be remembered is that the repetitive usage of simple rules generates complicated objects which possess some universal rules.

Another important notion is networks. In simple words, a networks is formed by a a large set of elements (nodes) which are connected through a pattern of different interactions (links). The world is full of networks: the ecosystems form networks and webs of species, our computers are linked to Internet or connected to the cloud computing, public transportation forms a network starting from local connections to intercontinental flights, economics and electric grids form a global network, social networks unite persons, etc. Again, there are several universal rules which help to understand life in global networks [8,19]. A powerful tool for describing networks is the graph theory which started with the problem of crossing Königsberg's bridges. L. Euler showed in the 18th century that given the number of bridges it is impossible to walk over all the 7 bridges only once. Nowadays we know much more about the structure and behaviour of networks. Despite the large number of nodes and links, a small world phenomenon exists with only six degrees of separation. Networks are in general terms stable and large networks do not usually break under the failure of one node or link but in some cases domino effects and cascading failures occur. The cases of failure of electric grids are known as warning examples with large-scale effects. The power-law governs the network structure but not as an ideal rule because in reality the power-law might have fat tails. There are certain limits in networks, in social systems for example, the Dunbar number (which is estimated around 150) limits the number of possible active social relations. The Matthew effect (the rich get richer) seems to be important not only in economy but also in science where attention is given preferably to known names (to Nobelists, for example). Hierarchical networks exist, possessing self-similarity and fractality.

Summing up, networks are skeletons of the complex world [8].

VALUES

Values play an important role in psychology, ethics, religion, etc and field of studies into values is called axiology (Greek *axios* — worth and *logos* — theory) — see for example [20].

Human behaviours are strongly influenced by values. In general terms, the basic values accepted by society according to T. Ash [21] are: freedom, peace, justice, prosperity, diversity, and solidarity. His analysis is concerned mainly with Europe and he stresses that this skeleton of values must have flesh in order to be acceptable at all circumstances in our 24-hour, 7/365 non-stop global world. But the values are space-dependent and environmental-dependent. It is not secret that the top athletes and top actors can earn more than top scientists, reflecting so the attitude from the society. Values are related to culture but the personal values of people may not entirely coincide with the general norms in societies. And certainly the societies are different when we speak about values. Inglehart and Welzel have constructed a cultural map of the world [22], where survival values and self-expression values are depicted against traditional values and secular-rational values. This map shows clearly the groupings of English speaking countries and Latin America, catholic Europe, protestant Europe and Confucian countries, ex-communist countries and Africa. Another possibility [23] is to use GDP per capita as one of the scales. Depicted against happiness and overall life satisfaction, their results show that religion, tolerance and society's level of democracy play important role for the happiness index. Religion and national pride were stronger factors in less developed countries than in developed ones. One should stress also that the level of satisfaction is more strongly influenced by economic conditions than the level of happiness. But their analysis takes also into account the temporal changes, for example the sense of free choice and subjective well-being shows clearly how the societies have been changed in time. Such an analysis [23] leads to demonstrating the human development path: from economic development, democratization and social liberalization the increase in sense of freedom follows which is in a strong correlation with the increase in subjective well-being.

Recently the attention is paid to happiness metrics which was proposed by the King of Bhutan in 1972 and later enlarged by many studies [24,25]. The Gross National Happiness (GNH) index measures the societal well-being based on several subjective and objective measures including beside the GDP also environmental wellness, social relation wellness, etc [24]. In some sense, it is a derivative of values because the factors of happiness include values into the key determinants of happiness (World Happiness Report, [26]).

SOCIAL SYSTEMS AND VALUES

Society is a complex social system. It can be modelled by networks and clusters, communities and alliances and is spatially and temporarily differentiated. Society is able to function not only because its structures but the behaviour of its members (constituents is physical sense) and links (interactions in physical sense) between them play the most important role. Turning to complexity of physical systems (Section 2), the interactions between the constituents are described by physical laws and can be measured at least with certain accuracy. In complex social systems the situation is much more complicated because the links are based on accepted rules (laws), traditions, language, and governance, on economic and environmental conditions and certainly on values. This leads to an interesting question how to combine our knowledge on complexity with „soft" qualities like values.

The problem is certainly old. For example, Plato believed into an objective measure of values in order to keep the system (ie society) in a state of harmony (see [27]). Actually his idea was related to maintaining a system with political power. In the contemporary world the situation is much more complicated. The qualities (good/bad, pleasant/unpleasant, etc) cannot be measured and the estimations of the qualities are based on observations, opinion polls and subjective judgements. Here a well-known experience from the history of science may be recalled. The Ptolemaic model of the Earth-centred solar system was based on observations. In order to explain the motions of planets, Ptolemy used combinations of epicycles which moved on a larger circle (deferent) and placed Earth out of centre of the deferent for describing the apparent speeding up and slowing down of planets. This theory proposed about 2000 years ago was used for about 13 centuries and only in the 16th century Copernicus proposed the Sun-centred system. His ideas were elaborated by Tycho Brahe, Kepler and Galileo but the explanation was finally given by Newton. The Newton's gravity law explained the reason why planets move in such away. By the way, the gravity law is nonlinear. So the observations were not enough, one should find the reasons.

The large cornucopia of knowledge in physical sciences can support the modelling of social systems including descriptions of phenomena and structures (Section

2). For example, the notion of hierarchical structures is useful in social sciences but the archaeologists have added heterarchy as another important notion [28] following ideas from neural nets [29]. When hierarchies have elements which can be ranked and ordered then heterarchies have elements which are unranked or have potential to be ranked in a different way.

When considering the effects and behaviours in social systems, the main problem is: whether the observations are good enough to give the full picture of social processes or something is hidden. And another problem follows: knowing the gravity law one can predict the motion of planets but what is the predictive power of observations? And what can be overtaken from studies of complexity in other fields into modelling and understanding social systems? And what is the role of values for interactions in society?

First important question to start is: what are values? The next question is whether values are fixed or are changing. It must be stressed that Inglehart et al.[23] have shown by analysing the changes in certain values in society over 1981–2007 that these values are indeed changing in time. The subjective well-being (SWB) index demonstrates many changes due to changing environment. One should also understand what universals in the content and structure of values are and what priorities in values are [30]. Based on those notions, other studies have also indicated how values are different in various cultures [31]. However, the values have clearly inertia. A detailed analysis on value system in Estonia [32] has shown that the Soviet occupation of Baltic Countries before and after the WWII could not change all the inherited values. Said the authors: „in spite of the Soviet dominance of officially visible societal culture, the older Estonian generations seem to have been able to transfer a basically West-European value structure to their children and grandchildren."

Another example on changes illustrates the erosion of values. Once I wrote an essay on beauty of science (Engelbrecht, [33]) bearing in mind the beauty of nonlinear dynamics. It is well known that Paul Dirac and Pierre Duhem admired the beauty of physics. Writing the essay, I checked many encyclopedias and dictionaries on the definition of beauty, starting from the celebrated Encyclopedia Britannica from 1769. I collected many definitions such as beauty „is pleasing to the sense and intellect" and „is the combination of all the qualities of a person or thing that delight the senses and please the mind". However, in one of the recent dictionaries the entry „beauty" has a very laconic explanation — see „cosmetics"! No comments are needed.

In order to manage organizational complexity, the notion of values has been introduced as attractors of chaos [34]. It is argued that neither rigid objectives nor instructions are effective but a shared set of values should be accepted by members of an organization. These values can be divided into ethical (honesty, integrity, sincerity, loyalty, etc) and competence (creativity, flexibility, order, intelligence, etc) values and the final state of an organization is then described as an attractor in a self-organized system.

Based on the conversation between Alice and Humpty-Dumpty (Section 1) let us remind how the concept of truth is understood by different scientists and scholars [35]. The concept of truth is related to notions: correct, valid, coherent and right. According to [35] natural scientists trust only the first two, social scientists the first and third, humanists the third and fourth. It seems that the starting question is to find the common language which may divide natural scientists and humanists like Snow showed in 1959 in his famous lecture „The Two Cultures" [36]. Kagan [35] added social scientists in his „The Three Cultures" to this pair and showed how the scientists and scholars of different fields use different wording and methods. Complexity might be a unifying area of knowledge where all three might find a common language.

The interest to complexity in social systems is growing. An overview by Byrne [12] is an excellent introduction to social systems from the viewpoint of complexity but one cannot find „value" in its index. In the large overview on complexity [11] describing many field of knowledge, is only one short subsection on values concerning the role of values in public policy resolution of complex dynamics.

EXAMPLES

Some examples how the knowledge from physical complex systems has improved understanding of social systems follow.

First, let us mention that the methods derived for the analysis of physical processes can also be effectively applied for the analysis of time-series in social processes. For example, the multi-scaling of low-variability periods and multi-affinity of time-series can be used for the analysis of financial time-series [37]. Further, the same authors have introduced „good" and „bad" notions for the analysis of portfolio optimization [38] attributing these notions to fluctuations of portfolio distributions. Actually these studies belong to the fast growing field of research called econophysics (cf [39]. A textbook describing macro-economical processes like business cycles, interregional trade, monopolies and oligopolies etc using the language and methods of nonlinear dynamics is masterly written by Puu [40].

One could use also network analysis for country-country and product-product links in order to estimate the structure of the world economy [41]. This analysis has estimated unexpected socio-geographic links which can be characterized as nonlinear interactions between the diversification of a country and the ubiquity of its products.

There are not so many examples where values are introduced into the analysis. One example is related to using the GDP which is usually taken only at its face value for determining the effectiveness of countries. A new metrics introduced for estimating the countries' fitness could give much more information [42]. The idea is to assess the non-monetary competitive advantage of diversification using nonlinear maps and taking into account the country fitness and product complexity. The fitness actually measures the level of the competitiveness of a country and is proportional to the sum of the products exported weighted by their complexity. Such an approach is able to understand the hidden potential of a country for development, ie to predict the growth. Typically, the power laws characterize the fitness [42]. The analysis has revealed the strongly heterogeneous patterns of evolution [43]. In the fitness-income plane the laminar and chaotic zones are estimated. For chaotic zones where the predictability is low, a data-driven method has proposed for assessing the future developments of countries. In these studies, fitness could be linked to values.

Information and communication technology (ICT) is a trademark of the contemporary society. The world-wide web with its nodes and links is an excellent example of a complex system. The use of the ICT has an essential impact on economy and social system but raises also ethical problems, ie value problems. The EU Future Emerging Technologies (FET) Flagship pilot project „FuturICT" had one of its goals Value Sensitive Design (VSD). The basic idea of the VSD is making social and moral values central to the development of ICT [44] stressing that it is a primary goal not a by-product. In general terms, the VSD aims at making values part of technological design, which means embedding technology into the complex society needs ethics taken into account. The „FuturICT" paid a lot of attention to a code of conduct of scientists developing the ICT: to promote human well-being, reduce vulnerability of the society, promote fairness, increase social capital and the happiness of people, protect privacy, etc [44].

FINAL REMARKS

Society is without any doubt a complex system and the idea to use the knowledge from the analysis of physical complex systems in the analysis of societal problems is tempting. Indeed, the notions of nonlinearity, interactions, self-organization, stability and chaos, unpredictability, sensitivity to initial conditions, etc are phenomena which could characterize also social systems. However, not everything is easy because:

„…physical and computational measures of complexity exist in abundance. These can provide a starting point for creating social complexity metrics, but they need refinement for the simple reason that electrons don't think".

„To harness complexity,…, we must take a generative perspective and see social outcomes as produced by purposive authors responding to incentives, information, cultural norms, and psychological predispositions."

S. E Page (2010) [45]

As shown above, one of preconditions is to speak in the common language. It is not the problem of cultures only [31], it is also a problem of scientific communities [35]. Another important problem is causality because the observations cannot always reveal the reasons. Forcing societies to fit in a box without understanding the reasons may lead to serious consequences like we witness in many world affairs. Interdisciplinarity is really a way the society together with scientists and scholars must move. There are surprising similarities in many fields of human activities and much can be learned from these [46]. Metaphors encompass often our everyday communication and can also be used in explaining the behaviour of complex social systems. Such an approach is advocated by Wheatley [47] for management and leadership. She does not enter into the technical details of chaos theory and complexity in terms of physical systems but recommends convincingly using these ideas to management of social systems and also for educational purposes.

Many phenomena in the physical world can be measured and counted. Even in social systems the counting has taken enormous pace, let it be citations of research papers or indices of productivity. However:

„Not everything that can be counted counts, and not everything that counts can be counted."

W. B. Cameron (1963) [48]

This saying is sometimes attributed to A. Einstein but actually it belongs to a sociologist not to a physicist. Now the important question comes: what shall we do with that which cannot be counted but is important? In physical complex systems constraints are used in order to limit or guide the process, in social systems it seems that values are leading and guiding factors. Common sense says that constraints may have slightly negative meaning but actually they describe certain limits of processes. On other hand, values generally have positive meaning but value systems in different communities may also be different and that may cause problems like we witness not only in Europe but worldwide. An interesting idea based on using metaphors is to determine values as attractors [4]. This means that the behaviour in a system may be attracted (trapped) to a certain space domain and not to another. However, following this idea, we might think about the co-existing attractors. In this case an external influence will move the motion, ie the behaviour to another space domain. Here is much to be discussed and analysed.

Beside values, the structures of systems are also important as well as interactions but social systems need something more. This is why we must think very carefully how to embed values into the analysis and explanations of processes. This is where physical scientists and social scientists could meet and learn from each other [50].

REFERENCES

[16] I. Prigogine and I. Stengers: *Order out of Chaos*. Heinemann, London, 1984.

[17] M. M. Waldrop: *The Emerging Science at the Edge of Order and Chaos*. Simon and Schuster, New York et al., 1992.

[18] S. Kaufmann: *At Home in the Universe: The Search of the Laws of Self-Organization and Complexity*. Oxford University Press, New York, 1995.

[19] P. Bak: *How Nature Works*. Oxford University Press, Oxford et al.,1996.

[20] S. Strogatz: *Sync*. Allen Lane Penguin Books, London et al., 2003.

[21] G. Nicolis and C. Nicolis: *Foundations of Complex Systems*. World Scientific, New Jersey et al., 2007

[22] P. Érdi: *Complexity Explained*. Springer, Berlin and Heidelberg, 2008.

[23] A. Barabasi and J. Frangos: *Linked: The New Science of Networks*. Basic Books, 2014.

[24] A. Toffler: „Foreword". In: I. Prigogine and I. Stengers. *Order out of Chaos*, Heinemann, London, xi-xxvi, 1984.
[25] R. Lewin: Complexity. Life at the Edge of Chaos. J. M. Dent Ltd, London, 1993.
[26] C. Hooker (ed.): *Philosophy of Complex Systems*. Elsevier, Amsterdam et al., 2011.
[27] D. Byrne: *Complexity Theory and the Social Sciences. An Introduction*. Routledge, London and New York, 2001.
[28] C. Mesjasz: „Complexity of social systems". *Acta Phys. Polonica A, 2010, 117, 4, p. 706–714.*
[29] A. Scott: *Nonlinear Science*. Oxford University Press, Oxford, 1999.
[30] J. Lighthill: „The recently recognized failure of predictability in Newtonian dynamics". *Proc. Roy. Soc. London, 1986, A 407, p. 35–50.*
[31] A. Scott (ed.): *Encyclopedia of Nonlinear Science*. Taylor & Francis, New York, 2005.
[32] B. B. Mandelbrot: *Les objets fractals: forme, hazard et dimension*. Flammarion, Paris, 1975.
[33] H.-O. Peitgen, H. Jürgens and D. Saupe: *Chaos and Fractals. New Frontiers of Science*. Springer, New York et al., 1992.
[34] G. Caldarelli and M. Catanzaro: *Networks. A Very Short Introduction*. Oxford University Press, Oxford, 2015.
[35] S. L. T. McGregor: „Transdisciplinary axiology: to be or not to be?" *Integral Readership Review 11(3), 20 pp, 2011*
[36] T. G. Ash: „Europe's True Stories". *Prospect, 2007, 131, p. 36*
[37] R. Inglehart et al. (eds): *Human Belief and Values. A Cross-Cultural Sourcebook based on 2002–2004 Value Surveys*. Siglo XXI, Mexico City, 2004.
[38] R. Inglehart, R. Foa, C. Peterson, C. Welzel. „Development, freedom and rising happiness". *Persp. Psychol. Sci, 2008, 3(4),p. 264–285.*
[39] R. Di Tella and R. MacCulloch: „Gross national happiness as an answer to the Easterlin Paradox". *J. Developm. Econ., 2008,86, p. 22–42.*
[40] M. Pennock and K. Ura: „Gross national happiness as a framework for health impact assessment". *Environm. Impact Assessment Rev., 2011, 31, p. 61–65.*
[41] *World Happiness Report*, ed by J. Helliwell, 2013, www. earth. columbia. edu/sitefiles
[42] K. Mainzer: *Thinking in Complexity*. Springer, Berlin et al., 1997.
[43] C. L. Crumley: „Historical ecology". In: C. L. Crumley and W. H. Marquardt (eds), *Regional Dynamics*. Academic Press, New York, 1987, p. 237–264.
[44] W. S. McCulloch: „A heterarchy of values determined by the topology of neurons". *Bull. Math. Biophys., 1945, 7, p. 89–93.*
[45] S. H. Schwartz and W. Bilsky: „Toward a universal psychological structure of human values". *J. Personality and Social Psychology, 1987, 53, 3, p. 550–562.*
[46] K. Leung, A. Au, X. Huang, J. Kurman, T. Niit and K.-K. Niit: „Social axioms and values: a cross-cultural examination". *Eur. J. Personality, 2007, 21, p. 91–111.*
[47] M. Lauristin and P. Vihalemm (eds): *Return to the Western World. Cultural and Political Perspectives on the Estonian Post-Communist Transition*. Tartu University Press, Tartu, 1997.
[48] J. Engelbrecht: *Nonlinear Wave Dynamics. Complexity and Simplicity*. Kluwer, Dordrecht et al, 1997.
[49] S. L. Dolan, S. Garcia, S. Diegoli and A. Auerbach: „Organizational values as „attractors of chaos": an emerging cultural change to manage organisational complexity". *UPF Economics Working Paper, 2000, 16 pp.*
[50] J. Kagan: *The Three Cultures*. Cambridge University Press, Cambridge, 2009.
[51] C. P. Snow: *The Two Cultures and a Second Look*. Cambridge University Press, Cambridge, 1969.

[52] R. Kitt and J. Kalda: „Properties of low-variability periods in financial time series". *Physica A, 2005, 345, p. 622–634.*
[53] R. Kitt and J. Kalda: „Scaling analysis of multi-variate intermittent time series". *Physica A, 2005, 353, p. 480–492.*
[54] B. Roehner: *Pattern of Speculation: A Study in Observational Econophysics*. Cambridge University Press, Cambridge, 2002.
[55] T. Puu: *Attractors, Bifurcations & Chaos. Nonlinear* Phenomena in Economics. Springer, Berlin and Heidelberg, 2003.
[56] G. Caldarelli, M. Cristelli, A. Gabrieli, L. Pietronero, A. Scala and A. Tachella: „A network analysis of countries' export flows: firm grounds for the building blocks of the economy". *PLoS ONE, 2012, 7(10), e 47278.*
[57] A. Tachella, M. Cristelli, G. Caldarelli, A. Gabriel and L. Pietronero: „A new metrics for countries' fitness and products' complexity". *Sci. Rep. 2012, 2, p. 723.*
[58] M. Cristelli, A. Tachella, L. Pietronero: „The heterogeneous dynamics of economic complexity". *PLos ONE, 2015, 10(2), e 0117174.*
[59] J. van den Hoven, D. Helbing, D. Pedreschi, J. Domingo-Ferrer, F. Gianotti and M. Christen: „FuturICT — The road towards ethical ICT". *Eur. Phys. J. Special Topics, 2012, 214, p. 153–181.*
[60] S. E. Page: „Complexity in social, political and economic systems". *American Economic Association, Ten years and Beyond: Economists answer NSF's Call for Long-Time Research Agendas, 2010, 6 pp.*
[61] T. Puu: *Arts, Sciences, and Economics*. Springer, Heidelberg et al., 2015.
[62] M. Wheatley: *Leadership and the New Science: Discovering Order in a Chaotic World*. Berret-Koehler Publ. Inc, San Francisco, 2006.
[63] W. B. Cameron: *Informal Sociology*. Random House, New York, 1963.
[64] A. Judge:. „Human values as strange attractors". *UNiS Journal, 1994, 5, 3, p. 12–30.*
[65] D. Helbing: „Pluralistic modelling of complex systems". *arXiv: 1007.2818 v 1, 2010, 20 pp.*

Miloš TRIFKOVIĆ*

CAN MORAL BEHAVIOR OF PUBLIC ENTERPRISES IN BOSNIA AND HERZEGOVINA BE IMPROVED BY LEGISLATED MODEL CODES OF ETHICS?

Abstract: The two entities in Bosnia and Herzegovina passed special laws on public enterprises trying to protect state interests in and ethical conduct of public services: Republika Srpska in 2004 and Federation of Bosnia and Hercegovina in 2005. Mandatory ethics program and supplemented Model Codes of Ethics led to legal recognition of public enterprises as moral persons and ethical agents. Normative analysis, based on the business ethics theory, shows Model Codes of Ethics and their replicas do not in practice satisfy the basic theoretical requirements regarding the creation, content, functions and implementation of corporate codes of ethics. Consequently, the Model Codes of Ethics can not improve moral behavior of public enterprises in BIH.

Key words: *model codes of ethics, moral behavior, public enterprise, Bosnia and Herzegovina*

CONCEPTUAL FRAMEWORK

History of ethics codification and research methodology

1. Codes of ethics are „distinct formal documents specifying self-consciously ethical constraints on the conduct of organizational life."[1] Historically, codes of ethics appeared in professions as businesses (doctors, lawyers, architects etc.). Companies' codes of ethics are relatively new and coincide with the collapse of the „myth of amoral business".[2] The first wave of corporate codification of ethics began in the late 1970 s and early 1980 s. By the 1990 s almost 90% of big U. S. corporations had some form of a code of ethics.[3] Companies from Europe[4], Japan and the rest of the world followed. Increasing globalization brought new qualities into

---

* President, Academy of Sciences and Arts of Bosnia and Herzegovina

[1] [53]. p. 45; [40] p. 28: „A code of ethics by most definitions is a written, distinct, formal document which consists of moral standards which help guide employee or corporate behavior."

[2] Historical development of the idea of codification of ethics, see at [7]. pp. 117–120.

[3] [53]. pp. 46–47; [40], p. 27.

[4] For UK developments, see [7]. p. 1078–1078.

corporate ethics and its codification, especially concerns for transcultural values and universal human rights.[5] A contemporary corporation acts not only within legal frameworks, but also within a web of different codes of ethics.[6] Its own code of ethics is usually at the center of this web.

2. In independent Bosnia and Herzegovina (BIH), the affirmation of business ethics was delayed by the postwar reconstruction, initial accumulation of private capital, slow privatization and weak corporate governance. These factors still influence general company regulation and the moral practice of business entities in BIH.[7] Under the circumstances, prolonged privatization of the most important state-owned companies created significant problems in their legal and ethical behavior, and the effectiveness of their public functions. In such an environment, ethical norms in intra-corporate life and market relations were treated mostly as specific legal duties.

New perspectives opened after the Law on Public Enterprises (LPE) was passed by the Republika Srpska (RS) in 2004 and by the Federation of Bosnia and Herzegovina (FBIH) in 2005. From a moral standpoint, the most interesting novelty relative to general corporate law was the requirement that all public enterprises *(„javna preduzeća”)* adopt a code of ethics. Despite extensive regulation in these two laws, the legislators of both entities felt compelled to append to them identical, mandatory Model Codes of Ethics.[8] At approximately the same time chambers of commerce started creating their own codes of business ethics, binding on their members.[9] Today, public enterprises are re-examining their codes of ethics,[10] while privately owned companies are beginning to draft their own.[11]

---

[5] [44]. pp. 610- 612. The process of globalization resulted in the „third generation” of business ethics and corporate codes of ethics, focusing on the rights of „humankind” or our collective humanity. (p. 612). See also p. 618. It seems that the first generation of global business ethics was concerned primarily with corruption issues (see [39]).

[6] [7]. pp. 120–121 enumerated 12 ethics codes binding a Canadian corporation. Today, a BIH public enterprise potentially deals with at least eight different ethics codes: its own corporate code of ethics; chamber of commerce code of ethics; stock exchange code, brokers', accountants', bankers' and lawyer's codes; state employee's codes and UN Code for Transnational Corporations Code and UN Global Compact, when applicable.

[7] [1]. p. 119: „1st pillar: Institutions”, point 1.17. Regarding ethical behavior of companies, BIH is ranked 134th out of 140 countries included in the survey.

[8] Unofficial translation into English of the Model Code of Ethics in FBIH (Official Gazette FBIH 29/05), see Appendix 1 to this paper.

[9] Canton Sarajevo Chamber of Commerce passed the Code of Business Ethics for its members on September 28, 2005. Republika Srpska Chamber of Commerce promulgated its Code of Business Ethics on March 15, 2006. It is worth mentioning that the membership in cantonal chambers of commerce is voluntary, while in RS it is mandatory.

[10] For instance, public enterprise „JP Autoceste FBIH”, d. o. o., Mostar (”Highways of FBIH”, Ltd.) published the first version of its code of ethics on March 17, 2011 and replaced it with a new one on June 17, 2014. JP „Sarajevo — šume” d. o. o. Sarajevo (*„Sarajevo — Forests” Ltd., Sarajevo)* adopted the second version of its Code of Ethics on June 15, 2015).

[11] For example, minority state-owned company „Bosnalijek” d. d., Sarajevo, passed its Code of Business Ethics and Organizational Behavior in 2004.

3. Codification of moral rules is at the epicenter of LPEs' regulation of business ethics. Therefore, the research question of this paper is whether a legislated Model Code of Ethics satisfies the theoretical criteria for a code able to improve internal and external ethical behavior of domestic public enterprises. We hypothesize that the answer is negative. We will prove that by comparing the theory of corporate codes of ethics to the regulation in LPEs and in Model Codes of Ethic. Consequently, this research will be normative in nature.[12]

Public enterprises are legally bound to publish certain information on their websites, alas not including their codes of ethics[13], which had to be collected by direct request.[14] Fourteen public enterprises' ethics codes were acquired.[15] This modest sample only allows their illustrative use.

Relation between morality and law

1. Relations between morality and law are essential to the study of business ethics, corporate codes of ethics[16], and Model Codes of Ethics of public enterprises in BIH. Morality is a specific, relatively independent societal subsystem dedicated to the creation and implementation of behavioral rules which are considered good because they potentially or actually contribute to the well-being and development of individuals, social groups and society as a whole.[17] The moral subsystem consists of subjects, rules and implementation mechanisms. These three elements do not appear in identical forms in different segments of society.

Creators of moral norms are primarily individuals with their understanding of „good" and „bad" behavior. The disposition of a moral norm always comprises a behavioral rule and a moral judgment. If a person breaches a moral rule, only they can feel the qualm and uneasy conscience as characteristic moral sanctions. It follows that moral norms are basically autonomous. Groups and society build their moral norms upon the self-imposed, individual ones. Sanctions for a breach of group or societal ethical norms are imposed by society at large, groups or institutions which aren't a part of the state apparatus. Therefore, societal moral norms are autonomous and heteronymous at the same time. In many social domains, eth-

---

[12] [42]. p. 27: „The lack of normative reflection on codes might be considered surprising given the explicit nature of codes."

[13] Article 2, section 2 of both [21]. and [22]. [40]. p. 34 pleads for „universal distribution to all stakeholders…" In this context, the author suggests that „placing of the code of ethics on the internet is one of the means of ensuring accessibility of the code by outside public."

[14] Survey of the internet sites of 14 public utility enterprises in Canton Sarajevo, performed on December 10, 2015, did not reveal a single code of ethics. [44]. p. 615 found that in eight industries researched, „81% (164 out of 202) of companies had Codes of Ethics on the web…"

[15] The structure of the sample is as follows: eight codes of cantonal public utility enterprises, four codes of public enterprises in FBIH ownership, and two codes of public enterprises in RS ownership.

[16] See [5]. pp. 42–44.

[17] For the definition of „moral" see [23]. p. 120.

ically homogenous groups, coherent systems of moral norms and dispersed implementation mechanisms develop slowly. In business, however, the speed, volume, and relative similarity of transactions contribute to ethical norms appearing fast.[18]

Contrary to moral norms, law is predominantly created by the state. The legislative process is relatively short. Sanctions are only those prescribed by the law itself and imposed by competent state bodies. Lawmakers follow „state reasons" and goals which are not always „good". Moral judgment is not an indispensable part of a legal norm's disposition. If necessary, a law can be consciously unethical. A legal norm which violates moral attitudes of its addressees or the society as a whole is still binding. Therefore, legal norms are exclusively heteronymous.

2. Morality is a broader societal subsystem than the law, which covers only areas of particular interest to the state. In spite of the fact that legal norms do not necessarily depend on ethical reasons, the law often includes moral norms either to protect them or to facilitate its own implementation. Such moral rules become legal norms without losing their ethical character.

Compared, the moral and law subsystems have their (dis)advantages. The moral subsystem covers a broader area of social relations than the law, and has deeper societal roots. The legitimacy of moral norms must be proven historically and by sociological and philosophical argumentation. The legitimacy of the law depends almost exclusively on the state; moral and other social arguments for justifying legal norms and their implementation might be of some importance only in the final, teleological interpretation of the law. Moral norms must be proven and applied in complex individual and societal circumstances. The law is more precise, general, and consistent. The implementation of the law is more predictable than the observance of moral norms. The differences notwithstanding, ethics and the law should not only support but also complement each other.[19] A conflict between the two is usually a sign of deeper social conflicts.[20]

Public enterprise in BIH legal system

1. Entities of Bosnia and Herzegovina (BIH) are responsible for legislation on business subjects.[21] Republika Srpska (RS) passed its first Law on Enterprises in 1998.[22] It was replaced by the Law on Business Societies in 2008 (LBS RS).[23] The Federation of Bosnia and Herzegovina (FBIH) promulgated the Law on Business Societies in 1999 and amended it several times since then (LBS FBIH 1999).[24] It was replaced by the new FBIH Law on Business Societies 2015 (LBS FBIH

[18] See [47]. pp. 102 -104 for the relation of moral norms and (good) trade usages.
[19] [5]. p. 40–41 calls this approach to moral and law as „Coinciding Views".
[20] [45]. p. 77
[21] Article III, 3 of the BIH Constitution
[22] [34].
[23] [32].
[24] [29].

2015).[25] Both LBSs contain the general legal regime for companies based on capital (corporations) and on persons (partnerships).[26] These subjects are designed for doing business in order to make profit and distribute it among the members. Therefore, the legal regime focuses on interest of a company and its owners. Protection of public interest and morality is only indirect.

In the late 1990 s, at the dawn of privatization,[27] all BIH state levels owned more than 80% of overall capital in the country.[28] In the new economic environment, neither the socialist-era Law on Public Enterprises[29], nor the Entities' general company acts, could adequately protect public interest. In order to cope with this problem, RS passed its specific Law on Public Enterprises in 2004 (LPE RS) and FBIH in 2005 (LPE FBIH).[30] The Entities' laws on business societies apply to issues not regulated in the laws on public enterprises.

Interpretation of the two laws on public enterprises reveals their general goals: preventing misuse of state property and public goods, curbing political party control over publicly owned companies, protecting state property prior to privatization, making state property serve all citizens, revenue raising, and better implementation of laws on conflict of interest. An elaborated restatement of those objectives was added in amendments to the Entities' LPEs.[31] Aware of the relatively poor rule of law in the country,[32] legislators also intended the new acts to improve ethical behavior of public companies. They did so by legally creating and imposing a system of corporate ethics, including identical Model Codes Of Ethics. This was a historically important turning point for business ethics in BIH[33]: corporations in the legal form of public enterprises were officially recognized not only as societal, economic and legal subjects, but also as moral persons and agents.

2. In the first LPE RS from 2004 the only requirement for the status of public enterprise was permanent engagement in activities of common interest[34]. The founder of an enterprise could be the RS, a unit of local self-government, or a private individual. Type of ownership, legal form of incorporation, and number of employees were irrelevant. Amendments from 2011 imposed cumulative conditions for the status of

[25] [28].

[26] See [49]. pp. 114–117

[27] [4]. The Entities' Laws on Enterprise Privatization were promulgated later.

[28] [36].

[29] [30].

[30] [31].; [27].

[31] See Art. 2 a of [22]. and [21].

[32] [2]. p. 68; [1]. By independence of the judiciary, BIH ranks 110th out of the 144 countries included in the Global Competitiveness Report 2015–2016.

[33] Neither LBS explicitly regulates any issue of business ethics. The RS Securities Commission's Standards of Corporate Governance (RS Official Gazette 117/11) several times explicitly insists on respecting business morality (e. g. 15.3; 16.1). By contrast, FBIH Securities Commission's Rulebook on the Management of Joint Stock Corporations from 23rd of March 2010 does not directly refer to ethical duties of participants in corporate governance.

[34] Art. 2, section 1 of [22].

public enterprise. First, only the RS or a local self-government unit may establish a public company. Second, it has to be registered as a corporation, i. e. Joint Stock (JSC) or Limited-Liability Company (Ltd.). And third, the portion of direct or indirect state ownership cannot be less than 50% plus one share.[35] Additionally, LPE RS is valid for all companies with RS majority ownership employing more than 50 persons.[36] The extension of the LPE RS scope beyond public enterprises is an important vehicle for increasing the number of corporations *ex lege* treated as moral persons.

The concept of public enterprise in FBIH evolved in the direction opposite to that in the RS. To qualify as a public enterprise under LPE FBIH from 2005, a company had to be either registered in the form of a corporation[37] or a public enterprise founded by law and have activity of „public social interest" determined by municipality, canton or FBIH, or have at least 50 employees and majority state ownership, regardless of type of business activity. The latter condition gave public enterprise status to a considerable number of state-owned companies that did not perform any activity declared to be of public interest. Both types of public enterprises had to implement business ethics regulation prescribed by the LPE. The 2008 amendment of the LPE Article 2 altered this paradigm by making public interest the only criterion for being a public enterprise. Majority state-owned corporations with more than 50 employees are no longer public enterprises and do not have to apply the ethics system from LPE FBIH.[38] The number of corporations legally required to act as moral subjects was thus reduced.

Corporation as a moral agent

1. In BIH, different legislative approaches to ethical issues in the general legal regime for corporations and in special regulations for public enterprises reflect a broader dilemma on whether corporations have ethical personhood. One theory holds that the answer is categorically negative. It is based on the assumption that only natural persons are capable of moral judgment, actions and, consequently, moral responsibility. This theory does not seem compatible with the contemporary role of corporations, development of organizational sciences and introduction of penal responsibility for corporations.[39] The second, affirmative response is more plausible: corporations are moral subjects. The main arguments in favor of this standpoint are: legal recognition of corporate personality, attribution of employees' acts to corporations,[40] existence of a specific corporate culture[41] and organization for making corporate decisions, including ethical ones, which may dis-

[35] Art. 2, section 1 of amended [22].

[36] Art. 2, section 2 of original [22]. and its amendment.

[37] See Art. 3 of [21].

[38] Art. 372 LBS FBIH 2015.

[39] [3].: „Responsibility of Legal Persons for Criminal Acts", Art. 126–148; [15]. pp. 168–169.

[40] [10]. pp. 39–40.

[41] See [19]. pp. 234–235.

agree with standpoints of individuals engaged by a corporation.[42] However, corporations, like human beings, are not always able or willing[43] to make and implement moral judgments: „in order to qualify as a moral agent, a corporation would need to embody a process of moral decision making"[44] and to control its implementation in „the structure of policies and rules,"[45]as well as in practice.

2. An „ethics program" is the organization of permanent corporate moral acting.[46] Incentives for adopting an ethics program can be external[47] or internal[48]. In practice, they act cumulatively. An ethics program can be: formal or informal[49], recognized or unrecognized, compliance- or value-oriented.[50] In any case, „a good corporate ethics program must be user friendly".[51] Scope and content of an ethics program depend primarily on external pressures, while the top management's commitment to ethical leadership is the most important internal factor in the program's implementation.[52]

In each case the aim of an ethics program is the standardization of employees' ethical attitudes and behavior. To achieve this goal, a corporate ethics program should provide for: bodies responsible for ethics management, an ethics management system, and a set of ethical rules along with policies for their creation and implementation. Using mandatory norms, the Entities' LPEs outline basic solutions for each of those four main elements of an ethics program.[53] Essential features of such an ethics program are: external (state) origin, mixture of le-

---

42 For the overview see [43]. pp. 207–210.

43 About difficulties of being an ethical person and acting like one, see [18]., especially pp. 69–72: „Myth 1: It's Easy to Be Ethical".

44 [12]. p. 17.

45 [12]. p. 30. For an excellent illustration of this standpoint see: Harvard Business School, Case 9–395- 127 (Rev. February 27, 1997): „Levi Strauss & Co: Global Sourcing (A)".

46 [6]. pp. 394–395.

47 External incentives come mostly from the state and public agencies. One of the first and most famous instruments were the US Principles of Federal Prosecution of Business Organizations [50]. Public agencies and professional organizations may also play an important role.

48 Moral attitudes of top management, corporate culture, the need to use the ethics program as a control system, etc.

49 See [18]. pp. 73–74: „Myth 3: Ethics Can be Managed Through Formal Ethics Codes and Programs".

50 [54]. pp. 41–42; [19]. p. 91.

51 [43]. p. 223.

52 [54]. p. 53.

53 For „bodies" see Art. 5, 7, 10, 16, 17 and 19 of [22]. and Art. 5, 6, 8, 11, 17, 20 and 21 of [21]. System of ethics management is regulated in Art. 5, 7, 19 and 20 of [22], and in Art. 6, 20 and 21 of [21]. Ethical rules and policies for the creation of a code of ethics can be found in Art. 2 a, 5, 7, 19 and 52 of [22], and in Art. 2 a, 8, 20, 47 and 52 of [21]. Art. 7, 16, 18, 20 and 47 of [22]. regulate the implementation of ethics rules, while [21]. enshrines norms on the same issues in Art. 21 and 47.

gal and ethical norms, formal character, and being officially recognized and compliance-oriented.

CREATION OF A CODE OF ETHICS

Determination of goals

1. Incentives for drafting a corporate code of ethics may have different sources and multiple purposes.[54] That is why business ethics theory unanimously asserts that the first task in the creation of a code is to determine why a corporation wants to make its own code. As a living moral subject and agent, a corporation usually sets several ethics goals. These goals should be understandable not only to the management, but to the employees and the stakeholders as well. Additionally, the goals are to be equitable,[55] justified[56], and achievable[57].

Determination of the goals largely depends on whether the ethics management is rules- or principles-oriented. The selected goals can be equal or organized hierarchically. In any case, they must be specific to the corporation's mission, „cultural context"[58] and internal and external relations. Generic codes of ethics should be avoided.[59]

2. Do LPEs' Model Codes of Ethics satisfy these criteria? Arguments for a negative answer are as follows. Adopting a code of ethics is a legal duty of a public enterprise.[60] Failure to do so is a punishable business offense for the public enterprise and its CEO.[61] The goals of the Model Codes of Ethics are the same as those of the LPEs.[62] In drafting the proposal of the code, the Supervisory Board must cooperate with the Internal Audit Board, whose head is nominated by the Entity's chief auditor.[63] Identical Model Codes of Ethics[64] were published right after the LPEs.[65] They enshrine seven legal principles along with three ethical principles of equal

[54] See [53]. p. 48 for some of most common intentions behind codifications of corporate ethics.

[55] [43]. p. 222.

[56] [40]. p. 37.

[57] [40]. p. 32.

[58] [8]. p. 1080.

[59] [43]. p. 222: „The company's code of ethics should not be window dressing or so general as to be useless."

[60] [22]. Art. 52 sets a six months period after the entry of the law into force. Art. 47 of [21]. mentions, but does not determine, a „prescribed period" for passing a code of ethics.

[61] Art. 47 of [22]., Art. 47 of [21].

[62] Art. 19 of [22]., Art. 20 of [21].

[63] Art. 19 of [22].; Art. 20 of [21]. Head of Internal Audit Board presides over the Board, but has no voting rights.

[64] For the English translation of the Model Code of Ethics in FBIH legislation see Appendix 1.

[65] [33].

standing.[66] Principle 10 states that „no deviation from this code or amendment of it is permitted". There is no explicit prioritization of any goal. Yet system analysis shows that the protection of state property and interests is the major goal and the implicit rationale for the Model Codes of Ethics.[67]

The conclusions are obvious. The incentives for adopting a code of ethics are external. The primary goal is the protection of the Entities' general interests in public enterprises. In drafting the code, the Internal Audit Board should strive to protect state interests rather than specific ethical needs and aims of a public enterprise. Mandatory content of legislation and Model Codes of Ethics does not give enough incentives for defining a public enterprise's specific goals. Consequently, the core content of individual codes is imposed and in essence generic. In this regime the specific interests of public enterprises are marginalized. Under the circumstances it is reasonable to suppose that individual codes can hardly satisfy specific moral expectations which originated the movement for codifying business ethics.

3. There were different practical reactions to the pressure of the LPEs. Some enterprises basically transcribed the Model Code of Ethics, inserting a few ethically irrelevant provisions.[68] Other public enterprises added their specific goals: integrity, transparency, consumers' and employees' satisfaction, environmental protection,[69] fairness, truthfulness, just and non-discriminatory treatment,[70] correct employee conduct and relationships.[71] One enterprise also listed the improvement of its business relations with all shareholders, employees, stakeholders[72] etc.

Drafting the codes of ethics

1. Every code of ethics is a normative and formal document. In this respect, codes of ethics are similar to general legal acts. However, different societal nature of juridical and moral norms requires business ethics theory to examine specific issues in drafting codes of ethics.

Making a code of ethics is a process, not a one-off drafting task.[73] As many employees and stakeholders as possible should be induced to actively participate in

[66] Principles 3, 7 and 9 contain principles of ethic. The rest are dedicated to legal issues.

[67] Reasons for Principle 4: „Protection and Correct Use of Company Property" and Principle 6: „Compliance with Laws, Rules and Regulations" can be discerned in other principles, as well.

[68] 2006 Ethics Code of public utility company „Vodovod i kanalizacija" d. o. o., Sarajevo (*PE „Water Supply and Sewerage", Ltd., Sarajevo).*

[69] JP „Toplane d. o. o. Sarajevo/District Heating System" in its 2005 Code of Ethics.

[70] JP „Elektroprivreda Bosne i Hercegovine" d. d. Sarajevo (*PE „Electrical Power Industry of BIH", JSC, Sarajevo)* in its 2005 Code of Ethics.

[71] JP „Sarajevo — šume" d. o. o. Sarajevo (*PE „Sarajevo — Forests" Ltd., Sarajevo).*

[72] JP „Elektoroprivreda Hrvatske zajednice Herceg — Bosna", d. d. Mostar (*Electric Power Industry of HZ HB*).

[73] For useful instructions see [6]. pp. 401–202.

the creation of the code.[74] Stages of good legal drafting (initiative, research, working team, scope, basic principles, structure determination, first draft, discussion of first draft, proposal) must be applied in accordance with the character of moral norms and ethics policy of the corporation. Due to the role of lawyers in the drafting process,[75] separation of moral and legal rules in codes of ethics is not an easy task. It is recommended to avoid legal language and to use positive and negative formulations.[76] In any case, the code must be comprehensible to the company's employees and stakeholders.[77]

The format of the code ought to be compatible with its functions and relatively short. Several formats appear in practice: creeds, mission statements, codes of conduct, compliance codes[78], standards and manuals, codes of ethics drafted like legal documents[79], and technical documents involving ethical rules. In order to facilitate application of the code, it is suggested to illustrate individual provisions with examples and provide a rationale behind a code „in those cases where the rationale is not self-evident[80]."

2. The LPEs legally require public enterprises to adopt codes of ethics, drafted in accordance with the prescribed Model Codes of Ethics, and to implement them. By doing so, the LPEs erase the line between law and ethics. Such legislative approach influences the drafting of the codes of ethics, among other issues.[81]

The format of the Model Codes of Ethics does not fit into the most widespread forms of ethics codes. Apart from the personal validity provision at the very beginning, the body of the text is divided into ten principles. Only Principle 9: „Understanding and Following this Code" has a solely ethical character. Other principles summarize and recount, in less formal terms, complex legal institutions like con-

[74] [40]. p. 32 makes the distinction between employees and stakeholders. A company has a moral obligation to include employees, i. e. to make them aware of the existence of and potential changes to the code. Stakeholders are „morally entitled to participate in the code creation process," but not obliged to comply with the code.

[75] [53]. p. 52. In BIH, Principle 9 of the Model Codes of Ethics instructs users who have dilemmas on interpretation or implementation of the code to turn to the legal counsel of a public enterprise.

[76] [40]. p. 31–32, argues that „negative tone language in a code (e. g., 'don't do x') appears to provide clearer direction (and is therefore more easily understood) than use of positive, inspirational language (e. g., 'try to do y') for certain types of activities…"

[77] [40]. pp. 31 and 37.

[78] Compliance codes encompass at least a company's technical and legal norms. As a part of its compliance program, they „focus on law and emphasize prevention and punishment." ([5]. p. 41). Compliance codes are typical for regulated industries. In this format of a code there is inherent danger of ethical transgressions by using lower standards in legal and technical regulations as a justification. For examples, see [11].

[79] [8]. p. 1079 notes that in practice, codes of ethics appear even as „annual reports presented to either shareholders and/or employees."

[80] [40]. p. 31.

[81] Influence of law and lawyers on the drafting of codes of ethics is not specific only to BIH and public enterprises. About coupling law and morality in corporate codes of ethics, see [53]. p. 52.

flict of interest or corporate governance.[82] Two out of ten Principles are formulated negatively — as interdictions.[83]

In preparation of a code of ethics, the Supervisory Board is only legally bound to cooperate with the Internal Audit Board,[84] not with the management or any other body. The argument for this solution is the deep insight of the Internal Audit Board into all aspects of the enterprise's life. The argument against it is the right of the Entity's Chief Auditor to nominate the president of the Internal Audit Board. Despite not having voting rights, the president might serve as a conduit for the government's ethical considerations. The Supervisory Board submits the proposal of the code of ethics to the Assembly (General Meeting) for adoption.[85] All procedures are the same as if the code of ethics were a purely legal act.

The mandated legal procedure for adopting the code of ethics does not prevent the Supervisory Board or other corporate bodies to conduct procedures and obey drafting principles established by the theory of business ethics. Unfortunately, there is no research data on whether they do. Yet, two outcomes are indisputable. First, the format of the code is subordinate to government's goals. Second, the drafting does not fully correspond to the requirements of the theory of business ethics. The analysis of the enterprises' code of ethics from the sample leads to the same conclusions.

CONTENT OF THE CODES OF ETHICS

General content of codes of ethics

1. In general, corporate codes of ethics concern moral issues in societal relations of companies and their employees in the course of doing business. The content of an individual code may depend on various factors: legislation and other external pressures, public commitment to ethics,[86] type of industry, corporate goals and culture, motives and orientation of top management, etc. In order to determine the prevailing, typical content of codes of ethics, the theory examines two basic aspects: topics regulated by the code[87], and core moral values.[88] Their results converge in the final analysis.

2. The topics are examined through meta-analysis of a large number[89] of research papers dealing with codes of ethics.[90] Those primary sources are descrip-

---

82 See Principles 1 and 2.
83 See Principles 8 and 10.
84 Art. 29 of [22]. and Art. 27 of [21].
85 Art. 7 and 5 of the [22]. Art. 8 and 6 of the [21].
86 [53]. p. 48.
87 [7]. pp. 122–124; [53]. p. 55–56.
88 [40]. pp. 30–32.
89 See [7]. pp. 122 -123; [53]. pp. 46 (Table 1).
90 As an example of analytical approach to the content of corporate codes of ethics, see [44]. pp. 615–617.

tive and statistical, and they allow ascertaining the core content of codes,[91] which can be predominantly oriented towards the company, the employees or the social environment.[92] Within each of these groups, the accent may be placed on different subjects (e. g. shareholders and stakeholders, management, female employees) or matters (e. g. finance, corruption, privacy, environment, conflict of interest, social responsibility).[93]

The topics covered by the code do not necessarily exhaust all „ethical concerns related to code content and the process involved in developing a code".[94] Among the missing concerns may be universal moral values or „standards"[95], like trustworthiness, respect, responsibility, fairness, caring and citizenship,[96] which should be included in corporate codes of ethics[97, 98] for them to be deemed truly ethical.

Moral content in the LPEs, Model Codes of Ethics, and in practice

1. The Entities' LBSs generally outline moral content in company law. The LPEs regulate specific business ethics issues in more detail. They determine the content of codes in almost the same manner.[99] Table 1 offers the overview of general and mandatory legislative solutions and their relation to the „Principles" of Model Codes of Ethics.

2. The first conclusion from Table 1 is that the Entities' LPEs regulate in detail the most important content of codes of ethics. Notwithstanding minor phrasing differences, the Model Codes of Ethics are fully congruent with LPEs' provisions. The second conclusion is that there is considerable overlap among the general company legislation, laws on public enterprises and Models Codes of Ethics. The restatement of law in Model Codes of Ethics serves to reinforce the rule of law

91 [7]. on p. 122, Tables IV and V, enumerates the ten most important topics in Canadian and in U. S. corporate codes of ethics. [53]. pp. 55–56, Table 3: „Common Content Of Codes Of Ethics" extracts the following generic issues: general matters, nature of the company, employee issues, legal matters, firm's stratus and actions in the market, and responsibilities to society.

92 [37]. p. 189, states that European companies have codes of ethics which are „…for both internal and external use, US companies' codes dealt more with conduct inside the firm…"

93 [7]. p. 123, Table VI, and p. 124, Table VII, [53]. pp. 55–56, Table 3: „Common Content Of Codes Of Ethics".

94 [40]. p. 29.

95 [40]. p. 37.

96 [40]. pp. 29–30.

97 [44]. p. 607: corporate codes of ethics „specify corporate ethical values".

98 [40]. p. 32, Table I, and p. 33, Table II.

99 Only articles which are generally and directly relevant for a specific duty (RS), or refer to Joint Stock Companies' management or Supervisory Board's members (RS and FBIH), are listed in Table 1.

Table 1: Subject matter content of the Model Codes of Ethic

No	Articles of LBS		Articles of LPE		Content in LPEs	Principles of Model Codes of Ethics
	RS 2008	FBIH 2015	RS	FBiH		
1	2	3	4	5	6	7
1	33, 34, 35, 37	36, 37, 258, 267	13, 19	20, 14	Prohibition to connected persons to enter into real or apparent conflict of interest with public enterprise	Principle 1: Conflict of Interest
2	32, 33	32	14	20, 15	Duty of connected persons to act professionally and conscientiously	Principle 3: Professional Abilities and Conscientious Conduct
3	33 309	257	15	20, 16	Duty of Supervisory Board and management to encourage control and protection of public enterprise's assets	Principle 4: Protection and Correct Use of Enterprise's Assets
4	309	253, 264	16	17, 18	Duty of Supervisory Board and management to comply with laws, rules and regulations	Principle 6. Compliance with Laws, Rules and Regulation.
5	309	264	16.	20, 17	Duty of Supervisory Board and management to encourage ethical behavior, whistle-blowing, and to report illegal or unethical behavior	Principle 7: Encouraging the Reporting of Illegal or Unethical Behavior
6	/	/	17	20, 17	Connected person's duty to report illegal behavior in public enterprise	Principle 6: Compliance with Laws, Rules and Regulations
7	38	39	19	20 14	Connected person's duty not to betray business secrets of public enterprise	Principle 5: Confidentiality
8	33, 35	34, 35, 40, 258	19	20	Ban on using corporate possibilities for own purposes and on connected persons to compete with public enterprise	Principle 2: Corporate Possibilities.
9	369	/	19, 40	20, 41	Ban on loans to management and Supervisory Board members	Principle 8: Loans to Management and Supervisory Board Members
10	369	/	19	/	Ban on loans to employees and members of enterprise's bodies	/
11	/	/	20, 47, 52	20, 47	Duty of management, on pain of penalty, to provide for the implementation of the code. In RS management must adopt guidelines for application of a code	Principle 9: Understanding and Following This Code.
12	/	/	47	20, 6, 47	Sanctions against public enterprise, Supervisory Board and management if code of ethics is not adopted or if it does not contain provisions from LPEs	Principle 10: Deviation and Disciplinary Action

by disguising legal duties as moral principles.[100] Clearly, the Model Codes of Ethics belong to the first generation of corporate codes of ethics.[101] Third, the considerable part of the content of the Model Codes of Ethics is explicitly addressed to connected persons only,[102] which contradicts the determination of the Codes' personal scope of application. [103]

The Model Codes of Ethics should not be assessed only according to the issues regulated; equally important and even more extensive is the missing content. The mandated templates do not mention a number of ethical relations which the theory of public enterprises considers indispensable to the codes' content: implementation of public interest, position of employees in an enterprise (information gathering, salaries, non-discrimination, affirmative action, gender relations, equitable treatment, promotion, etc.), ethical issues in internal employee relations, managers' behavior, stakeholders' rights, technology and environmental protection, corporate social responsibility, specific moral sanctions, etc. These lacunae in the content of the Model Codes of Ethics corroborate our previous conclusion that the real aims of ethics codification in public enterprises are actually goals of the state in disguise.

The limited content of the Model Codes of Ethics caused different reactions in practice. Even a small sample of codes of ethics suggests classifying them in three groups. The first group of public enterprises simply copied the Model Code of Ethics, sometimes with minor additions.[104] Public enterprises which made significant additions to the Model Code of Ethics are in the second group. The codes of those enterprises conform not only to the Model, but to theoretical content requirements as well.[105] The third groups is made up of public enterprises which did not tran-

[100] [40]. p. 30 points out that „it would not be sufficient for a company to merely restate the law in its code, as the law would not sufficiently express the moral standards (other than possibly citizenship)".

[101] [44]. p. 614: „First generation… is fundamentally about being consistent with the law while maximising returns to the general shareholders of the company."

[102] See Principles 1, 2, 3, 5, 6, 9.

[103] The introductory provisions of both Model Codes of Ethics state that the individual code applies to all employees, including agents, members of Supervisory and Audit Boards, and public companies which in RS control at least 5% and in FBIH at least 10% of voting rights in a public enterprise. „Connected persons" are mentioned only within the phrase „the relation of connected persons," which is impossible to interpret grammatically. Members of management are not mentioned at all.

[104] Art. 13 of 2006 Code of Ethics of the public utility company „Vodovod i kanalizacija" d. o. o., Sarajevo (*PE „Water Supply and Sewerage", Ltd., Sarajevo)* established a five-member commission for monitoring the implementation of the Code. See also the ethics codes of „Elektroprivreda BiH — Zavisno društvo Rudnik mrkog uglja Kakanj" d. o. o., Kakanj, dated 1st of April 2011, „KJP Komrad, d. o. o", Bihac, dated 8th of July 2007, and „KJP Saobraćaj i komunikacije Tuzla, d. o. o.", „KJP Veterinarska stanica, d. o. o.", Sarajevo, dated July 4, 2007, and „KJP Park, d. o. o.", Sarajevo.

[105] Codes of Ethics of the following public enterprises: „Autoceste FBIH" (Art. 13 e. g.), „Sarajevošume" (e. g., Chapters IV — VI), „Elektroprivreda BiH", and „Elektroprivreda HZHB".

scribe the Model. Instead, they imbedded the mandated content into their own formulation of ethical principles and rules.[106]

3. Attempts to establish moral principles justifying corporate codes of ethics have a long history.[107] The examination of the mandatory subject matter in the light of universal moral standards, as defined by Schwartz,[108] reveals the ethics content of Model Codes of Ethics.

Table 2: Moral content of Model Codes of Ethics

Principle	Principles of Model Codes of Ethics	Application of universal standards described by Schwartz
1	Conflict of Interest	Citizenship; Trustworthiness
2	Corporate Possibilities.	Citizenship; Trustworthiness; Fairness
3	Professional Abilities and Conscientious Conduct	Trustworthiness; Responsibility
4	Protection and Correct Use of Enterprise's Assets	Trustworthiness; Responsibility; Caring
5	Confidentiality	Trustworthiness; Responsibility
6	Compliance with Laws, Rules and Regulations	Caring; Trustworthiness
7	Encouraging Reporting of Illegal or Unethical Behavior	Caring; Trustworthiness
8	Loans to Management and Supervisory Board Members	Fairness
9	Understanding and Following this Code	Trustworthiness; Citizenship
10	Deviation and Disciplinary Action	Citizenship; Responsibility

By itself, Table 2 suggests that the Model Codes of Ethics conform satisfactorily to broadly conceived universal moral values. However, in the light of conclusions from Table 1, the assessment is less favorable: the moral content of the Model Codes of Ethics already exists in the law. Despite the fact that morality is a broader concept than the law, the Model Codes of Ethics do not protect ethics beyond the boundaries of the legal system. This finding confirms the previous conclusion: the mandated Model Codes of Ethics are designed to support implementation of the

[106] See „JP Toplane Sarajevo/District Heating System" in its Code of Ethics from 2005, „JP Autoceste FBIH, d. o. o.", Mostar, June 2014. „KJP Sarajevo-šume, d. o. o.", Sarajevo, in Article 2 of its code declared the „building of trust" as the most important goal of the code, as did „KJP GRAS, d. o. o.", Sarajevo in the preamble of its code.

[107] See [42]. p. 29–31 and 35–36

[108] For a brief description of the scope of moral standards see [40]. pp. 29–30. The relations between code content, moral obligations and basic moral standards are summarized in p. 33, Table II, „Code content and moral standards". See also [42]. p. 39.

existing law, not to stimulate the improvement of public enterprises' ethical standards and behavior. [109]

FUNCTIONS OF CODES OF ETHICS

General functions of codes of ethics

1. Corporate codes of ethics have varied goals and complex content. They operate within diverse internal organizational schemes, corporate cultures, business and social environments. That is why codes of ethics serve several purposes and functions.[110] Those functions may be intended or unintended, actual or potential. Functions which occur more often than others have standard names and typical formats. Depending on circumstances, the same ethical phenomenon can be an ingredient of different standard functions. Therefore, business ethics theory is not unanimous about the classification of the standard functions of codes of ethics.

2. The distinguishing function has a core role in a corporation's business ethics. A code of ethics defines and affirms specific and most important elements of business ethics in internal, business and social relations. This function is not limited only to written moral rules for anticipated situations. It also contains guidelines for situations in which more than one moral standard is equitable and applicable.[111] Finally, the distinguishing function offers a behavioral compass for completely new ethical problems, proving the „moral maturity" of a corporation.

The legitimatization function tends to strengthen the social position of a corporation and to reinforce its citizenship beyond the recognition granted by the law.[112] This function is oriented both inward and outward. Its first task is to facilitate the internalization of corporate values and culture by shareholders, employees and stakeholders. The increase of internal cohesion around a unique corporate ethics culture makes it easier for corporation to act in a socially responsible manner. Therefore corporate codes of ethics should contain at least basic provisions on corporate social responsibility.

The controlling function directs employees and shareholders to behave according to a corporation's requirements. A code of ethics helps achieve this primarily by strengthening corporate culture. The existence and implementation of a code of ethics keep moral issues under permanent scrutiny. In such an environment employees have to take moral issues seriously[113]. If not, peer pressure alone or in cooperation with implementation bodies makes everybody respect the corporation's

---

[109] An interesting example is the Code of Ethics of „KJP GRAS, d. o. o.", Sarajevo, whose preamble contains some Kantian references to ethical principles and respect thereof.

[110] [53]. p. 47–48: „…codes can have multiple, not necessarily consistent organizational roles."

[111] [6]. p. 401.

[112] [6]. p. 401: „An especially dangerous situation is created when employees conclude that whatever is not prohibited is permitted."

[113] [43]. p. 220.

moral bottom line.[114] Successfully implemented, the controlling function makes business operations easier and more efficient in the long run.

The public relations function should create the most favorable possible social environment for a corporation, primarily by creating a lasting good moral image among external stakeholders, professionals and the general public, especially consumers. That is why companies use their codes of ethics, including corporate social responsibility, not only as a part of their general public relations policy, but also as a powerful marketing tool.[115] Public support for a corporation as a moral agent helps to alleviate corporate defensiveness in moral disputes with stakeholders, consumers, state bodies and the society as a whole[116].

Finally, corporate codes of ethics have a very strong protective function. In internal relations, a code of ethics is an important factor in preserving of a unique moral personality of a corporation. Success in this endeavor often discourages government regulation and may protect a corporation from legal and other types of responsibility.

Functions of the Model Codes of Ethics

1. The Entities' legislation sets the basic framework for public enterprises' ethics programs, and includes several provisions on the codes' content.[117] Its detailed elaboration is left to the Model Codes of Ethics. Their provisions restate the existing general and special legislation, including the moral values they contain. Ethical norms remain incorporated into and limited by legal rules. Consequently, the functions of the Model Codes of Ethics may be in a different category from the usual functions of corporate ethics codes. Omitting the legal content of the Model Codes of Ethics from the analysis helps overcome the difficulty of collating juridical and ethical acts. On the theoretical level, this approach can be justified by the fact that the moral and the legal system exist simultaneously, are intermingled and each has its own sanctions which can be applied together or separately. The practical explanation for the methodology adopted is even more convincing. Comparison of the functions of the Model Codes of Ethics and the quintessential functions of corporate ethics codes is intended to show to public enterprises possible directions for extending their own codes of ethics beyond the horizon of the Models.

2. The Model Codes of Ethics are mandatory and generic. They are meant to provide public enterprises with unified core values and ethical norms, as seen by the legislators. Should dilemmas or new issues appear, the clarification and advice

[114] [8]. p. 1081: „…behavioral impact of a Code of Ethics can only be fully understood and explained through reference to interaction of…" formal-, social-, and self-control. Also, see the scheme on p. 1089.

[115] [13]. pp. 12–23 especially.

[116] [43]. p. 220–221.

[117] Art. 19 of [22]. and Art. 20 of [21].

must be solicited from the chief legal counselor of public enterprise,[118] not its ethics officer. Obviously, the creators of the Model Codes of Ethics had unity within the law as their primary goal. That is why the Model Codes of Ethics do not have the distinguishing function. Yet, the door for introducing this distinguishing role into individual codes of ethics is not completely closed. Article 52 of the LPE RS requires public companies to adopt appropriate guidelines for the implementation of their codes of ethics. Those guidelines can be a suitable tool for inserting distinguishing moral norms into a public enterprise's ethics program. The LPE FBIH does not mention guidelines. Here, the only remaining way for inserting distinguishing ethics rules into individual codes of ethics is the interpretation of Principle 9, which allows public enterprises to go *praeter* Model Code of Ethics. Our sample of codes of ethics shows some companies did[119] and other did not[120] use this opportunity.

Generally, the legitimatization function is outside the scope of the Model Codes of Ethics. The only exception could be their focus on the duties of connected persons.[121]

The reasons for passing the LPEs led to a strong presence of the controlling function in the Model Codes of Ethics. Principle 3 requires connected persons to act with due diligence, professionally and conscientiously. Principle 6 expressly imposes the duty of control on the Supervisory Board and management. Interestingly enough, this duty refers only to legally relevant behavior. The control of ethical conduct outside legal norms is completely omitted. Finally, Principle 7 requires the Supervisory Board and management to promote reporting on illegal and unethical behavior and to report such behavior of other employees.[122] Thus whistle-blowing becomes an instrument of peer pressure.

The LPEs forbid charitable donations, except if approved by specific legislation.[123] The Model Codes of Ethics do not mention other issues of corporate social responsibility. The orientation toward the protection of state interests makes the model codes of ethics blind to the public relations potential of corporate codes of ethics.

---

[118] Principle 9 of each Model Code of Ethics.

[119] „JP Toplane Sarajevo/District Heating System" in its Code of Ethics from 2005, „The Code of Behavior of Agricultural Institute of Republika Srpska — Banja Luka" dated February 10, 2010, 'The Code of Behavior and Corporate Governance 'Krajinapetrol d. d. ', Banja Luka, September 9, 2012, „JP Elektoroprivreda HZ HB" in the code from June 2005.

[120] Code of Ethics of „KJP Vodovod i kanalizacija, d. o. o.", Sarajevo, Code of Ethics of „JP Elektroprivreda BiH — Zavisno društvo Rudnik mrkog uglja Kakanj, d. o. o.", Kakanj, dated 1st of April 2011, Code of Ethics of „JP Komrad, d. o. o.", Bihac, dated 8th of June 2007, and Code of Ethics of „JP Saobracaj i komunikacije Tuzla, d. o. o."; Code of Ethics of „JP Elektro Doboj, d. d.", dated 10th of May, 2005.

[121] See Principles 1, 2, 3, 5, 9.

[122] [41]. p. 335: „Despite many respondents not being aware of the reporting obligation as stipulated by the companies' codes, most respondents still believed that employees should be obliged to report all violations." Unfortunately, there is no research of this issue in BIH.

[123] Art. 40 of [22].; Art. 41 of [21].

The regulation of the protective function in the LPEs and the Model Codes of Ethics reflects the essential reasons of the state for passing those acts: protection of companies' assets[124], rule of law[125] and economic success of public enterprises.[126] Therefore, different aspects of the protective function are elaborated in each of Models' ten principles.

IMPLEMENTATION OF CODES OF ETHICS

General requirements for successful implementation

1. A number of essential factors determine the life of a code of ethics in the practice of an individual corporation. The quality of the code itself, is the first factor in a successful implementation of a code of ethics. The code may be considered good if it satisfies a critical majority of theoretical requirements regarding goals, creation and the content. Additionally, a good code must reflect the company's tradition and present situation.

Even the best-drafted code will not be implemented at all,[127] or at best partially, if other factors are not in place. Prominent among them are the moral qualities of the employees. This „individual factor" encompasses an array of features which influence moral perceptions and attitudes of each employee: education, age, gender, duration of employment generally and within the corporation, individual culture and values, locus of control, self-control, role identification etc.

Individuals do not work alone in a corporation. Consequently, a successful implementation of the code depends on internal situational factors: size of the corporation, location of headquarters and production units, the degree of division of labor, peer influences and pressures, size and values of corporate bureaucratic enforcement apparatus, and, last but not least, moral attitudes and behavior of top management. The theorists are unanimous that ethical leadership, „tone at the top" in particular, decisively shape moral behavior of employees and ethical climate in a corporation.[128] A corporation is not a stand-alone subject on the market. The most important external situational factors shaping corporate moral personality are: stability of society and societal ethics, structure of the market, the economic cycle, competition, type of government, etc.

[124] Principles 3, 4, 5, 8.

[125] Principles 2, 7, 9, 10.

[126] Principles 1, 2, 3, 5.

[127] Enron Code of Ethics from the year 2000 can be found at http: //mishkenot. org. il/Hebrew/docs/ethics/Enron%20 Code%20 Of%20 Ethics. pdf. For the history of Enron collapse see [25]. Legislative response to the Enron collapse was Sarbanes-Oxley Act of 2002; see [20]. pp. 2123–2141.

[128] See [9]. p. 227 and [40]. p. 38. In [20]. pp. 2124, we find the claim that „…corporate code of behavior is only as good as the directors and officers responsible for implementing it." See also pp. 2128, 2130, and 2132.

2. Fundamental to a corporate ethics program are the bodies responsible for its creation and implementation. There is a consensus in the theory that all corporate organs, departments and employees should be involved into the implementation of the code of ethics. However, their involvement is not equal. The most active is the board of directors or its counterpart in continental systems of corporate governance, the supervisory board. The effective role of these bodies depends on the regulation and traditional practice of corporate governance in each country.[129] In the aftermath of the Enron collapse, the ethical engagement of boards of directors in common law systems increased.[130] In corporate administration, ethical issues are most often in the purview of legal and human resources departments.

Notwithstanding the corporate governance system, the management is the most responsible for the implementation of the code of ethics.[131] The paramount position in all ethical processes belongs to the top management: Chief Executive Officers (CEOs) in common law or „*Vorstand*" („*uprava*") in continental legal systems. It affects the implementation of the code of ethics through moral attitudes of its highest-ranking officers, by setting ethics policies, and through its position toward the ethics management system as a control tool of corporate activities. In decentralized corporations, middle management plays a more important role than in centralized ones.[132] Larger corporations sometimes appoint individuals specifically in charge of ethics processes, either within top management, or at divisional or lower levels. Those persons are called ethics commissioners, ethics managers or ethics officers. They organize training activities, monitor and direct compliance with the code of ethics in practice, investigate moral misdeeds and propose or determine moral sanctions.

Standing ethics committees and commissions are appointed bodies whose only duty is to take permanent care of moral issues within a corporation.[133] Their role is mostly advisory and investigative. Sometimes standing bodies serve as the second instance in moral disputes. The theory recommends that they include external experts. The corporation may also individually hire an external ethics consultant. They are especially useful in ethical audits.

3. Functioning ethics management organization and policies are the third condition for the successful implementation of a code of ethics. Their first component

[129] Comparative law overview can be found in [52]. pp. 43–54 and [51]. pp. 375–394. A classification of corporate governance systems for the purpose of analyzing codes of ethics, see [14]. pp. 684–685.

[130] [14]. p. 682 and 693 established a positive correlation between participation of outside directors in the Board of Directors and board ownership with the content of codes of ethics and their implementation. This influence is stronger in common law than in continental systems; see also [14]. p. 198.

[131] [14]. p. 683: „…the composition of the board in regard to its independence and diversity plays the main role in the ethical commitment shown by the firm." For corporate governance in BIH, see [49]. pp. 224–252.

[132] [55]. p. 391.

[133] [43]. p. 223 considers ethics committees in charge of communicating the code, its interpretation, facilitation of the use of the code, investigation of grievances, etc.

is a top-down communication subsystem. This means that the code of ethics ought to be distributed and discussed prior to its application.[134] Existing and newly hired employees should sign the receipt of the code.[135] It is desirable to distribute explanatory materials, a letter from top management on the code of ethics, and follow-ups on code implementation. Whether the code of ethics will be available to external stakeholders and the general public depends on the company's transparency policy. At the moment of internal distribution of the code, an ethics training subsystem should be in place.[136] It is commendable to make training regular,[137] organized for specific groups (top management, middle management, all employees, employees in specific sectors, etc.), and focused on the corporation's general experiences and needs, or on critical sectors of activity, e. g. finance. „Sufficient training would be attained at the point where employees would not violate the code due to lack of understanding of how the code's provisions apply."[138]

The investigative subsystem has several important roles in the implementation of the code of ethics. First, it supplies the necessary information for testing the quality of the code. The data could serve to reinforce the code's implementation by allocating more money, better bottom-up communication lines (ethics hotlines and helplines, anonymous violation reporting system[139]), timely reporting and proper handling of code implementation reports, internal or external ethics audit, etc. Second, the investigative subsystem supplies information on violations of the code, their consequences for the corporation and for moral wrongdoers. Success of these tasks depends on the chosen policy options. Reactive investigations will produce lesser results than proactive. Systemic checking of each complaint is more effective but more expensive than the random approach. Secret examination of complaints or suspicions may or may not gives better results than public inquiry. Principles of fairness and respect demand that the responsible body provide information to the reporting employee on steps taken by corporate bodies. In any case, the accused person should be informed in due time and with respect for their privacy.[140] The investigative subsystem serves to improve the code and the design of prevention measures.

Finally, the enforcement subsystem provides for corrective actions. Its constituent parts are responsible bodies, types of corrective actions, consistent application and fair enforcement policy. Corrective actions are punitive: publication of the breach, oral or written public warning, annual „award" for the worst ethical act or

---

[134] [40]. p. 34 grounds the distribution of a code prior to its entry into force in the principles of procedural fairness, caring and responsibility.

[135] For employees' attitudes about prior dissemination and signing of a code of ethics see [41]. pp. 332–333.

[136] [43]. p. 223 insists that a „part of all employee training programs should be devoted to ethics."

[137] [41]. p. 333: „All code commentators concur that without sufficient training, codes remain ineffective in influencing behavior."

[138] [40]. p. 34.

[139] See [41]. p 336.

[140] [40]. p. 35.

employee, transfer of the wrongdoer etc. Positive sanctions are the counterpart to the negative ones: award for the most ethical employee of the year, public recognition for moral acts, publicity, etc.[141] Corrective actions stem from oppressive and bureaucratic enforcement policy, while positive sanction are rooted in a participatory and rewarding approach to ethics program implementation. Punishment or reward must be proportionate.

Implementation requirements for the Entities' legislation and Model Codes of Ethics

1. Concrete factors for the successful implementation of codes of ethics in BIH are difficult to determine.[142] A detailed content analysis of the Model Codes of Ethics shows they do not satisfy a majority of theoretical requirements regarding topics of codes of ethics. That is why the Model Codes of Ethics cannot be deemed as good. Human resources capacity for implementing codes of ethics in public enterprises can be assessed only indirectly. Due to the absolutely dominant state ownership, the public interest those enterprises satisfy, the monopolistic position they have and the political interest vested in them, public enterprises are very attractive employers. Consequently, the quality of their personnel should be above average, and should not be an obstacle to the successful implementation of codes of ethics.

Internal situational factors of the successful implementation of codes of ethics in public enterprises vary considerably. Theoretically, two constants may be ascertained. First, public enterprises have a strong and capable bureaucratic apparatus. Second, their management is under considerable influence of politics, so „the tone at the top" must be assessed on a case-by-case basis. External situational factors in BIH negatively influence the moral behavior of domestic companies. Thanks to the societal, business and political position of public enterprises, the negative impact of social environment factors is lesser on public enterprises than on other corporations.

2. The two LPEs have identical definitions of the bodies in charge of implementing codes of ethics. Their structure basically follows the theoretical recommendations. The duties of each particular body are adjusted to its general legal role in a public enterprise.

Beside duties in preparing and proposing a code of ethics, the Supervisory Board passes general acts regulating „operational and functional aspects of enterprise bodies in accordance with the law, by-laws and code of ethics."[143] The Supervisory Board must not transfer these regulatory duties. The general competencies of the Supervisory Board include the supervision of ethical behavior inside and

141 [18]. p. 79: „The reward system may be the single most important way to deliver a message about what behaviors are expected."

142 For general overview see [35]. On p. 116 of [35]. SOEs is marked as one of the areas „with significant knowledge gaps". See also [1]. pp. 118–119

143 Art. 11 of [22].; the formulation in Art. 19 of [21] is similar.

outside the enterprise. Additionally, the LPEs explicitly require the Supervisory Board to foster ethical behavior and to encourage whistle-blowing.[144]

The management („*uprava*") is primarily and directly responsible for the implementation of the code of ethics.[145] In LPE FBIH the management is explicitly in charge of initiating labor law disciplinary procedures for ethical misbehavior.[146] The ethical procedures and sanctions are not mentioned in the law or in the Model Codes of Ethics. Prior to delegating duties related to the implementation of code of ethics to one of its executive directors, the management must obtain unanimous written consent of the Supervisory Board.[147] Appointing an ethics officer does not relive management from responsibility for ethical behavior of a public enterprise. If it does not implement a code of ethics, a public enterprise and the responsible individuals, including members of management, can be punished for a misdemeanor.[148]

3. There is no empirical research on ethics management and policies in public enterprises in BIH.[149] Therefore, the conclusions about this requirement for a successful implementation of the Model Codes of Ethics must be derived from the LPEs and the Models themselves. Examples from our sample of codes of ethics also cast some light on this dark area.

The communications subsystem is organized top-down. Codes of ethics are adopted and made known to employees in the same way as any other general legal act of the company. First of all, the Model Codes of Ethics are published in the Entities' official gazettes. When a public enterprise passes its own code of ethics, it is communicated through the usual internal channels. Principle 9 of the Model Code of Ethics stipulates a general duty of employees to get acquainted with the code. Sometimes, it is required from employees to sign the code of ethics and an appropriate declaration[150] of its acceptance. If workers have moral dilemmas or find themselves in an ambiguous position, they are required to ask for additional explanations and advice, primarily from the chief legal counsel of a public enterprise. Obviously, in the implementation process, the communication system works from the bottom up.

---

[144] Art. 16 of [22]., Art. 17 of [21]., Principle 7 of the Model Code of Ethics.

[145] Art. 20 of [22]., Art. 11, 19, and 21 of [21].

[146] Art. 21 of [21].

[147] Art. 20 of [22].; Art. 21 of [21].

[148] Fines for public enterprises are between 5.000 and 15.000 KM, and for responsible individual from 500 to 1.500 KM (Art. 47 of [22].; Art. 47 of [21].)

[149] Database search for keywords „javna preduzeća" (public enterprises), „etički kodeksi" (codes of ethics), „Model etičkog kodeksa" (Model Code of Ethics), „poslovna etika" (business ethics) by the Library of the Faculty of Law, University of Sarajevo, in January 2016, produced only one paper reporting on empirical research of ethical attitudes of employees in Croatia. See [24].

[150] See Code of Ethics of „KJP Toplane/District Heating System, d. o. o.", Sarajevo, from 2005.

The investigative subsystem in the LPEs does not differentiate between law and ethics.[151] Ethical codes from the sample do not have provisions on specific procedures for moral, as opposed to legal, issues.

In the Model Codes of Ethics and the codes from the sample, the enforcement system for moral breaches is the same as for legal ones. Besides fines, unethical acts are subject to disciplinary punishment, including discharge from the present position.[152] Specific moral corrective actions are not present in the public enterprises' codes of ethics from the sample.

CONCLUSIONS

1. Public enterprises are owned by the state and should serve common interests. To ensure moral conduct in public services, the Entities' special laws on public enterprises introduced obligatory corporate ethics programs and Model Codes of Ethics. Thus public enterprises became legally recognized as moral agents. Unlike FBIH, the RS law still considers as moral agents all corporations with majority state ownership employing at least 50 persons. Adopting a code of ethics with prescribed minimal content is a legal duty of public enterprises. This fact, though not unique to BIH, is a serious indicator of a still unsatisfactory position of business ethics in the public service sector and in business generally.

2. The LPEs' provisions related to business ethics programs are concentrated on promulgation and implementation of code of ethics. Behavioral rules are mostly enshrined in the mandated Model Codes of Ethics, appended to special laws on public enterprises and identical for both Entities. The assessment of the mandated business ethics requires a clear methodological distinction between law and morality, and the application of the normative approach. The absence of empirical studies and doctrinal discussions on corporate codes of ethics in BIH makes general business ethics theory the necessary criterion for evaluation of the Model Codes of Ethics.

3. The legislators imposed the Model Codes of Ethics as an instrument for protecting state interests and enhancing the rule of law, rather than for improving business ethics. Those Model Codes of Ethics and their replicas do not in practice satisfy the basic theoretical requirements regarding the creation, content, functions and implementation of codes of ethics. Consequently, the Model Codes of Ethics are not sufficient to improve the moral behavior of public enterprises.

4. Further advancement of business ethics in BIH depends primarily on organized social action. In order to facilitate a grass-roots movement for business ethics, both in public enterprises and more generally, continuous theoretical and empirical research are necessary. The following steps in this direction seem appropri-

[151] Art. 7 of [22].; Art. 10 of [21].

[152] Principle 10 of the Model Code of Ethics.

ate: normative analysis of codes of ethics of public enterprises, comparative examination of codes of ethics adopted by public enterprises and by chambers of commerce, normative analysis of private corporations' codes of ethics, and empirical research o codes of ethics and their implementation in corporate practice.

REFERENCES

[1] Country/Economy Profiles: Bosnia and Herzegovina. In: The Global Competitiveness Report 2015–2016 (ed. Klaus Schwab). Geneva: World Economic Forum, 2015. p. 118–119.
[2] M. Agrast, J. Botero, J. Martinez, A. Ponce and C. S. Pratt: „WJP Rule of Law Index 2012–2013". Washington D. C.: The World Justice Project, 2012. p. 246.
[3] BIH Penal Code (Official gazette (Off. gaz.) BIH 3/03 with amendments), Chapter XIV „Responsibility of Legal Persons for Criminal Acts"; FBiH Penal Code (Off. gaz. 36/03 with amendments).
[4] BIH state Framework Law on Privatization of Companies and Banks was passed on July 17, 1998 (Off. gaz. BIH 14/98 and 18/2000).
[5] M. S. Blodgett: „Substantive Ethics: Integrating Law and Ethics in Corporate Ethics Programs", J. Bus. Ethics, 99, 2011. p. 39–48.
[6] R. J. Boatright: „Ethics and Conduct of Business", 4th ed., Upper Saddle River: Prentice Hall, 2003. O. 452.
[7] L. J. Brooks: „Corporate Codes of Ethics", J. Bus. Ethics, vol. 8, No 2/3, March 1989. p. 117–129.
[8] C. Cassell, P. Johanson and K. Smith: „Opening the Black Box: Corporate Codes of Ethics in Their Organizational Context", J. Bus. Ethics, 16, 1997. p. 1007–1093, 1997.
[9] M. A. Cleek and L. L. Sherry: „Can Corporate Codes of Ethics Influence Behavior", J. Bus. Ethics, 17, 1998. p. 619–630.
[10] P. Davies: „Introduction to Company Law", Oxford: Oxford University Press, 2002. p. XXIII, 312.
[11] V. Di Lorenzo: „Business Ethics: Law as A Detriment to Business Conduct", J. Bus. Ethics, 71, 2007. p. 275–299.
[12] T. Donaldson: „Corporation and Morality", Englewood Cliffs: Prentice Hall, Englewood Cliffs, 1982. p. 214.
[13] Ph. Kotler and N. Lee: „Korporativna društvena odgovornost.: učiniti najviše za svoju kompaniju i za izabrani društveni cilj" (Corporate Social Responsibility: Doing the Most Good for Your Company), Beograd: Hesperia: Ekonomski fakultet, 20074. P. XII, 347.
[14] I.-M. Garcia-Sanchez, L. Rodriguez-Dominguez and J.-. V. Frias-Aceituno: „Board of Directors and Ethics Codes in Different Corporate Governance Systems", J. Bus. Ethics, 131, 2015. p. 681–698.
[15] V. Ikanović: „Odgovornost pravnih lica za krivična djela". Banja Luka: Međunarodno udruženje naučnih radnika — AIS, 2012. p. 328.
[16] A. Jamnik: „Business Ethics as new Challenge in Modern Economy", Proceedings International Conference Transition to a New Society, 20–22 March 2014, Podgorica, Montenegrin Academy of Science and Arts, 2014. p. 167–178.
[17] J. Katz Palley and L. Sharp Paine: „Levi Strauss & Co: Global Sourcing (A)", Cambridge, MA: Harvard University, Harvard Business School, (Rev. February 27, 1997), Case 9. p. 395–127.
[18] L. Klebe Trevino and E. M. Brown: „Managing to be ethical: Debunking five business ethics myths", Academy of Management Executive, vol. 18, No. 2, 2004. p. 69–81.

[19] L. Klebe Trevino and R. G. Weaver: „Managing ethics in Business Organizations", Stanford, CA: Stanford University Press, 2003. p. XXIII, 364.
[20] „The Good, the Bad, and Their Corporate Codes of Ethics: Enron, Sarbanes-Oxley and Problems with Legislating Good Behavior", Notes, Harvard Law review, vol. 116, No 7, 2003. p. 2123–2141.
[21] LPE FBiH (Off. gaz. FBiH 109/12)
[22] LPE RS (Off. gaz. RS 78/11)
[23] R. D. Lukić: „Sociologija morala", Beograd: Srpska akademija nauka i umetnosti, 1974. p. XV, 683.
[24] M. Dabić: „Croatian Employees' Behavior and Attitudes With Respect to Ethical Norms for Business Practice", Tržište, vol. XXI, br. 1, 2009. p. 55–68.
[25] B. McLean and P. Elkind: „The Smartest Guys in the Room — The amazing Rise and Scandalous Fall of Enron", New York: Portfolio, 2003. p. XXV, 435.
[26] R. A. G. Robert and N. Minow: „Corporate Governance", Malden, MA; Blackwell publishing, 2004. p. XVI, 564.
[27] Off. Gaz. FBiH 8/05, 81/08, 22/09 and 109/12.
[28] Off. Gaz. FBiH 81/15.
[29] Off. Gaz. of FBiH 22/99, 45/00, 2/02, 6/02, 29/03,68/05, 91/07, 84/08, 88/08, 7/09, 63/10 and 75/13.
[30] Off. Gaz. RBiH 4/92, 21/92 and 13/94.
[31] Off. Gaz. RS 75/04 and 78/11.
[32] Off. Gaz. RS 127/08, 58/09, 100/11 and 67/13.
[33] Off. Gaz. RS 82/04: Off. Gaz. FBiH 29/05.
[34] Off. Gaz. RS 24/98 with later amendments.
[35] „Rebalancing Bosnia and Herzegovina: a Systematic Country Diagnostic". Sarajevo: World Bank Group, 2015. p. 174.
[36] Republic of BIH Law on Transformation of Social Property (Off. gaz. RBIH 33/94); RS Law on Transfer of Socially Owned Assets to Sate Property (Off. gaz. RS 4/93).
[37] L. Rodriguez-Dominguez, I. Gallero-Alvarez and I. M. Garcia-Sanchez: „Corporate Governance and Codes of Ethics", J. Bus. Ethics, 90, 2009. p.: 187–202.
[38] RS Security Commission's Standards of Corporate Governance, in its Standards of Corporate Governance (Official gazette RS 117/11).
[39] L. R. Schmeltzer and M. M. Jennings: „Why an International Code of Business Ethics Would Be Good for Business", J. Bus. Ethics, 17, 1998. p. 57–66.
[40] M. S. Schwartz: „A Code of Ethics for Corporate Code of Ethics" J. Bus. Ethics, 41, 2002. p. 27–43.
[41] M. S. Schwartz: „Effective Corporate Codes of Ethics: Perception of Code Users", J. Bus. Ethics, 55, 2004. p. 323–343.
[42] M. S. Schwartz: „Universal Moral Values for Corporate Codes of Ethics", J. Bus. Ethics, 59, 2009. p. 27–44.
[43] W. H. Shaw and V. Barry: „Moral issues in Business", 9th ed., Belmont, CA: Thomson/ Wadsworth, 2004. p. XII, 627.
[44] C. Stohl, M. Stohl and L. Popova: „A New Generation of Corporate Codes of Ethiccs", J. Bus. Ethics, vol. 90, No. 4, 2009. p. 607–622.
[45] A. Sultanović, M. Trifković and M. Simić: „Teorija države i prava, statusnog i obligacionog prava", (Theory of State and Law, Status and Obligations Law), Sarajevo: Veselin Masleša, 1984. p. 547.
[46] Translation in English of Model Ethics Code in FBiH (Official gazette FBiH 29/05).
[47] M. Trifković: „Nelojalna utakmica" (Unfair Competition), Sarajevo: Svjetlost, 1990. p. 181.

[48] M. Trifković: „The Impact of Globalization on Bilateral Investment Treaties and Their Models — the Case of Bosnia and Herzegovina", Proceedings International Conference Transition to a New Society, 20–22 March 2014, Podgorica, Montenegrin Academy of Science and Arts, 2014. p. 191–203.
[49] V. Trivun, V. Silajdžić, F. Mahmutćehajić and M. Mrgud: „Business Law", Sarajevo: School of Economics and Business, 2015. p. 756.
[50] US „Principles of Federal Prosecution of Business Organizations", Principle 8, pp 14–16 in http: //www. justice. gov/sites/default/files/opa/legacy/2008/08/28/corp-charging-guidelines. pdf, (last approach 15. 01. 2016).
[51] M. Vasiljević: „Company Law", Belgrade: Publication Center of the University, School of Law, 2006. p. 607.
[52] M. Vasiljević: „Korporativno upravljanje: pravni aspekti", (Corpporate Governance: Legal Aspects), Beograd: Pravni fakultet: Profinvest, 2007. p. 351.
[53] G. R. Weaver: „Corporate Codes of Ethics: Purpose, Process and Society Content Issues", Business & Society, vol. 33, issue 1, 1993. p. 44–58.
[54] G. R. Weaver, L. Klebe Trevino and P. L. Cochran: „Corporate Ethics Programs as Control Systems: Influence of Executive Commitment and Environmental Factors", Academy of Management Journal, vol. 42, No 1, 1990. p. 41–57.
[55] S. Weller: Weller Steven: „The Effectiveness of Corporate Codes of Ethics", J. Bus. Ethics, 7, 1988. p. 389–395.

APPENDIX
Unofficial Translation

In accordance with the article 53 of the Law on Public Enterprises in Federation of Bosnia and Herzegovina („Official Gazette FBiH" 8/05) it is hereby released

MODEL CODE OF ETHICS
FOR PUBLIC ENTERPRISES*

Based on Article 6 Paragraph 1 b) of the Law on Public Enterprises („Official Gazette FBiH" 8/05), the General Meeting of Public Enterprise ___________________, JSC or Ltd meeting on ____ 2005, adopted the

CODE OF ETHICS
OF PUBLIC ENTERPRISE____________

This Code of Ethics applies to:

1. All employees of the public enterprise (the Enterprise in further text), including individuals and representatives named by the Enterprise for particular activities;
2. All members of the Supervisory and Audit Boards
3. All public Enterprises or individuals which control, directly or indirectly, at least 10% of total voting shares of the Enterprise.

A relation between „connected persons" is considered to exist (the term being used in further text according to context) in each of the following cases:

Principle 1
Conflict of Interest

A connected person is obliged to avoid real or apparent conflicts of interests with the Enterprise in personal or professional relations.

A conflict of interest appears when the personal, viz. professional interest of a connected person makes, could make, or appears to make it materially impossible to pursue the interests or operations of the Enterprise, or for the connected person to fulfill their duties and responsibilities.

A connected person must provide the Management, the Supervisory Board or another supervisory body with access to all transactions or relations which the connected person has reason to believe might create a real or apparent conflict with the interests of the Enterprise.

In the course of its operations, the Enterprise may not offer more favorable terms to connected persons than to non-connected ones. As pertains to this paragraph, a connected person is understood as one of the following:

1. Members of the immediate family of a connected person up to third degree of relation by blood or marriage, as well as members of the connected person's household;
2. Legal persons in which the Enterprise has at least 10% (or less) of total voting rights;

* Published in „Official Gazette FBiH" 29/05

3. Legal persons with voting rights in the Enterprise;

4. Legal persons in which a Enterprise has at least 10% (or less) of total voting rights;

5. Legal persons in which a connected person or a member of the immediate family thereof, as defined in 1., belongs to the Supervisory Board or the Management.

If any connected person knows or should have known that another connected person has broken the stipulations of this paragraph, the first connected person is obliged to report this to the Management and the Supervisory Board or other supervisory body.

Principle 2
Corporative Possibilities

In performing their duties, connected persons ought to further the legitimate interests of the Enterprise when the opportunity arises.

The connected persons themselves ought not to take advantage for their own needs of the opportunities discovered while performing duties related to the Enterprise, or use the Enterprise's property, information, or their position with the Enterprise for personal gain.

Competition between the connected person and the Enterprise in each of the above-mentioned cases, resulting in financial damage to the Enterprise or Enterprises, is not allowed.

The Management, the Audit Board and the Supervisory Board will determine whether any of the above mentioned actions cause financial damage to the Enterprise, based on all relevant facts and circumstances, including in the cases when the Enterprise's opportunities are used for personal ends, regardless of whether the Enterprise had previously declined to take advantage of those opportunities.

Principle 3
Professional Abilities and Conscientious Conduct

Persons connected to the Enterprise are obliged to perform their functions and duties with due attention, professionally and conscientiously.

Principle 4
Protection and Correct Use of Enterprise Property

In performing their duties, the Supervisory Board and the Management are obliged to encourage responsible use and control of the Enterprise's property and resources. Enterprise property, including data, materials, stocks, intellectual property, buildings and facilities, software and other property owned, leased or possessed by the Enterprise, ought to be used exclusively for justified business ends of the Enterprise.

Principle 5
Confidentiality

Connected persons shall respect the confidentiality of the information they gain access to in the course of performing their duties, except in the cases where the publication thereof is permitted by the Enterprise or required by law. Confidential information includes, among others, all the non-public information which might be useful to the competition.

Principle 6
Compliance with Laws, Rules and Regulations

In the course of performing their duties, the Supervisory Board and the Management are required to actively participate in verifying compliance with existing laws, bylaws and other regulations within the Enterprise. In addition, if any connected person learns any information which they consider to be evidence of material breach of the law, that person is obliged to bring that information to the attention of one or more of the following persons: president of the Supervisory Board, main legal counsel of the Enterprise, the General Shareholder Meeting, police and other state organs.

Principle 7
Encouraging the Reporting of Illegal or Unethical Behavior

The Supervisory Board and the Management are obliged to influence the Enterprise to actively promote ethical behavior and encourage the employees to report evidence of illegal or unethical behavior of individual employees.

Principle 8
Loans to Management and Supervisory Board Members

Public Enterprises are not allowed to give or organize giving of individual loans to members of the Supervisory Board, the Management, the Audit Board or the employees directly, indirectly or through subsidiaries, or to extend or materially change existing loans to those persons. The Management and the Supervisory Board should not solicit or help obtain individual loans from the Enterprise contrary to the above.

Principle 9
Understanding and Following this Code

Connected persons are expected to act according to the stipulations of this code. Each person is responsible for studying and acquainting oneself with this code, to seek further clarification and advice from the Enterprise's chief legal counsel in connection with the interpretation and the requirements of this code, and in connection with any situation which appears to violate this code.

Principle 10
Deviation and Disciplinary Action

No deviation from this code or amendments of it is permitted. Every violation of the stipulations of this code will result in the immediate activation of disciplinary procedures and the adoption of disciplinary measures, including dismissal.

This code enters into force on the day of its adoption by the Enterprise's __________________JSC or Ltd General Meeting.

Josef LAZAR*

TECHNOLOGY AND KNOWLEDGE TRANSFER IN POST-TRANSFORMATION ECONOMIES

Abstract: Within this contribution the questions of how the knowledge and technology transfer within a non-university research institution in a post-communist country could be managed. The presented experience comes from the Czech Republic that went through the transformation to market economy, loss of the former markets, reorientation to new ones and is now trying to catch up with the Western Europe. The present structure of Czech industry reflects this transformation and has specific expectations and demands towards the academia. This raises questions about what is the role of publicly funded research, what the scientists should do and what might be a violation of the principles of fair competition. The push from governments on academia to produce applicable results or even to generate financial return through contract research makes this problem very urgent.

Institutionalized knowledge and technology transfer is quite new initiative in our environment. Experience shows that a certain level of maturity of both academia and industry is inevitable to make the system working. A question of what should be included in the knowledge and technology transfer will be addressed in this contribution through the concept of a broadly defined societal relevance and responsible research and innovation. The establishment of the knowledge and technology transfer office of the Czech Academy of Sciences will be presented. Its concept is a network-based system with a combination of centralized and distributed activities, a central office and a host of contact-persons and local TTOs at the level of discrete research institutes.

INTRODUCTION

Knowledge and technology transfer is an activity that we interpret as an integral part of scientific research. The Czech Academy of Sciences is looking for a concept or strategy within this field able to answer the key questions about the purposes, mission, target groups and specific approaches for various sectors of research.

The experience and background is based on the recent history of the Czech Republic that went through the transformation to market economy, loss of the former markets, reorientation to new ones and the effort to catch up with the Western

* Czech Academy of Sciences

Europe. The present structure of Czech industry reflects this transformation and has specific expectations and demands towards the academia. This raises questions about what is the role of publicly funded research, what the scientists should do and what might be a violation of the principles of fair competition. The push from governments on academia to produce applicable results or even to generate financial return through contract research makes this problem very urgent.

CZECH ACADEMY OF SCIENCES

The Czech Academy of Sciences is a non-university research institution doing in-depth and focussed research in fields of science covering natural sciences, life sciences, social sciences and humanities. Its basic principle is a focus on quality and efficiency. Top quality is the key criterion for providing financial support of research with periodic international evaluation of all of research activities and concentration of human and material resources into specific research programmes. Together with quality the Academy is pursuing social relevance and openness through support of economic competitiveness and innovation performance of the Czech Republic and involvement of partners from education and application spheres in research programmes together with intensive cooperation at the European and international level.

MISSION OF THE KNOWLEDGE AND TECHNOLOGY TRANSFER

The motivation for knowledge and technology transfer (TT) may be quite diverse. It may easily be only politically motivated, because it is fashionable to do it and it is what the politicians want to have. This may easily lead to disfunctioning institutions only pretending this activity. Another approach (quite often) is simply only to earn more money for research. More complex attitude includes serving society in the broadest sense, because when science is funded by taxpayer's money, TT is a form of return of the investment to the society. There may be a number of non-financial benefits (environment protection, expertise for authorities & government, etc.) that can be well included into TT. Contribution to well-being of society and contribution to competitiveness can easily be a part of this wider concept as well. Next to it the ability of finding applications for research results is also quite motivating for scientists themselves. So we try to define TT as simply an inevitable part of science management

Institutionalized knowledge and technology transfer is quite a new initiative in our environment. Experience shows that a certain level of maturity of both academia and industry is inevitable to make the system working. An important question is what kind of activities should be included into the knowledge and technology transfer. Within the concept of a broadly defined societal relevance and responsible research and innovation it may not be only the traditional approach of licensing patents that are a by-product of (fundamental) research. Broadly shared experience shows that this works more or less only in bio-pharma sector. If arranging of collaborative or contract research should fit into the scheme, a question whether publicly financed research institutions should do research (applied) on demand is raised. This may be interpreted as commercial activity just like any other and doing it with partial or full support of public money can be seen as a distortion of market. To which extend or whether at all should public research institutions become demand oriented and state funded design bureau is not easy to answer. This is something what we are in the Czech Republic at the moment only trying to resolve.

APPLIED RESEARCH AND INVOLVEMENT OF INDUSTRY

Differentiation between applied and fundamental research seems to be more and more and obsolete concept. Sometimes pure fundamental blue-sky research quickly transforms into breakthrough application and on the other hand applied research with a clearly defined target results into non-mature technology with pretty long way to go before it turns into commercial product. Unfortunately this differentiation often serves political struggles for research funding. The position of academia vs. industry differs and industrialists often consider industrial development to be applied research.

According to the EU stand, public funding of applied research/development/innovations is acceptable only in case that there is a significant development risk involved, which contrasts with the considerable potential benefits should the initiative succeed; that the ensuing costs are very high and can only be met by pooling multiple public sources; that the period of time until practical benefits emerge is too long; that it involves cross-cutting or key technologies (e. g. new materials); and that the result cannot readily be marketed, but there is a general social or environmental need. This can be considered a well-defined limitation to avoid the market distortion.

REALITY OF THE POST-TRANSFORMATION ECONOMY

The position of industry in the Czech Republic is very strong; this country is the most industrialized country in the EU with the largest contribution of industry output to the GDP. The structure is dominated by mechanical engineering and electrotechnology production mostly on demand for Western Europe and the US. This can be considered the legacy of the difficult period of the transition to the market economy and a result of the transformation process. There is too little number of innovative companies and the majority does only routine production. Foreign experience from technology transfer centers in Western Europe shows that the traditional concept of TT based on licensing patents works only in biotech and towards pharmaceutical industry. This might mean, that to perform TT in this country is doomed to be mission impossible. To make technology transfer work and to define which form it should have in the Czech Republic, i. e. towards let us say mechanical engineering is something we have to find out ourselves.

The goal of the post-transformation economies — at least speaking for the Visegrad Four — is clearly the change in the structure of industry from supplier of components for the richer world towards production of outputs with higher added value, i. e. this means to climb the value ladder. New ideas and disruptive technologies are welcome including creative destruction. This is something that can hardly happen within any apriori defined priorities. More, it is in conflict with the too inclusive and cautious concept of RRI (Responsible Research and Innovations) pushed through by the EU.

A Concept derived from the law of comparative advantages representing „Smart" Specialization on the other hand tends to preserve the status quo. It reflects the idea to find the comparative advantage and concentrate on it defining it as a preferred sector. But sectors differ in added value and we want to climb the value ladder. Setting priorities is a popular idea among politicians and industry managers but there is a danger that the result will be setting of the priorities set by interest groups and preserving of the status quo leading into stagnation. We consider the freedom of scientific research as something that must not be infringed. As Pavel Bělobrádek, the vice prime minster for science of the Czech Republic stated: „Let there be more science in politics and less politics in science".

STRATEGY OF THE CZECH ACADEMY OF SCIENCES

The Czech Academy of Sciences launched its new Strategy AV 21 with a motto „Top Research in the Public Interest". It should contribute to increasing of the social relevance of scientific knowledge, and reflect the globalization and acceleration of the worldwide exchange of knowledge and the financial demanding nature of modern science. Towards the Academy it aspires to exploit the potential of the CAS for resolving the current scientific and societal challenges and its ability to react to the dynamics of development. It should strengthen the role of the CAS in science and society and promote synergy of interdisciplinary and inter-institutional collaboration. Transfer of results into the educational, application, and the public spheres is and inevitable part of it.

The establishment of the knowledge and technology transfer office of the Czech Academy of Sciences is seen as a horizontal activity within the Strategy AV 21 serving all its programmes. Its concept is a network-based system with a combination of centralized and distributed activities, a central office and a host of contact-persons and local TTOs at the level of discrete research institutes. We have drawn inspiration from models in Western Europe and from the experience of TTOs in our country. We consider the institutional model the most promising while the regional model is of limited functionality not only in the Czech Republic. Here the regional TT centers mostly converted themselves into start-up incubators.

SUCCESS STORY OF TECHNOLOGY TRANSFER

The Institute of Scientific Instruments of the Czech Academy of Sciences in Brno has been doing methodology oriented research in physics and engineering for more than 60 years. One of its long-term programmes is electron optics and microscopy. The first electron microscope in former Czechoslovakia was built here in the group of Prof. Armin Delong. This later resulted in start-ups and a long-term research relationship with them.

Now there are very successful companies well established on the market in Brno that together hold 40 % of the market of all electron microscopes worldwide that are produced in Czech Republic. Tescan is today one of the global suppliers of scanning electron microscopes and solutions for materials science, industry, biology and life sciences, forensic science and others and FEI Electron — optics designs, manufactures, and supports the broadest range of high-performance microscopy workflows that provide images and answers in the micro-, nano-, and picometer scales.

Mathieu DENIS*

SCIENCE AND TECHNOLOGY, AND THE WORK OF THE INTERNATIONAL SOCIAL SCIENCE COUNCIL

Abstract: In this presentation, I intend to do two things. The first is to develop a historical argument about the lack of engagement of the International Social Science Council with questions of technology and innovation in the recent years. I will show that this was not always the case and that during its first decades, the ISSC has commissioned some interesting research on the links between science and technology. Academies from all around the world have been active in this work. it would be important to renew with this tradition, as the current lack of reflections on the links between science and technology is probably limiting the outcomes of some of our advocacy action. As primary body representing the social sciences internationally the ISSC operates today on several global platforms calling upon „Science, Technology and Innovation" to provide solutions to priority challenges, like sustainable development. On those STI platforms, the ISSC is often promoting a „voice for science", without however considering seriously enough the nature of these separate worlds that are science, technology and innovation, nor the level and nature of their interactions. I would like to expose this insufficient engagement and why I believe it impacts our action. The second thing that I would like to do is to outline a short history of the presence and involvement of social science academies in the ISSC (beyond the question of the links between science and technology), and show the steady decline of their active participation in the decade. The result of this disengagement is a lack of representation and voice of the social science research of certain regions at the global level. Perhaps „science and technology" offers a ground of common interest that can help rejuvenating those links.

* Executive Director, International Social Science Council, Paris

Ljubiša RAKIĆ*

TECHNOLOGY — SOCIETY RELATION, CHALLENGE FOR FUTURE EXISTENCE

Abstract: The subject technology-society and the future have a complex and universal significance for the destiny of mankind. This requires changes in the methodology of our approach to science and its implications to society. Technological advances followed by enormous scientific contribution are a prerequisite for the future existence of mankind. Unidirectional technological development which is forced to support advanced research and innovation for the economy, followed by material progress resulted with less attention to general consequences of environmental changes and human adaptation. This includes many elements of the conference, as well as social standards and education for the future adjustment for a new society. Scientific literacy demands the ability to evaluate and address questions to scientists fully and critically interpret data and evidence narrowly supporting conclusions. Changes in scientific methodology should have more prognostic than the reductionistic approach. Could we create a person of the new society? The term „renascence man" has been used to connote a person with many talents with the accent of his profound knowledge in the broad areas of life. He is not alone. His work is welcome and initiates positive trends in society and science. Such a turn is possible only if the scientific community and entire society are capable of recognizing and supporting these individuals.

Key words: *Future, Man and Environment, Unidirectional Development, Mental Pollution, Radiation, Nuclear Weapons, Depleted Uranium*

The subject technology-society and the future have a complex and universal significance for the destiny of mankind. This requires changes in the methodology of our approach to science and its implications to society. Technological advances followed by enormous scientific contribution are the prerequisite for the future existence of mankind. Unidirectional technological development which is forced to support advanced research and innovation to general consequences of environmental changes and human adaptation.

This includes many elements of the conference, as well as social standards and education for the future adjustment for a new society. Scientific literacy demands

* Serbian Academy of Sciences and Arts, Belgrade, Serbia

an ability to evaluate and address questions to scientists fully and critically interpret data and evidence narrowly supporting conclusions.

Without getting into details, I wish to emphasize some general positions between *unidirectional technological development and side position of the human being* his lonely position in the society, in the relation to the environment.

The Relationship between Man and His Environment is comprised of three basic issues [1]. The first relates to *ontological questions* of being and existence. Traditional ontology studied existence in isolation, contemplated the world as it is apart from man and human consciousness. Marxist philosophy must be considered in relation to human practice in the broadest sense, including not only physical activity performed by humans but sensory perception, symbolic mathematical operation, logical conclusions and intuitive reasoning as well. Therefore, according to the Marxist philosophy we, in fact, study the human world as limited by human capacities, transformed by human action, comprehended in the light of human needs, using technical instrumentation and conceptual and linguistic apparatus humanly developed.

The second group of basic philosophic issues consists of *Gnostic problems*: how we acquire knowledge and how we ascertain whether cognition coincides with reality. There have been many attempts to idealize and absolute the process of cognition and in this way to dehumanize it. Knowledge has often been viewed separately from human consciousness: as absolute truth independent of man, and universal logic as a structure similar to reality. The humanistic theory of knowledge makes these questions irrelevant. Philosophers can discuss only human knowledge, the logic of human thought. The structure of reality is inevitably simplified, and truth is accordingly seen in a historical context, subject to subsequent reconsideration. Whenever philosophical aspirations are higher, they attribute absolute meaning to the limited and relative knowledge of man and only succeed in guardians against future improvement.

The third group of basic philosophical issues is composed of *axiological problems*: which alternatives we should choose to strive for. Ever since its origin, axiology has been primarily treated as a theory of absolute and transcendental values which can be taken ideally, regardless of actual human behavior. Marxists have, in general, avoided dealing with the problems of value. This is obviously a major omission for a philosophy which is directed to the future and is calling for an active change of the world in a defined direction. Marxism clearly puts forth a set of values aimed at satisfying human needs. Subsequently, in claiming that man is „a natural being" (divine and demoniac) necessarily become opposed. The existence of God is implicitly negated by Marxists. A creator who made him after his own image, that man is completely different from natural beings and is endowed with a unique capacity („spirituality") which allows him to be the master of the Earth and everything living on it.

There is also a more complex implication in the idea that man is „a natural being", that is, that he is in constant interaction with his environment in the general course of working and living. He is influenced by the world around him and also influences this world as a material force among other such forces. However, these formulations still do not express the full implication of the idea of Man as a natural being. The basic question still remains no elucidated: What is nature? Thus far, we have only defined nature indirectly, stating that it is everything except society and culture.

The distinction between natural and non-natural (social, cultural) is convenient since it justifies the use of the term „unnatural" (artificial) relating to man-made objects (industrial, artistic, etc.). These are unnatural in the sense that man has made them serve his own purpose. From the vantage point of the human time scale, nature is relatively constant and generally more slowly changing in comparison to social dynamics which are often seemingly arbitrary or stochastic and characterized by rapid flux.

A major problem in relation to „man and his environment" is to find the optimal interaction which will ensure the harmony of man's somatic, psychological and social being [2]. Many „revolutionary" philosophies of the 19th and 20th centuries which exhorted people to destroy established values for the sake of future „progress" not only failed in achieving their aims but actually took civilization a step backward. This had long-term negative consequences of suppressing the creative, psychological potential of the broad population for several generations. The discrepancy between word and deed, aims and reality, truth and hypocrisy were the unfortunate accompaniments of many „revolutionary" movements. The disillusionment and the failure of these ideas brought can be considered as a new form of pollution — let us say a „mental" one — whose consequences for civilization are as important, if not in some cases greater, than those of a physical-chemical nature [2].

This *ideological pollution* induces the most conflicting moral crisis in individuals and the human community in general. Even if an equal level of self-deprivation could be attained for all members of the human community (which has seldom been the case), the question of purpose still remains. What would e the human purpose of sacrificing entire generations, (even in cases when the initial political and economic conditions are provided for a somewhat higher level of satisfying individual needs)? Naturally, a clement of conscious and voluntary self-sacrifice is present in each true „revolutionary" activity: this activity is always conducted on a collective level with collective aims. In order to participate and in that way experience human fulfillment, the individual exposes himself to risk and deprives himself of some of his personal aspirations. In this way, he overcomes his alienation and attaches himself to a social ideal which provides him with a profound purpose to his existence. However, in post-technological society, a total sacrifice of an entire generation for the ideal of a better life for future generations is not morally justified even if the ultimate outcome is completely favorable.

In the case of radioactivity, it is possible to see all the benefits that the swarming technology development offers. On the other hand, *the technology of nuclear weapons yields self-destructiveness as a result*. Radiation has, almost since its discovery, about 120 years ago, been used not only to provide energy, or for medical purposes. Nowadays, radiation is the most powerful weapon, the ideal, invisible killer, which, in case of the military use of depleted uranium, has already irreversibly changed all natural resources, contributed to mass migration of population, destruction of social relations, and *in vivo* experimentation with the health of human population and the overall living world.

Instead of blitzkrieg as it has been the case in Hiroshima and Nagasaki in 1945, we are faced today with the consequences of repeatedly/low/slow radiation doses due to the use of depleted uranium.

Our recent study [3–5] showed that we are faced with confusing, and unpredictable phenomena in the environment: weather and climate extremes, earthquakes and volcanic eruptions… At the same time, a significant increase in the incidence of inflammatory, degenerative and malignant diseases showed the remarkable increasing trend in soldiers, as well as in civilian population in last decades all around the world.

It is almost inconceivable that in the era of unimagined technology development, databases, immeasurable knowledge, and experience, the world silently follows nearly three decades using of nuclear weapons (including the depleted uranium) in local conflicts in different parts of the world. This tendency is increasing. We should bear in mind that the conclusions on the health effects of the military uses of depleted uranium were made over the years, based on the contradictory data and statements. Nevertheless, an increasing trend in the incidence of malignant and non-malignant diseases in Serbia, Europe and globally, provides a new insight and is crucial for creating a critical attitude and ignoring the half-truths launched by quasi-experts.

After the Hiroshima and Nagasaki experience, the best scientific evidence of radiation effects on humans came unfortunately from epidemiologic studies of atomic bomb survivors (Pollycove, 1998). The primary objective of our recent publications [4, 5] is to contribute to a better understanding of the interaction of depleted uranium as a source of low dose radiation with the living world and a man in the contaminated environment. The man is the main subject of our study. Understanding of basic principles of cell biology and radiation interaction with living matter was supported by authentic medical data obtained from patients originated from the territories which were geographically close to each other (Serbia and Montenegro seaside and Bosnia and Herzegovina, the territories of the former Yugoslavia) [3, 6].

There has been increased interest in biological effects of low dose radiation after Chernobyl [7]. The uncertainty of epidemiological studies about the health effects of low-dose radiation arises from the fact that the biological effects of low-dose radiation do not relate obligatory to DNA damage. Military use of depleted uranium (DU) for decades put the problem of low-dose radiation exposure in the spotlight. The explanation related to the limited effects of α-emitting nuclear weapons, including DU, was based to some extent on the fact that alpha particles have a short track in air [8]. This paradigm has changed with the realization that nano- and micro-sized particles of DU could have a global atmospheric movement [4]. The idea about spreading of uranium particles through air masses across the globe arose from the results of measurement of air pollution [9]. Due to the uncontrolled military use of high amounts (a thousand tons) of depleted uranium, numerous unusual environmental physical manifestations were recorded in the last two or three decades [4].

Natural and depleted uranium differ in their isotopic composition, but both are α, β and γ emitters, with a dominant alpha radiation emitted during their radioactive decay. DU exerts *mixed, radioactive (α, β, γ emitter's) and chemotoxic heavy metal properties* [10]. Our knowledge concerning uranium or DU toxicity has evolved since 1999 when DU was considered as a Group III agent (not classifiable as carcinogenic to humans) by the International Agency for Research on Cancer (IARC). According to [11], DU has been categorized as a Group I agent — alpha emitter (i. e., as carcinogenic to humans).

Our knowledge has been evolved from in vitro studies of radiation exposure to more comprehensive understanding of Lithosphere-Atmosphere-Ionosphere and Biosphere coupling.

Busby and Morgan (2006) [9] tried to answer the question whether the use of uranium weapons in the Second Gulf War resulted in contamination in Europe. The authors found an excess of uranium in the air along the trajectories across Europe, of some 500 nBq/m^3, assuming that uranium particles originated from the Persian Gulf battlefields. It was found about 48,000 particles of 0.25 μm diameter in one cubic meter. By the authors' approximate estimation, each person would have inhaled about 23 million particles of uranium in six weeks. One-half of the total mass of the uranium oxide consists of particles smaller than the wavelength of visible light. The behavior of DU particles may be taken approximately to that of a gas, whose dispersion may be expected to be similar to the dispersion of radioactive gasses from nuclear accidents like the Chernobyl accident.

In the 78 days of NATO bombing in March-June 1999 during Operation Allied Force, the best estimates are that 30 tonnes of DU were dropped throughout Serbia (including Kosovo).

The idea about spreading of uranium particles through air masses across the globe arose from the results of measurement of air pollution by Busby and Morgan, (2006) [9]. The authors revealed a statistically significant increase in uranium in all the filters observed in the UK, beginning at the start of the Second Gulf War and ending when it ended. One-half of the total mass of the uranium oxide consists of particles smaller than the wavelength of visible light. The behavior of DU particles may be taken approximately to that of a gas, whose dispersion may be expected to be similar to the dispersion of radioactive gasses from nuclear accidents like the Chernobyl accident.

Close to the battlefields where the blasts of projectiles with DU lead to direct contamination of the external environment and people, causing exposure to higher doses of radiation, deliberated micro or nano particles of DU, in the form of air pollution, are easily transferable to the remote distances from the place of explosion [9].

It was possible to estimate an approximate 2,400-mile radius around the Persian Gulf, as well as around Bosnia and Herzegovina and Serbia, with the putative expansion of air pollution containing DU particles, but without taking into account any geographic or meteorological peculiarities of the potentially exposed area. Having in mind that the distance of Baghdad from Belgrade is only 1500 miles, since 1991, the territory of the Republic of Serbia has been repeatedly exposed to radioactive DU particles. The spreading of radioactive dust originating from DU from battlefields, across remote regions around the globe has been assisted by natural phenomena, including sandstorms [4, 5, 12].

Depleted uranium has been *repeatedly* used by the military, approximately every four years since 1991 (Iraq 1991, Bosnia 1994–1995, Kosovo, Serbia, and Montenegro 1999, Afghanistan 2001–2003, Iraq 2003–2011 and in numerous conflicts in North Africa or West Asia, which are just the regions where dust storms usually occur. DU has induced the *low dose* radiation (air pollution easily transferable to the remote distances from the place of explosion), *slow doses* (the DU ammunition remnants can be fully oxidized into corrosion products twenty-five to thirty-five years after impact) and its further prolonged contribution to the maintenance of alpha particles radiation [4, 5, 12].

These data support our hypothesis that after the local military conflicts during which DU ammunition was used, an unpredictably wide territory has been contaminated by aerosols, and later water and ground natural resources. From the air, the particles fall very slowly and contaminate the ground and grass, vegetables, fruit, entering the alimentary chain. From the rain, those particles could penetrate the earth and enter springs and subterranean waters [13].

More precisely, the entire territory of Europe was exposed to DU contamination at the time of military operations during which radioactive ammunition was used! The hypothesis of limited contamination after the use of nuclear weapons has been undermined by loads of evidence that we mentioned in our recent publications [4, 12].

DU induces prolonged, low/slow dose radiation in wide population, at the global level. DU exhibits a heavy-metal & radiation synergic impact on the biosystem

As in the case of other metal-oxide nanoparticles, with a higher temperature of the explosion, the DU deliberated particle size is lower. The dimensions of DU particles are inversely proportional to their penetrability. There is an evidence of exposure to the dispersion of a new type of uranium, the ceramic submicron oxide particles, especially in European countries closer to Iraq, than those in remote parts of Europe [9]. Because the ceramic DU dust particles are not soluble, they remain in the body much longer than other soluble forms of uranium. The „Trojan Horse effect", described by [14] and „lysosome-enhanced Trojan horse effect" demonstrate the importance of the fine insoluble particles that, due to high penetrability, can cause harmful effects in the cell, facilitating entering of other toxic components, or interacting with cellular structures [15, 16].

Exposure to depleted uranium can occur by inhalation of DU dust, ingestion of DU directly, or in contaminated food, soil, and water, embedding of DU fragments in the body, contamination of open wounds with DU dust, and absorption through contact with the skin [8].

The lag time in the understanding of biological effects, their extensiveness and health effects is a consequence of demanding procedure for exact detection of DU in the tissue. Later on, Italian authors concluded that the presence of DU particle in the tissue was not obligatory to determine whether a person was exposed [5].

Even though uranium is a powerful genotoxic stressor, the health effects caused by DU radiation may not appear for years. DU is primarily an alpha emitter and inducer of a mixed radio-chemical exposure [8]. Exposure to depleted uranium can occur by inhalation of DU dust, ingestion of DU directly, or in contaminated food, soil, and water, embedding of DU fragments in the body, contamination of open wounds with DU dust, and absorption through contact with the skin. Due to long pulmonary retention of 1,470 days, as expected in the case of inhalation of uranium oxides, a wide range of clinical manifestations can occur, depending on the individual predispositions of the exposed persons. The overwhelming radioadaptive/radioprotective tissue capacity may later cause autoinflammatory/autoimmune disorders accompanied by numerous symptoms and degenerative and inflammatory diseases [17]. All tissues with oxidative metabolism were targeted, particularly kidney and bone. Cancer is one of the late consequences of low-dose radiation.

Up to 75% of DU absorbed into the blood may be excreted during the first week, followed by slow excretion for up to a year [13]. DU will be deposited in bones and organs, especially the kidneys. DU will remain in the kidneys for at least three months and in bones for at least twenty-five years [8].

The toxic properties of DU primarily affect the kidneys [18].

Due to a global spreading of contaminated air masses, the inhalation of DU particles is the most common path of internal contamination. Repeated exposures to low/slow dose radiation may induce the lupus erythematosus cell-phenomenon in the bronchoalveolar lavage specimens, what we understood as one of early health effects of depleted uranium.

Small and insoluble metal oxide particles penetrate the alveoli into the circulation from which they are rapidly distributed into the entire organism. Tissue penetration from alveoli to the blood vessels is highly particle-size dependent. Particles the size of 100 nm, when inhaled, enter the blood flow within 60 seconds and can be found in internal organs in a matter of minutes [19].

The metal oxides can cross the blood-brain barrier. Experimental exposure to DU led to impaired coordination and movement performance in rats with multisystem damage including the brain [20]. DU also crosses the placenta and is stored in the fetus [21].

Repeated exposure to low doses of alpha radiation originating from the decay of internally deposed DU particles was understood as a main contributing factor to the onset of Gulf/Balkan syndrome. Gulf/Balkan War Syndrome may not be exclusively a disease of soldiers who participated in these wars. Taking into account prolonged exposures to alpha radiation (from the blast and later due to corrosion of armaments), Gulf/Balkan syndrome can be understood as a multicausal disease with multisystem involvement and time-dependent expression of symptoms from no cancerous diseases, to cancers in later phases affecting soldiers, as well as overall civilian population [4, 5, 12].

The carcinogenic effect of tobacco smoke may act synergically with tobacco-containing radionuclides, which are mostly alpha-emitters which induce cumulative doses at bifurcations.

Cancer incidence and mortality in Serbia has been generally increasing over the 10-year period since the bombing of Serbia and Montenegro. The increasing trend of the overall cancer incidence in Serbia started immediately after the bombing of Serbia and nearby territory with DU projectiles. This might be a consequence of prolonged (since 1990) exposure to long-lived isotopes, which were released into the air in the Persian Gulf and Bosnia and Herzegovina (1994/5). Another possibility is that stress in the population, which was exhausted by the EU sanctions, bombing, social conflicts, supported the expression of some kind of maladaptation (according to Sousa, 2016, [22]), which contributed to alarmingly higher cancer incidence and mortality in Serbia than in the majority of European regions [23].

Since then, we have defined a new model which could be of importance for cancer, as well as for preneoplastic conditions [4, 5, 24]. Its role might be anticipated in the complex signaling-regulatory network, lying in damaged tissue micro-architecture in malignant and nonmalignant lung diseases. We found a dose-response relationship in smoking and low-dose-radiation exposure based on a neural network method. The method represents a step forward in achieving individualized screening and risk estimation. In terms of radiobiology, it contributes to a better orientation and distinction of protective and damaging mechanisms during carcinogenesis evoked by long-term inhalation of contaminated air.

The impact of open innovation efforts on individual scientists can vary depending on what role they play in the change of paradigm. We presented a new vista on DU and the Schumann Resonance Hypothesis based on lithosphere-atmosphere-ionosphere and biosphere coupling [5].

Light emission induced by alpha particles in the air was first observed by Sir William and Lady Huggins in the early years of the 20th century.

Given the Earth's overall diameter and the surface, the local areas of military campaigns where bombs containing depleted uranium have been used can be comprehended as the stippled sources of imprinting uranium dust into air, after which α and β particles and gamma radiation are emitted during uranium radioactive decay.

The Earth can be regarded as a nearly conducting sphere, around which the thin, dielectric atmosphere extends up to the ionosphere. The atmospheric electric discharges generate broadband electromagnetic waves that propagate between the surface and the ionosphere. Bearing in mind the proposed geometrical and atmospheric attenuation factors and adding thunderstorms roll over Earth, producing some 50 flashes of lightning every second, we have understood that each lightning burst creates electromagnetic waves that begin to circle around Earth. Some of the waves may combine to form the Schumann resonance. The Schumann Resonance is a standing wave (around 8 Hz) in the atmosphere [25].

A phenomenon, known as the Schumann resonance, was detected by satellite in space, well beyond the upper boundary of the resonant cavity which is formed by the Earth's surface and the lower edge of the ionosphere [26]. Random lightning strokes with spatial probability distribution peaking over the continents, particularly in the low latitude regions, induce development of standing waves whose wavelength is related to the radius of the cavity.

Many of these effects may be induced by a man-made ionospheric disturbance [27]. Numerous military actions, in which DU ammunition was used, occurred in low to middle latitude regions. The contamination of the environment, caused by man in the event of a nuclear war, assumes a release of the considerable amounts of different forms of uranium. Up to 70% of the DU penetrators are converted to aerosols. The repeated discharge of large amounts of the uranium oxide fumes from the battlefields in the Persian Gulf, the Balkans, Afghanistan, and other places, contributes to sudden artificial imprints of charged particles, resulting in the induced light pulses in the atmosphere. After colliding with high energy protons and nuclear fragments from cosmic rays, a „runaway process" can start inducing lightning initiation [5].

Nuclear wars may be considered as very rare events, but electromagnetic changes induced by the imprinting of charged particles in the Earth's mantle have the power to result in considerable physical phenomena (light, gradient magnetic field etc). It is possible that extremely low-frequency electromagnetic fields can be induced by artificial imprints of the unpredictable amounts of charged particles into the atmosphere during (and after) nuclear conflicts, and that these magnetic fields could interfere with living matter. The contamination caused by nuclear wars induces an unpredictable expression in the atmosphere.

This approach opens an opportunity to observe one of the key phenomena, the Petkau effect, in relation to the field of low-dose radiation, in a more comprehensive way.

In 1972, a researcher in Canada, Dr. Abram Petkau [28], found that when cells were irradiated slowly, a smaller total dose was needed to cause damage. This discovery is known as the „Petkau Effect". Dr. Abram Petkau discovered that at 26 rads per minute (fast dose rate), a total dose of 3,500 rads is required to destroy a cell membrane. However, at 0.001 rad per minute (slow dose rate), only 0.7 rads is necessary to destroy the cell membrane.

Although the Petkau effect was described in the literature as an in vitro phenomenon [29], the repeated bombing of relatively close areas in the Persian Gulf and the Balkans, with subsequent emission of ionizing radiation and a prolonged release of alpha particles, emitted during radioactive decay of DU, which originates from corroded DU armaments, provides an opportunity for the estimation of the in vivo Petkau phenomenon and its effects.

We have already discussed the hypothesis on the lithosphere-atmosphere-ionosphere and biosphere coupling and the hypothesis on the wave nature of the Petkau effect.

The low-dose radiation, originating from the charged particles or photonic radiation can interfere with the biofrequencies of cell structures, primarily the cell membrane or the endomembrane system, which results in higher cytotoxicity [5].

CONCLUSION

Having in mind all these facts, we conclude that radiation has, almost since its discovery, about 120 years ago, been used not only to provide energy, or for medical purposes. Nowadays, radiation is the most powerful weapon, the ideal, invisible killer, which, in case of the military use of depleted uranium, as we discussed in this paper, has already irreversibly changed all natural resources, contributed to mass migration of population, destruction of social relations, and *in vivo* experimentation with the health of human population and the overall living world [5].

People often refuse to accept the facts which they can't understand or they are afraid of. All this is part of the story on depleted uranium which was used in recent nuclear wars. As a consequence, the immeasurable suffering of global proportions ensued.

There are three possibilities: 1) not to accept the existence of the risk of military use of depleted uranium; 2) to accept the facts in line with the saying ²*Ave, Cesare, morituri te salutant*²; 3) to embark on a comprehensive assessment of the consequences and develop a strategy for overcoming these consequences.

As for me, I am in favor of the last one. I hope that the rich collection of specimens at my disposal is going to be a foundation for some future research that can contribute to better understanding and treatment of health effects of the military use of depleted uranium.

It is necessary to raise awareness on safe handling of ionizing radiation sources to highest possible level. This entails the development of succinctly described procedures, coordinated at the international and national level, on what measures to take in case of massive contamination that can take place not only during nuclear wars but also in the case of peacetime nuclear disasters. Above all, IT IS NECESSARY TO PUT A BAN ON THE USE OF NUCLEAR WEAPONS OF ANY KIND, WITHOUT DELAY!

Could we create a person of the new society? The term „renascence man" has been used to connote a person with many talents with the accent of his profound knowledge in the broad areas of life. He is not alone. His work is welcome and initiates positive trends in society and science. Such a turn is possible only if the scientific community and entire society are capable of recognizing and supporting these individuals.

REFERENCES

[1] L. Rakić: „Regulatory system and values". *Int J of the Unity of the Sciences*, Vol. 3. No 2. 1990. p. 165–185.

[2] L. Rakić: „Systems Regulating Behavior". Academy of Sciences and Arts of Kosovo. Prishtina, 1978.

[3] S. Žunić and L. Rakić: „Hormetic effects of depleted uranium to the biosphere and lithosphere-atmosphere-ionosphere coupling". *J Environ Occup Sci,* Vol. 2. No 2. 2013. p. 103–107. doi: 10.5455/jeos. 20130911102811.

[4] S. Žunić and L. Rakić: „Environmental and health effects of depleted uranium". Chapter 3. In: *Uranium: Sources, Exposure and Environmental Effects*. Nelson, JR. (ed.). Nova Science Publishers. New York, 2015; p. 53–86.
[5] S. Žunić and L. Rakić: „Depleted Uranium Induced Petkau Effect: Challenges for the Future". Nova Science Publishers. New York, 2016; *in press*.
[6] S. Žunić. 2013–1: „Lupus erythematosus cell phenomenon in pediatric bronchoalveolar lavages: possible manifestation of early radioadaptive response in radiation induced alveolitis". *J Biol Regul Homeost Agents,* Vol. 27. No. 2. 2013. p. 389–398.
[7] K. Baverstock: „Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis". *Mutat Res*, Vol. 454. No. 1–2. 2000. p. 89–109. doi: 10.1016/S 0027–5107 (00)00100–7.
[8] Military Toxics Project Information Sheet (first version): [„"Depleted" Uranium Munitions: Nuclear Waste as a Weapon"]. [2003 June] Available at: http://www.dmzhawaii.org/wp-content/uploads/2009/02/depleted-uranium-fact-sheet.pdf.
[9] C. Busby and S. Morgan: [„Did the Use of Uranium Weapons in Gulf War 2 Result in Contamination of Europe? Evidence from the Measurements of the Atomic Weapons Establishment"] [2006] Aldermaston, Aberystwyth, Green Audit. Available at: http://www.llrc.org/aldermastrept.pdf.
[10] M. Burger: „The risks of depleted uranium contamination in post conflict countries: Findings and lessons learned from UNEP field assessments". In: *Assessing and Restoring Natural Resources in Post Conflict Peace-building*. Jensen, D; Lonergan, S. (ed). Earthscan, London, 2012. Available at: http://environmentalpeacebuilding.org/sites/default/files/vol.5_ch.8_burger_colorcoverpage.pdf.
[11] F. K. Baverstock: [„The toxicity of Depleted uranium"]. Presentation to the Defence Committee of the Belgian House of Representatives: [2006 November 20]. Available at: http://www.kbaverstock.org/page6.html.
[12] S. Žunić: „Cytological characteristics of lung washings from children in depleted uranium stroked region". *J Biol Regul Homeost Agents.* Vol. 27. No. 4. 2013. p. 961–967.
[13] WHO, 2001: [„Health effects of depleted uranium"] A 54/19. World Health Organization. Fifty-fourth World Health Assembly. [2001 April 26]. Available at: www.who.int/environmental_information/radiation/depleted_uranium.htm.
[14] E. J. Park, J. Yi, Y. Kim, K. Choi and K. Park: „Silver nanoparticles induce cytotoxicity by a Trojan-horse type mechanism." *Toxicology in Vitro,* Vol. 24. No. 3. 2010. p. 872–878. doi: 10.1016/j. tiv. 2009. 12. 001.
[15] R. Ortega, C. Bresson, C. Darolles, C. Gautier, S. Roudeau, L. Perrin, M. Janin, M. Floriani, V. Aloin, A. Carmona and V. Malard: „Low-solubility particles and a Trojan-horse type mechanism of toxicity: the case of cobalt oxide on human lung cells". *Part Fibre Toxicol*, Vol. 11. No. 14. 2014. doi: 10.1186/1743–8977–11–14.
[16] S. Sabella, R. P. Carney, V. Brunetti, M. A. Malvindi, N. Al-Juffali, G. Vecchio, S. M. Janes, O. M. Bakr, R. Cingolani, F. Stellacci and P. P. Pompa: „A general mechanism for intracellular toxicity of metal-containing nanoparticles". *Nanoscale*, Vol. 6. No. 12. 2014. p. 7052–7061. doi: 10.1039/c 4 nr 01234 h.
[17] A. Duraković: „Medical Effects of Internal Contamination with Uranium". *CMJ,* Vol. 40. No. 1. 1999. p. 1–18. Available at: http://www.mindfully.org/Nucs/DU-Medical-Effects-Mar99.htm/. (2016 April 26).
[18] M. Gatti and S. Montanari: [„Impact on health by nanoparticles created by high temperature explosions"]. In: 8th ETH Conference on Combustion Generated Nanoparticles. [2004 August]. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.297.1017&rep=rep1&type=pdf.
[19] P. Gehr and J. Heyder: „*Particle-lung interactions*". (ed.). CRC Press, 2000.

[20] J. H. Seideman, B. Stančević, J. A. Rotoloa, M. R. McDevittc, R. W. Howelld, R. N. Kolesnicka and D. A. Scheinberga: „Alpha Particles Induce Apoptosis through the Sphingomyelin Pathway". *Radiat Res*, Vol. 176. No. 4. 2011. p. 434–436.
[21] A. Ulrich, A. Mayer, M. Kasper, A. Wichser and J. Czerwiński: „Emission of metal-oxide particles from IC-engines". *Silniki Spalinowe*, Vol. 50. 2011. p. 72–88.
[22] N. Sousa: „The dynamics of the stress neuromatrix". *Molecular Psychiatry*, Vol. 21. 2016. p. 302–312; doi: 10.1038/mp. 2015.196.
[23] J. Mihailović, P. Pechlivanoglou, M. Miladinov-Mikov, S. Živković and M. J. Postma: „Cancer incidence and mortality in Serbia 1999–2009". *BMC Cancer*, Vol. 13. No. 18. 2013. DOI: 10.1186/1471–2407–13–18.
[24] S. Žunić: „Hormesis-threshold model for individualized lung cancer risk assessment in smoking and low-dose radiation exposure". *Prague Medical Report*, Vol. 116 (Supplement). 2015. p. 43–44.
[25] I. Miller: „Schumann Resonance, Psychophysical Regulation & Psi (Part I) „. *Journal of Consciousness Exp loration & Research*, Vol. 4. No. 6. 2013. p. 599–612.
[26] F. Simões, R. Pfaff, and H. Freudenreich: „Satellite observations of Schumann resonances in the Earth's ionosphere". *Geophysical Research Letters*, Vol. 38. No. 22. 2011. p. L 22101. doi: 10.1029/2011 GL 049668.
[27] Hainsworth, LB. The Effect of Geophysical Phenomena on Human Health. *Speculations in Science and Technology*, 1983; 6(5): 439–44.
[28] A. Petkau: „Effect of 22 Na + on a phospholipid membrane". *Health Physics,* Vol. 22. No. 3. 1972. p. 239. doi: 10.1097/00004032–197203000–00004.
[29] E. B. Burlakova, A. N. Goloshchapov, G. P. Zhizhina, A. A. Konradov: „New aspects of the effects of low intensity radiation". *Radiats Biol Radioecol*, Vol. 39. No. 1. 1999. p: 26–34.

Winston P. NAGAN[*]
Megan E. WEEREN

TECHNOLOGY, SCIENTIFIC CONSCIOUSNESS AND VALUES

The Challenge of Scientific Responsibility for the Future of Science

INTRODUCTION

Today we live in a world that is in the midst of an accelerating technological revolution. The consequence of dramatic technological innovation and change quite literally imposes dramatic changes on the way social process works. The physicist Albert Einstein put the dilemma this way: „There are only two ways to live your life. One is as though nothing is a miracle. The other, as if everything is." So dramatic have technological developments been that they challenge the traditional grounding of human identity, spiritual aspiration and transcendental consciousness. Today we live in a world that is radically transforming itself. First, we experience the radical transformations in communications and transportation technologies. Communication has been compressed between human beings so that information is instantly communicated across the planet and technological innovation in travel have radically compressed the distance of both time and space between human beings. In the context of major coercion and more, the development of modern armaments including thermonuclear weapons and delivery systems put in the reach of human decision the basic question of whether humanity will be sufficiently shortsighted to destroy itself. In the areas of industrialization and mass production of goods and services, technological innovations are increasingly dependent on modern innovations and less dependent on human labor. This is an area where change requires a radical rethinking of the role of labor and social stability in human relations. Even more remarkable are the developments in the areas of artificial intelligence. Scientists predict that shortly within the grasp of modern science will be in-

[*] Visiting Professor, Al-Farabi Kazakh National University of Kazakhstan

struments of artificial intelligence vastly superior to those of the humans that created it. This may raise the difficult question of whether such artificial forms of intelligence may resist control by human agency. Other technological prospects include the radical new developments for the advancement of solar energy. Scientists have already determined that in the molecular structure of sand there are elements which if isolated could dramatically increase the collection, storage and distribution of solar energy. Since this is an inexhaustible supply of energy, it could have radial implications for political economy in the social process. These few introductory comments are simply used to raise the question of the role of values in the evolution of the technological capacity of the human family.

SCIENCE AND HUMAN CONSCIOUSNESS

We would contend that values are implicated in virtually all levels of technological innovation. The problem with values in this context is that values are produced and understood by the same intellectual processes that generate technological innovation and change. In short, technological progress and the importance of values in understanding and providing normative guidance for such processes emerge existentially from the process of human consciousness. The question is, what do we understand about human consciousness? For the scientists, human consciousness would simply be necessary for the development of scientific reason and scientific rationality. From the perspective of the culture of transcendental experience, human consciousness is the tool or lever for the development of spiritual conscious aspirations. In general, scientists tend to accept the idea that there does exist a form of consciousness which indirectly influences scientific reason and scientific achievements. However, scientists have had difficulty in understanding a possible connection between the study of the human brain and the study of human consciousness. The central problem is whether consciousness is a reality or an illusion. To some scientists the idea of consciousness is simply one of the great mysteries that confront scientific inquiry. To other scientists it is really a non-problem. Following on this conclusion, many scientists believe that consciousness is insufficiently scientific to waste such time on it. At most, consciousness may simply be a byproduct of complex physical processes. Another problem is that in general, scientists tend to believe that consciousness is something that lies outside of the boundaries of normal science. An important contributing factor to the notion that consciousness is outside of science is the philosophy of science grounded in positivism. Positivism suggests that the concerns of science be completely objective and distinct from the contamination of human subjectivity and values. It insists on the principle that science has an exclusive preoccupation with the *is* and not with the *ought* implied in value analysis.

Modern physics has raised important questions, which implicate the process of consciousness; this further implicates the problem of values. In the 1920's Heisenberg, one of the founders of quantum physics, made a completely inexplicable discovery. He discovered that when observing subatomic phenomena, it was impossible to separate the observer from what was observed. The observer influenced the movement of subatomic particles. This means that the observer has a level of subjectivity that influences the object of observation. This is an uncomfortable conclusion for strict positivism. [1]

HUMAN SUBJECTIVITY, CONSCIOUSNESS AND MODERN SCIENCE

Human subjectivity[2] in the form of perspective has been largely a field monopolized by the psychological sciences. It has been in a very important way also, a field

[1] The evolution of human consciousness has a rich intellectual popularity in our time. Donald presents a theory of consciousness that is multi-layered draws its efficacy from a cultural matrix. The author makes a convincing argument for the centrality of the concept of mind in the evolution of consciousness. Donald proposes that „the human mind is a hybrid product, interweaving a super-complex form of matter with an invisible symbolic web to form a „distributed" cognitive network". Among the most important works A Mind So Rare: The Evolution of Human Consciousness by Merlin Donald. (2001).

Theorists from the Noetic sciences have also contributed to a better understanding of the issue of consciousness. For example Peter Russell compares the consciousness of animals to that of humans. He makes a point that animals are also conscious, but what animals and humans generate as a form on consciousness is different. He explores consciousness in terms of biological evolution including the role of language in consciousness and goes further to transcend language in the sense that consciousness goes beyond language coalescing around self-consciousness. He sees our evolutionary mandate as of an unfolding consciousness that is incomplete. The importance of our evolutionary consciousness is that we can think ahead on the projector of time and use tits faculty to shape our possible futures.

Consciousness has historically been connected to religion, faith and transcendental understanding. Here, the general assumption is that human consciousness is dynamic in the sense that it's evolving towards some greater and ultimate, initial course. Piyasilo (1991). In the Christian tradition, the example of Christ is often referenced as a model of Christ-conscious. The assumption behind this conclusion is that consciousness had advanced in term of spiritual self-knowledge and understanding. This consciousness brings a person closer to god or the universal spirit.

Carl Jung had important insights into the notions of human consciousness. In particular, the identification of a collective unconsciousness, which has a connection to the human consciousness. Collective unconscious, a term coined by Carl Jung, refers to structures of the unconscious mind which are shared among beings of the same species. According to Jung, the human collective unconscious is populated by instincts and by archetypes: universal symbols such as the Great Mother, the Wise Old Man, the Shadow, the Tower, Water, the Tree of Life, and many more.

[2] In bringing human subjectivity to the center of an appropriate focus of inquiry for scientific consciousness, raises the critical question of the absence of objective measurable indicators of shared human subjectivity and shared professional consciousness. This is an issue that has generated an important interest in the measurement of subjectivity. A founding presence in this initiative was William Stephenson. Stephenson was an Englishman. He obtained a PhD in both physics and psychology. He is credited with developing a credible scientific method for the measurement of shared human subjectivity. His method was called the Q Methodology. The Q methodology is described as „a methodology for dealing with intra-individual data. Its relations to other methods of multivariate data analysis are described

dominated by the religion. Today this sharp division has been eroded as the field of quantum mechanics has disclosed properties and insights of micro-particles and waves. The experiments in quantum physics confirm results that are sometimes described as weird. The results do not make sense in the world of cause and effect as objectively observed. One of the insights of quantum physics is the role of the observer in shaping the behavior of the particles observed. This has raised the question that human consciousness when focused on the particles has an influence on how the particles behave. In short, observational consciousness appears to be a form of participatory interaction. It has been shown experimentally the cells of the body and the DNA communicate through this subtle field of energy that is difficult to quantify or measure. More than that it is been shown that human emotion has a direct influence on living DNA. These effects eliminate the interposition of distance between these objects. According to the physicist Amit Goswami, „when we understand us, our consciousness, we also understand the universe and separation disappears." The scientific results from quantum physics experiments indicate that the human DNA has an effect on the particles that constitute the matter of the universe. It is also established that human emotion has an effect on DNA, which in turn affects the particles the world is made of. Additionally, the connection between emotion and DNA has effects which transcend space and time. Scientists now believe that there is, in space, a matrix of energy that connects any one thing with everything in the universe. This connected field accounts for the unexpected results of experiments. It is further believed that the DNA of the human body gives us access to the energy that connects with the universe. Emotion is the key for the tapping into this field. According to the famous quantum physicist Max Planck „As a man who has devoted his whole life to the most clear-headed science, to the study of matter, I can tell you as a result of my research about the atoms this much: There is no matter as such! All matter originates and exists only by virtue of a force which brings the particles of an atom to vibration and holds this most minute solar system of the atom together… We must assume behind this force the existence of a conscious and intelligent Mind. This Mind is the matrix of all matter." (Cited in Gregg Braden's Book pp. 216)

The central insight of modern physics is that we live in a participatory universe. Human consciousness, it is believed, participates in this universe via human perspectives and emotions and represents a profound insight and even deeper challenge to the age- old question of the being and becoming of humanity. This participatory universe generates the future of multiple possibilities which gives strength and responsibility to the idea of creative orientation. Which of the possibilities may emerge as real would therefore appear to be influenced by emotion filter through consciousness and observation? In short, there is more to the idea of a focus of attention. A focus of attention generates the enemy of human consciousness which

---

and, in particular, the implications of factor analysis for it… the practical applications to different fields, e. g. type psychology, social psychology, projective tests, etc" See Stephenson, The study of behavior; Q-technique and its methodology (1953). See also Brown, „Q Methodology and Qualitative Research" (1996)

Brown, „A Primer on Q Methodology" (1993), www.operatsubjectivity.org may create a possible future reality. Scientists still dispute the precise meaning of the nature of possibilities and overlapping possibilities. Three of the most important of these interpretations is the Copenhagen Perspective. Theorists here focus on experiments which indicate that a person observing an electron moving through a slit in a barrier suggests that observation itself is what turns quantum possibilities into reality. Second there is the many worlds interpretation. This interpretation is similar to the Copenhagen Perspective but suggests that the possibilities are infinite and all of them exist simultaneously. However, in the „many worlds" view each possibility happens in its own space and cannot be seen by others. These unique spaces are called alternate universes. Finally, there is the Penrose interpretation. Here, Penrose maintains the belief of many possibilities existing at the quantum level. However, his theory is distinctive as to what it actually is that „locks" into a particular possibility that becomes our reality. Penrose recognizes that each possibility has its own gravitational field. It takes energy to maintain this field and the more energy a probability requires the more unstable it is. The consequence was that without enough energy to sustain all possibilities they collapse into a single state which represents our reality. The conclusions that are drawn from the insight of quantum possibilities are that emotion as a part of consciousness is the central factor in the choice of reality.

From this point of view, it is the language of human emotion that speaks to the quantum forces of the universe and to Planck's intelligent matrix. The polar extremities of feeling and emotion, which may feed into human consciousness, are the extremes of love and hate. Thus, the greatest challenge presented in the world of quantum physics and human consciousness has a similarity to the challenges posed by great religious and mystical insights. For example, Central to love is the idea of compassion, empathy and positive sentiment which we describe later as „affection". Positive sentiment in the form of compassion is according to the Buddhist tradition the feeling of „what connects all things". And compassion in this tradition is both a force of creation and an experience. In short, science and mystical experience seem to converge on the importance of positive sentiment for personal growth and transformation with large- scale existential implications. In short, it is love, compassion, and empathy that we must embody in our lives and feelings as the way we choose to experience the world. On the other hand, there is the inevitability of choice in the orientation of emotion and feeling. Such choices may well reflect the framework of the pole of hate which is reflected in the existential fears human experience in terms of abandonment, low self-worth, and lack of trust. The negative sentiment would be the feature for the creation of a negative utopia and the ultimate expression in reality of a negative utopia would be the practices and policies for the extermination of human aggregates.

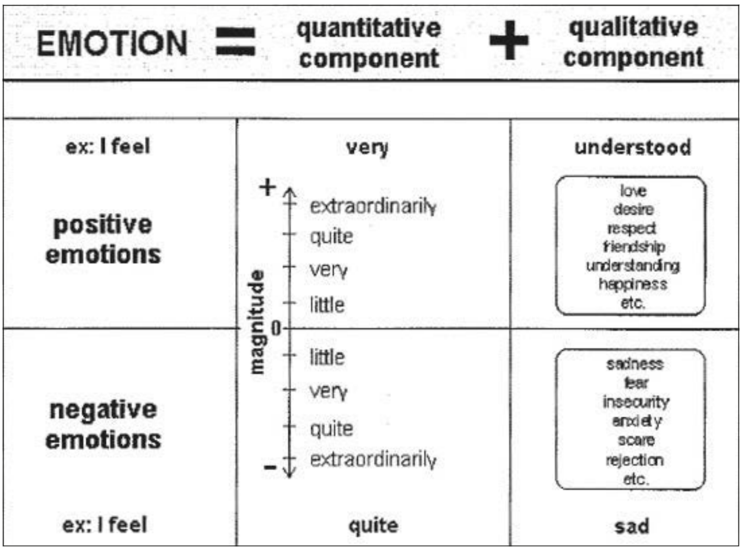
HUMAN SUBJECTIVITY- EMOTION AND CONSCIOUSNESS AS A DRIVER OF HUMAN VALUE

It may also be that, in general, societies take for granted the importance of emotion and sentiment in the construction of future generations. Here, intellectually, the idea of affection or positive emotional sentiment may need to be more explicitly recognized as an important cultural and policy preference. In short, emotion and sentiment permeate all human behavior. Emotion and sentiment may be the driving force about what is right concerning the human prospect and what is required to avoid was wrong with it. Modern scholarship has drawn attention to the importance of the emotions encapsulated in positive and negative emotion. We provide a provisional overview of positive and negative sentiment. Indeed what we suggest is that genocide is impossible when culture, law, and politics give due deference to the principles of positive sentiment or affect and heightens the prospect of genocide and atrocity when the negative symbols of emotionalized hate are dominant. Perhaps the most important insight here is that positive sentiment is a critical foundation for the culture of human rights. Negative sentiment is critical for the denial of the cultural of human rights.

The following diagram is an illustration of modern psychological science connecting emotion to the ideas of positive and negative sentiment. The diagram does not quite explain that positive sentiment as affects is an identifiable social process.

To the extent that we are living in a participatory universe, positive and negative emotions require the guidance of basic values. Below, I set out a generalized model of positive and negative sentiment that we can assume permeates the culture of science and any other discipline. Negative sentiment is a psychosocial process of community wide salience. Below we reproduce a model of the structure of negative sentiment as a social process.

The first line of inquiry must be the ubiquity with which human beings generate the culturally acknowledged and received symbols of identity. We generally consider this to be a natural process. The „I" is born into a family, or analogous micro-social unit, and soon the identification of the „I" broadens to include



the „we". But how inclusive or exclusive is the „we"? We realize that the expansion of the „we" is not unlimited and the boundaries of the „we" invariably demarcate those groups that constitute the „non-we" that is to say the group or class of „non-self others". This is an ordinary process that happens in all human communities.

The social process also generates the identifiable markers of a social process of positive sentiment. Part of positive sentiment maximizes within the personality of the individual self system the salience of affection, empathy and solidarity with humanity as a whole. As such, it is a process that is very fundamental to social organization that seeks to universalize the dignity of man. As such, a social process of positive sentiment is an antidote to anti-Semitism, to racial discrimination, to prejudice, to group domination and to group extinction.[3]

It is important for us to recognize that every technological innovator comes to his craft with human consciousness influenced by human subjectivity and emotion. If we accept the guidance of Socrates, namely „know thy self", then we would have to admit that all scientists and the rest of humanity come to their vocation with a context of emotions, some positive and some negative.

TECHNOLOGY, SCIENTIFIC CONSCIOUSNESS AND SOCIAL RESPONSIBILITIES

It is widely acknowledged today that science, technology and innovation are some of the most powerful forces directing the future of our global social process. It is also recognized that technology represents remarkable advances as well as existential threats to humanity. Some aspects of technology are, in fact, fairly strictly controlled politically. These areas include nuclear technology, pharmaceuticals, agricultural chemicals, and food additives. Other areas of technological development would appear to be somewhat more anarchic. These areas include the computerization of financial transactions, automation, biological research, and telecommunication systems. The speed of technological development and distribution appears now to be way ahead of the capacity of governance to adapt to the changes that technology generates. This results in social stress, uneven social development, social upheaval, displacement and mass-migration and vast disruptions of stability in social process globally. Leading thinkers in international governmental institutions and global scientific institutions continue to stress the critical importance of the issue of values in scientific research and education and are of great importance in the formulation of wise public policy. Michel Jarraud recently stressed the issue of social responsibility for the management of scientific activity. Ivo Šlaus, in similar vein, stressed the acceptance of a collective and individual duty from a global point of view for a commitment to the realization of sustainable development objectives. Raymond Torres stressed the question of technology's imprint on global income inequality and insecurity. He also insists upon a socially responsible form for the governance of technological innovation. Marie-Paule Kieny from WHO also insists on a recognition of a

[3] For a comprehensive table on both positive sentiment and negative sentiment processes, see Nagan, *Lectures on Genocide and Mass Murder,* Landbridge University.

mutual sense of social responsibility addressing the tension between the promotion of global health and the commercial objectives of pharmaceutical interests. Alexander Likhotal warns of the corrosive aspect of money-power on technology. Herwig Shopper underlines the special responsibility of scientists and intellectuals toward global society. Garry Jacobs draws particular attention to the problem of the perspectives of technological innovators. His fear is that their perspectives may be unduly influenced by selfish motives such as careerism, competition for grants and intellectual prominence. He insists on a refinement of scientific values in the public interest. Martin Lees is another important world leader who draws attention to the difficult problem of political responsibility versus intellectual and scientific responsibility. Christophe Rossel stresses the importance of classical scientific values and their ethical guidelines. He insists that regular assessments of the social and economic impact of technology are an urgent necessity. Professor Momir Durovic draws attention to the problem that technological innovation has an incipient tendency to determinism. This means that human beings do not control technology; technology controls human beings. He too stresses the importance of strengthening mechanisms to improve the social responsibility factor. What is implicit in these important views is that technological innovation and development is a critical driver of paradigm change in the context of appropriately developing the theoretical frameworks to better understand, to better control and regulate the scope and character of revolutionary technological changes. It is apparent that there is a critical link between the issue of social responsibility and consciousness and the critical relevance of a deeper and more comprehensive understanding of the role of values in scientific consciousness, political consciousness, and in general, the consciousness of humanity.

This summary of the perspectives that stress scientific responsibility, the centrality of ethics and morality and values is, of course, the critical challenge of understanding the interrelationship of consciousness, technology, and human values. Alexander Likhotol puts this challenge in terms of a level of practicality when he states the following:

„ Political leaders, in particular, badly need to be exposed to scientific vision. The mind, once stretched by a new idea, never reverts to its original dimensions. Unfortunately, we have to recognize that today's governments are ill-equipped to understand science, sophisticated technological challenges, or the opportunities facing the world. New instruments are needed to ensure that science and technology are adequately applied to address the wide range of increasingly urgent global problems- and not just to make our Smartphone batteries last longer. This will require a rapid transition to a different model of development; one which not only takes into account the interest of short –term growth, but provides opportunities for sustainable and inclusive development."

CONSCIOUSNESS, VALUES, TECHNOLOGY AND SCIENCE

The discussion of consciousness and values in scientific culture has always been an uneasy business. From a scientific point of view, the proper scientific culture is to be value-free. If the discourse of science is permeated with values, it is permeated with human subjectivity and not scientific objectivity. On the other hand, we know that in human society the important stakes about community organization, endurance, and promise seem to be tied up with values in some form or another. The traditional limit on the use of values from a scientific point of view remains a problem for the subjectivity of value-toned discourse. Let me start with a distinction. Values in the context of intellectual culture are used in two distinct ways. First, values are used descriptively. In this sense, the scientific observer is merely observing the value-conditioned behavior of social or legal participators. What does the observer see? He sees individual human beings acting in a community, energized to pursue the things that they desire or value. In this sense, viewed from an anthropological point of view, what we call things that are desired or valued might, in a basic sense, be the human needs that the individual seeks to secure in the social context of his or her life. This is simply a descriptive inquiry into what the individual wants, how the individual goes about getting what he wants, and what he does with the desired thing that he has gotten. This will give us a description of the system of community or public order as it is. There is another sense in which the term values is used. In this sense, the term is vested with normative importance. In other words, the question is not how values are produced and distributed but how they ought to be produced and distributed. This, therefore, is not a descriptive exercise; it is an exercise of normative judgment. In the case of values used as a description of community order as it is, we are dealing with propositions that can be proved or disproved by observation, creating a hypothesis about what is observed. Further observation may prove or disprove the hypothesis. This is an empirical inquiry. When values are used in a normative sense, we are really evaluating the goodness or badness of their production and distribution. The determination of the normative priority or the preference given to a value statement reflecting the „ought" will have to be established by some other criterion of validation. That criterion, at least in the context of moral philosophy, is based on the idea that a statement about a normative preference or „ought" can be validated by reasons external to the statement-maker. In short, there are objective, justifiable reasons that may be formulated to determine the currency, or lack of it, of a moral or value proposition. We shall be using the terms value in both a descriptive and a normative sense, but we will attempt to secure a sufficient clarity of exposition that while we discuss them as interrelated matters, we can keep them sufficiently distinct in order to establish different insights into the problems we are discussing about society.

HUMAN NEEDS AND VALUES IN THE ANTHROPOLOGICAL SCIENCES

The anthropological literature has given us a key to understanding life in a very elementary community. Life revolves around human beings energized to satisfy human needs. Anthropologists also identify the structures that emerge from society which are specialized in whatever degree of efficacy to facilitate securing those needs. When we map needs onto institutions, we emerge with a social process that is based on the interaction of energies directed at securing needs through institutions. These institutions direct human energies, in some degree, to the satisfaction of those needs. We can now begin to identify basic human needs as the goods, services, honors, and gratifications that people in society desire or need. Moreover, we can classify these desires/needs in terms of the basic values that the individual social participant acts to secure for himself and those dependent on him. Thus, we may emerge with a model of social process in which human beings pursue values through institutions based on resources. Now, this is a purely descriptive inquiry, but it is possible to observe that the needs/values and the institutions specialized to secure them are, generally speaking, identifiable. What are these values and what are the institutions specialized to secure them in any social process?

THE HUMAN PERSPECTIVE AND CONSCIOUSNESS IN THE EVOLUTION AND INTERDETERMINATION OF VALUES IN THE HUMAN SOCIAL PROCESS

Values	Institutions	Situations	Outcomes
Power	Governance-Political Parties	Arena	Decision
Enlightenment	Universities- WAAS	Forum	Knowledge
Wealth	Corporations	Market	Transaction
Well-Being	Hospitals, Clinics	Habitat	Vitality
Skill	Labor Unions, Professional Organization	Shop	Performance
Affection	Micro-social Units (Family) Macro-social Units (Loyalty)	Circle	Cordiality, Positive Sentiment, Patriotism
Respect	Social Class	Stage	Prestige
Rectitude	Churches, Temples	Court	Rightness
Aesthetics	Museums, Monuments, Culture	Creative Orientation	Symbols of Cultural Beauty and Aspiration

In this representation, values and institutions are represented descriptively in order to describe the system of community order as it is. It should, however, be understood that the social process of the community is a dynamic process in which there is an energy flow between the participators, the values, the institutions, and the results. Some of the results are generative of conflict. Other results are generative of the success of institutions functioning optimally. What is important is that social process is a generator of problems, and these problems are about the acquisition and distribution of values. This means that the dynamism of society requires a decision process that is frequently challenged to produce a solution to the problems of value conflict, value deprivation, or value over-indulgence. Thus, the community response to the problems that values pose for community order invariably must implicate a normative dimension about the optimal allocation of values in society. Indeed, some political scientists describe political science as concerned with the authoritative allocation of values in society.

In reviewing this map of values and institutions of social process, it is important to keep in mind that it is the human perspective that gives meaning and life to the values and institutions in society. The human perspective comes with the perspective of identity, ego-demands, and the value ideals of expectation. These perspectives are driven by deep drives for self-actualization, self-realization, and psycho-social fulfillment. In this sense, the private motives of personality, even when displaced on public objects and rationalized in the public interests, still represent an underlying force that moves the personality in all social relations. This underlying force may be the force of self-affirmation for self-determination and is the most foundational energizer of the demand for human rights and dignity. The relationship between personality and value achievement may itself generate a sense of inner-fulfillment, which, in turn, becomes the driver of still greater levels of value creation and achievement.

CONSCIOUSNESS IN THE IDENTIFICATION AND ALLOCATION OF VALUES IN SOCIETY

The problem of the allocation of values implicates the idea that there may be different standards which justify one form of allocation over another. Historically, at least in law, there has been an assumption that legal interventions are meant to discriminate between the claims for values that are just and those that are unjust. It is this challenge that has given rise to the great traditions of jurisprudence and, most importantly, the jurisprudence of natural law. Natural law, however, could only generate procedures, not substantive rules, to facilitate the use of right reason in the resolution of value conflicts. Two of the most enduring of these natural law-based rules have survived and are essentially matters of procedural justice: audi alteram partem [the obligation to hear both sides] and nemo iudex in causa sua [no one should be a judge in his own cause]. However, we had to await the aftermath of the tragedy of the Second World War before we got a kind of official code of natural law in the form of the Universal Declaration of Human Rights. Although couched in the form of rights, the Declaration may be reduced to nine fundamental value-needs categories. The adoption of a code of moral priority, intended to bind all participants in the international system limited the speculation about the role of values in the social process. Although most intellectual and scholastic speculation stresses the notion that values are somewhat opaque, difficult to distill, and even more difficult to clarify, the adoption of the United Nations Charter has served as a political impetus for the development and clarification of values.[4]

GLOBAL VALUES, THE UN CHARTER: THE NORMATIVE VALUE GUIDANCE FOR SCIENCE AND SOCIETY

Based on UN Charter, the world community also adopted an International Bill of Rights. The central challenge to a scholastic understanding of the International Bill of Rights is the need to clarify and distill its basic, underlying values. It may

[4] For a comprehensive keynote regarding the UN Charter, see Nagan, *Power of Values and the Process of Value Realization.*

now be with confidence stated that we can distill at least nine functional values that underlie the entire international bill of rights. In a general sense, these rights, when considered collectively, represent the integrated, supreme universal value of human dignity. The central challenge then, is that those charged with decision-making responsibility must prescribe and apply a multitude of values in concrete instances and hope that their choices contribute to the enhancement of human dignity and do not, in fact, disparage it. At an abstract philosophical level, distinguished philosophers such as Sir Isaiah Berlin have maintained that it is futile to attempt to integrate these values with the abstract principle of human dignity because fundamentally, these values are incommensurable. Not everyone agrees with this. Specialists in decision and policy acknowledge that human dignity based on universal respect represents a cluster of complex values and value-processes. Therefore, the challenge requires that ostensibly conflicting values be subject to a deeper level of contextualized social insight and a complete sensitivity to inter-disciplinary knowledge, procedures, and insights. Thus, decisions in these contexts are challenged with the task of broader methods of cognition and a better understanding of abstract formulations of value judgments. Disciplined intellectual procedures have been developed to provide better guidance in particular instances of choice to approximate the application and integration of values in terms of the human dignity postulate. Does the ethic of universal respect and human dignity demand absolute, universal compliance at the expense of other universally accepted values? Ensuring that the values of respect, democratic entitlement, and humanitarian law standards are honored requires fine-tuned analysis and great subtlety in the structure and process of decisional interventions. Rules of construction and 'interpretation' are painfully worked out, which hold, for example, that even if a peremptory principle (ins cogens) of international law embodies an obligation erga omnes. It should be evaluated, appraised, and construed to enhance rather than disparage similar rights, which may also have to be accommodated. The currency behind the universal ethic of essential dignity and respect is that it provides practical decision-makers with goals, objectives, and working standards that permit the transformation of law and practice into a greater and more explicit approximation of the basic goals and standards built into the UN Charter system itself. This prescribes a public order committed to universal peace and dignity for the people of the entire earth-space community.

GLOBAL VALUES, SCIENTIFIC RESPONSIBLY AND THE PERSPECTIVE OF GLOBAL GOVERNANCE

Consciousness, Values and Public Order

It is useful to approach the questions of value in terms of the nature of the public order that the rule of law system seeks to promote and defend. The system of public order secures the complex values that it is committed to defend by making an essential distinction between the minimum-order aspects and the optimum-order aspects of the system of public order.

Consciousness, Values and the Minimum Order

The problem of scientific responsibility, values and the prospect of at least realizing a system of minimum order in the global governance of humanity now represents a critical challenge for scientific consciousness. We may understand the relationship between community, minimum order, and values by imagining a society without an expectation that agreements and exchanges made in good faith and according to law will be honored, that wrongs (delicts) inflicted upon innocent parties will be compensated, that basic interests and expectations of entitlement [as in fundamental norms of right and wrong] shall be sanctioned by a collective community response, or that basic structures of governance and administration will respect the rules of natural justice such as nemo judex in sua causa or audi alteram partem, and will in general constrain the abuse of power and thus the prospect of caprice and arbitrariness in governance. The necessity of minimum order in a comparative, cross-cultural, historic reality is that human beings interact within and without community lines. In doing so, they commit wrongs intentionally or unintentionally, they require some security over their possessions and entitlements, and their systems of governance aspire invariably to constrain the impulse for abusing power. These are the minimum values of social coexistence. It is in this sense that law as minimum order confronts the idea of justice and potentiality. It is commonly thought that minimum order is a critical, but not absolute condition of a more just, more decent, more optimistic human prospect. The rule of law precept is uncontroversial in the sense of minimum order and its 'boundaries. ' Peace, security, and minimal standards of human rights are reflections of these values in international, constitutional, and municipal law. Fundamentally, the quest for the maintenance of a minimum order in society would appear to be an essential condition for the individual or aggregate of individuals to evolve toward a social process that maximizes value production and distribution. It is possible to see in this an evolutionary idea of progressive change relating to the production and distribution, optimally for all social participants. It is imperative that in the education of scientists and technology innovators, that their sense of social responsibility is at least minimally influenced by the global values of a minimum sustainable system of world order.

Consciousness, Values and the Optimum Order

This challenge to the public order raises the question of the production and the distribution of values beyond the minimum for social coexistence. This is an insight that is more challenging to the question of scientific responsibility and the values that ought to guide it. Clearly, a great deal of science will have an imprint that goes beyond minimum order and will be let loose in the domain of optimal possibilities and prospects. Here, it is critically important that value clarification be a component of the definition of scientific social responsibility. This is the challenge of the unequal distribution of opportunities or results. Human beings exist not only spatially, but also in terms of the duration of time and events. There is hopefully a tomorrow, a next week, next month, next year, and next century. Human beings, such as scientists, are also transformative agents who make things happen, and in doing so underline the question embedded in the nature of law and community that we can change things for better or worse, for the common good or the special interests, for the sense of expanding human dignity or the prospect of a negative utopia, the rule of human indignity. This is a critical challenge for scientific consciousness. The central challenge for values posed by the optimum order precept is the problem of the procedures and methods for producing values as well as the procedures methods and normative ideas about the fair distribution of the values that are produced in society. At the back of the concern for human values is the belief in human capacity for the essential, energized generation of value at every level of the social process and the human resource as a producer of ideas, insights, and values of exponential salience. At the back of the human dignity idea is the belief that widespread human dignity flourishes when the dignity of the individual flourishes and reproduces values of exponential importance for the common interest of all. Fellows of the Academy have suggested that the nine values embedded in the International Bill of Rights [power, wealth, respect, rectitude, enlightenment, skill, affection, health and well being, and aesthetics] are the key to the notion of a public order of human dignity. They postulate that the maximal production and distribution of these values on a universal basis is the key to improving the human prospect and approximating a public order of human dignity. This means that the prescription, application, and enforcement of the fundamental values behind human rights remain a major professional challenge for the global processes of governance charged with the defense of global public order. We may conclude that value needs are a condition and a consequence of focusing and directing the energy of the human perspective into concrete operations that establish institutions concentrated and specialized to value realization. In this sense, values and needs are incentives that generate a self-directed force, which ultimately evolves into institutions of effective power crucial to the allocation of values. It is possible to see these generalizations in the evolution of the sovereign authority of the nation-state and its own evolution from state absolutism to sovereignty routed in people's expectations. Another insight of this model is found in the notion that the power process itself is energized by human expectations, especially expectations of demand. Without demanding or claiming an aspect of social power, society would be static. Thus, we see in the power process, the social activist. In the United States, Rosa Parks resented segregation in public transportation, so she staked a claim to repudiate racial discrimination in public transportation. Gandhi was thrown off a train in South Africa because he was not white. He initiated a claim to challenge the power of the state to impose unjust discriminatory laws. His challenges to the power process brought him to India as a leader of the Indian Independence Movement. Nelson Mandela challenged apartheid and indicated in open court that he was committed to human dignity and democracy and that these ideals were ones that he was prepared to die for. Therefore, it is important that we have a clear understanding of the process of effective power, and what the limits and strategies are of mobilizing bases of power, to effect meaningful social change. It is quite obvious that scientific consciousness, driven by a commitment to scientific social responsibly, will have to carry a significant level of commitment in utilizing social power so that the results of technology serve human purposes that are constructive and avoid those that are destructive. As Einstein suggested, the development of science and technology should be a blessing and not a curse on human kind.

From the perspective of science, consciousness and value the following framework is provided as value condition guidance for the technological innovators of our time and the immediate future.

VALUE FRAMEWORKS TO GUIDE SCIENTIFIC CONSCIOUSNESS AND SOCIAL RESPONSIBILITY

1. *The value of life*: This is a centrally valued human subjectivity. It is referred to not in the „pro-life" sense (that a pregnant woman must bear a child), but in the Bill of Rights sense (that a person has right to personhood and autonomy). The value of life, therefore, includes the respect and deference given to the individual in the global community.

2. *The status of the value of power and security*: Should it be narrowly or widely shared? Is the common interest of all honored in a system that seeks to secure the widest possible participation in all key areas the power process? One of the central values identified in the Atlantic Charter was the freedom from fear. This concern for freedom has evolved so that today no one denies that there is a critical interdependence between the concept of peace as a human right and all the other values in the UDHR. Peace and security might well be included under the functional category of power. However, peace is recognized as a complex peremptory component of the human rights value system. It is of value to again recognize that there are complex ways in which all human rights values have an influence on peace and security, recognizing as well that peace and security at all levels are critical conditions for the effective mobilization of human rights values. A central aspect of the values of peace and security relates to the connection between the mobilizing force of strategy for the realization of human rights goals and the realization of these goals themselves. For example, is it appropriate to deploy violent strategies of action to achieve human rights objectives? Is it appropriate to disengage the value discourse involving strategy and struggle on the one hand and idealistic value objectives on the other hand? Gandhi, for one, insisted that the morality of struggle was even more important than the morality of distant idealistic objectives. Indeed, he also insisted that a disconnect between struggle, strategy, and goals was morally indefensible.

3. *The status and value of economic and wealth processes*: Is the common interest of all better secured by optimizing the capacity to produce and distribute wealth or the opposite?

4. *The status and value of respect and equalitarian values*: Should invidious discrimination be fully prohibited (covering all areas of race, gender, alienage, etc.)? Can equality be meaningful if it is only a formal, juridical idea without regard to the legacy of exploitation, repression, and discrimination?

5. *The status and value of educational and enlightened values*: Should these values be widely produced and distributed or narrowly experienced? In the context of science, the critical value that secures scientific innovation and the liberation of

scientific consciousness is the freedom of inquiry. The challenge posed by dramatic technological innovation is that further scientific consciousness will generate an internal process focused on scientific responsibility and a deeper sense of the value implications and consequences of technological innovation. The problem with regulating science is the problem that it will be regulated by a politically ignorant constituency, who may seek to appropriate technology with selfish special interests.

6. *The status and value of skill and labor values*: The centrality of labor and skills values to the human condition indicates that these are central and fundamental values implicated in the rights and expectations of those who seek to create and sustain these rights and labor values. Should these rights and expectations be widely shaped or narrowly shared?

7. *The status and value of health and well-being values*: The delivery of reasonably formulated and accessible healthcare and social services to all is now widely regarded as crucial entitlements, if the most basic standards of decency in politics and society are valued. Today, unemployment aid, social security, Medicare, and other social services are considered crucial to a society that cares for its people.

8. *The status and value of the family and other affective values*: Because the family is the basis of collective existence and is central to the human rights of children, the public policies of a society that destroys family (and other affective ties) pose a problem for the wide generation of affective values including the loyalty values of patriotic deference.

9. *The status and value of moral experience and rectitude*: A system that endorses the centrality of moral experience to the legal and political culture and seeks to maximize the spiritual freedom of all is yet another of the central themes of the human rights

How do we translate expectations of care or fundamental moral experience into the practical prescription of law and policy?

10. *The status and value of cultural and aesthetic experience*: The term cultural includes the concept of the aesthetic. In fact, the word „cultural" could encompass all the value preferences that we might extract from the UDHR. There is, however, a narrower meaning that the term culture might carry. That meaning ties in with the notion of human rights as also emblematic of the diversity of human experience, experience that reflects the cultural richness of humanity as a global community. There is great controversy about the issue of culture and tradition, culture and creativity of the present, culture and the elaboration of the aesthetic, which may capture and nurture the cultural narrative of creativity and beauty which may in fact be the critical psychological view of how the glue of social solidarity promotes creativity. The boundaries of this discourse are controversial. Sensitive matters of sexual regulation which may differ widely may be justified by culture and yet here the culture of tradition may not be compatible with the culture and creativity of the present or the future in human rights terms. For example, female genital mutilation justified by cultural tradition is not justified by either religion or by the science of human sexuality. Human rights thus provide a process by which these boundaries may be appropriately protected and appropriately expanded according to the normative challenges of human dignity. The current discourse often suggests that

universality trumps cultural relativity or vice versa. This is not necessarily helpful unless one sees these ideas as only the starting point for value clarification and application from a human rights perspective.

11. *The status and value of the eco-system*: Today, we recognize a complex right to a viable eco-system on what theorists have seen as Spaceship Earth. The values embedded in the protection and promotion of a healthy eco-system, are, like many other values, issues of complex inter-dependence and inter-determination. However, implicit at least, in the concern for the integrity of the eco-system is clearly the notion that there are no human rights if there is no environment in which human beings can survive and possibly even improve the human prospect. But this insight suggests an even higher level of moral consciousness in the sense that the eco-system (with its plant life and animals, wild and domesticated) is part of a complex cycle, in which human beings are both custodians and also utterly dependent as individuals and as society. This means that we now see in nature not something irresponsibly exploited and destroyed but central to our identity as a sentient species. To take a simple example, for all the vaunted technology of human progress and human egotism, no one has seen a dog or a cat or a rat or indeed the most elemental of recognizable life forms outside of this lonely and unremarkable planet called Earth. Thus, as humanity, we now look at life even in its most humble forms as not only indispensable to the interconnected chain of life on this planet but we see in it something new and utterly connected to the very consciousness of being human and being alive. In short, we know that our dogs identify with us. We may now know those ordinary pets in terms of how they and all other living forms have shaped our identity both psychologically and physiologically.

CONCLUSION

This paper has sought to clarify the salience of the difficult concept of scientific consciousness, the importance of cultivating that consciousness not only in creative ways but in ways that are morally and ethically compelling. This means that consciousness should be alert to the dynamics of positive and negative sentiment in the shaping of the technological paradigm of the future. Even more importantly, it is crucial for scientific consciousness to self-regulate itself by being better informed about the values it seeks to promote and defend. Successful self-regulation of science avoids the danger of control and regulation by forces completely ignorant of the implications of science and technology. This means that scientific leadership must be more articulate in the defense of the values that sustain a creative, dynamic and responsible scientific culture as an indispensible foundation for an improved world order based on human rights and human dignity.

Noam LIOR[*]
Mirjana RADOVANOVIĆ[**]

SUSTAINABILITY AND ITS MEASUREMENT

This paper critically reviews the existential need, history, role and status of applying quantitative scientific sustainable development in all human activities of globally-affecting magnitude, such as energy, water and food, and it organically incorporates criteria and effects of the interactions between technology and society.

Sustainability metrics and their ongoing development are described, and their combination into a single aggregate indicator for functional use in analysis and optimization is formulated. In contrast with most studies that focus on using the metrics and indicators mainly for monitoring progress to sustainability, this paper emphasizes the importance of integrating them into the planning, design, and development process, for a-priori creation of sustainable development, products, and systems. Some of the main obstacles that scientists and engineers face in this endeavor are defined as (a) the reductionist practice of scientific research tends to focus on the details of a system, while paying little attention to the broader implications of the work, (b) the difficulty in crossing disciplinary boundaries due to lack of consilience (c) the arrogance of specialization, (d) definition of time and space boundaries, and use of the very wide-ranged multiple scales, and (e) some weakness of tools for solving Very Large Complex Systems. While formidable, these obstacles can be overcome, especially through education beginning from the earliest ages. The weaknesses of the political system to implement national and global sustainable development because of the need for long-term multi-generational and international scope, as well as the critical need for an ethical approach, are identified. There is clearly a need for effective multidisciplinary work, creating a common language and mutual respect; the advent of sustainability science.

A brief example of the application of sustainability analysis for national planning is included, which is taken from a quantitative examination of sustainable development in 10 developing Southeast European countries, with comparison to

[*] University of Pennsylvania, Philadelphia, USA
[**] Educons University, Novi Sad, Serbia

some developed ones, which Prof. M. Radovanović from Educons University, Novi Sad, and I have recently conducted. One of the foci of the study was to find whether global or conventional sustainability indicators, such as the Gross Domestic Product (GDP-PPP) and conventional climate change indicators are also the most important for such emerging countries. The results show significant differences between levels of sustainable development achieved by using these different approaches. We concluded that sustainable development planners and policy makers should be aware of these facts and should carefully choose indicators and weights that are suitable for their countries, especially when the countries are at their initial stages of sustainable development. Uniformity and scientific consensus-based standardization of sustainability analysis methodology are critically needed.

INTRODUCTION: SUSTAINABILITY DEFINITION AND ITS EXISTENTIAL ROLE (PARTLY FROM [1])

„Sustainability" is an increasingly common term in the broader society, often used in a somewhat loose or even fraudulent fashion. It has many definitions which depend largely on the application and the user. Probably the best known is that of the UN Brundtland commission 1987 report, as that *„humanity makes development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*" [2]. Two hundred years earlier Thomas Jefferson wrote: *„Then I say the Earth belongs to each generation during its course, fully and in its right… Then no generation can contract debts greater than may be paid during the course of its existence*" [3].

Such definitions must be quantified as a vital first step in an attempt to approach sustainable development scientifically. The current ambiguities in the definition of sustainability not only impede sensible development but also give rise to the fraudulent use of this existentially important concept and its terminology, thus diminishing its value by desensitizing society and sowing distrust [4].

Sustainable development is of existential importance for humanity, and as shown below in more detail, its planning and implementation are rather complex, so the most effective way (or the only practical one) for that is by applying scientific principles. These, like any science, require proper measurement and quantification, to largely replace the myriad of ongoing prattle. As Lord Kelvin stated *„I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be"*.

The *needs* in the definition of sustainability are *economic, social* and *environmental*, and must be provided in a properly balanced manner. These three needs are considered to be the pillars of the sustainability concept, integrated with human *values*, which differ among different nations and societies. The pillars are closely inter-related.

The existential importance of sustainable development is obvious noting that the „Living Planet Index", a metric which measures trends in the Earth's biological diversity, has from 1970 to 2010 declined by 52%, and that in 2010 humanity required the capacity of 1.5 Earths to satisfy its consumption [5]. Among other existence-threatening phenomena resulting in important part from unsustainable development are the rising effect of global warming, including and increasing water contamination and scarcity: currently about one-fifth of the world's population lives in areas of physical scarcity, and 500 million people are approaching this situation, and another quarter of the world's population faces economic water shortage. The UN predicts that by 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could live under water stress conditions [6,7]. Sustainable use and development of energy are an overwhelming problem worldwide, mostly due to its environmental impacts and insecurity [8–13]. All these trends are clearly unsustainable, increasingly alarming, and explicitly require immediate changes to implement sustainable development. Humanity's survival depends on adoption of sustainable development, which thus has a meta-ethical foundation, a definition of right and wrong paths of a Universal Truth that is humanity's desire to survive, with good life quality.

The focal topic of this „Technology + Society =? Future" conference is the interaction between technology and society, which is clearly a subset of sustainable development in general, and thus must also be done sustainably to lead to a satisfactory future for humanity. The weaknesses of the political system to implement national and global sustainable development because of the need for long-term multi-generational and international scope, as well as the critical need for an ethical approach, are identified. There is clearly a need for effective multidisciplinary work, creating a common language and mutual respect; the advent of sustainability science.

SUSTAINABILITY ANALYSIS METHODOLOGY PRINCIPLES (PARTLY FROM [1])

For the quantitative analysis, sustainability *metrics,* or *„indicators*", are selected and defined to quantify in sufficient detail the different aspects of the sustainability pillars, and usually a large number of such indicators is needed and used. For example, the U. N. „Millenium Goals", established in 2000 used about 150 indicators to measure sustainability of countries and their development for meeting freedom from extreme poverty and hunger; quality education, productive and decent employment, good health and shelter; the right of women to give birth without risking their lives; and a world where environmental sustainability is a priority, and women and men live in equality [14]. More recently [15] a set of main global sustainability global goals was expanded to 17, with 100 indicators.

Regardless of the specific definition, and their inherent complexity, the sustainability metrics must satisfy some common sense criteria. The metrics must:

— Be inclusive of economic, environmental and social concerns (the three pillars of sustainability)

— Be relatively simple, and widely understandable,

— Be reproducible,
— Satisfy the laws of nature,
— Be normalized to allow easier comparisons

The next step in quantitative sustainability analysis would thus be to aggregate the values of the selected indicators, M_i into a single (at best) *composite sustainability indicator* () using weights (w_i) for each, which express their relative importance, as illustrated in Fig. 1:

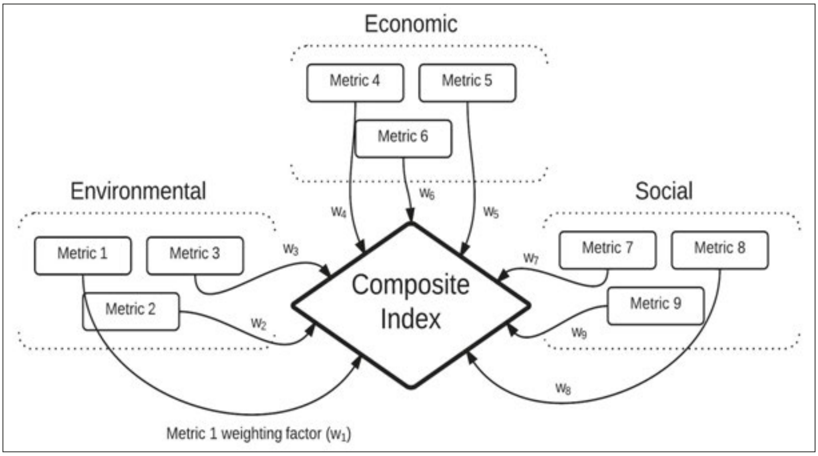


Fig. 1 A diagram for Composite Sustainability Index (CSI) construction

The *CSI* are in their simplest way expressed as

$$\sum_i M_i\left(\vec{x}_{ij}\right) w_i\left(\vec{y}_{ik}\right) \quad \text{or} \quad CSI = \prod_i M_i\left(\vec{x}_{ij}\right) w_i\left(\vec{y}_{ik}\right)$$

or using some other mathematical aggregation method, where

$\vec{x}_{ij}$ the j system parameters that affect the metric M_i; Example: if a metric is environmental, the „system parameters" may be impact on biota, gaseous emissions, etc.

$\vec{y}_{ik}$ the k system parameters that affect the weight w_i; Example: if a weight is related to an environmental metric, the „system parameters" may be the relative importance of the impact on biota, gaseous emissions, etc.

i index of a metric-weight pair (M_i-w_i)

j index of a metric (M_i) — dependence parameter $\vec{x}_{ij}$

k index of a weight (w_i) — dependence parameter $\vec{y}_{ik}$

This equation mathematically relates the composite sustainability index (*CSI*) to all the chosen 'system parameters' that affect it, so the *CSI* can serve as the objective function for mathematical sensitivity analysis and optimization, down to the level of 'component variables', or be part of it.

Some models for sustainability are in development, for example The EU recently funded project INSURE developed a flexible methodology for representation, analysis and evaluation of sustainability at the regional level. INSURE aimed to develop a practical and ready-to-apply method and toolkit for working with regional sustainable development indicators [16]. Validity of these evolving models is still unknown.

Perhaps the most daunting obstacle to sustainability analysis is not just the definition and quantification of the appropriate metrics and weights, which is a very significant problem and burden for even „just" environmental impact statements, but the significant increase in their number, complexity and indeterministic nature (plurality). While many of the environmental metrics, such as concentrations of chemicals relative to desire values, is relatively simple and deterministic, others such as those dealing with ecology are much more complex and unclear, and so are many of those associated with social impacts. Disciplinary and interdisciplinary work are, however, progressing rapidly to characterize sustainability as a science, and to that end quantitative scientific definitions of its metrics are evolving and gradually becoming a part of standards and regulations (e. g., [13, 17–23]).

Weights (w_i in eq. (1)) are a quantitative expression of the importance of a metric (M_i) relative to the others. In some cases they are calculated using some quantitative analysis, but very often via polling, with some statistical significance, the opinions of experts and stakeholders, including decision makers that may include politicians. Weights can be established directly, or indirectly following a formal method. The determination of weights, whom to ask and by which method to calculate them, is likely to cause more controversy than other parts of sustainability analysis.

A procedurally complicating but vitally important component of the development of relevant and practical sustainability indicators is that broad-based sustainability metrics must carefully consider the needs and opinions of the stakeholders.

The *CSI* characterized by Eq. (1) is most often calculated by using multi-criteria analysis (MCA) techniques.

The recommended quantitative sustainability analysis process steps should follow these steps [1]:

1. Definition of the system and its spatial and temporal extent
2. Preliminary definition of the sustainability objective function and its units
3. Definition of all sustainability metrics and their system-variable dependence quantification (considering spatial effects and temporal evolution)
4. Reduction of their number to a necessary minimum
5. Normalization of the metrics and unification of their units
6. Final definition of the sustainability objective function and its units
7. Definition of the metrics' relative weights
8. Decision on the method of the aggregation of the metrics, considering space and time
9. Aggregation
10. Error analysis
11. Sensitivity analysis

12. Optimization
13. Testing under practical conditions
14. Iteration and development of learning experience for this and future projects.

The development of sustainability metrics is, as described above, a very formidable task, in which some of the main obstacles that scientists and engineers face in this endeavor are:

— The reductionist practice of scientific research tends to focus on the details of a system, while paying little attention to the broader implications of the work.

— Exacerbation by the difficulty in crossing disciplinary boundaries: lack of consilience[1] in the objectives of different disciplines that consider the economic, philosophical, cultural, and scientific and engineering aspects.

— Definition of time and space boundaries and use of the very wide-ranged multiple scales.

— The arrogance of specialization.

— Some weakness of tools for solving Very Large Complex Systems.

While formidable, these obstacles can be overcome, especially through education beginning from the earliest ages.

By definition, sustainable development of large scale must be planned and executed to maintain the well-being of future generations, meaning that it has to extend to the far future and be global in extent. Long-term strategic planning is, however, fraught with difficulties, which presently often make it impossible. In accord with a number of studies [24], it is recommended that currently the best planning option is the reflexive iterative process: monitoring the progress and circumstances periodically, adjusting for need changes in the plan, and carefully learning from the experience, while maintaining the overall objective, with appropriate participation of stakeholders.

Sustainable development also has responsibility across global (and beyond) geographic boundaries, both since the future generations we try to keep happy may live anywhere in the world and not just in the country of their ancestors' (our!) birth/residence, and because it is impossible in the long term to maintain sustainability of a country without ensuring the sustainability of most of the other countries on earth.

In contrast with most studies that focus on using the metrics and indicators mainly for monitoring progress to sustainability, we emphasize the importance of integrating them into the planning, design, and development process, for a-priori creation of sustainable development, products, and systems.

The current democratic political systems are not amenable to sustainable national development because are based on short-term election of political leaders and resulting short-term planning, typically making multigenerational planning impossible, and excessive nationalism makes global planning very difficult. Preferred ways by which democratic governments could overcome them are also described in [24]. They range from more rigorous development and use of scientific

[1] The unity of knowledge, a coming together of knowledge.

methodology in sustainable development, through proper public education, longer terms of office of elected officials responsible for *SD*, and to enlightened legislation that employs reflexive sustainable development with participation of relevant stakeholders and establishes sustainable development leadership bodies that are given a legal/constitutional obligation and responsibility to ensure continuity of *SD* plans and implementation at the multi-generational time scale. All this must stand on a firm ethics foundation: it is widely recognized that corruption, on individual through corporate and to governmental levels, may be the strongest enemy of sustainable development. Much remains to be done, very creatively.

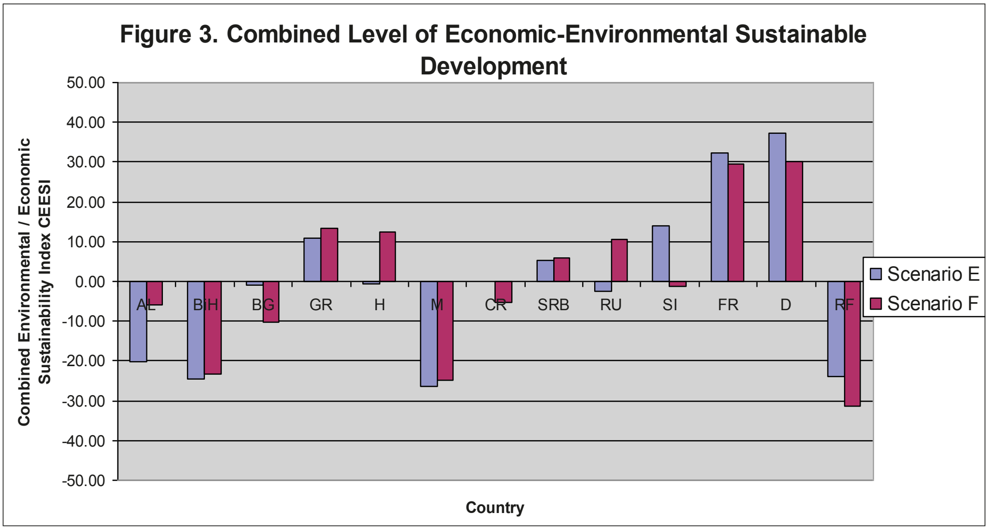
A SUSTANABILITY ANALYSIS EXAMPLE (unpublished work based on [1], [25–27])

To demonstrate the use of sustainability analysis, a brief example of its application for national planning follows. It is taken from a quantitative examination by the authors of sustainable development in 10 developing Southeast European countries, with comparison to the developed countries Germany France, and the Russian Federation. One of the foci of the study was to find whether global or conventional sustainability indicators, such as the Gross Domestic Product (GDP-PPP) and conventional climate change indicators are also the most important for such emerging countries. Twenty indicators of sustainable development, each with a weight, were selected for the analysis in which composite sustainability indicators were calculated.

The analysis was done for six scenarios. On the economic side, Scenario A is the typically adopted one in which the GDP-PPP indicator's weight dominates over that of the Gini Index of equal GDP-PPP distribution among the citizens, and Scenario B in which the Gini Index weight dominates over that of the GDP-PPP. On the environmental side, one scenario (C) is the typically adopted one in which the weights of the climate change indicators dominate over those of increased agriculture, forestation, and energy use, and the other (D) where the weights of increased agriculture, forestation and energy use indicators dominate over those of climate change.

Scenario E combines the features of Scenarios A and C and thus represents the currently typical approach to sustainability analysis in Europe, and Scenario F combines those of Scenarios B and D and thus represents an approach to sustainability analysis that somewhat lowers the dominant effect of GDP-PPP and climate change to favor sustainability criteria that may be more suitable for developing countries like those in SEE.

Figure 1 shows the results of the research display significant differences between levels of sustainable development achieved by using these two different approaches. It is also noteworthy that in some countries the same changes have different (positive or negative) effects. Sustainable development planners and policy makers should be aware of these facts and should carefully choose indicators and weights that are suitable for their countries, especially when the countries are at their initial stages of sustainable development. Uniformity and scientific consensus based standardization of sustainability analysis methodology are critically needed.



Regardless of the applied scenario, Germany and France continue to show the best results in the group. Russia, Bosnia and Herzegovina, and Macedonia show the worst three results in both scenaria.

The results under Scenario E (high value of GDP and climate change indicators) among the SEE countries show positive results only by Slovenia, Greece, and Serbia. Application of Scenario F (lesser importance of GDP and higher importance of natural resources) are different than under Scenario E: in most countries the change is moderate (Bosnia and Herzegovina, Greece, Macedonia, Croatia, Serbia, France). In Germany, Bulgaria and Russia the combined *CSI* dropped with a more significant change, and in Hungary, Romania and Slovenia it is significant. Only 3 of the SEE countries, Bulgaria, Croatia and Slovenia, show a reduction of the *CSI* under Scenario F, indicating that this scenario favors the sustainability of most of the SEE countries.

Choosing between economic development at any cost, and finding a balance between the economy and the environment is definitely a country's choice based on its preferences and priorities at any given time. Choice of a sustainable development strategy must be accompanied by the selection of an appropriate measurement methodology that would properly evaluate the conditions of the country and that would be flexible and under constant supervision by professional staff. Use of traditional GDP-based or sustainable beyond-GDP-based measurement and assessment methodologies is a country's choice, but policy makers must be aware of such differences, which may be large, and that strategic decisions based on disputable measurement results may thus have very complex long-term consequences.

Besides the right assignment to the GDP, another weight choice example is associated with use of fertilizers. Without fertilizers a country cannot produce sufficient agricultural product from which it could create an income and GDP-PPP. On the other hand, most current methods for using fertilizers are environmentally harmful. Yet another example of a frequently used sustainability indicator is the extent of the agriculture that is organic, but countries that depend on agriculture as a source of income cannot easily transit to organic production, just because of the environmental benefit, because the cost of organic agriculture products is typically higher and the yield lower.

Sustainable development evaluations that assign higher importance to wealth of natural resources have proved to show higher sustainability indicators for most countries.

CONCLUSIONS

Sustainable development is of existential importance for humanity, its planning and implementation are rather complex, and the most effective way (or the only practical one) for that is by applying scientific principles. These, like any science, require proper measurement and quantification. Significant work critically needed to develop uniformity and scientific and political consensus -based standardization of sustainability analysis methodology.

REFERENCES

[1] N. Lior, „Quantifying sustainability for energy development". *Energy Bulletin No. 19, 8–24. International Sustainable Energy Development Center under the Auspices of UNESCO, July 2015* (published in English and Russian).

[2] UN World Commission on Environment and Development, Our Common Future: Report of the World Commission on Environment and Development, 1987, Gro Harlem Brundtland, Chair. http: //www. un-documents. net/our-common-future. pdf

[3] T. Jefferson, From The Founders' Constitution, Chapter 2, Document 23, Papers 15: 392—97, *Thomas Jefferson to James Madison, 6 Sept. 1789*. Philip B. Kurland and Ralph Lerner, eds. University of Chicago Press and the Liberty Fund, 2000. http: //press-pubs. uchicago. edu/founders/documents/v 1 ch 2 s 23. html

[4] N. Lior, „Sustainability Ethics and Metrics: Strategies for Damage Control and Prevention", *J. Environmental Accounting and Management 1(1) (2013) 15–24.*

[5] WWF, „Living Planet Report" 2014, http: //wwf. panda. org/about_our_earth/all_publications/living_planet_report/ International, Avenue du Mont-Blanc, 1196 Gland, Switzerland (accessed 4. 1. 2016)

[6] United Nations International Department of Economic and Social Affairs, International Decade for Action 'Water for Life' 2010–2015 http: //www. un. org/waterforlifedecade/quality. shtml

[7] UNEP, Clearing the waters, http: //www. unep. org/PDF/Clearing_the_Waters. pdf

[8] J. Parikh, N. Lior, „Energy and its sustainable development for India, Editorial Introduction and commentary to the Special Issue of Energy — The International Journal", *Energy 34 (2009) 923–927.*

[9] H. Jin, N. Lior, X. Zhang, Energy and its sustainable development for China: Editorial introduction and commentary for the special issue of Energy — The international journal". *Energy 35 (2010) 4246–4256*

[10] N. Zhang, N. Lior, H. Jin, „The energy situation and its sustainable development strategy in China. *Energy 36 (2011) 3639–3649.*

[11] M. Golušin, O. Munitlak Ivanović, S. Domazet, S. Dodić, D. Vučurović, „Assessment of the effectiveness of policy implementation for sustainable energy development in South East Europe", *J. Renewable and Sustainable Energy, Vol 3, 2011.*

[12] N. Lior, „Sustainable Energy Development (May 2011) With Some Game-Changers". *Energy 40 (2012), pp. 3–18*.

[13] M. Radovanović (Golušin), S. Dodić. S. Popov, „Sustainable Energy Management", *Elsevier — Oxford Academic press, 2013* http: //store. elsevier. com/product. jsp?isbn=978 0123914279&pagename=search

[14] UN Department of Economic and Social Affairs, „The Millennium Development Goals Report" 2013 ISBN: 978 -92–1-10128 4 -2. http: //www. unfpa. org/publications/millennium-development-goals-report-2013.

[15] The Leadership Council of the Sustainable Development Solutions, „Network Indicators and a Monitoring Framework for the Sustainable Development Goals" Revised working draft (Version 7), *March 20, 2015*, http: //unsdsn. org/wp-content/uploads/2015/03/150320-SDSN-Indicator-Report. pdf

[16] Innovation Seeds, „Insure", http: //www. innovationseeds. eu/Virtual_Library/Results/INSURE. kl

[17] N. Lior, „About sustainability metrics for energy development", *invited keynote presentation and proceedings paper at the 6th Biennial International Workshop „Advances in Energy Studies", Graz, Austria, 29 June — 2 July 2008, Graz University of Technology Publication ISBN 978–3-85125–018–3, 390–401.*

[18] A. Azapagic, S. Perdan, „Indicators of sustainable development for industry: A general framework". *Process Safety and Environmental Protection, 78, 2000, 243–261.*

[19] R. B., Gibson, S. Hassan, „Sustainability assessment: criteria and processes", *Earthscan, London, 2005*

[20] S. A.,Waage, K. Geiser, F. Irwin, A. B. Weissman, M. Bertolucci" P. Fisk, G. Basile, S. Cowan, H. Cauley, A. McPherson, „Fitting together the building blocks for sustainability: a revised model for integrating ecological, social, and financial factors into business decision-making". *J. Cleaner Production 13, 2005, 1145 -1163.*

[21] OECD, ISPRA, „Handbook on constructing composite indicators: methodology and user guide" *— ISBN 978–92–64–04345–9 — OECD 2008*

[22] A. A. Martins, T. M. Mata, C. A. V Costa, S. K. Sikdar, „Framework for Sustainability Metrics". *Ind. Eng. Chem. Res. 2007, 46, 2962–2973.*

[23] F. Szekely" M. Knirsch, „Responsible Leadership and Corporate Social Responsibility: Metrics for Sustainable Performance". *European Management J. 2005; 23(6): 628–647*

[24] N. Lior, „Reconciling long-term Sustainable Development and R&D planning with the short-term preferences that drive governments, businesses, institutions, and individuals". *Paper FP-85 in the 6th UNESCO sponsored Conference on Sustainable Development of Energy, Water and Environment Systems, September 26–29 2011, Dubrovnik, Croatia. ISBN 978–953–7738–12–9.*

[25] S. Filipović, M. Verbič, M. Radovanović, „Determinants of energy intensity in the European Union: A panel data analysis", *Energy (2015) Vol 92; str. 547–555.*

[26] M. Golušin, O. Munitlak Ivanović, A. Andrejević, S. Vučenov, „Survey of socio economic growth in SE Europe — new conceptual frame for sustainability metrics", *J. Economic Surveys, Vol 28, Issue 1, p. 152–168, 2014.*

[27] M. Golušin, O. Munitlak Ivanović, L. Jovanović, S. Domazet, „Determination of ecological-economic degree of development in Countries of SE Europe — weight coefficients technique", *Problems of Sustainable Development, Vol 7, No 1, 2012.*

Vesna BALTEZAREVIC*
Radoslav BALTEZAREVIC**

THE INTERNET AND VIRTUAL „REALITY"

Abstract: The Internet is undoubtedly one of the most provocative sociological and psychological phenomena. In addition, the Internet is a new virtual world of „reality". Computer Communications and entire virtual culture show inseparable connection between technology and society. The Internet connects people, connects all those struggling communicators who cannot cope in the real world. But, would it be fair to speak about human interaction in space, which is not a space, in the time that is stuck somewhere between computer programs and the people who are not people but „borrowed fictional characters". We have to accept that the Internet is networking, or virtual society as a space inhabited by virtual friends. At the moment, we lack many answers, but running away from reality indicates that in the real world there are so many problems which lead humans to a desire to escape into the virtual world.

Humanity has lost interest in everything that happens in the real world. Conformism prevailed not only in behavior, but also in thinking. Modern man has less and less time for real meetings and socializing. Globalization, the reduction of individuality,cloned sameness kills the charm of the real life, socializing and communication.

Key words: *the Internet, virtual, reality, computer, people, communication*

INTRODUCTION

The Internet communication and the whole cyber-culture show an inherent connection between technology and society. The social interactions of millions of people around the world, along with the creation of their virtual identities, social relationships and communities, lead to the scenario in which the computer technology and virtual communication are actually forming the parallel society and the new virtual cultural space.

Mass communication has become the dominant mode of information exchange necessary for a contemporary man. In the system of general globalization,

* Full professor, John Naisbitt University, Faculty of Culture and media, EASA fellow
** Assistant professor, American University Middle East Kuwait, Faculty of business administration

the mass distribution of information has become increasingly globalized, and omnipresent. Space without „boundaries" in the media sphere provides a media platform for creating the layout behavior of public opinion. Thus, contemporary media „outgrew" its basic informative role, consequently transforming into the creator of „reality" [1].

Each individual has an awareness of the self and his/her belonging to the specific type of people, as well as the ability to identify one's own personality traits, skills and knowledge, share convictions, values and attitudes that are different in relation to any other group [2]. The skill of a communicator to establish a good communication relationship with others determines his/her position within the social group. In a situation where an individual is not satisfied with the expression of one's own personality within a social setting, because the degree of realizing social integration did not bring the expected recognition, the person begins his/her search for a new social framework. One of the alternatives is the use of the Internet, which can significantly contribute to the alleviating of the feelings of loneliness [3].

SOCIAL BELONGING

Each individual has an awareness of the self and his/her belonging to the specific type of people, as well as the ability to identify one's own personality traits, skills and knowledge, share convictions, values and attitudes that are different in relation to any other group. A person builds its identity through preserving the individual, while adapting to the collective behavior patterns. In an environment characterized by a high percentage of psychological problems experienced by the general population, the need for finding security within the group becomes more pronounced. Belonging to a group, or a certain collective, apart from security brings also a certain sense of self-evaluation. This phenomenon not only identifies one with a particular group, but also provides the experience that the group bestows some special qualities, thus making one stand out from the others.

Man is a social being with a potent desire to belong, both at the individual and larger social group levels. If satisfactory level of communication is not achieved in the real world, spiritual groups create online communities to promote their beliefs and the community becomes an informally bound group of people who share their expertise and passion. How successful is the modern man coping with a globalized, alienated world where there is less and less time for face–to–face contact? It is but a small group of people who can successfully cope with the unstoppable current of daily changes, who are able to build their own social capital. Such individuals or groups achieve an advantage over other players who are struggling in the modern age. Alienation, increasing isolation and burden of searching for ways to meet basic human needs in times of transition, as well as the accumulated effects of the global crisis in poor societies is constant, resulting in restrictive human encounters and the communication deficit. Persons who have problems with social adaptation, who are burdened with a sense of low self-esteem and rejection by other members of the group, are looking for alternative methods that can help them fill these gaps.

In cyberspace, we often have the opportunity to meet the complete lives of others. As one has written a diary that is being exposed to the sight of the observer: there are photos of all events, often in chronological order placed on a daily basis. A full life is exposed to the bare nakedness and available to everyone. The persons, who are doing this in a virtual community, are usually detached and unavailable for conversation and sharing of secrets in real life.

Social anxiety is for many the biggest real life obstacle for establishing relations and contacts with other people. In the online world, one is spared of such an obstacle: we can be anyone. Acceptance for socially isolated people, can mean a great deal, can invigorate their lives and bring personal satisfaction. Virtual communication gives the illusion of conversational easiness, and virtual friends can sometimes understand us, unburdened by our past, lifestyle and habits. Internet is undoubtedly one of the most provocative sociological and psychological phenomena.

True friendship is based on a sincere relationship, the intimacy and confidence, body language, signals. Can a network provide that? Friendship on social networks is largely based on the same or similar interests, because someone behind the monitor came to the same place where you are, for a definite reason. In cases of people who are, for example, living in a small town and cannot meet people with similar interests, it is a unique opportunity to find a „soul mate".

Internet connects people, connects all those struggling communicators who cannot cope in the real world. Would it be fair to speak about human interaction in space, which is not a space, in the time that is stuck somewhere between computer programs and the people who are not people but „borrowed fictional characters". We have to accept that Internet is networking, or a virtual society as a space inhabited by virtual friends. Statements by some members of these communities, such as: *Who is not on Facebook, does not exist*, does not show the degree of correlation, but the level of more drastic alienation [4].

Visitors of the virtual space claim for the virtual communities that they are „more real than their real-life" and that real life is just one of the „windows" and not necessarily a place in which a person feels better [5].

The person on the Internet can create a virtual role that will appear with a fictitious identity, form a new entity, or a different view of themselves. Often the new person has been in opposite relation to the real one. It has everything that a visitor of internet wanted to become, but did not [6].

THE INTERNET AS GLOBAL REALITY

Communication methods, as well as the position of man in a social setting, have been simultaneously changing with the development of human society and its technological advancement. In the absence of real time for meeting with people, the attraction of the Internet becomes new phenomena of the human community. Virtual world offers pleasure to a communicator positioned by his own choice in the computer world, as opposed to dissatisfaction or disorientation of the real word.

Internet allows individuals to be involved in these virtual creations. They are providing users with an opportunity to meet new people reacquaint with old

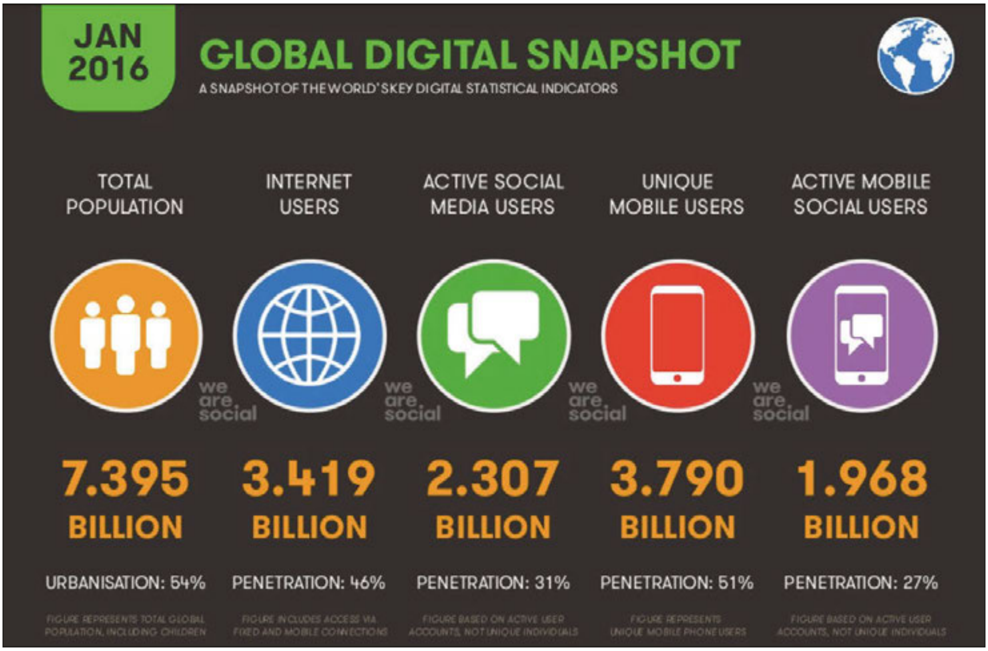


Figure 1. Using of the Internet technology [9].

friends and quench their communication needs. It does sound nice, but we need to ask ourselves whether such communications actually result in alienation.

But on the Internet, in virtual space people are feeling free, and often cross into communication anarchy in the absence of censorship. In such behaviors the excess of their freedom, often leads to endangering other people's freedom [7].

Avatar is a virtual body the one who enters into the virtual community inhibits. In this case, an avatar is a body that is used when a person from the real world goes into the virtual world to visit other members. Avatars usually have a human face, but they are also present in the form of animals or objects. Avatars are built mainly on some of the characteristics or preferences of their owners. Entering the virtual world is like going to a plastic surgeon: one can change the appearance according to the personal preferences, while the „surgical" procedure is painless and free of charge.

Anonymity that the Internet provides to its users represents a surrogate mask which is, by turning on the computer, mounted on the face.

„When self-doubt in one's own beliefs, person adopts other people's beliefs or actions in order to receive their guidelines for appropriate behavior. The theory of social comparison explains that conformity provide us different means of self-evaluation" [8].

Figure 1. illustrated that the Internet technology has become part of our everyday life: Almost 50 percent of the world's population, or 3.42 billion people use the Internet every day. Mobile phones actively using the 3.79 billion people, or 51 per-

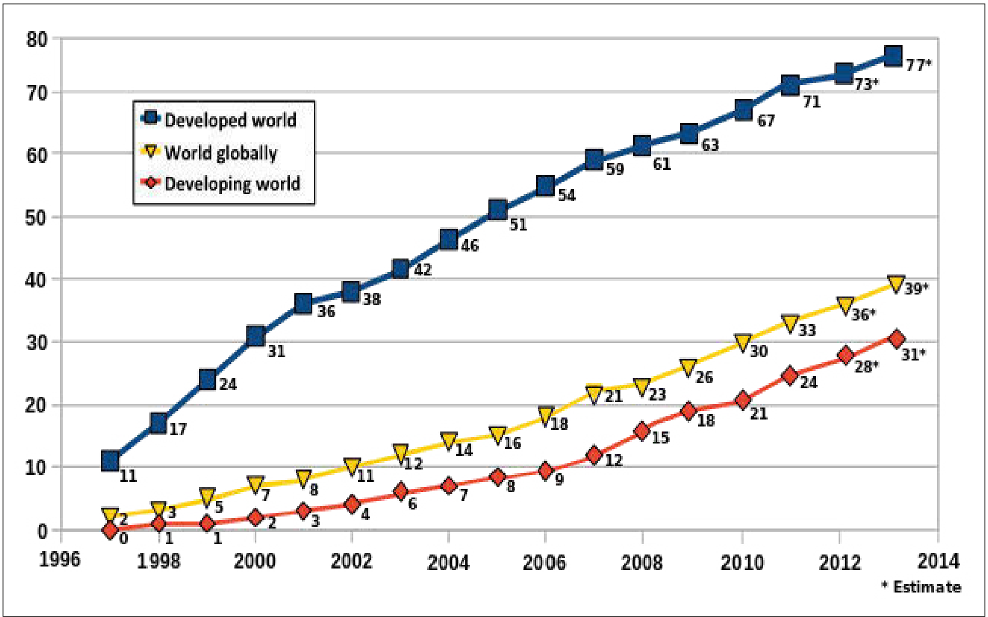


Figure 2: Growth in the number of Internet users 1996–2014 [10].

cent of the world population. Profile on social networks has one-third of people, or more than 2.3 billion. Nearly two billion social network users access their profiles via mobile phone — 27 percent of the world population. Cyber society is, in fact, a society created by the modern technology, mainly computer technology. However, mobile communication, telephone communication and audio-visual communication also belong to the virtual society, within which every action takes place in real time, but in the invisible, virtual space.

From the figure 2. we can see that in a developed world number of the Internet users has emerged from 11 percent in 1996 to 77 percent in 2014; the developing world recorded significantly weaker progress-from 2 percent at the beginning of the observed period to 39 percent in 2014. Use of the Internet is an interactive process in which users, with distinctive characteristics, are on one side and a virtual space with its specificities on the other side [11].

Virtual communication has significantly affected the nature of social life and social interaction at the end of the 20th century. Through contact with other people we fulfill both our individual and collective needs [12].

SOCIAL NETWORK

The number of social network site users is growing on the yearly basis, but over time there are also an increasing number of people, especially on Facebook, shutting down their accounts or using it much less frequently. The reason for this is the

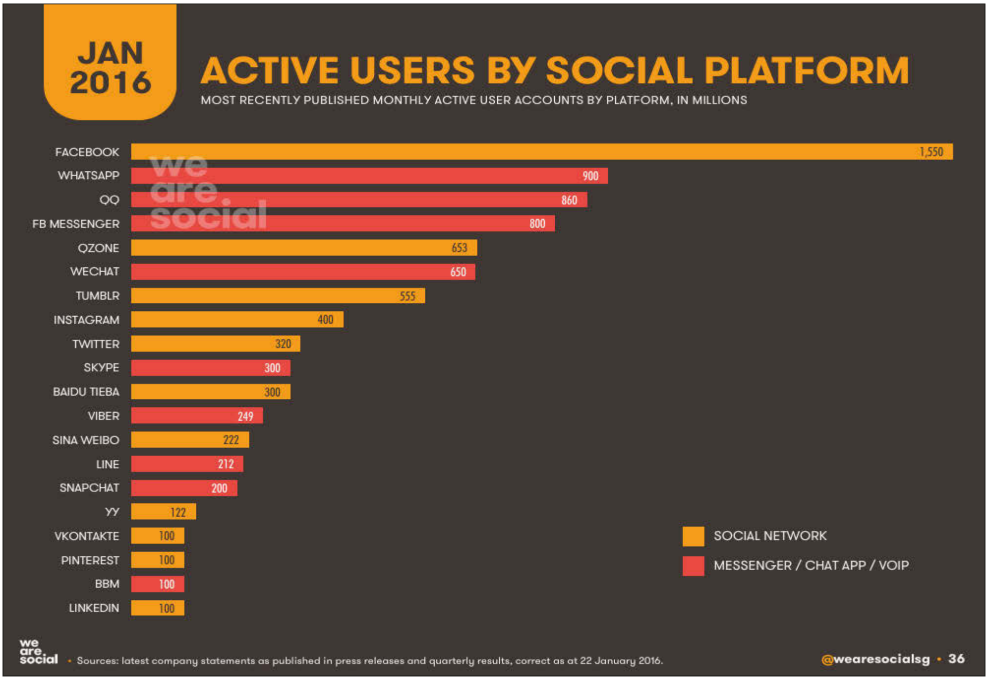


Fig. 3. Social network users [13]

options by means of which other users, as well as the newly introduced options, are rendering the services obsolete and strenuous.

From the fig. 3. we can conclude that Facebook is the largest social platform. People go to Facebook to „meet” their friends and to find out what they are doing. Facebook is a bank full of photos, and it looks like some kind of modern record of who is who and what he/she is doing.

Although the reasons why people join social networking are heterogeneous, one factor stands out as a particularly strong motivation: the desire to maintain contact with friends [14]. Researchers speculate about another factor — our need to publicly show social contact and closeness. Social networking has its other seemingly paradoxical way: contributing to feel lonely.

There is a connection between the extensive use of the Internet and the sense of loneliness and depression. After the first online experience, level of satisfaction with their own lives and the degree of social cohesion as a decreasing function of ways, i. e. scope of use of the Internet begins to decrease [15].

The relationship between Facebook and unhappiness is conditioned by social comparison. It is our intention to compare with people at relevant parameters considered similar to themselves. In the context of social networks, of course, we tend to network administration with such people. If they inform us about their personal or professional achievements, here appears less sense of values. When the owner of the profile limited to passive participation — monitoring posts of your friends without commenting and *like*- Facebook has the opposite effect: it reduces the feeling of connection, and increases the feeling of loneliness.

CONCLUSION

People passing through various stages of development of human society reacted differently to the changes that have transformed their way of life. With the advent of computers and the Internet, a technological leap in the human community took place, laying the foundations of a new, parallel virtual world. The need for communication, as well as the challenge sets sail for the inexhaustible virtual landscapes and typing of the feelings on the keyboard, is opening a recently initiated odyssey quest for answers.

We can conclude that the modern era, although providing with highly productive technological discoveries, demands a shift towards a genuine human being. Although the social life is focused on virtual contacts, communication is still considered a central component of effective social processes with priority given to the respect of human.

Modern technologies have significantly contributed to the redefinition of communication, and the transition to the techno sphere is carried out with the support of IT network which increases the risk of value systems conditioning. The benefits of the Internet are great, but only when it is understood as a tool, and not as an instant replacement of real life.

REFERENCES

[1] Baltezarevic, V., Baltezarevic, R. & Baltezarevic, B. (2016*). Behind the Media Curtain*. Saarbrücken, Germany: Lap Lambert Academic Publishing. p. 15.

[2] Radović Marković, M., Baltezarević, V., Baltezarević, R., Marković, D. (2014): *Virtual organisation and motivational business management,* Alma Mater Europea-Evropski centrer Maribor & Economics Institute Belgrade, Ljubljana-Beograd. p. 101.

[3] McKenna, K., & Bargh, J., (2000)."Plan 9 from cyberspace: the implications of the Internet for personality and social psychology", Personality and Social Psychology Review, 4: 57–75.

[4] Baltezarevic, V., Baltezarevic, R. & Baltezarevic, B. (2016*). Behind the Media Curtain*. Saarbrücken, Germany: Lap Lambert Academic Publishing. p. 53–54

[5] Turkle, S. (1997). *Life on the Screen. Identity in the Age of the Internet*, Paperback edition, pp. 10–13, New York: Touchstone.

[6] Baltezarevic, V., Baltezarevic, R. & Baltezarevic, B. (2016*). Behind the Media Curtain*. Saarbrücken, Germany: Lap Lambert Academic Publishing. p. 62.

[7] Baltezarević, V., Baltezarević, R., Jovanović, D. *Communication trap in cyberspace,* Media dialogues, Journal for research of the media and society, Year VIII No 21, Podgorica, March 2015. (p. 365–373).

[8] Pennington, D., (1997). *Osnove socijalne psihologije*. Jastrebarsko: Naklada Slap, p. 247.

[9] Using of Internet technology. http: //wearesocial. com/uk/special-reports/digital-in-2016

[10] International Telecommunication Union (2014) Global ICT developments, http: //www. itu. int/en/ITU-D/Statistics/Pages/stat/default. aspx
[11] Bugarski, V., (2005). *Zavisnost od interneta-istina ili zabluda?,* E-volucija, 11. http: // www. bos. rs/cepit/evolucija/html/11/net_zavisnost. htm.
[12] Walters, D. (2000). Virtual organizations: new lamps for old? Management Decision, 38,5/6, 420–436.
[13] Social network users phttp: //wearesocial. sg/blog/2016/01/digital-2016/
[14] Wilson, R. E., Gosling, S. D., & Graham, L. T. (2012). A review of Facebook research in the social sciences. *Perspectives on Psychological Science*, *7*(3), 203–20.
[15] Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox. A social technology that reduces social involvement and psychological well-being? American Psychologist, 53 (9): 1017–31.

Ullica SEGERSTRALE*

COOPERATION AS A SOCIAL TECHNOLOGY

Abstract: Social technologies have to do with the organization of social life and the solution of human problems. One of the most important social technologies is cooperation. This essay discusses an ongoing multi-disciplinary effort by evolutionarily oriented anthropologists, sociologists, political scientists, psychologists, historians and economists to examine the contribution of cooperation to human evolution. Experiments, field research and modeling have increasingly demonstrated that people are in fact concerned about the common good. Evolutionary game theory has been instrumental in investigating the conditions for the emergence and sustainment of cooperation. A new paradigm of cooperation seems posited to replace the old one postulating individual selfishness.

INTRODUCTION: WHAT IS A SOCIAL TECHNOLOGY?

Technologies are often seen as involving the development of things, typically machines of various sorts. The focus is on the product and what it can do. But technologies can be defined much more broadly. They can be regarded as strategies for doing things. This means they have to do with the organization of social life and the solution of various human problems. These are what I call social technologies. And one of the most important social technologies is cooperation.

One can actually find agreement with such a view among researchers on technology. For instance, my favorite historian of technology Rudi Volti whose textbook is now in its 7th edition, defines technology as follows:

„A system created by humans that uses knowlede and organization to produce objects and techniques for the attainment of specific goals" (Volti, 2007, p. 6).

It is even more encouraging to see his endorsement of Lewis Mumford's view of the first machine:

„There is considerable merit in Lewis Mumford's assertion that the first „machine" was not a physical object, but the organizational structures that the Egyptian pharaohs employed to build the pyramids" (Volti, 2007, p. 5).

---

* Illinois University, Chicago; WAAS fellow

In this essay I will look at recent developments which I believe represent an important paradigm shift in behavioral research. What has been emerging over the last two decades or so is an implicit — or sometimes explicit — collaboration between different types of social scientists interested in evolutionary reasoning about the origin of cooperation: anthropologists, sociologists, political scientists, psychologists, historians and — importantly — a new brand of economists. We see an upswing in game theoretical modeling, which demonstrates under what conditions cooperation is likely to take place, comparative field studies of the norms underlying cooperation in small scale societies, and ingenious experiments of individual choice in economics laboratories. One scientist whose whole life in fact has been dedicated to finding ways to improve the human situation, both the conditions for achieving cooperation and the strategies for resolving conflict, is political scientist and game theorist Robert Axelrod, who recently received the Presidential Medal for Science from President Obama.

A NEW CLIMATE FOR RESEARCH — BEYOND „THE SELFISH GENE"

Towards the end of the twentieth century, the social climate was increasingly turning away from the environmentalist explanations of „culturism" and the post-World War II taboo on biological explanation of human behavior. By 2000 the taboo had been broken. With the Human Genome Project and the promise of biotechnology, genetics was becoming practically a household word. „Gene talk" even became popular, and the media started reporting ever new discoveries of a „gene for risk taking" and the like.

In other words, the climate had become much more receptive to the idea of a biological foundation of human nature, a human „species nature" (a basic point of E O Wilson's treatises on sociobiology, 1975 and 1978).

Instead of the significant cultural differences that Margaret Mead and other anthropologists had so vividly described, new anthropological studies now documented the existence of human cultural universals (Brown, 1991). The nature of animals also was reinterpreted. During the sociobiology controversy (from 1975 onwards, see Segerstrale, 2000), there had been great unwillingness to draw parallels between humans and animals, because of the emphasis on such traits as aggression (ever after Konrad Lorenz' *On Aggression*, 1966). Of course, Hamilton (1964) had famously shown that it had indeed been possible also for a trait such as altruism to evolve, but that was typically regarded as limited to helping close relatives („kin selection"). But in the 1990 s, research on both ape language and culture presented chimpanzees as much more similar to humans and considerably 'nicer' than depicted in the 1960's (de Waal, 1996 and later). Important new connections between nature and culture in both animals and humans could also be found in the interdisciplinary field of nonverbal communication (Segerstrale and Molnar, 1997).

So the general climate had become more open to biological explanations of human behavior. But what was the language that was being used like? The discussion was still stuck in the language from the sociobiology controversy and Richard

Dawkins' *The Selfish Gene* (1976). There seemed to be no getting away from the talk about selfish genes — especially since the leading research paradigm (which focused on the survival of genes, rather than individual organisms) was often called „selfish gene theory".

Of course, the title *The Selfish Gene* was a kind of tongue-in-cheek title — genes can obviously not be 'selfish' in a human sense. But genes can be seen as self-replicating, and Dawkins' added anthropomorphic twist made for a very vivid explanation, even for his biological colleagues. (In fact, Hamilton himself had used the „gene's-eye" perspective in his early papers to illustrate how altruistic behavior could be explained by gene-centered reasoning; this Dawkins later took to new pedagogical heights).

The problem was that the title was misunderstood from the very beginning. It takes a pre-existing background acceptance of evolutionary theory to be able to play along with ideas such as the selfish gene in order to improve one's scientific understanding. For those who do not have such a background, „selfish" just makes a direct connection with the psychological and moral realm, which is what happened in many instances. Many did see the book as condoning selfish behavior, and approved. Some academics, too, criticized the book just because of its perceived exhortation to individual selfishness (including Karl Popper, the famous philosopher of science), and especially during a time of Thatcher's Britain and Reaganomics in the United States.

Was Dawkins guilty of anything else than using a catchy, though easily misunderstood metaphor? Well, a new check of his book produces the following uncomfortable citation:

„We are survival machines — robot vehicles blindly programmed to preserve the selfish molecules known as genes.… Let us teach generosity and altruism, because we are born selfish" (Dawkins, 1976, p. 7)

This quote would seem to suggest that our selfish genes make us selfish, which is of course nonsense, but it does indicate that the author believes that human nature is primarily selfish. He is here rather adopting a Thomas Henry Huxleyan view of the world: nature is basically amoral, or bad, and this is why we need culture and education to teach us to be moral. This view may in fact represent a larger undercurrent in the British biological tradition, which probably goes hand in hand with the view of competition as the driving force in evolution.

But not everybody was buying into this kind of metaphor. „Selfish" didn't sound good in everyone's ears. „Kin selection", when you thought of it, didn't sound much better. Were we supposed to primarily stick to our kin and ignore others? In any case, „selfish" and „kin" did not necessarily have positive social connotations.

Moreover, some biologists had early on reasoned that what seemed to be altruism was not really so: a donor that helped an individual that shared its genes was just indirectly promoting its own fitness. Or as biologist Michael Ghiselin (1974) put it: „Scratch and altruist, and watch a hypocrite bleed".

Was there, then, an alternative? Yes, cooperation! What a welcome and intuitively positive word, and with plenty of good examples that could be brought in. This was a satisfactory term for both scientists and non-scientists who wanted a change of language and emphasis. And of course, cooperation as a scientific topic was awaiting further exploration. Its turn had come.

EXPANDING EARLIER THEORIES OF COOPERATION

Kin selection could be seen as a type of cooperation, but it is limited to some kind of genetic relatedness. This relatedness typically involves relatives, hence the term „kin selection". However, this term (launched by his colleague Maynard Smith) limited Hamilton's initial vision of „inclusive fitness" (having to do with the fact that social individuals affect each others' life chances), because he interned it to apply also to individuals that were not formally relatives, but happened to share the same gene „for" altruistic behavior. But how would they find each other? He suggested that the altruistic gene could be connected to a „superkinship trait", that is, some kind of phenotypic identification which would make it possible for such individuals to identify fellow altruists) (Hamilton, 1964; 1975).

A more obvious candidate for cooperation is the theory of „reciprocal altruism" (or rather, reciprocity), proposed by Robert Trivers (1971). This was a theory that Hamilton welcomed as an important complement to his own theory involving altruism based on relatedness („kin selection"). It is in principle more general, since it does not expect that the interacting parties are related. The theory's basic idea is „I'll scratch your back, you'll scratch mine", exemplified for instance by mutual grooming among many bird and mammal species, or coalition-forming by animals, or mutualism (mutual assistance between members of different species, for instance cleaner fish and their hosts).

But later research has suggested that reciprocal altruism may in fact be rather rare among animals. For it to be direct reciprocity, individuals would have to recognize each other and also remember their earlier encounters; this is not easily achieved. It is now believed that reciprocity appears mostly among humans and higher primates.

A typical problem in regard to reciprocity is *cheating*, that is, taking advantage of a benefit that has been offered, but then not paying back. Evolutionary psychologists believe that humans for this reason are particularly adept at cheater detection. (So are also higher primates, to some extent). But later extensions of the idea of reciprocity have expanded the possibility of cooperation to include much bigger groups. One such idea is *indirect reciprocity* (Alexander, 1987; Nowak and Sigmund, 1998). Indirect reciprocity has to do with building one's reputation, and using *reputation* as a proxy of sorts. This means that an individual with a reputation for helping would be more likely to be helped by others in the same community. (This can also explain why humans are so interested in gossip about others).

This was one attempt to expand reciprocity, but for many this did not yet provide a satisfactory explanation for the problem that needed an answer: what about situations in which it is hard for even indirect reciprocity to work? Especially: how can cooperation among strangers in large scale societies come about? Moreover, how might the problem of cheating be resolved there? The obvious answer would be to have some kind of *sanction for non-cooperation,* or „free-riding". Was this going on in real life? Anthropologists explored and documented the existing solutions to this in small scale societies (e. g., Henrich and Boyd, 2001).

Still, one question that arose was: Just how would this punishment system work? Who would do the punishing? Wouldn't meting out punishment be costly and unrewarding for individuals, and potentially give rise to a „second order free rider problem" involving those who shirked their duty to punish free-riders?

This is where the interesting concept of „*altruistic punishment*" was introduced into the discussion:

„The punishment of free riders constitutes a second-order public good. The problem of second-order public goods can be solved if enough humans have a tendency for altruistic punishment. That is, if they are motivated to punish free riders even though it is costly and yields no material benefit for the punishers" (Fehr and Gachter, 2002)

These two economists set out to investigate experimentally a) if people in fact engage in „altruistic punishment" of this kind, and b) how this affects achieving and sustaining cooperation. Their study involved a game of „investment" in a „public good" and the possibility of „punishing" participants who were deemed not to contribute their „fair share". The study showed, surprisingly, that *people were in fact willing to pay in order to punish free riders — and this in „one-shot" encounters where they would not reap any benefit from it themselves.* The researchers explained this seemingly irrational behavior by suggesting that free riding causes strong negative emotions, which trigger a wish to punish. In other words, *emotions* are an important proximate factor for altruistic punishment. And because we are aware of the anger that cheating and free riding causes, we are sensitive already to the mere threat of punishment, the researchers noted.

This was a controlled economic experiment, but was this related to real life? The answer was yes. Anthropologists found a number of ingenious solutions in small societies, the evidence from the experiment agreed with data from studies of public goods, and was also consistent with historical studies of collective action (Bowles and Gintis, 2004).

Looking into this evidence Bowles and Gintis concluded: „cooperation is maintained because many humans have a predisposition to punish those who violate group-beneficial norms, even when this reduces their fitness relative to other group members". In other words, there was more to human nature than self-interest.

But who would be doing the punishing? Here entered a new concept: *strong* reciprocity (Gintis, 2000). Strong reciprocators do not only cooperate themselves but they also punish non-cooperators. To demonstrate the feasibility of this idea as a factor in human evolution, Bowles and Gintis decided to do an agent-based modeling to do a dynamic simulation over a span of 100,000 years. They showed how high levels of cooperation could be sustained in a population containing a mixture of cooperators and selfish types, as long as it also contained at least a few strong reciprocators. The model showed that the latter would be increasing over time (Bowles and Gintis, 2004).

So this research further supports the idea of human predispositions for fairness and adherence to norms, in this case expressed as a wish to punish those who deviate from what is good for the group.

THE CONDITIONS FOR COOPERATION: GAME THEORY AND TIT FOR TAT

Game theory was originally developed in the 1940 s and 1950 s by the mathematician John von Neumann and the economist Oskar Morgenstern. In game theory the realization is that the interests of individuals („actors") involved in an interaction (a „game") are not necessarily compatible. At the same time, each actor's best move is dependent on what the other actors do. Many aspects of social life can de described by game theory.

The prototypical two-person game is the famous Prisoner's Dilemma. The proto-typical multi-person game is The Tragedy of the Commons. Both models illustrate how the lack of cooperation between interacting individuals produces a result that makes everyone worse off than if they had cooperated. The Tragedy of the Commons is perhaps the more immediately obvious model. The „commons" is any shared resource for a group of individuals, and the tragedy is the short-sighted over-use of this resource by each individual without consideration for how this will affect the eventual outcome if everybody did it. (This leads to over-grazing, overfishing, pollution, destruction of the environment, traffic jams, etc). But in principle this tragedy can be avoided in various ways: through better information, getting people involved, incentives and punishments, norms, regulations, laws, etc.

The Prisoner's Dilemma model applies to many situations in real life as well. Two prisoners are arrested for a crime for which there is insufficient evidence. Each one is separately invited to confess („defect"), being promised a greatly reduced prison sentence. If both keep quiet („cooperate"), there is little evidence to keep them in prison. If both confess, both will get a severe penalty. But the worst penalty would come about if one kept quiet (cooperated) while the other one confessed (defected). This was typically the case with individuals in laboratory experiments with Prisoner's Dilemma-type games played by economists and political scientists in the past. There each partner reasoned separately that he would be better off defecting — and so both ended up worse off than if they had cooperated.

We are acquainted with Hamilton as the person who solved Darwin's puzzle about altruism through his idea of inclusive fitness („kin selection"). But later, he moved on to the question of cooperation between unrelated individuals as well. He was particularly concerned about what he saw as the inevitability of Prisoner's Dilemma situations in social life. It was hard for him to imagine how cooperation between unrelated individuals could ever evolve. There didn't seem to be any obvious way out of the dilemma, and this depressed him. But later, together with game theorist Robert Axelrod, Hamilton was able to show how cooperation between unrelated individuals could, in fact, come about. Their joint paper, „The Evolution of Cooperation", was later awarded the American Association for the Advancement of Science's (AAAS) Newcomb-Cleveland prize for the best paper published in *Science* in 1981.

Their classic paper aimed at demonstrating how game theory could be used to formalize various potential strategies for social actors in real life, and also to identify the conditions under which cooperation could come about. They provided a model which made it possible to make testable predictions over a wide range of species — all the way from bacteria to humans. Their basic reasoning was the following: In order for cooperation to work, individuals would either have to have disincentives to act selfishly, or incentives to act cooperatively. One possible condition would simply be not to be able to get away with acting selfishly. This would naturally happen if individuals could be counted on to meet again and be recognizable to one another. In other words, they would be involved in a *repeated or iterated Prisoner's Dilemma game*

Axelrod and Hamilton demonstrated how insights from an iterated Prisoner's Dilemma framework could illuminate the conditions under which cooperation between unrelated individuals could in principle evolve. What was needed was a high probability that individuals would meet (and „play") again. The basic insight was similar to Trivers' „reciprocal altruism", with the difference that game theoretical modeling made it possible to express that mathematically.

Biologically this principle could be realized in different ways. It could involve for instance maintaining continuous contact (e. g., inter-species mutualism), employing a fixed location (e. g., cleaner fish waiting for „customers"), territoriality (e. g., birds), ability to recognize faces (humans), or some kind of cues that indicated a promise of continued interaction. The interesting fact is that cooperation by reciprocity does not require a brain or memory — it is even applicable to bacteria! Bacteria are highly responsive to the chemical aspects of their environment, and can develop conditional strategies of behavior depending on what other organisms around them are doing. These strategies can be inherited. Higher intelligence organisms, of course, can play much richer games, since they are able to discriminate between individuals and can in this way reward co-operation and punish defection (Axelrod and Hamilton, 1981)

If the right conditions are present, cooperation can get started and be sustained even among antagonists (e. g., in politics or in wartime; for instance between the French and the Germans in World War I). Cooperation can develop in a population as long as there are small clusters of individuals who interact with each other and reciprocate. Such interaction clusters can be, and are in general, too, socially promoted through hierarchies, organizational structures, and spatial arrangements (see details in Axelrod, 1984).

To find out what is the most robust and desirable strategy, Axelrod famously used the method of computer tournaments between various strategies suggested by colleagues. The strategy that achieved the highest score was TIT FOR TAT. This strategy is very simple: *cooperate on the first move, and then do whatever the other player does. If the other player defects, retaliate, but then go back to cooperation.* In other words, TIT FOR TAT is „forgiving". It is also „nice" — it always starts by cooperating. Game theorists early on found that this strategy worked remarkably well and was widely applicable — be it to personal life, business or international politics. Later there have been updates: for instance a strategy called „generous TIT FOR TAT" is programmed to sometimes „forget" to retaliate to avoid chains of retaliation, and other measures may be needed to take care of defections that are in fact responses to errors or misunderstandings.

„TECHNOLOGY TRANSFER" TO HUMANS FROM INSECTS AND SLIME MOLDS

We can regard the process of evolution as a long trial-and-error search for sustainable social technologies. Scientists have started to tap into this enormous data base of accumulated information. Here are a couple of examples of what could be called „technology transfer" by mimicking living organisms.

It has long been believed that the secret behind teamwork can be found in the cooperative behavior of social insects. Recently this was investigated in a project involving biologists, computer scientists and engineers. First the biologists studied how ants solved various problems, for instance finding the shortest path to a food source, or determining when to dispatch workers to forage and bring back more food for the colony and bring it back. Then computer specialists simulated the situation with the help of agent-based modeling. These scientists were looking to find simple algorithms and simple rules behind the ant behavior that would later be usable for solving problems in real life, such as solving traffic congestion problems or moving objects up a slope. One of the important insights from this study was, incidentally, that rather than aiming for the best possible solution, just find a good one.

One of the things the researchers did was to mimic electronically the shortest path to a food source for a swarm of ants, indicated by the trail of pheromones left behind. When more ants use a particular trail the scent gets fortified; trails that are not used lose their scent. The artificial ants in the model deposited a digital equivalent of pheromone, proportionate to the shortness of the route. Just like real ants, also artificial ant agents learned to follow increasingly shorter routes (Peterson, 2000).

Living organisms can be amazing problem-solvers when it comes to calculating the shortest distance between two points. A slime mold (!) was able to beat serious experts on network analysis when it came to finding the shortest way through a maze or even planning a railway system. And this it did several years in a row (Gudrais, 2010, 44–50).

THE DARK SIDE OF COOPERATION RESEARCH

The evolution of large-scale cooperation was addressed already by Darwin in *The Descent of Man*. There he discussed the virtue of bravery and self-sacrifice and the general competitive advantage of groups with large numbers of altruistic individuals over groups with fewer. As a topic, however, this was not focal in evolutionary biology during the end of last century, because of a general emphasis on individual self-interest, competition and strategic calculation rather than spontaneous pro-sociality and cooperation as natural features for humans.

The challenge of dealing with unrelated strangers in large societies clearly required something beyond kin selection and reciprocity. As we saw, some researchers saw the solution in expanding the principle of reciprocity. Others, however, have taken a second look at *group selection* — a theory that has been out of favor for the last half century — or more properly termed, *„multi-level selection”*, since humans typically form hierarchically organized larger entities. Note that many group level phenomena, including different forms of cooperation, can be explained as beneficial for the individual, so invoking the process of group selection may not be necessary. Group selection strictly speaking requires a situation with sufficient genetic variation between competing groups, where the less fit „go extinct”. Applied to humans, it would mean that groups with a higher proportion of self-sacrificing individuals would tend to replace groups with fewer altruists.

Some leading biologists seem to take for granted that the „group extinction” required by group selection has most plausibly involved killing off the defeated group (e. g., Bowles 2006, Wilson, 2012). Boyd and Richerson (2009), however, suggest that members of the defeated group may rather get absorbed by the winner and learn their culture by resocialization, and bring in examples to support this view. Meanwhile there are different assessments about the level of killing in prehistory. It is, however, believed that genomic data will help improve our understanding of human evolution, including the timing of genetic changes and human population sizes and migration patterns.

I see the strong emphasis on ingroup-outgroup opposition of some researchers as the dark side of cooperation research. It is not clear what aim this serves, except to fortify the belief in the necessity of group conflict. We humans so easily commit the naturalistic fallacy, reading normative prescriptions into naturalistic statements — in this case thinking that what exists naturally is naturally „good” or „right”. Now those who are prone to thinking this way will only be fortified in their belief by the matters proclamations by „guru” scientists writing for the public. It matters whether or not you believe that ingroup-outgroup opposition is inevitable, or that such a conflict is the best or only way to bring about the desired goal of cooperation! Especially if you are an important social decision. Fortunately there are also researchers at work studies investigating how people in fact construe „ingroups” and „outgroups” (e. g. Cikara and Van Bavel, 2014), as well the various conditions under which cooperation can develop independently of the threat from an outgroup.

CONCLUSION

Recently there has been an increased interest in explaining various aspects of human cooperation, with special focus on the origin of large scale cooperation of unrelated humans. This quest goes beyond such proposed extensions as „strong reciprocity” and „altruistic punishment”. The question that is now challenging an multi-faceted community of researchers is: how did such large scale cooperation evolve in the ancestral human environment in the Pleistocene, which originally featured only small mobile groups of hunter-gatherers? Some see this question as intimately related to another big puzzle: the tripling of the human cranial capacity during the past 2 million years. These scientists are looking for explanations beyond the received view that this was due to some kind of mutation or „cognitive explosion", which has been a long-standing view. The result is a truly interdisciplinary project.

Nobody can go back to the Pleistocene, but plausible conditions can be modeled by comparison with existing small societies of hunter-gatherers and by considering available information about population movements, climate changes, and the like. Human evolution has typically involved cooperative and costly activities related to public goods, such as hunting big game, meat sharing, and warfare. This has brought in a new type of experimental economists, interested in working together with anthropologists and social scientific modelers, who together strive to explain how this evolution was possible. What made people participate in these costly cooperative activities, and how was this cooperation sustained? It seems increasingly clear that norms regarding this were developed originally in small scale societies and that the adherence to norms was closely monitored

An interesting alternative to the group extinction thesis is the suggestion that the human propensity for cooperation may well have arisen through *gene-culture co-evolution*, and here with *culture* as the driver. How can culture affect genetic evolution? Culture can in fact quickly create a new environment for adaptation and in this way put pressure on the genes — especially in times of rapid environmental or climatic change.

Also in another respect is culture given a larger role than before as a factor in human evolution. The „group extinction" required by group selection theory can in fact happen in the realm of culture. In other words, the variation that is needed between groups for there to be evolution (selection) at all can be of a purely cultural kind. Groups have naturally developed different social norms and ways of doing things. But the next step does not require inter-group competition or group extinction. It can happen by imitation of „better" approaches seen in neighboring groups. Or, as mentioned, after a conflict, members of the defeated group may simply get absorbed by the winner and learn their culture by resocialization (Boyd and Richerson, 2005, 2009). Alternatively, a selection pressure for „cooperative" genotypes might have been created by cultural rules alone (Bell, Richerson and McElreath, 2009).

These are exciting times for researchers interested in formulating a new encompassing theory of human nature and its probable origins, united by the wish to uncover and substantiate the until recently underrated role of cooperation as a factor in evolution. This could in fact be described as just going back to basics — that is, to the view of Darwin himself. At the same time, this effort can be seen as a current collective attempt to bring in a much needed paradigm in regard to human nature, one that both scientifically and morally rings more true than a paradigm based on human selfishness in the world today.

Acknowledgement: I wish to thank the Kone Foundation for financial support.

REFERENCES

[1] Alexander, R. D. (1987). *The Biology of Moral Systems*. New York: de Gruyter.
[2] Axelrod, R. and Hamilton, W. D. (1981). The evolution of cooperation. *Science* 211: 1390–1396.
[3] Axelrod, R. (1984). *The Evolution of Cooperation*. New York: Basic Books.
[4] Bell AV, Richerson PJ" and McElreath R (2009). Culture rather than genes provides greater scope for the evolution of large-scale human prosociality. *Proc Natl Acad Sci USA* 106: 17671–17674
[5] Bowles S (2006) Group competition, reproductive leveling and the evolution of human altruism. *Science* 314: 1569–1572
[6] Bowles, S and Gintis H (2004). The evolution of strong reciprocity: cooperation in heterogeneous populations. *Theor Pop Biol* 69, 17–28.
[7] Boyd R and Richerson PJ (2005) *Not by Genes Alone*. University of Chicago Press, Chicago
[8] Boyd R and Richerson PJ (2009) Culture and the evolution of human cooperation. *Philos Trans R Soc B* 364: 3281–3288
[9] Brown, D. E., (1991). *Human Universals*. McGraw-Hill, New York.
[10] Cikara, M. and Van Bavel, J (2014). The Neuroscience of Intergroup Relations: An Integrative Review. *Perspectives of Psychological Science*, Vol 9 (3), 245–274.
[11] Dawkins, R, (1976). *The Selfish Gene*. Oxford, Oxford University Press.
[12] DeWaal, F. (1996), *Good-Natured*. Harvard University Press, Cambridge, MA
[13] Fehr, E and Gachter, S (2002). Altruistic punishment in humans. *Nature* 415: 137–40.
[14] Ghiselin, M. (1974). *The Eonomy of Naure and the Evolution of Sex*. University of California Press.
[15] Gintis, H (2000). Strong reciprocity and human sociality. *J Theor Biol* 206: 169–179.
[16] Gudrais, E. (2010). Networked: Exploring the weblike structure that underlie everything from friendship to cellular behavior. *Harvard Magazine*, May-June 2010, pp. 44–50.
[17] Hamilton, W. D. (1964). The genetical theory of social behavior. I and II. *J. Theor. Biol.* 7: 1–16; 17–32.
[18] Hamilton, W. D., (1975). „Innate Social Aptitudes of Man: an Approach from Evolutionary Genetics." In R. Fox (ed.). *Biosocial Anthropology*, New York: John Wiley & Sons, pp. 133–157.
[19] Henrich, J and Boyd, R. (2001). Why people punish defectors. *Journal of Theoretical Biology* 208: 79–89.
[20] Lorenz, K. (1966). *On Aggression*. Methuen, London.
[21] Peterson, I. (2000). Calculating swarms: Ant teamwork suggests models for computing faster and organizing better. *Science News*, Vol. 158, pp. 314–316.
[22] Segerstrale, U. (2013). *Nature's Oracle: the Life and Work of W. D. Hamilton*. Oxford: Oxford University Press.
[23] Segerstrale, U. and Molnar, P. (Eds.) 1997, *Nonverbal Communication: Where Nature Meets Culture*. Lawrence Erlbaum, Mahwah, N. J.
[24] Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology* 46: 35–57.
[25] Volti, R. (2007). *Society and Technological Change*. New York: Worth Punlishers.
[26] Wilson, E. O. (1975). *Sociobiology: The New Synthesis*. Cambridge, Massachusetts: Harvard University Press.
[27] Wilson, E. O. 1978. *On Human Nature*. Cambridge, MA: Harvard University Press.
[28] Wilson, E. O. 2012. *The Social Conquest of Earth*. New York: W. W. Norton.

Peter F. McGRATH*

SYNTHETIC BIOLOGY: OPPORTUNITIES AND GOVERNANCE

Abstract: Synthetic biology is already producing results that may have far-reaching implications in such sectors as biomedicine and agriculture.

However, with research and development advancing quickly, new techniques accessible and affordable to many, and the potential for harm as well as for good, synthetic biology is raising a number of issues in the fields of ethics and responsible research.

In 2014, IAP published its 'Statement on Realising Global Potential in Synthetic Biology: Scientific Opportunities and Good Governance', calling for capacity building in the field of synthetic biology so that its benefits can be exploited, responsible research, and encouraging its member academies and others to communicate with scientists, social scientists, ethicists, regulators and users (including the public) and to debate the ethical implications of synthetic biology.

Key words: *Synthetic biology, CRISPR-Cas 9, gain of function, responsible research, bioethics, science advice, science academies*

INTRODUCTION

In March this year, representatives of academies of science, engineering and medicine agreed to establish an umbrella organization, the InterAcademy Partnership[1].

The decision took place at the IAP — the global network of science academies, general assembly in South Africa that was held immediately after a 3-day conference on the issue of 'Science Advice'[2].

The InterAcademy Partnership brings together some 130 national, regional and global academies. At the general assembly, academy representatives also agreed on a structure for the Partnership (Fig. 1), as well as a strategic plan.

The strategic plan builds on the activities and track record of the three constituent networks of the InterAcademy Partnership that have been active since 1993 in

* InterAcademy Partnership (IAP), c/o ICTP, Trieste, Italy

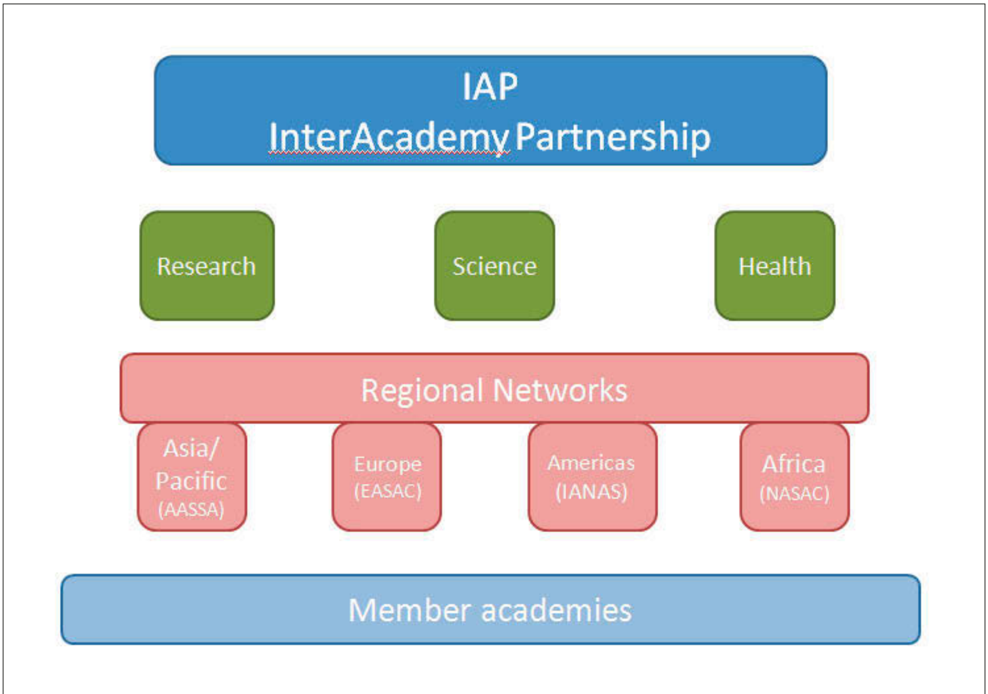


Figure 1. The structure of the newly-established InterAcademy Partnership

the case of IAP (now re-named IAP for Science), and since 2000 for the InterAcademy Medical Panel (now re-named IAP for Health) and the InterAcademy Council (now IAP for Research). It focuses on four thematic areas:

— Provide evidence-based advice and perspectives on global issues;

— Build a scientifically literate global citizenry;

— Strengthen the global scientific enterprise;

— Strengthen the global network of academies, including establishing new academies in countries where they do not currently exist.

Academies are typically independent, self-perpetuating national institutions that recognize excellence and achievement. They are merit-based, with members selected from among the leading scientific, medical and engineering minds within a country.

This gives academies the credibility to review, analyse and synthesise the latest scientific findings and to present the outcomes of their deliberations — which are independent of vested interests — to policy-makers at both national and international levels. In other words, the InterAcademy Partnership (IAP) is able to harness the power, authority and credibility of its member academies and to access their combined scientific talent.

Indeed, among the activities of IAP networks to date have been the production of statements and reports that aim to inform policy and provide recommendations to decision-makers. Likewise, the aforementioned conference held from 28 February to 1 March 2016 in South Africa focused specifically on different mechanisms and modalities of providing science advice[2].

One such area in which IAP and its member academies and regional networks have got involved is that of synthetic biology.

SYNTHETIC BIOLOGY

Synthetic biology is defined as the deliberate design and construction of customized biological and biochemical systems to perform new or improved functions. While the field is still in its infancy, it is already producing results that may have far-reaching implications in such sectors as biomedicine and agriculture.

Research and development are also advancing quickly. Already a major milestone in synthetic biology has been reached — that of defining the genome requirements for a minimal cell, which should pave the way for the construction of novel organisms[3].

However, it could be that genome editing will prove to be a simpler route to achieving various goals using synthetic biology.

Techniques such as CRISPR-Cas 9, for example, are becoming standard procedures in hundreds of laboratories worldwide. The accessibility of these techniques, combined with their potential — including the possibility of altering germlines, and use for harm as well as for good — are raising a number of issues in the fields of ethics and responsible research.

CRISPR-Cas 9 can be used to induce targeted mutations in somatic cells and germline cells alike. Unlike traditional genetic modification techniques that involve transferring DNA across species boundaries, CRISPR-Cas 9 can be used to modify organisms without introducing 'foreign' DNA. Not only is this a powerful technique, but it also has legal implications regarding the status of the resulting organism, especially given that the modification cannot be detected using the processes typically used to identify genetically modified organisms (GMOs).

Indeed, a number of plant, animal and fungal varieties produced using gene editing techniques are already, or soon will be, commercially available. In September 2015, for example, scientists in China announced the development of dwarf pigs using TALENs (transcription activator-like effector nucleases) — initially designed to make it more economical to carry out medical tests on pigs, but also allowing the institute that developed the so-called Bama pigs to raise funds by selling them as pets[4].

This followed on from the commercialization in the USA in 2015 of the first ever non-transgenic genome-edited crop, SU Canola™, designed to be resistant to a herbicide[5], followed by release in Canada in 2016[6]. And more recently, the US Department of Agriculture (USDA) ruled that a gene-edited mushroom designed to stay white longer — made by using CRISPR-Cas 9 to delete a few base pairs of DNA, so disrupting the activity of an enzyme that causes browning — does not need to be regulated as a GMO would. According to *Nature*, the „mushroom did not trigger USDA oversight because it does not contain foreign DNA from 'plant pests' such as viruses or bacteria. Such organisms were necessary for genetically modifying plants in the 1980 s and 1990 s, when the US government developed its framework for regulating GMOs."[7]

Synthetic biology can also be used for the production of high-value biological chemicals, especially in instances where yields obtained by cultivating the source plant cannot keep up with demand. This is the case with the anti-malarial compound artemisinin[8], for example, as well as ginenosides[9], the sought-after active ingredients of the Chinese medicinal plant, ginseng. However, transferring production of such compounds to microbiological fermentation systems can have knock-on effects, for example on the livelihoods of farmers who may lose the market for their crops. For these reasons, Friends of the Earth, the ETC Group and others have called for a moratorium on synthetic biology until a number of principles are put in place[10].

Another area in which synthetic biology may play a part is in gain-of-function experiments. Among the most controversial to date were two parallel sets of trials which introduced specific mutations into the H 5 N 1 virus that causes avian influenza[11,12]. The researchers were criticized as they were able to create a strain of the virus that, unlike the original H 5 N 1, could be transmitted via aerosols. If such experiments were carried out under less-than-ideal isolation conditions (in this case, all biosecurity regulations were observed), such a virus could potentially cause a severe human epidemic, and there was a heated open debate on whether or not the research should be made public[13].

But perhaps the genome-editing advance that has caused most consternation is that reported by Gantz and Bier[14]. Working with CRISPR-Cas 9 in *Drosophila*, they developed a system whereby a mutation in one chromosome (a heterozygous individual) was duplicated into the second chromosome, making individuals homozygous for the mutation. In this way, a desired mutation can quickly spread through an entire population, an effect known as 'mutagenic chain reaction' (MCR) or 'gene drive'. One idea is to generate a mutation in disease-transmitting mosquitoes that would make them incapable of reproducing and developing normally. Such a mutation linked to a gene-drive mechanism could, theoretically, wipe out an entire population or even a species.

„Failure to take stringent precautions could lead to unintentional release of MCR organisms into the environment," warn the authors of the paper, who add their voice to a call or „a dialogue on this topic [to] become an immediate high-priority issue" and recommending the consideration of „biosafety measures and institutional policies appropriate for limiting the risk of engaging in MCR research while affording workable opportunities for positive applications of this concept."

Indeed, in a subsequent paper, the authors of the original MCR paper joined with 25 others to consider „safeguarding gene drive experiments in the laboratory" — one of a number of publications demonstrating that the scientific community is tackling such issues and that dialogue and careful consideration are already taking place.[15]

In addition, such is the relative simplicity and accessibility of various synthetic biology techniques, a 'movement' of DIY synthetic biologists has been established — students and others who are buying DNA 'building blocks' off the internet and recombining them into such organisms as bacteria and yeast in efforts to develop microbes with new functionality. The iGEM (International Genetically Engineered Machine) competition, for example, has introduced students, increasingly from high schools and colleges in Asia and Africa as well as from Europe and the Americas, to the principles and practices of synthetic biology[16].

IAP STATEMENT

The recommendations made by Gantz and Bier[14] and others mirror those made by IAP in its 2014 'Statement on Realising Global Potential in Synthetic Biology: Scientific Opportunities and Good Governance'[17].

The Statement called for capacity building in the field of synthetic biology so that its benefits can be exploited. At the same time, however, IAP also raised the issues of responsible research, global regulation (that would not be too restrictive and deny society any potential benefits), and called on its member academies and others to debate the ethical implications of synthetic biology.

Such IAP statements are developed by a working group of experts nominated by IAP member academies. Once a final version is approved by the IAP executive committee, it is sent out to all member academies for their endorsement. If a majority of academies endorse the statement, then it is released. The IAP Statement on synthetic biology reached the required level of endorsement by IAP members and was released on 7 May 2014.

In a parallel Worldview column in *Nature*, IAP co-chair Volker ter Meulen noted: „The topic is, however, controversial, and that is jeopardizing its promise. Environmental groups argue that it poses risks to health and the environment and have called for a global moratorium. We have been here before: exaggerated fears and uncritical acceptance of claims of the risks of genetic modification led to excessively cautious regulation and a block on innovation that not only slowed the development of new products, but also deterred basic science."[18]

Since they were first commercialised in 1996, GM crops have been planted across a cumulative total of 2 billion hectares in 28 countries, providing benefits to farmers of more than US$150 billion. Indeed, nearly 18 million farmers now grow GM crops each year, 90% of whom are small, resource-poor farmers in developing countries. In Europe, however, the „excessively cautious regulation" that ter Meulen warns about has confined the growth of GM crops to a little over 110,000 hectares in just five countries[19].

INTERNATIONAL ENGAGEMENT

The release of the IAP Statement was timed to coincide with the scheduled 18th meeting of the Convention on Biological Diversity's (CBD) Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-18), which met in Montreal, Canada, in June 2014 to review potential positive and negative impacts of synthetic biology on biodiversity and was under pressure from some environmental groups to impose a moratorium on synthetic biology research and development[10].

Two years later and the CBD is still discussing the issue of synthetic biology. Indeed, its latest documents have developed a new „operational definition" of synthetic biology: „Synthetic biology is a further development and new dimension of modern biotechnology that combines science, technology and engineering to facilitate and accelerate the understanding, design, redesign, manufacture and/or modification of genetic materials, living organisms and biological systems."[20]

This definition was the result of deliberations of a specially-implemented Ad Hoc Technical Expert Group (AHTEG) on Synthetic Biology and a moderated online forum. Again, IAP submitted its Statement for deliberation by the forum and AHTEG, one of 27 submissions received by the CBD[21]. Members of the IAP Statement Working Group were also proposed as members of AHTEG. Although none were eventually selected, academies did have one voice in the group, nominated by the Royal Society, UK.

AHTEG members also concluded that „living organisms developed through current and near future applications of synthetic biology are similar to LMOs (living modified organisms) as defined in the Cartagena Protocol"[20] — so paving the way for the same kinds of regulation as GMOs (equivalent to LMOs), which goes against the text of the IAP Statement. However, the AHTEG did also encourage Parties to the CBD, other Governments and relevant organizations to: „Conduct research on the positive and negative impacts of synthetic biology, on biodiversity, with a view to filling knowledge gaps and identifying how those impacts relate to the objectives of the Convention and its Protocols,"[18] and: „Promote and enable public and multi-stakeholder dialogues and awareness-raising activities on the potential positive and negative impacts of synthetic biology on biodiversity, taking into account ethical considerations in the context of the three objectives of the Convention, with the full engagement of indigenous peoples and local communities."[20] These two points are in line with the IAP Statement and steer well clear of any proposed moratorium.

It is also clear that, by requesting additional research and multi-stakeholder engagements, the discussions surrounding synthetic biology are far from over.

In addition to the CBD, IAP is also engaged with the Biological and Toxin Weapons Convention (BWC). An IAP Biosecurity Working Group (BWG) comprising representatives of academies from Australia, China, Cuba, Egypt, India, Nigeria, Pakistan, Russia, the United Kingdom and the United States and currently chaired by the Polish Academy of Sciences has been engaging with the BWC for several years, in particular feeding into various meetings of experts, providing up-to-date scientific information for deliberation.

Most recently, IAP provided input into the Meeting of Experts that convened in Geneva, Switzerland on 10–14 August 2015, which discussed various recent rapid advances in the life sciences (including synthetic biology), along with 'warnings' from regional and global outbreaks of infectious diseases including SARS, bird flu and Ebola.

However, there are worries that the current processes of the Convention do not adequately take into account developments in science and technology. In addition, many of the 173 States Parties that have signed up to it also argue that there is not enough attention being paid to strengthening cooperation and assistance, especially to developing nations — something that signatories to the Convention have undertaken to do.

Speaking at the Meeting of Experts in August 2015, the author highlighted IAP's role in supporting the activities of the BWC to promote responsible research practices and build awareness of dual-use research[22]. Among these activities are the publication of a report, 'Responsible Conduct in the Global Research Enterprise: A policy report'[23], and, more recently, the release of a guide for teachers, 'Doing Global Science: A guide to responsible conduct in the global research enterprise'[24]. As well as such projects carried out by the IAP itself, IAP also supports projects carried out by its member academies. One recent example was implemented by the Pakistan Academy of Sciences and involved reaching out to biotechnology students in remote areas of the country[25].

Indeed, in his intervention on behalf of the IAP BWG to the Meeting of Experts in Geneva, Ryszard Slomski of the Polish Academy of Sciences called for more awareness-raising activities to be implemented, for example, by engaging with national agencies such as academies of science[22].

Immediately prior to the Meeting of Experts, the IAP BWG, and especially the US National Academies of Sciences, organized an information-sharing workshop on 'Advances in Design and Use of Microbial Production Systems: A workshop for the BWC community'. Workshop speakers reviewed the implications of advances in bioscience research and in the industrial bioscience sector.

As Piers Millett (Biosecure Ltd., UK) summed up: „Advances in areas such as tool and platform development, automation, and experimental analysis are leading to progress on multiple fronts in design and development of biological production processes. However, the field is not yet at a stage in which a researcher could simply enter a desired end product into a software package, have the system map out the metabolic pathways, and robotically conduct the experiments necessary to achieve the desired result. A significant role remains for tacit knowledge and specialized resources. Practical challenges also remain in scale-up from laboratory to industrial-scale production of relevant microorganisms. Complex system aspects must be controlled, making it difficult for someone to switch from one route of production to another, whether that would entail use of a new organism, feeding an organism a new feedstock, or trying to produce a new end product. Each synthetic scheme would require intense optimization to achieve robustness and cost-effectiveness."[26]

Such conclusions should provide some reassurance to those who worry that wider access to DNA sequences and synthetic biology technology will make it is easier for rogue scientists to weaponise viruses or develop ways of mass-producing biological toxins.

These and other deliberations of members of the IAP BWG are being taken forward to the 8th BWC Review Conference scheduled for late 2016.

GAIN OF FUNCTION

Academies continue to engage with governance issues that involve science, as reflected by recent activities on the gain-of-function (GOF) issue. As stated before, GOF is one possible target of synthetic biology research, and also something that could be used for good or potentially also for harm.

In October 2015, EASAC (IAP's regional network for Europe) published its report, 'Gain of Function: Experimental applications relating to potentially pandemic pathogens'[27]. Among the recommendations of the report was the proposal for self-regulation among scientific institutions in parallel with raising the awareness of researchers regarding their responsibilities. It was also pointed out that risk assessment cannot be a 'once and for all' calculation, but that there is a need for continuing evaluation.

The issue of public engagement was also tackled, with strong recommendations on building a climate of trust and openness, with scientists, their institutions — and academies of science — involved in public dialogue to discuss the objectives of research projects, potential risks and benefits, as well as informing about the biorisk management practices that are in place.

Elsewhere, following a series of avoidable incidents involving biohazard materials in the USA, in October 2014 the White House announced the suspension of federal funding for certain types of GOF research pending a review of procedures. The US National Academy of Science was tasked with convening experts from different disciplines to undertake the review through a series of workshops and other mechanisms, overseen by a newly-established National Science Advisory Board for Biosecurity (NSABB). The discussions of the second such workshop have just been published[28], with the final report of the NASABB due for publication by the end of May 2016.

CONFERENCE ON SCIENCE ADVICE

As the examples above clearly demonstrate, there is a role for academies of science and medicine to play in providing advice to governments. Academies are unique in that they are able to bring together the best minds in each country and are independent from political or commercial interests. However, around the globe, different national governments have developed different mechanisms for receiving science advice — from the appointment of a single expert science advisor, to ad hoc committees. In addition, how advice is presented can vary depending on whether there is time to deliberate and debate a particular topic, or whether there is an emergency situation.

Such issues were discussed at the IAP Conference on Science Advice (South Africa, February/March 2016).

Indeed, the conference dedicated a session to 'Science Advice in the International Arena with a Special Focus on Synthetic Biology'.

Among the outcomes of this session was the opinion that research into synthetic biology is moving quickly, but that regulatory oversight is failing to keep pace. In addition, participants raised the concern that products derived via synthetic biology could be seen as equivalent in all respects to genetically modified organisms (GMOs). In this case there is a need to work with social scientists on ways to engage the public in outreach and debate so that the benefits of synthetic biology are not curtailed or over-regulated as they have been with GMOs in some parts of the world (see above). It was also noted that many synthetic biology practitioners are operating outside academia, so it is difficult to ensure responsible and ethical research. For these reasons, it was proposed to engage more with these informal groups so that potential misuse of research can be spotted early and averted[2].

CONCLUSION

DIYbio. org is an online hub for people interested in pursuing DIY biology, and which lists more than 80 local groups and communities around the world. The website (www.diybio.org) also has sections where people can review a code of ethics that has been developed, or ask an expert about biosafety issues. Todd Kuiken, a US-based researcher and co-founder of DIYbio. org, notes that the DIY biologists „proactive culture of responsibility is an advance on the post hoc scrambling that often occurs within the scientific establishment," and highlights that „the current culture of responsibility among DIY biologists, their collaborative style of working and the fact that community labs are open spaces in which everyone can see what is going on reduce, if not eliminate, doomsday scenarios of mutant organisms escaping from basements and causing harm."[29]

Such considerations, allied with the outcome of the IAP Conference on Science Advice, have prepared the ground for collaboration between academies of science — representing the scientific establishment — and the DIY biologists. Indeed, discussions are already under way to bring the two groups together, especially with the involvement of the Global Young Academy.

As well as these efforts, as prescribed by several of the papers and reports presented here, including the IAP Statement[14,15,17,18,27], there is a need for engaging the wider community, including social scientists, ethicists and science communicators, and being open and transparent with the general public when it comes to explaining the rationale for, and benefits and potential risks of, synthetic biology experiments.

To this end, IAP encourages its member academies to take another look at the 2014 Statement and to promote the recommendations therein within their nations and to join with IAP and its regional networks in promoting them internationally. For its part, IAP will continue to engage with international processes such as the Convention on Biological Diversity and the Biological and Toxin Weapons Convention.

IAP is also providing financial support to the Federation of European Academies of Medicine (FEAM) for a project that is reviewing the European landscape for human genome editing, comparing and contrasting current national legislation, again with the aim of developing Europe-wide recommendations for presentation to the European Commission, while EASAC (IAP's regional network for Europe) is undertaking a separate project looking at all genome editing applications.

The fact remains, as outlined in the IAP Statement, that „by applying the principles of systems biology, engineering and chemical design to biological systems, synthetic biology will lead to new applications of considerable societal value. Proof-of-concept has already been demonstrated in establishing less expensive ways of producing pharmaceuticals and other high-value chemicals and there are likely to be other early achievements in the generation and optimal use of biofuels. Further ahead there are possible applications of this biological toolbox in biomedicine, agriculture, land and water decontamination, biosensing, new materials, nano-machines and novel approaches to information processing."[17]

Thus, the benefits of synthetic biology are likely to be enormous, but they must be achieved in a responsible and transparent manner if governments and the public are to be persuaded to accept whatever risks will need to be constrained as new products are developed and commercialised.

REFERENCES

[1] International networks of academies create umbrella organization. 2 March 2016. http://www.interacademies.net/News/PressReleases/29843.aspx

[2] Summary of the IAP Conference on Science Advice. 4 March 2016.http://www.interacademies.net/News/29857.aspx

[3] Hutchison III, C. A. *et al.* (2016) Design and synthesis of a minimal bacterial genome. Science, 351: 6280. 25 March 2016. http://science.sciencemag.org/content/351/6280/aad6253.full

[4] Gene-edited 'micropigs' to be sold as pets at Chinese institute. *Nature*. 29 September 2015. http://www.nature.com/news/gene-edited-micropigs-to-be-sold-as-pets-at-chinese-institute-1.18448

[5] Cibus and Rotam announce launch of their first non-transgenic commercial product. Press release, 19 November 2014. http://www.cibus.com/press/press111914.php

[6] Sulfonylurea-tolerant canola eyed for 2016 launch. 26 March 2014. http://www.agcanada.com/daily/sulfonylurea-tolerant-canola-eyed-for-2016-launch

[7] Gene-edited CRISPR mushroom escapes US regulation. *Nature*. 14 April 2016. http://www.nature.com/news/gene-edited-crispr-mushroom-escapes-us-regulation-1.19754

[8] Paddon, C. J. *et al.* (2013). High-level semi-synthetic production of the potent antimalarial artemisinin. *Nature*, 496, 528–536, 25 April 2013.

[9] Dai, Z. *et al.* (2013). Metabolic engineering of *Saccharomyces cerevisiae* for production of ginsenosides. *Metabolic* Engineering, 20, 146–156.

[10] Friends of the Earth, CTA and ETC Group (2012). The Principles for the Oversight of Synthetic Biology. http://www.etcgroup.org/content/principles-oversight-synthetic-biology

[11] Herfst, S. *et al.* (2012). Airborne transmission of influenza A/H 5 N 1 virus between ferrets. *Science*, 336: 6088, 1534–1541. http://science.sciencemag.org/content/336/6088/1534.full

[12] Imai, M. *et al.* (2012). Experimental adaptation of an influenza H 5 HA confers respiratory droplet transmission to a reassortant H 5 HA/H 1 N 1 virus in ferrets. *Nature,* 486: 7401, 420–428. http://www.nature.com/nature/journal/v486/n7403/abs/nature10831.html

[13] Work resumes on lethal flu strains. *Nature*, 493: 460. 24 January 2013. http://www.nature.com/news/work-resumes-on-lethal-flu-strains-1.12266

[14] Gantz, V. M. and Bier, E. (2015). The mutagenic chain reaction: A method for converting heterozygous to homozygous mutations. *Science*, 348: 6233, 442–444.

[15] Akbari, O. S. *et al*. (2015). Safeguarding gene drive experiments in the laboratory. *Science*, 349: 6251, 927–929. http://science.sciencemag.org/content/349/6251/927
[16] http://igem.org
[17] IAP — the global network of science academies. 7 May 2014. 'Statement on Realising Global Potential in Synthetic Biology: Scientific Opportunities and Good Governance'. http://www.interacademies.net/10878/Scientific_Opportunities_and_Good_Governance.aspx
[18] ter Meulen, V. (2014). Time to settle the synthetic controversy. *Nature*. 7 May 2014. http://www.nature.com/news/time-to-settle-the-synthetic-controversy-1.15169
[19] ISAAA Brief 51–2015: Top ten facts about biotech/GM crops in their first 20 years, 1996 to 2015. http://www.isaaa.org/resources/publications/briefs/51/toptenfacts/default.asp
[20] Convention on Biological Diversity, Subsidiary Body on Scientific, Technical and Technological Advice, 20th meeting, Montreal, Canada, 25–30 April 2016, Item 6 of the provisional agenda, Synthetic Biology.
[21] Convention on Biological Diversity. http://bch.cbd.int/synbio/submissions/
[22] Meeting of Experts (10–14 August 2015). http://www.unog.ch/__80256ee600585943.nsf/%28httpPages%29/46cac219b57f8b49c1257db20030bce8?OpenDocument&ExpandSection=9#_Section9. See also 'Biological and toxic weapons': http://www.interacademies.net/News/27904.aspx
[23] IAP (2012). Responsible Conduct in the Global Research Enterprise: A policy report. www.interacademies.net/file.aspx?id=19789
[24] IAP (2016). Doing Global Science: A guide to responsible conduct in the global research enterprise. www.interacademies.net/File.aspx?id=29738. Princeton University Press.
[25] IAP (2015). Annual Report 2014, 'Dual-use education in Pakistan' (p. 40–41) http://www.interacademies.net/Publications/27799.aspx
[26] IAP BWG, S. Mueller and K. Bowman, rapporteurs (2015). Advances in Design and Use of Microbial Production Systems: A Workshop for the BWC Community. http://www.iapbwg.pan.pl/index.php?option=com_content&view=category&layout=blog&id=9&Itemid=111
[27] EASAC (2015). Gain of function: experimental applications relating to potentially pandemic pathogens. http://www.easac.eu/home/reports-and-statements/detail-view/article/easac-report-1.html
[28] National Academies Press (2016). Millett, P., Husbands, J., Sharples, F. and Thevenon, A., rapporteurs. Gain-of-Function Research: Summary of the second symposium, March 10–11, 2016. http://www.nap.edu/catalog/23484/gain-of-function-research-summary-of-the-second-symposium-march
[29] Kuiken, T. (2016). Governance: Learn from DIY biologists. Nature 531, 167–168, 10 March 2016. http://www.nature.com/news/governance-learn-from-diy-biologists-1.19507

Oksana SLYUSARENKO[*]

THE CURRENT STATE OF POLITICAL REPRESENTATION OF WOMEN AND BASIC METHODS OF THEIR INVOLVEMENT IN THE POLITICAL PROCESS

Abstract: The analysis of the political participation of women in the political process. Codified classification methods and ways to increase your political representation of women have been used in different countries. It been proved that women can become more politically active agents not only through the active support of the state and society, but also through self-improvement and change of identity.

Key Words: *globalization, stereotypes, rationing, quotas*

In the context of globalization of processes and export of cultural property, large scale use of computer and electronic equipment, inspirational destruction of stereotypes seems not very difficult to find someone who would at least once heard these words and phrases as „gender," „gender equality" „discrimination" and so on. However, despite the global interest in this problem, holding numerous conferences and scientific discourses, this question has no logical solution. More than half century of international organizations have developed numerous documents, strategies, conventions, signed by nearly all states, and they are ratified started work on implementation. Everything looks quite nice, and allegedly transparent. In practice, the situation is less encouraging. Almost in every state there are certain forms of discrimination against women, especially in the political sphere and decision making. For illustrative international standards are numerous tricks: create „decorative post"; party lists to make 30% of women, but they are not included in the number of entrance; national action plans and strategies ostensibly designed but implemented primarily in the sphere of development of new legislation and more.

If the state restricts access to the fair sex to power, it creates additional challenges for the social change. Also these barriers include: lack of awareness and understanding of gender issues greater part of society. To overcome these barriers and

[*] Doctor of Economics, Professor; corresponding member of NAS Ukraine

address gender discrimination must first begin work on the destruction of archaic stereotypes about traditional roles, because of the lack of women in power structures hindered the development of the society in a democratic direction. Power and woman must be related concepts and have prospects in a changing world, and the fair sex can not be excluded from the authorities and the process of making important decisions simply because the society is available disease that has drugs — patriarchal model of building social relations. Due to existing stereotypes and traditions most of society rejects women's intelligence, talent, skills and education, but the fair sex is easier to compromise is more proactive than men, and more sociable and flexible communication, namely, these traits contribute the successful and timely resolution of any problem.

Modern history is changeable and stormy. Rapidly developing technologies, innovation and, most importantly break down age-old stereotypes. Earlier, no one could imagine that a woman can become president, prime minister, leader of the political force, pilot or astronaut. But today, fortunately, the situation changes dramatically.

In 1974 the first woman in the history of mankind was democratically elected to the post of head of state, and by 2000 this position has occupied 17 of the fair sex. The first woman president in the world has become Isabel Martínez de Perón (Argentina). Vihlis Fynnbohadotip (Iceland) became in 1980 the first woman president, which has been elected in direct elections. The first woman Prime Minister — Sirimavo became the world Bandaranayke, who headed the government of Ceylon in 1960–1965, 1970–1977 and 1994–2000, respectively.

After the Second World War there were only 3 % of women who were members of the lower house of parliament. In 55 years this figure rose to 13.8 %, i. e. the deviation 2000 to 1945 was 10.8 %. The fair sex who are members of the upper chambers of the supreme legislative bodies in 1945 accounted for only 2.2 % and in 2000 — 13.9% (percentage deviation — 11.7 %). While this positive trend can be traced to the involvement of women in political activities but frightening rate of growth (too slow).

Picture 1. Representation of women in the parliaments of the world for the 1945–2000 biennium [1]

	1945	1955	1965	1975	1985	1995	2000	Deviation
numbers of parliaments worldwide	26	61	94	115	136	176	172	146
women members of the lower house, %	3,0	7,5	8,1	10,9	12,0	11,6	13,8	10,8
female members of the upper chambers,%	2,2	7,7	9,3	10,5	12,7	9,4	13,9	11,7

Known fact is that the appearance of women in the political structures of Western countries and developing countries, have contributed to the overall processes empower various social groups that previously did not participate in political life at certain aspects. That last fact was the kind of basis for a more stable social and political system. Due to the fact that the electoral management process and added new aspects of social interests, all contributed to attracting new groups of political life, party competition for new segments of the electorate has changed and how the overall direction of government policy and party programs. Such electoral behavior and more confidence can be explained by the fact that since the 1970 s, Women who voted in the elections, have to give their vote because the candidates or parties in their programs declared protection of the interests of the fair sex, which concerned the issues of reproductive rights, social security, participation in decision-making, the elimination of all forms of discrimination and violence in the family and much more. The behavior of these women and the tendency of their actions in the first half of the 90 s was subjected to a special study conducted by the United Nations. As being developed democratic societies, the advantage of the fair sex to a particular candidate, began to gain increasing value of the „political market" women have to play the role of the factor that decided the fate of parliamentary or presidential elections. This can be explained by several factors: demographic composition of the electorate in these countries and political differences electoral behavior of women compared to men electoral behavior.

Of course, increasing the number of women represented in the government held with the kind of change in the social and economic role of the state, and has become an important element of the institutionalization of gender equality policy [2].

Increasing the number of women who participate in solving important issues in the West, accompanied by qualitative changes in the content of various kinds of public policies, political participation that the fair sex in the government was more a mechanism of representation of social interests and rights of women.

But we can say that the process of increasing the number of women in government and related qualitative changes in government policies are purely social and economic direction. After the process of ensuring equal opportunity policies in the West took place under the influence and with the participation of the women's movement, and the relation of the state to the principle of equality between women and men has not been from the beginning (or always clear) positive.

Over the last fifteen years of the XX century, all political actors that have influence on the decision-making process in most States in which an increase in the rate of representation of women in legislative bodies have taken special measures and developed strategies that have direct focus on the fastest setting actual equality between both sexes in making important political, economic, social solutions and more. These strategies were developed and has been applied to achieve a certain percentage rate of the fair sex in the various subjects of political life, political parties, parliaments and /or public oversight councils and executive bodies. Unfortunately, to evaluate the effectiveness of these measures is very difficult, because different states they brought identical results and are still the subject of public debate.

Today, international experience suggests the presence of several fundamental approaches used by political parties, government and civil society on the issue of increasing the representation of women in government [3].

In the world there are many different forms, methods and approaches to forming party lists, including:

1) gender-neutral approach — which, unfortunately, used in Ukraine and is the promotion of the fair sex parties during the nomination of candidates for election as a single-member constituencies and on party lists. Its essence is to ensure that political power is underlined ignore the question of civil gender of candidates; in fact gender-neutral approach means promoting the election of candidates-men, women rarely put forward by parties and averaged only — 5.10% of the total number of members of the supreme legislative authority.

2) system supporting actions („affimative actions"), which is the use of party policy that clearly expresses and confirms the intention to practical actions with respect to support and promote the fair sex. Supporting women in the application of this system manifested in various forms of interest to the ladies at the initiative of nominating their candidates for election to executive positions; to conduct special courses, seminars and conferences for women who wish to level of men to share power functions etc.

3) The policy of" positive discrimination „, which is the most radical form. Its main feature is the use of gender rationing mechanisms — i. e. quantitative rules of participation in power structures apply to both genders in different from 10 % to 50% proportions. The main purpose of its use includes reproduction rights and equalize the starting opportunities for women and men. This system is mainly used as forced temporary measure which should facilitate the process of accelerating the removal of „historical injustice" to the citizens of women. From the outset, in most cases, the use of gender normalization used at the recommendations and targets and taken note of by the parties. As of 2001, according to the UNIFEM, gender norms (which are sometimes called „quotas") for the fair sex in Parliament or in party lists used in at least 30 states. The possibility and the adoption of measures of positive discrimination varies in different countries. Their use and how to depend on the political culture, the nature of party-political and state system, measures the development of the women's movement and support of its requirements from the state. As part of the policy of „positive discrimination" can distinguish three different types of regulation, which differ in aims and principles of quotas:

— Party valuation (quotas) at institutions parties. When using this system in the party lists indicates the proportion of male and female names, sometimes it also provides a guarantee based on the list of names of proportionality placing both sexes on the candidate list when nominating candidates in single-mandate constituency. Use of this system was typical for most social democratic parties in Western Europe since the 70's. Although it is worth noting also the fact that it still is the most popular in most of these countries. And in 80 years a large number of countries that have developed, also began to use party valuation method;

— Gender normalization (quotas) in electoral law at the creation of lists of candidates. This kind of policy of „positive discrimination" can also be divided into two subtypes: first — specifying only the composition of party lists on the basis of gender, ie identifying and fixing a minimum percentage of members of one sex or by using the instructions on the numerical value, such as „not vary more than one „; second — includes not only regulation and the numerical ratio of male and female names, but their sequence in the lists of political parties;

— Valuation (quota) seats. Today, this view is only five states where it is legislated and regulated;

4) political quota. One of the main features of this type of quotas was that she always used privately. Most countries used this form of the socialist bloc. It included the installation of 30% quota for women in elections at the national level and 40–50% of the voting rules at the local level. In some states of the former socialist camp, this system is used today. Political quota system is ostensibly consistent with the principle of affirmative action promotion of the fair sex in the government, but it has specific characteristics, including such as formal and symbolic representation of women to classify it as a historically unique and individual look.

Analyzing the situation of women in world politics must emphasize the strong tendency to grow. Primarily this is due to the destruction of the archaic stereotypes and traditional gender roles, growth kind of women as voters, the appearance of bright and prominent women leaders, public awareness of the fact that the problem better understand the fair sex, and can decide themselves.

In the past century and at the beginning it was more than 30 elected women presidents and more prime ministers, not only in Western countries but also African and Islamic, which indicates an increase in trust in the fair sex, acting leaders for its people.

REFERENCES

[1] Official website of the International Union of Parliamentarians. — [Electronic resource]. — Access: http://www.ipu.org/wmn-e.
[2] Larmore C. The Morals of Modernity. / C. Larmore. Cambridge: Cambridge University Press. 1996. — p. 315.
[3] Yu Hradskova of education for teaching. The history of women in Europe. / Yu Hradskova // National University of Ireland. Magazine Study sotsyalnoy policy. — 2006. — №4. — p. 35–42.

A. Nuri YURDUSEV

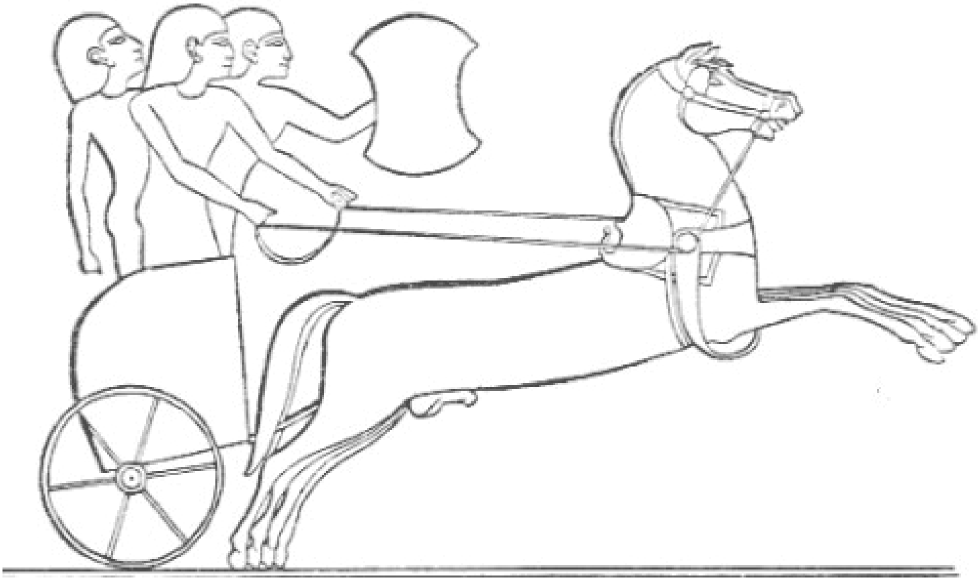
TECHNOLOGY-DRIVEN CHANGE IN INTERNATIONAL RELATIONS: QUANTITATIVE OR QUALITATIVE?

Abstract: This paper takes the view that technological inventions and changes, although appear to be precipitating in the last decades, have always been pivotal for international relations. The paper begins with some examples of technical inventions such as saddle, gunpowder and heavy artillery, steam engine and rail ways, telegraph and telecommunication technics, and digital and online technologies and argues that these technics made great impact upon international relations in respective periods. The paper then deals with the issue of whether these technology-driven changes resulted in quantitative or qualitative changes in international relations in terms of its content and procedures. It concludes by arguing that those changes led to both quantitative and qualitative changes in the nature and conduct of international relations.

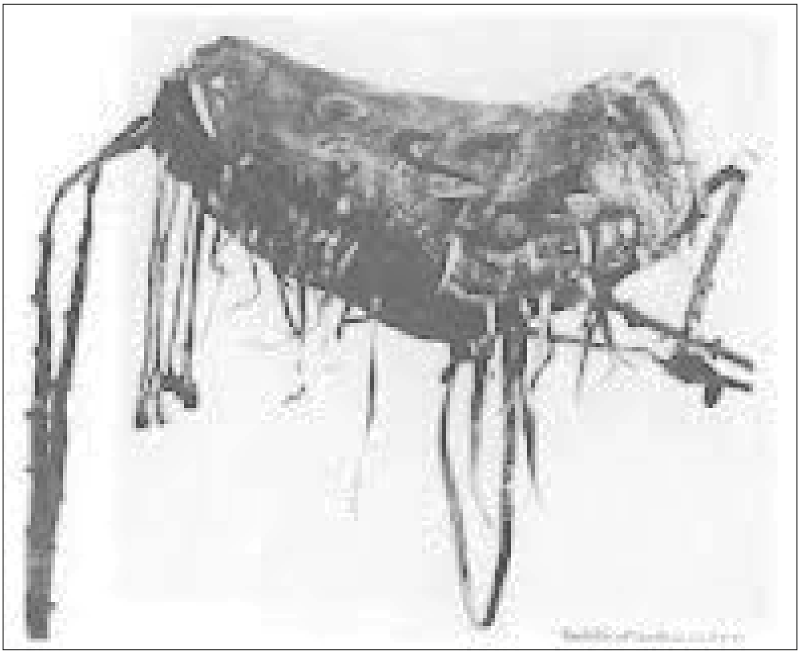
INTRODUCTION

Modern vs. pre-modern
International relations vs. inter-societal relations
Going beyond the local
Domestication of horse (from 3500 CB to 2000 CB)
Chariot (2000 CB to 1300 CB)
Saddle (700 CB)

* Vice President, Turkish Academy of Sciences



Hittite chariot (drawing of an Eygptian relief)



A sythian pad saddle

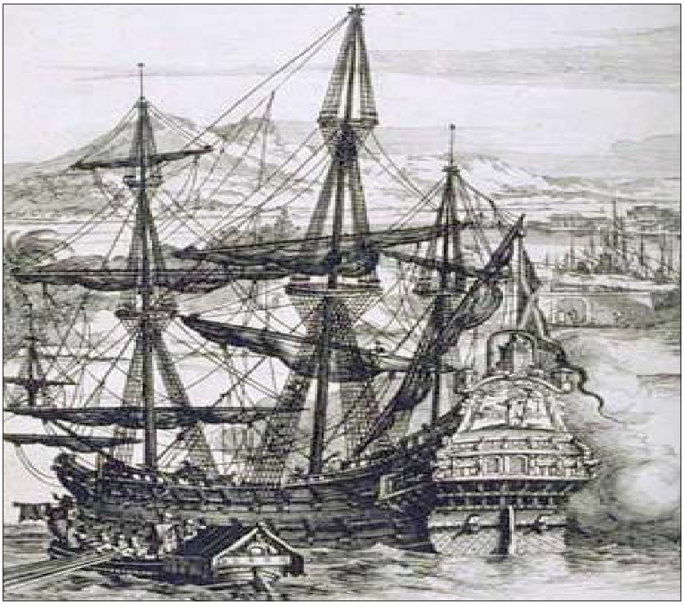
HIGH MOBILITY AND MASSIVE MOBILIZATION

Gunpowder and heavy artillery (9th to 15th centuries)
From China through the Middle East to Europe

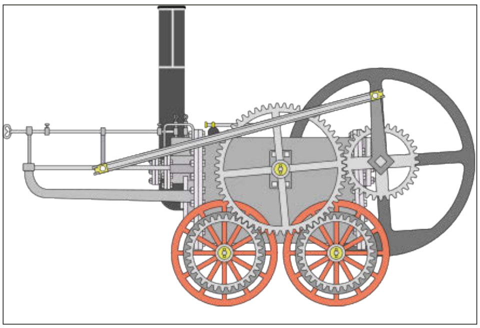
Yuan Dynasty hand cannon (dated 1288)

Dardanelles gun — Şahi topu (dated 1453)

Conquest of castles & walled cities
Consolidation into centralized kingdoms
Sailing vessels, steam engine and railways (16th to 19th centuries)



16th century Spanish Galleon



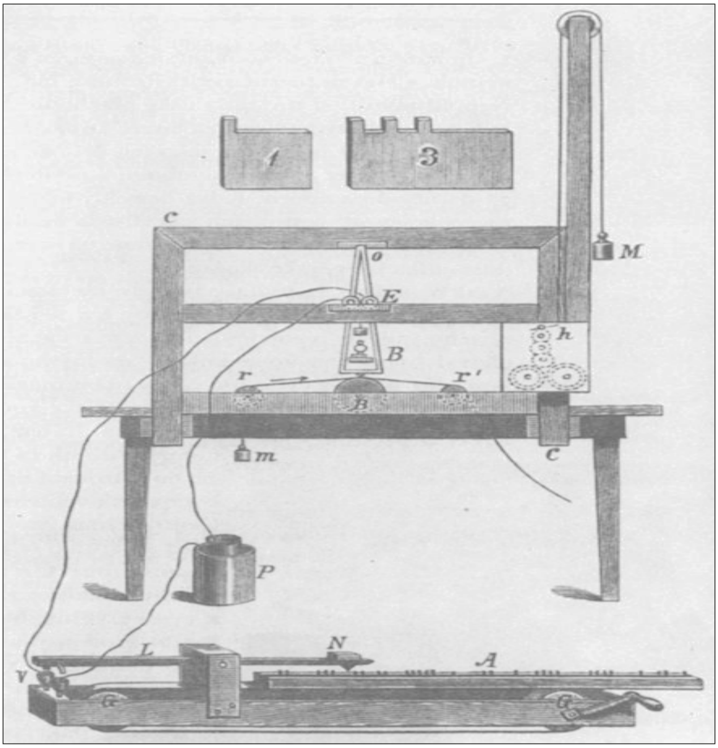
R. Trevithick 1802 Coalbrookdale locomotive

1817 beam and blowing engine

Inter-continental transportation
Inter-continental conquest
Increased production

GLOBALIZATION

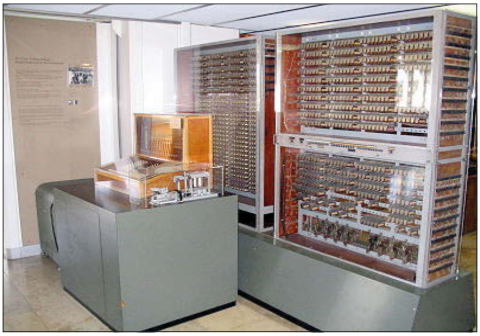
Telegraph and telecommunication technics (19^{th} century)



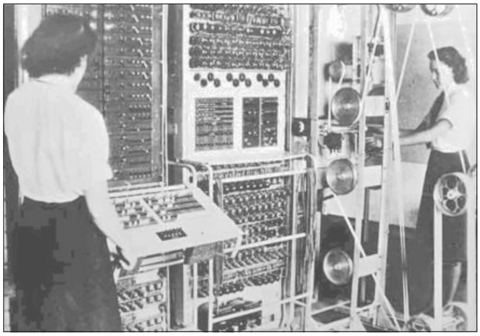
Samuel Morse telegraph

Before telegraph a letter from London to
New York 12 days
Istanbul 19 days
Bombay 33 days
Sydney 73 days

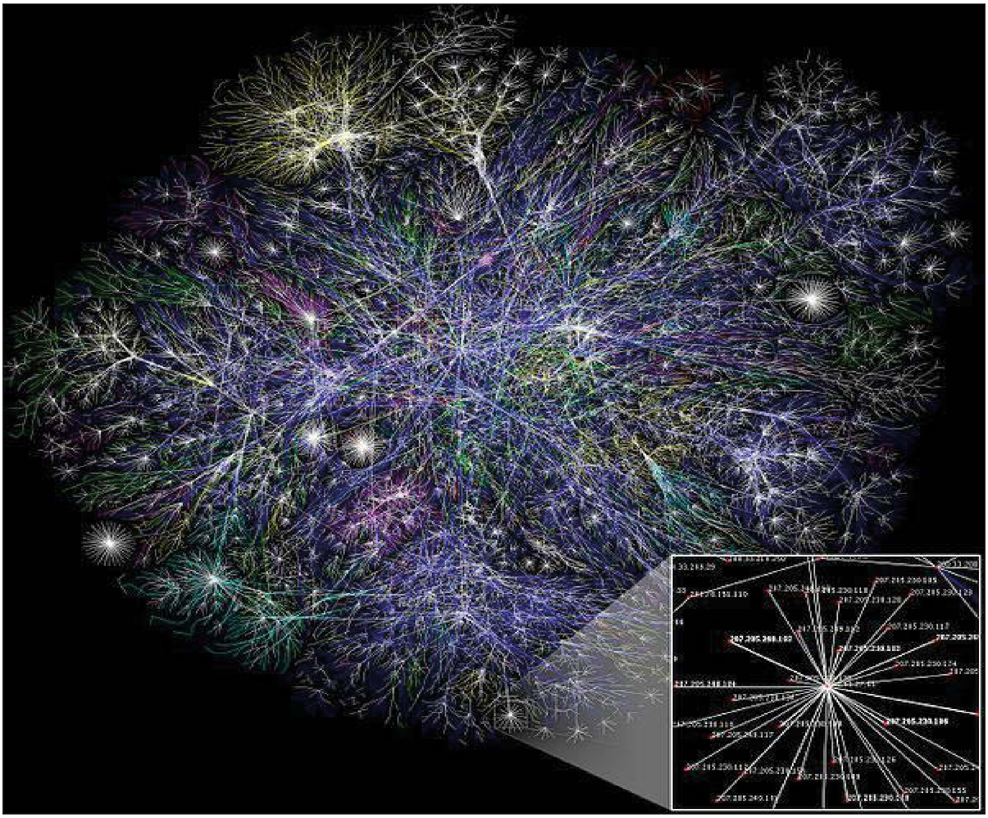
15 words a minute were transmitted by 1840
Speedy communication
Computers, digital technologies and online resources
(20^{th} to 21^{st} centuries)



Replica of K. Zuse's computer (1939)



Colossus computer (1943–45)



Visualization from the Opte Project of the routes through
a portion of the Internet in 2005

Instant communication, comprehensive storage and ubiquitous availability

QUANTITATIVE CHANGES

Integration of the globe
Enormous increase in the number of actors and elements
Huge increase in the volume of interactions

QUALITATIVE CHANGES

Increase in the type of actors
Variety of the issues (high politics to low politics)
Decrease in significance of conventional actors and methods
Blurring of international vs. domestic distinction

Zlatko LAGUMDŽIJA*

SHARED SOCIETY AND VALUES — GOALS AND TOOLS OF SUSTAINABLE DEVELOPMENT

Abstract: Curent relationship in between People, Planet and Production is seting us in time of great changes.

Segregated and conflicting societies; environmetal polution and global warming; production that is almost seen a goal of development; are generating a fears for the future. New Paradigme or Partnership in between People, Planet and Production are needed not only to give us a new hopes, but also requires well defined set of tools that can help us to make our ideas live. So the first issue is overcoming our fears by reaching our hopes with right means.

Social, environmental, and economic development are becoming more and more interconected and mutualy reinforcing, either positively or negatively. It leads us to the second issue that meeting the goal of sustainable development requires their integration and necessitates coordination acros these disciplines.

At the same time information technology, knowledge and education, are transforming with greater speed then ever. It leads us to the third issue of predicting and leadin changes in these three areas.

* Former Chairman of the Council of Ministers and Minister of Foreign Affairs of Bosnia and Herzegovina, member Club de Madrid, member of WAAS, founder of Shared Societies and Values Sarajevo Foundation, School of Business and Economics and School of Electrical Engineering, University of Sarajevo

3 CONTEMPORARY WORLD CHARACTERISTICS

- Current relationship in between People, Planet and Production/Profit setting us in a time of great Change and Challenges
- Inequality in segregated and conflicting societies; Environmental polution and global warming ; Production (profit) as a goal of development are generating old and new fears for the future
- Need for new Paradigm or Partnership in between People, Planet and Production/Profit for Prosperity

3 CHALLENGES FOR THE FUTURE

- Overcoming Fear by reaching Hopes with right Means
- Social, Environmental and Economic Development growing interconncetion, interdependance and mutual reinforcing requires more equitability and their integration or/and coordination
- Predicting and leading change across the greater than ever speed of transformation in three key areas: Knowledge, Education and IT

3 Pillars of FEARS, HOPES and MEANS

- Partnership of 3P (People, Planet, Production/Profit) for Prosperity
- Smart, Sustainable,Inclusive,Equitable Growth
- Sustainable Development,Shared Society and Values with Knowledge, Education and IT support

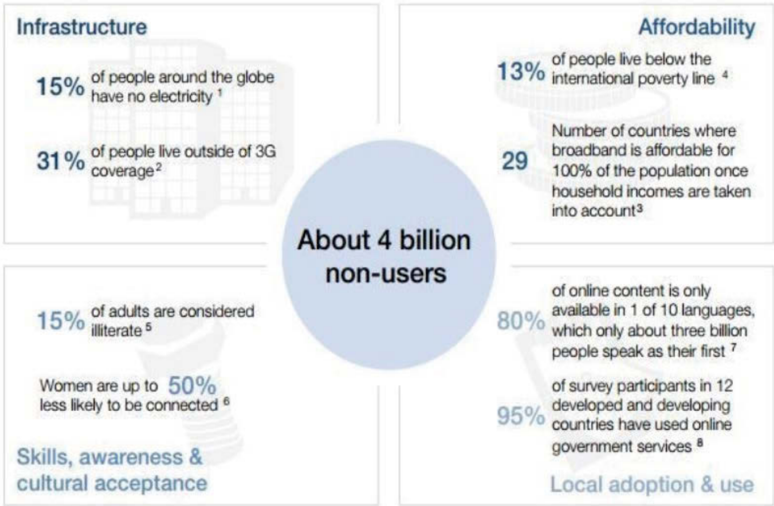
Framework defined by What-Where-Who-When

THE 7 CHALLENGES OF NEW KNOWLEDGE REVOLUTION

- Structure, Life and Organization (from book to metaweb with cognitive and social communication capacities)
- From Text to Image
- The Human Being and the Machine (with “consciousness” and “inteligence”)
- Complexity and Chaos (Non-Linear Feedback Loops with largely unpredictable and secondary systems emergence)
- Comptuer Science and Scientific Research
- Convergence, Interaction and Transformation (bio-info-nanotechnology, BINT)
- Methodology of Interrelated Studies and Appropriate Policy - Making (increasingly needed along bigger complexity and real problems of our lives)

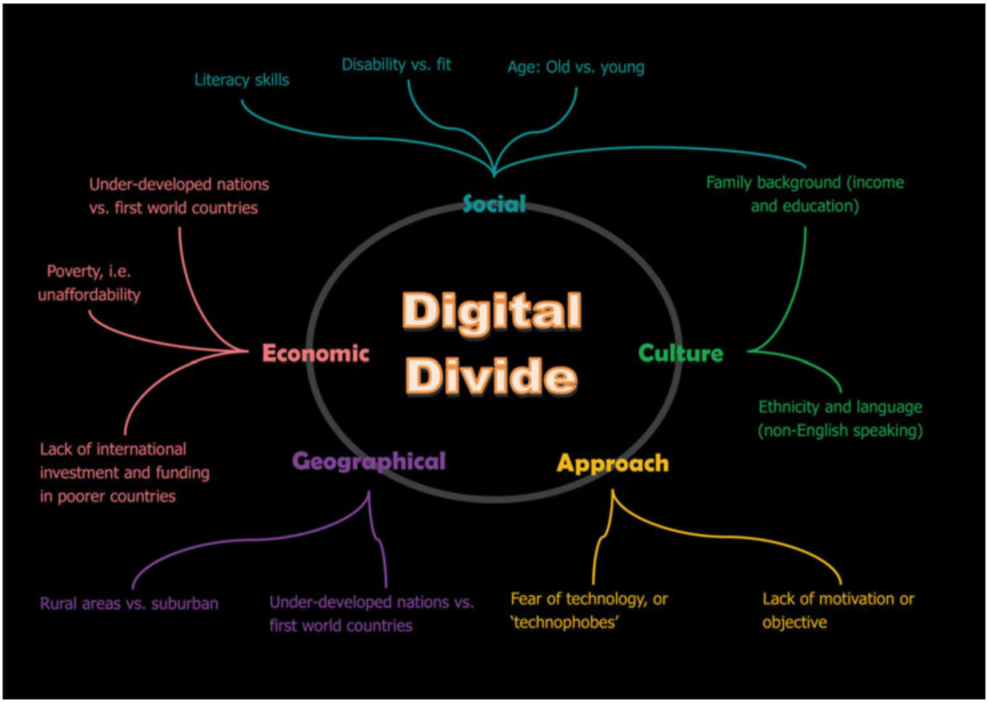
THE TRANSFORMATIVE REVOLUTIONARY CONTEXT OF IT

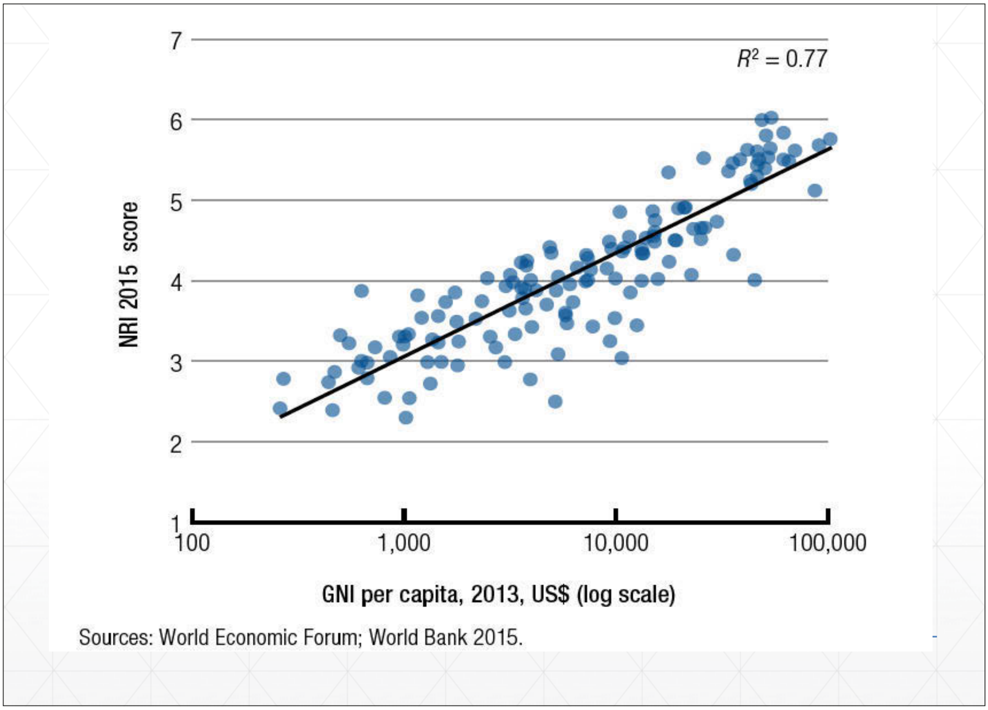
- Digital Divide ? ! ?
- Big Data
- Privacy
- Security
- Social Conectivity

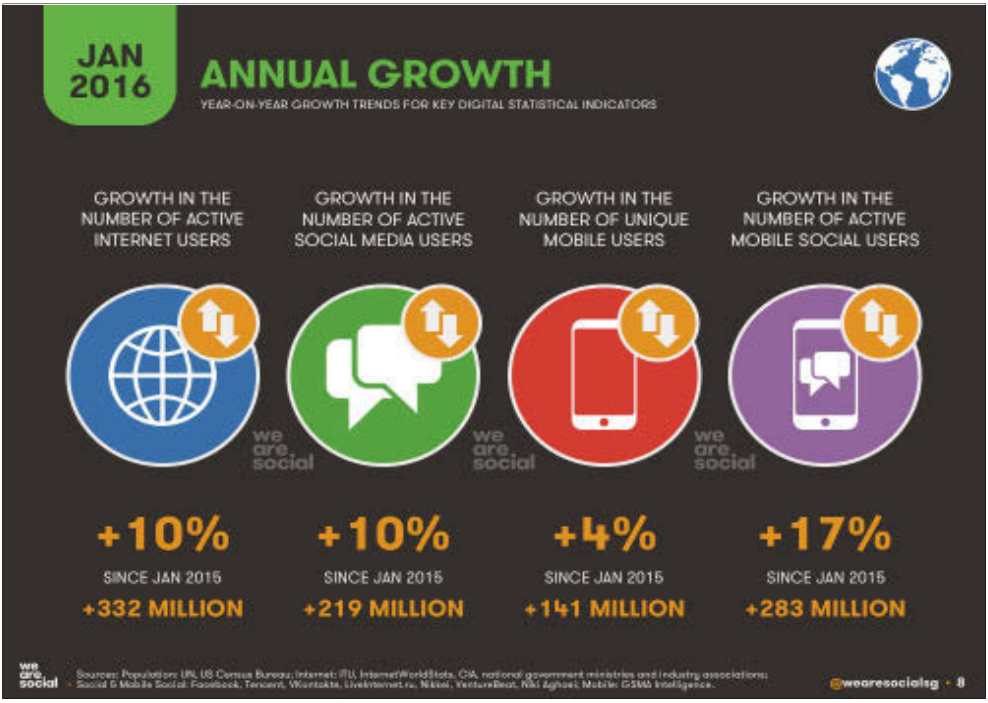


Over half the world's population are not yet online

Image: World Economic Forum's Internet For All report. Data sources include World Bank, ITU, UNESCO and the World Wide Web Foundation




$R^2 = 0.77$
NRI 2015 score
7
6
5
4
3
2
1
100
1,000
10,000
100,000
GNI per capita, 2013, US$ (log scale)
Sources: World Economic Forum; World Bank 2015.

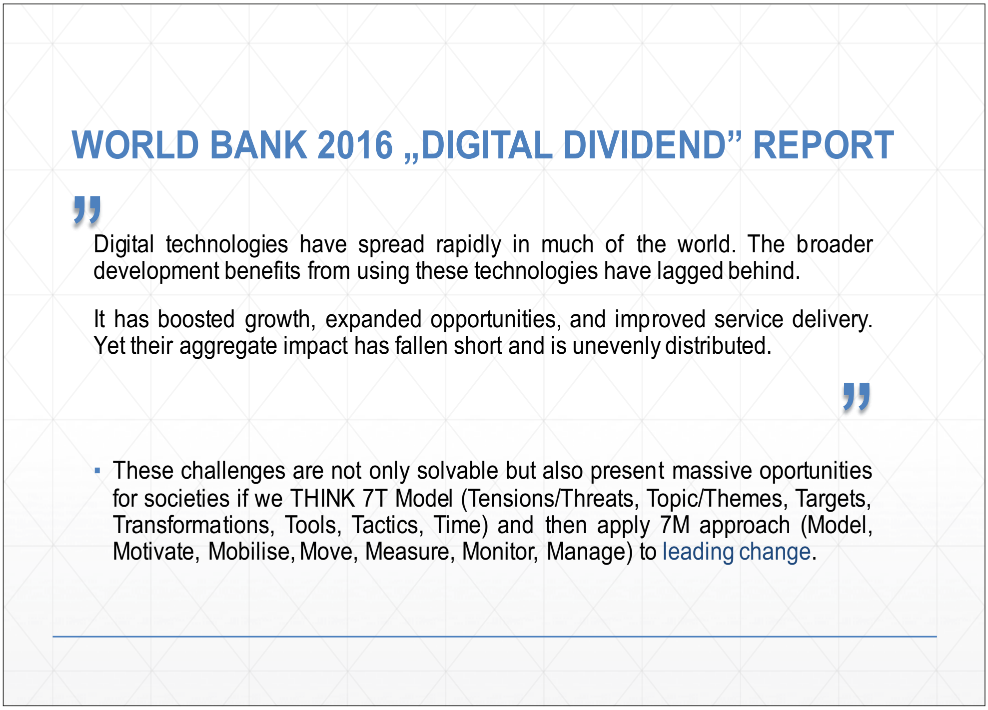

JAN 2016
ANNUAL GROWTH
YEAR-ON-YEAR GROWTH TRENDS FOR KEY DIGITAL STATISTICAL INDICATORS
GROWTH IN THE NUMBER OF ACTIVE INTERNET USERS
GROWTH IN THE NUMBER OF ACTIVE SOCIAL MEDIA USERS
GROWTH IN THE NUMBER OF UNIQUE MOBILE USERS
GROWTH IN THE NUMBER OF ACTIVE MOBILE SOCIAL USERS
+10%
SINCE JAN 2015
+332 MILLION
+10%
SINCE JAN 2015
+219 MILLION
+4%
SINCE JAN 2015
+141 MILLION
+17%
SINCE JAN 2015
+283 MILLION
we are social
Sources: Population: UN, US Census Bureau; Internet: ITU, InternetWorldStats, CIA, national government ministries and industry associations; Social & Mobile Social: Facebook, Tencent, VKontakte, LiveInternet.ru, Nikkei, VentureBeat, Niki Aghaei; Mobile: GSMA Intelligence.
@wearesocialsg • 8

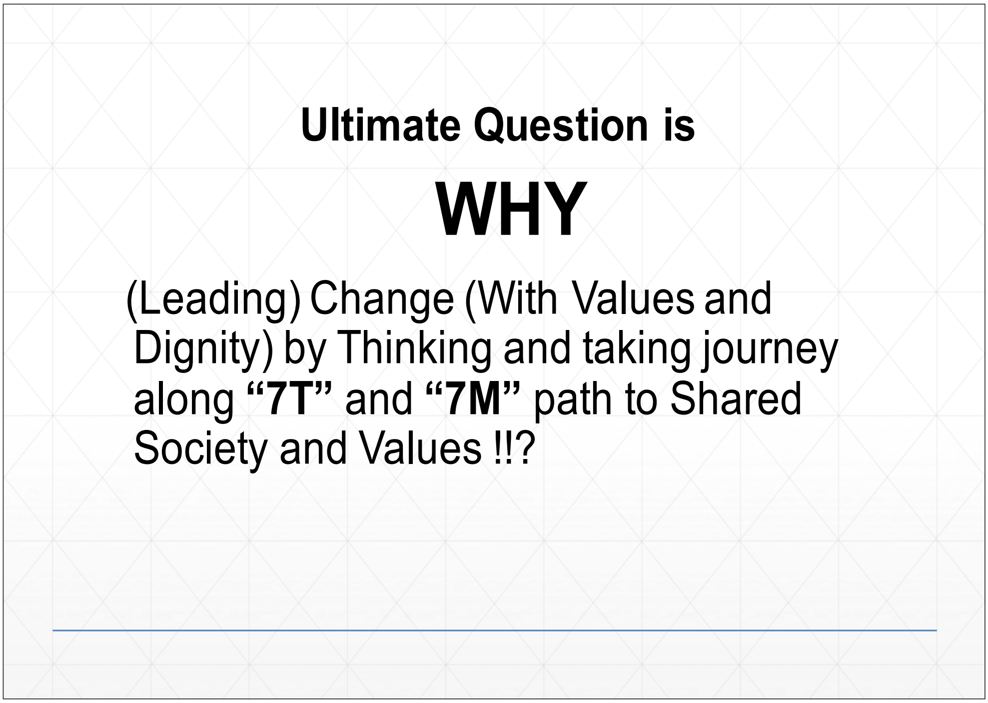
BIG DATA AND IT

- University of California 2007 estimate that all recorded history of humanity produced 256 exabytes
- 1 exabyte is billion billion bytes (100.000 times amount of printed information in the Library of Congress)
- Google is alleged to have about 10 exabytes on its servers with another 5 exabytes on its back up tapes
- Between 2010-2013 Internet usage grew 20x
- On current pace as of last year exceeded one exabyte per day on Internet

TECHNOLOGY 6 MEGA-TRENDS (IN NEXT 10 YEARS)

- People and Internet (wearable and implantable technologies with 'digital presence')
- Computing, communications and storage everywhere
- The Internet of Things
- Artificial Intelligence (AI) and Big Data
- The sharing economy and distributed trust (new business models)
- The digitalization of matter


WORLD BANK 2016 „DIGITAL DIVIDEND" REPORT
„
Digital technologies have spread rapidly in much of the world. The broader development benefits from using these technologies have lagged behind.
It has boosted growth, expanded opportunities, and improved service delivery. Yet their aggregate impact has fallen short and is unevenly distributed.
"
▪ These challenges are not only solvable but also present massive oportunities for societies if we THINK 7T Model (Tensions/Threats, Topic/Themes, Targets, Transformations, Tools, Tactics, Time) and then apply 7M approach (Model, Motivate, Mobilise, Move, Measure, Monitor, Manage) to leading change.


Ultimate Question is
WHY
(Leading) Change (With Values and Dignity) by Thinking and taking journey along "7T" and "7M" path to Shared Society and Values !!?

FEARS, HOPES and MEANS have no alternative to 5 Pillars of Change

- (Sustainable and) Shared Development
- (Shared and) Sustainable Environment
- (Shared) InformationTechnology
- Shared Society (Equitability, Inclusiveness, Identity)
- Shared Global Knowledge Bank - (Education vs Catastrophy)

No one is Passenger – Everyone is Crew

Erich HOEDL*

HOW TO GOVERN TECHNOLOGICAL ADVANCES BY EDUCATION?

Abstract: Whereas the technological future of the society is traditionally discussed in the polarity of society and technology we enlarge the perspective to the triangle of society, technology and population. By this we get grip of the role of population in shaping future technologies. Referring to some classical investigations, which expect a coming „megamachine" we argue that human-centred education will minimise „technological cages" and it will change the society profoundly. Taking the European Union as an example we will show that current and mid-term technology policies go toward softened technologies, but their successes are mainly hampered by the backward-oriented educational policies for „employability". After that we discuss the implications of a shift from a rationalistic to a dialectic understanding of sciences were living systems come in and the civil society gains of importance. But the implied division of society into a high labour intense and a high capital intense sector can endanger an overall transition to human-centred technologies. However, societal development has already become an open process with a remarkable influence of the general population. Human-centred education will unfold its immense creativity in favour of human-centred technologies, especially when it is supported by a new economic theory and an accordingly designed paradigm of societal development.

Key words: *Technological Advances, European Technological Policy, Human-centred Education*

SOCIETAL-TECHNOLOGICAL INTERRELATIONS AND HUMAN-CENTRED EDUCATION

Fortunately, previous beliefs that technology is mainly an independent force of societal development and has weak relations to social organisation and its cultural and ethical values, have disappeared. Nobody favours any more a pure technological determinism and actually we perceive the intimate interrelations between society and technological advances, which develop under ecological, social and eco-

* European Academy of Sciences and Arts (EASA); Former Rector of University of Wuppertal and Graz University of Technology

nomic restraints. Under these conditions we should not ask, if technology is the servant or the master of the society, but we have to look at the already existing amalgam of society and technology and this perspective is especially important for the search how to govern technological advances. Methodologically, we cannot any more divide between the society and its technology, because we have for neither of these areas a well-accepted theory. But even if we had such theories without a self-regulating mechanism toward a human society, for governing the amalgam we have to introduce a third actor and the only one possible is the population itself. Therefore governing technological advances can only take place within the triangle of the existing society, the relatively separated technological advances and the population engaged in societal and technological affairs. As the engagement of the population for a human technology depends on the degree and orientation of the education, the latter is of decisive importance for governing technological advances. Moreover, if the population wants alternatives to existing technologies the consequences will induce considerable changes of the society. Creating human technologies will be supported by a new paradigm of societal development (Jacobs 2012) in which human-centred education will play the key role.

Let us shortly refer to some prominent voices of long-run technological development and its relation to society. Jaques Ellul (1964) defines his „technique" mainly as rationalistic, traces the historical developments in the economy and the state and discusses the possibilities of human technologies in a supposed „monolithic technical world". He rejects solutions by technologies of the „second degree" and votes for the definition of new ends for a human society in the technological age. According to this rationalistic analysis he comes to a decisionistic policy approach without clearly defining the ends and goals of a human society. Lewis Mumford (1974), who goes into more details of the interaction of society and technology concentrates on the coming „megamachine" with its power structures, which restraint the potential societal richnesses beyond quantitative economic wealth. Based on his dialectic methodology — inspired by Darwin — he regards the society as a living system with complex organic structures, not far away from the present discussion of eco-systems and entropy and with some relations of Georgescu-Roegen's approach. Although, Mumford and Ellul derive on the micro level quite different consequences they agree that on the macro-level the society is endangered by a monolithic technical world, resp. a megamachine with their power structures. In many respects early sociologists, like Max Weber (1922), Karl Mannheim and others, as well as philosophers, like Martin Heidegger came to the same and rather pessimistic conclusions. However, these investigations do — with some exceptions of Mumford — not refer to the potential contribution of the population and its education to a transition into a technologically underpinned human society.

Classical treatments of the technological society have included manifold historical, cultural and ethical dimensions, but since a few decades we are confronted with a strong turn to a narrow economic focus, which only recently goes reluctantly toward a broader perspective. This is due to the far-reaching economic and societal crisis and demonstrates the limits of primarily economic innovation and dissemination of technologies. To our regret, technological innovation is strongly war-driven and — as an example — European research policy was highly influenced by the economic competition with the USA (Servan-Schreiber 1970) and has a straight line to the European Framework Programmes, the Horizon 2020 (Commission 2011 a) and the foresights in Global Europe 2050 (Commission 2011 b). European educational politics are far behind, which means that priority is not given to the empowerment of people by education, but to production of „things" for them by an economically competitive economy. In academic research of technological innovation we find since the 1970 ies, starting with Schumpeter's „creative destruction" and Kontratieff's „long waves" many optimistic concepts to prevent a decline of economic growth. But even in the framework of the narrowly defined GDP this strategy to master societal development by accelerated technological innovation was not successful. Earlier warnings by the Limits of Growth (Meadows) and the Social Limits to Growth (Hirsch) represented some counterweight to the technological optimism. But the now emerging technologies are to a large extent considered as chances to regain high economic growth, not for more social equality and even less for the empowerment of people by human-centred education.

We have described the amalgam by the interaction of society and technology and in simplified view technological advances are produced by the „man-made brain power industries" (Thurow 1999, pp. 314), which depend highly on the general educational system. Comprehensive education is a precondition for the establishment of an effective research system (Hoedl 2007). Certainly, the brain power research system changes over time the content of the educational system as well as the organisational structures of both systems. Until now we find a dominance of the rationalistic understanding of sciences and a corresponding production of new technologies with restricted organisational innovation. If we want to go toward a dialectical development of technologies, research and education has to adapt much more to societal needs, which can only be generally and vaguely specified. But even, if we could define them clearly, this would lead to a decisionistic approach for which neither the economy nor the state can have valid information. It is only the population, which can develop a vision about the technologies wanted and only human-centred education can be the governing force for human-centred technological advances.

SOFTENED TECHNOLOGY POLICIES AND RESTRICTED TURN TO EDUCATION

Science and technology policies are growingly synchronised world-wide and we take as examples the European policies, specified in Horizon 2020 and in Global Europe 2050. Especially, in the longer term study we find a softened technological determinism: On the one side frontier research should ensure global scientific competitiveness and on the other practical innovations should furnish solutions to cope with the Great Societal Challenges. It is not any more a pure rationalistic spectrum of technologies, which is proposed for application and it should be developed and applied in some cooperation with the society. An early and specific instrument of firms is the Consumer Related Management (CRM), which anticipates consumer preferences. On the regional level a variety of clusters cooperate in the framework of open innovation, which is related to open research and includes people's participation already before the spreading on the markets. No question, these examples are mainly motivated by economic criteria, but in the majority of cases they have also positive societal effects and give activating impulses for peoples participation and their learning processes. The need for an involvement of educated people is even greater in the up-coming trend to social innovation, which enhances organisational changes and is an important step toward embedded technologies, which need a participatory approach. Softening technological advances is bound both to interdisciplinary education and research as well as to highly complex technology policies, which induces also some changes of the societal development.

Let us illustrate the enormous complexity of the European technology and innovation policy, which can never be managed by firms and the state without an active participation of the population. Instead of the ideological assumption of self-regulation and innovative economic competition the Europe 2020 Strategy (Commission 2010) aims at enhancing simultaneously economic, social and ecological sustainability. They should be realised by the interdependent priorities of a smart, sustainable and inclusive growth, which aim — until now without any modification of the GDP indicator — to a higher and more stable economic growth than before the crisis. Smart growth will be based on knowledge and innovation, sustainable growth on a more resource-efficient, green and competitive economy and inclusive growth should create more employment and social and territorial cohesion. All three priorities are bundled into seven flagship initiatives, the technological content of which is more specified in Horizon 2020 by again three mutually reinforcing priorities of Excellent Science, Industrial Leadership and Societal Challenges, complemented by the European Institute for Innovation and Technology (EIT) and the Joint Research Centres (JRC). This highly complex organisation of the European technology policy interacts with the innovation impulses of the private economic competition system and represents the guidance for the longer-term technological development, which is mainly oriented toward global economic competitiveness. If we enlarge our perspective to the societal development and include cultural and ethical dimensions we cannot any more say who is driving and who is driven within the amalgam of societal and technological interactions. On the micro- and meso-level different kinds of technology assessments will contribute to more human-centred technologies. But without an underpinning by well-defined values, derived from an adapted societal paradigm, they will fail. And responsible and ethical research (Karatzas 2012), which itself became highly complex and difficult to manage will not be an adequate counterweight.

In an economy-driven technological development the correctives of public technology policies and people's participation have a limited influence and they are even smaller in cases of a low educated population. But in the longer-run we are confronted with the additional problem of large infrastructures, which need high capital investments and represents sectorial adapted superstructures, which may lead to corresponding technocratic cages (Mumford 1974, p. 833). In Global Europe 2050 a variety of more systemic and holistic technologies, for example for mobility and the energy, are proposed to cope with the future societal challenges. Such systems may render services more cost-effective and respond partly to societal needs, but one should not hesitate to question some dimensions of the global information systems including the Internet, because we do not know in how far and for whom they are in sum beneficial. Large infrastructure could organisationally be made more socially viable, but if they are owned by large corporations and the state they create (global) monopolies and tend to induce a techno-economical determinism to which the society and the consumer have to adapt. Global Europe 2050 gives certainly more importance to the changing socio-political environment than Horizon 2020, but it neither questions the endogenous dynamics of technologies nor the primarily rationalistic understanding of science. It votes for massive investments in „human capital" and its application in the private and public sector, but leaves the fundamental structure of our economic society beyond its considerations. In such an analytical framework the relation between technology and society cannot be discussed and we can say that European technology and innovation policy follows a technologically underpinned economic determinism, which is complemented by an economically oriented education instead of a human-centred education.

In our short references to the historical discussions of the technology-society relations we referred to the importance of the concept of sciences and the educational implications. What we see now globally is still a dominance of economically coined educational systems. In face of the increasing unemployment, which itself derives from the increasing substitution of labour by capital, „employability" has become the key word for education. The narrow and discipline oriented specialisation of an ever increasing variety of study courses and the financial dependence of the educational system on private funding turns it to a short term orientation toward the economy. Although Universities have become more flexible, they are still the transmitter of inherited knowledge without larger changes toward a new understanding of science and scientific education, which would prepare for societal engagement and action instead for immediate needs for employment. At the same time the above described softening of technological advances need broader and holistic perspectives. Actually, there exists a discrepancy between the qualification needs in progressive economic and societal fields and what the majority of educational institutions furnishes. The employment needs more and more fully developed personalities to cope with increasing intra- and entrepreneurship (Picot 2001, pp. 451), which are signs that the „human factor" gains of importance both in the economy and society. No private or public institution can be run without a department for „human resources". In a longer perspective, the prevailing University system will probably transform profoundly toward learning instead of teaching and to more practical and action-oriented interdisciplinary knowledge. We may argue, that the future of education has to concentrate on human-centred contents, which will be in favour of human-centred technologies and a human society.

MORE RADICAL TECHNOLOGICAL SHIFTS AND LIMITING POWER STRUCTURES

What we learn from the prevailing tendencies in global technology and innovation policies are the tensions between the inherited rationalistic perspective and a dialectic development, where organic and living systems are in the centre. Paul Crutzen (2000) has reminded us that we are in an Anthropocenic Epoch during which humans are not only the cause, but also the potential to surmount existing difficulties. If we succeed to reorganise our society humans can unfold their potential in favour of human-centred technologies, more equal global development and minimise societal crises as well as military conflicts. Instead of an antagonistic competition we can turn to cooperation and finally to a cooperative creativity (Huether 2016). We could develop and implement solutions, where empathy will play an increasing role and lead to a consciousness of our biosphere in which we live (Rifkin 2011, pp. 253). In an eco-centric perspective we are able to anchor our analysis in entropy and coordinate human activities by lateral, less hierarchical regional and global networks. By this, we generate more ecologically viable and human-centred scientific and technological advances, because it enhances the human creativity instead of promoting ever growing only economically efficient large production and governmental structures, which cannot be run without suppression of the involved population. More radical technological shifts are bound to decentralisation and technological advances will be primarily bottom-up induced.

Nearly half a century ago Fritz Schumacher (1973) has proclaimed that „Small is Beautiful" and in many areas relevant opportunities are emerging. But at the same time automation and robots begin to ripe and alleviate from rationally-repetitive work and in the future robots may become intelligent and self-learning. Far-reaching automation needs enormous research and development and we do not know in how far the reduction of work will be compensated by the increasingly outsourced infrastructures and brain work. The most probable future of economic structures will be characterised by a division between a highly automated and capital intense sector producing for large markets and a partly informal sector with high labour intensity directed toward regional and local demand. Tentative prognoses say that in 2050 the civil society will account for half of total employment (Rifkin 2011, p. 281). In terms of employment we can expect a crowding out of the automated sector by the informal sector, which will be composed by a high diversity of small and medium firms with self-employment, non-profit orientation etc., responding primarily to increasing demand in social, health and education services, including activities for repairing and recycling with flexible working times (Peach 2015, pp. 113). The economy will allow a further shortening of working time, but not for isolated leisure time, but by new work-life balances, which give room for more practically oriented interdisciplinary education, partly for individually tailored knowledge needs.

The informal sector and its educational demands are by no way clearly separated from the automated sector. If we assume that large industries are bound to large infrastructures they depend highly on the informal sector, which furnishes services for consulting, advertising and other outsourcings. Seen from the traditional economic theory we can say, that the market failures of the automated sector can only partly be repaired by the state and the growth of the informal sector with its broader societal orientation will be an indispensable complement. However, we have to ask in how far the automated sector itself will develop toward living systems. No question, many large technological systems, for example in energy production, can be substituted by networks of smaller units. In other areas, like the automotive industry large production units will remain. The running of such large technological systems will need less workers and more white-collar employees and related brain power workers. But the production of such system will for the sake of economic efficiency follow the rationalistic perspective to which the digital revolution contributes. Including the emerging digitalisation of private households we are possibly on the track to form our brains accordingly (OECD/CERI 2007) instead of looking first at the humans. Some decades ago, the human-oriented analysis of the Fordism (Bravermann 1977) has led to political programs for a „humanisation of work" (Matthöfer 1980) and a reorientation of education (Bosch 1992), but they had limited effects. Some hopes that the introduction of the then emerging information and communication technologies would humanise work by itself were not confirmed. Beyond the certainly human-oriented effects of decentralisation of production there may emerge isles of new technological cages, which have by feedback negative consequences on the actually developing and rather human-centred informal sector and the civil society.

In our simplified distinction between a high capital intense and a more labour intense economic sector we identified the latter as the progressive field, in which more human-centred technologies appear. Additionally, we detected in the globally synchronised technology and innovation policies a variety of reluctant approaches toward human-centred technologies. But for seriously judging further advances we have to look at some main obstacles, which concern over-optimistic judgements of the future role of the informal sector. With few exceptions, we find worldwide an analytical neglect of the totality of societal dynamics, which may overrule the progressive elements of the civil society (Prisching 2005). We confine our considerations to some economic dynamics, which dominate actually to a large degree many political, cultural and ethical dimensions. In the framework of a Socio-Ecological Market Economy we can ascribe ecological sustainability to less natural capital inputs, economic sustainability to less man-made and financial capital inputs and social sustainability by higher employment. Actually, we have no tendencies to reduce capital inputs in favour of higher employment and within capital inputs a steadily increase of financial capital. Can we under these multi-dimensional power structures (Russell 1968) expect a turn to a human-centred technology, were the majority of the population shape it? Certainly to a limited extent, but only under restraints of the prevailing basic rules and values of the society. So we should be aware of the some experiences during the last fifty years, where partly successful reform policies in the 1970 ies were cancelled-out by the neoliberalism without bringing better results. Some foresights for the next decades suggest — although they are based on past developments — that global inequality will considerably increase (Piketty 2014). However, in face of the immense social power of the population largely underutilised (Harish 2015), p. 37) we should optimistically count on a dictum that „power of vested interests are largely exaggerated compared with the gradual encroachment of ideas" (Keynes 1967, p. 383). Therefore, it is wise to engage intellectually for the development of a new paradigm for societal development and human centred education.

BEYOND „IRON LAWS" OF DEVELOPMENT AND CHANGES OF SOCIETAL PARADIGMS

Societal development is not governed by formerly supposed „iron laws", especially supported by rationalistic economic growth theories, but is a dialectic and open process in which the total population becomes increasingly more important. Purely economic estimation of „human capital" in highly industrialised countries show that it accounts for more than three quarters of total economic resources (Slaus 2015, p. 107). No doubt, the most influential impulses for the development of the amalgam of society and technology are the „man-made brain power industries" and the educational systems along the live-long learning chains. But if these drivers have no vision about the research priorities and the content of the educational curricula, they may not enhance societal security, welfare and wellbeing. Increasing deviations from this generally accepted goals can partly be reduced by an adequate technology and innovation policy, which has to include the aspirations of the population. If the rather diffuse aspirations can be canalised toward a spirit of anticipation about the future of the society wanted, anticipation (Poli 2014, pp. 23) could more strongly anchor the vision and the goals of the population. Certainly, the transition to a new society is hampered by vested interests, but decentralisation and lateral governance, which are increasingly enforced by the coming technological advances give more weight to the large population, the education of which has to go far beyond the iron laws and employability.

The basic ideas of what we call here human-centred education have a long tradition going back to the early Enlightenment were societal questions should be managed by the population itself, educated individually and as a society (Hoedl 1997, pp. 27). To cite a few names: For Jean-Jaques Rousseau education should develop the individual according to the human nature, for Immanuel Kant it should enable the individual to use its own reason and for Pestalozzi it has to develop the personality for a pure human wisdom. All of them give priority to personal development vis-a-vis professional qualification. According to such principles Wilhelm von Humboldt designed a University, where learning has priority over teaching, but just a few decades later professional qualification took over and actually economisation has lost sight of the fundamental human orientation of education. It is not by chance, that modified reconsiderations of the classical ideas of education are developed in the current period, which need a redefinition of the role of the individual and the society with a comparable depth. In a broader sense some discussions speak about the need of a „New Enlightenment" (Forum Alpbach 2016). On this occasion I will not discuss any detail of the recently profound reflections on human-centred education (Jacobs 2012, Zucconi 2012). Although there are some differences to the capability approach of Amarta Sen (2003, pp. 347), the basic ideas to give priority to the human potential of the individual and society are in a clear neighbourhood. So we can be somewhat optimistic, that an enlightened population will contribute to the creation of a human amalgam of society and technology.

Human-centred education and its interdisciplinary orientation is a powerful instrument to unfold the potential of human capabilities. To make them effective for governing technological advances we have to go back to the triangle of society, technology and the population and human-centred technological advances will change each of the three actors. Therefore, there exists a vital need for a new paradigm of societal development and if we consider the prevailing economisation, the same urgency exists for a new economic theory. Since a decade a new understanding of the economy is tackled from different angles and recently contours of a New Economic Theory have been proposed (Jacobs 2015, pp. 139). Evidently, there is still a long way to go to a coherent new economic paradigm, but it should not follow the rationalistic understanding, by which natural sciences largely influenced economics and resulted in closed systems. It has to be an interdisciplinary and open paradigm, including theoretical and practical questions. Probably it will not fit into the commonly accepted term of a „scientific revolution" (Kuhn) and will not be a ready-made recipe for politicians, who are inclined to implement it „both when it is right or wrong" (Keynes 1967, p. 383). A complementary line to develop a new understanding of the economy centres around the critique of the narrow discipline-oriented economic categories and the need to include in principle all relevant social and natural dimensions. The development of a new macroeconomic theory (Jackson 2011, pp. 148) will not cover the problems with which the society is confronted. More promising is the concept of a Socio-Ecological Market Economy (Hoedl 2014), which is fully open for interdisciplinary approaches without losing contact to prevailing economic power structures. The changes of them depends in such an institutionally oriented framework also on a rigorous empowerment of people by human-centred education.

Let us now summarise our conclusions for the question how to govern technological advances. Those who await a clear-cut scheme for implementation will be deceived, because they are still a victim of a rationalistic and decisionistic understanding of science. What we found out is: *Firstly,* an irreversible tendency to a softening of technological advances toward ecological and social dimensions, partly supported by public technology policies and also by private firms. The main existing deficiency in all this areas is the low importance given to education and the still dominant target of employability. *Secondly,* there are increasingly more rigorous approaches to technological advances, guided by a dialectical understanding of society and technology, but their implementations are limited to specific areas and the civil society. And accelerating and spreading their implementation more widely touches on the basic values and rules of the society and its power structures, like the global financial system. From these two findings, we can *thirdly* conclude, that a turn from employability-oriented education to human-centred education will question existing power structures and new paradigms for the societal and economic development will enhance a transition to human technologies. And *finally*, the transformation of the above described amalgam of society and technology needs still highly complex scientific research and will be a longer term open process. But for humanising technological and societal developments we have no other institution than the humans themselves and their empowerment by human-centred education.

REFERENCES

[1] Bosch, G. (1992), Retraining — Not Redundancy, Geneva.
[2] Crutzen, P., Stoermer, E. (2000), The Anthropocene, in: Global Change Newsletter, Nr. 41, pp. 17–18.
[3] Ellul, J. (1964), The Technological Society, New York
[4] European Commission (2010), Europe 2020, COM (2010), 2020, Brüssel, 3. 3. 2010
[5] European Commission (2011 a), Horizon 2020, COM (2011), 809 final, Brussels, 30. 11. 2011
[6] European Commission (2011 b), Global Europe 2050, Brussels, 28. November 2011
[7] Forum Alpbach (2016), New Enlightenment, Neue Aufklärung, Vienna
[8] Harish, J. (2014), Society and Social Power, in: Cadmus: Vol. 2, Issue 3, pp. 37–49.
[9] Hoedl, E. (1997), Organisatorische Hochschulreform ohne bildungspolitisches Leitbild?, in: Beiträge zur Hochschulreform, Remscheid, pp. 17–30.
[10] Hoedl, E. (2007), Die Europäische Union als Wissensgesellschaft, in: Wirtschaft und Gesellschaft, Vol. 4, pp. 529–551.
[11] Hoedl, E. (2014), European Transition into a Socio-Ecological Market Economy, in: Cadmus, Vol. 2, Issue 3, pp. 84–93.
[12] Huether, G. (2016), Warum fällt uns das Umdenken so schwer?, Presentation to the 3. Conference „Wachstum im Wandel", Vienna.
[13] Jackson, T. (2011), Wohlstand ohne Wachstum, München.
[14] Jacobs, G. (2012), The Emerging Individual, in: Djurovic, M. (ed.), Humanities in the contempory World, pp. 347–362.
[15] Jacobs, G. (2015), Contours of New Economic Theory, in: Cadmus, Vol. 2, Issue 4, pp. 139–161.
[16] Karatzas, D. (2012), The Ethic Review of EU-Funded Research Projects, in: Djurovic, M. (ed.). Humanities, op. cit., pp. 221–237.
[17] Keynes, J. M. (1967), The General Theory of Employment, Interest and Money, London.
[18] Mumford, L. (1974), Mythos Maschine, Wien
[19] OECD / CERI (2007), Understanding the Brain: The Birth of a Learing Science, Paris.
[20] Paech, N. (2015), Befreiung vom Überfluß, München.
[21] Picot, A., et. al. (2001), Die grenzenlose Unternehmung, Wiesbaden.
[22] Piketty, T. (2014), Capital in the Twenty-First Century, Cambridge/M.
[23] Poli, R. (2014), Anticipation: A New Thread for Human and Social Sciences?, in: Cadmus, Vol. 2, Issue 3, pp. 23–36
[24] Prisching, M. (2005), Zivilgesellschaft in Europa, in: Hoedl, E. (ed.), Europäische Wirtschafts- und Gesellschaftsordnung, Marburg, pp. 125–145.
[25] Rifkin, J. (2011), Die Dritte Industrielle Revolution, Frankfurth/M.
[26] Russell, B. (1969), Power, New York.
[27] Schuhmacher, E. F. (1973), Small is Beautiful, London.
[28] Sen, A. (2003), Ökonomie für den Menschen, München.
[29] Servan-Schreiber, J. J. (1967), Die amerikanische Herausforderung, Reinbek bei Hamburg.
[30] Slaus, I. (2015), Employment and the Unity of Social Sciences, in: Cadmus, Vol. 2, Issue 4, pp. 104–115
[31] Thurow, L. (1996), The Future of Capitalism, New York.
[32] Weber, M. (1922), Wirtschaft und Gesellschaft, Tübingen.
[33] Zucconi, A. (2012), The Fully Functioning Person: A Bio-Psycho-Social Viewpoint, in: Durovic, M. (ed.), Humanities, op. cit., pp. 463–475.

Veselin VUKOTIĆ[*]

SENSE OF FUTURE OR LEARNING FROM LIFE

BACKGROUND OF THE IDEA

The idea of this paper comes out from the question: Why this time can be described as the time when young generation is underestimated? This question has arisen from life.

Youth unemployment rate in Europe is 35–50%! Can we consider unemployment as the way to reject an individual from the community? Unemployment is the biggest personal disaster for an individual, isn't it?

Young generation is often called jobless generation. If we know that Alexander the Great built his Empire while he was in the age of 23 to 33, and his contemporary peers still live with their parents in that age — the question is what happened? Did biology change? Did technology change? Did civilization change? Should we understand the issue of youth unemployment as the question of current momentum and technical question, or is it the question, which comes out from the essence of this civilization model — Western civilization, before all…

„Something is rotten in the state of Denmark", says Shakespeare.

Something is rotten in this civilization.

Do we come to an end of one civilization context?

Can we understand contemporary migrations, colons of thousands of migrants, boats overloaded with people heading from Asia and Africa to Europe as the warning?

Is the population map given below the warning?

Map is showing how would state borders look like if they would represent the size of population, not the size of territory as now. Can we stop migration by building walls in the long run? Should we think more of integration?

Aren't these two facts: youth unemployment and new great migration — serious research platform for all of us, researchers? Should we deal with such life issues

[*] Rector of University of Donja Gorica — UDG; Associate member of Montenegrin Academy of Sciences and Arts

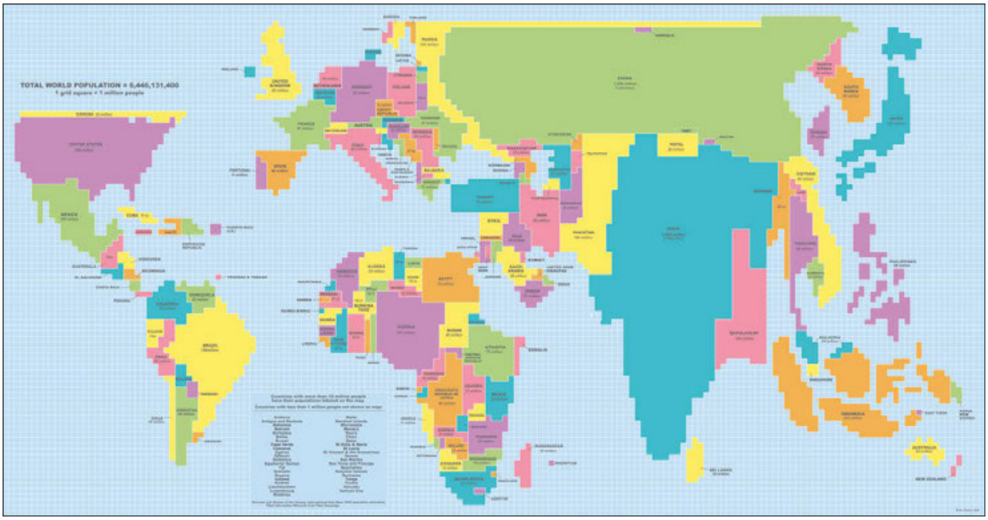


Illustration 1: Population map
Source: https://www.flickr.com

or should we write lifeless papers for publishing in Journals listed in Science Citation Indices?

Should we just describe the world we live in, or should we learn from the world we live in? Karl Marx wrote: „The goal of a philosopher is not to describe the world, but to change it!"

GLOBALIZATION

All of this brings us to the question: Can we think of globalization as of description of today's world, or the globalization is the creation of new civilization and the big change of current civilization model?

Is the globalization this essential difference?

Is the globalization this new civilization context?

I don't think that globalization is this techno-technological addition to current model of civilization… It is the new civilization. Or better said — it is a dawn of civilization?

What does globalization change in my opinion?

1. It changes the dominant paradigm;
2. It changes sources of growth and development;
3. It changes the role of education, i. e. the role of school.

1) THE CHANGE OF PARADIGM

Economy is the base of today's paradigm. Many people call this economic imperialism. Economy is the base of society. Material values are the base — spiritual values are the overhead. All of us from ex-socialistic countries know that model very well.

Homo economicus is in the essence of understanding of our world. National state is the fundament of organization of human life.

However, what happens with this paradigm in information society and in the globalization environment, with growing interdependencies? Paradigm, which considers the economy as the base of society, is transforming into paradigm where culture is the base.

Homo ludens, the man of the game, is taking the role of homo-economicus, as the main actor of social change. In this paradigm an individual is not the raw material for building society and collective, but it becomes the subject. Instead of an individual subordinated to society, the focus is moved to an individual who is a researcher, who transforms himself into the subject, and the initiator of changes. Without doubts, this mutation will have both positive and negative consequences, as it equally emphasizes freedom and alienation…

In my opinion, new paradigm is destructing national state. The survival of national state becomes harder, which is confirmed through growing public debts in all states, including the most developed ones, and high unemployment of young people. The borders of national states cannot survive the pressure of public debt and unemployment, not to mention climate change and pollution.

2) CHANGE OF THE SOURCES OF GROWTH AND DEVELOPMENT

Change of paradigm necessarily changes the sources of growth and development in the society. Culture is in the center. Culture is the totality of human activities. Culture is related to spirit. It is related to engagement of the spirit.

On one hand, it is the set of values, customs and practices, which make the totality of life of specific group of people. However, I understand it as the set of producing skills. Technology is also the expression of culture. Attitudes toward economy, society and work all originate from culture. Niche said „the development capital of one society is the capital of will and spirit, not capital understood as isolated money or technology".

The culture leads to so-called culture industry. Creativity and innovation become drivers of development. Ideas are the most convertible market goods today. And ideas don't recognize limits… „Imagination is more important than knowledge", as Einstein said. Contemporary time confirms his thought.

Return to culture is return to genetic roots of life. Culture is created by the species of Homo and Homo sapiens during around 200.000 years. People has survived for very long time in history without production, they collected fruits and herbs, and hunted in order to provide food. In the time of leisure they had been occupied with art, music, and magic… Current anthropological research rates so called cave art very high. Human beings started to produce 12.000 years ago, when agriculture was discovered as human activity. Production gave birth to economy. Thus, we must have in mind that culture preceded economy and that the change of paradigm, which happens, is just the return to our human roots in new conditions.

3) DOES GLOBALIZATION LEADS TO THE END OF EDUCATION? DOES IT LEAD TO THE END OF SCHOOL? DO WE FACE THE END OF EDUCATION? IS GLOBALIZATION HEADING TO THE END OF SCIENCE?

Can current monopolistic position of school and science survive in information and globalized society? Can we predict the directions of change? Let us not forget that formal education has started in France in 1498. However faster development of education started in 17^{th} century. Enlightenment was the movement which promoted formal education. School is created as an institution which will replace the role of church: to develop ideologies aimed to provide power and political authority to the ruling elites. Did something change today? Why current curriculums are full of ideology? What does current state accreditation bodies for accreditation of school and university curriculum do? Why private universities are still undesirable in Europe, which is the cradle of current civilization? Doesn't education institution still leave most of population out of their reach? According to UNICEF data more than 60% of children who enroll primary education now will not reach the level of education, which is considered mandatory in the countries of their origin, but will drop out before that. However, the minority will get 20–30 years of formal education.

The real problem is that changes in the real world are much faster than changes in the schools and at the university. This gap will, I am sure, completely change current school system and the understanding of its role. Will the revolution of information technology and globalization bring us to the end of science?

Education will release from closed spaces. Internet is making the process of losing importance of knowledge even more rapid. People are finding the way to avoid bureaucratic obstacles. People will be accepting the approach that knowledge is personal experience, which means that the only way to get the knowledge is not to learn about life, but to learn from the life.

I am not talking from the perspective of debates if there were some unexplored areas, or if theory of everything and theories of specific professions would make the science to lose its subject of research. I don't believe in this.

I believe that the end of science has come, when we speak about the science as isolated spiritual activity of life. The science is facing the challenges of its internal integration but also integration with other spiritual activities of human kind. It is becoming more obvious that we cannot come to the truth with partial, isolated activities.

INSTEAD OF CONCLUSION

The only way to reach essential truth is through unity and synergy of four, now separated fields of spiritual life of a human being:

— Science;
— Philosophy;
— Arts;
— Religion.

The question is: how can we integrate these?

I don't have the final answer, however similar to previous questions; I have the feeling and intuition about the future challenges we will face.

When we are aware of the challenges — we made the first step toward the solution.

But, first we have to realize that these tectonic disturbances in current civilization model are the challenges and problems of young generation and migrations. It is illusion to think that these problems can be solved only in the context of the current way of thinking and in current institutional framework in the society.

I didn't give you the picture of future, but I talked about the sense of future. It is more intuitive, then empirical approach. This is my thinking out of concept, „out of box"! In this time, there is no constructivism clichés. Complexity and uncertainty, along with growing speed of changes are the main features of contemporary world. In this world, you should dream more. You should not just wait and watch, but you should have more ideas!

As previously noted, we will have to face two big challenges:

1. Youth unemployment
2. Migration.

However, instead of conclusion, I want to put emphasis on something else. In contemporary fast changing world rapid changes cannot be avoided. It is usually said that the adaptation to changes is needed in order to survive. My opinion is that an individual and society have to go one step further if they want to develop. I will make an analogy with examples from the evolution of species, in order to illustrate this point. What is my message?

The truth is that one must adapt in order to survive. If the one doesn't take a step to adapt to changes and continue to act as in the past by inertia — it will disappear. That is what happened to dinosaurs for example.

If the one adapts, but after the changes take place; if it adapts to the changes ex-post, it will not develop but remain at the same level of development. The analogy from animal world is zebra, which remained the same in its evolution path.

However, if the one is capable to adapt to the changes, but to introspectively adapt those changes to his/her needs then he/she develops. Thus, human ancestors developed from monkeys to Homo. The ability to look the world around you, notice changes and anticipate changes in order to adapt processes of change in the environment you live to your own needs is the precondition to develop in contemporary world.

REFERENCES

[1] Abeles, Mark (2013) *Anthropology of Globalization*, Biblioteka XX vek, Beograd

[2] Apaduraj, Ardžun (2011) *Culture and Globalization*, Biblioteka XX vek, Beograd

[3] Barzun, J. (2003) *„From Down to Decadence — 500 Years of Western Cultural Life, 1500 to the Present"*, Masmedia, Zagreb.

[4] Glušćević, Boško *Lectures 1970/71*, School of Economics, University of Montenegro

[5] Harari Yuval Noah (2015) *Sapiens: A Brief History of Humankind*, Fokus, Zagreb
[6] Horgan, J. (2009), „*The End of Science*", Jesenski-Turk, Zagreb;
[7] Huizinga, Johan (1992) „*Homo Ludens: A Study of the Play-Element in Culture*", Zagreb, Naprijed,
[8] Huxley, Aldous (2009) „*Brave New World*", Libreto, Beograd
[9] Huxley, Aldous (2014) „*In the Name of Spirit*" (The Door of Perception and other selected essays), Naklada Jesenski i Turk, Zagreb
[10] Kolombato, Enriko (2014) „*Market, Morals and Policy Making*", CID, Podgorica
[11] Kox, B; Forshaw, J. (2009) „*Why E=m·c 2?*", Dacapo Press, London
[12] Miloš, Česlav (2006) „*Imprisoned Mind*", Paideia, Beograd
[13] Nietzsche Friedrich (1997) „*The Future of Our Education Institution*", Library Zoran Stojanović, Sremski Karlovci;
[14] Ohmae, K (1999), „*Invisible Continent*", Harper Collins Publisher, New York;
[15] Pejović, Stiv (2011) „*Law, Informal Rules and Economic Performance*", CID, Podgorica
[16] Ralston Saul, John (2010) „*The Unconscious Civilization,* Karpos, Beograd
[17] Rifkin, Jeffrey (2005) „*The Age of Access*", Bulaja naklada, Zagreb
[18] Ritzer, G. (1999) „*The McDonaldization of Society*", Jesenski i Turk, Zagreb, str. 16;
[19] Taleb, Nassim (2010) „*The Black Swan*", Heliks, Smederevo
[20] Tapscott, Don (2010) „*Grow Up Digitaly*", Mate, Zagreb;
[21] Touraine, Alailn (2011) „*The New Paradigm for Understanding Today's World*", Službeni glasnik, Beograd
[22] Twenge, Jean (2013), „*Generation ME*", CID, Podgorica;
[23] Ouspensky, P. D. (2007) „*The New Model of Universe*", Metafizika, Beograd;
[24] Vukotić, V. (2011)„*The History of Future*", CID Podgorica, mediasystem
[25] Vukotić, V. (2013) „*Anthropology of Creation*", UDG, Podgorica
[26] Vukotić, Veselin (2013) „*Almanac of Study — the Concept of Philosophy and Vision of University of Donja Gorica*, UDG, Podgorica
[27] Wahl, A. (2011), „*The Rise and the Fall of the Welfare state*", Pluto Press, Norway.

Lorenzo GASCÓN*

SHAPING THE WORLD AT AN ALMOST UNCONTROLLABLE SPEED

Abstract: The Middle Ages lasted 800 years, the Industrial revolution 200 and the digital era skips stages every two years.

— The space race, computing, biology, are shaping the world at an almost uncontrollable speed.

— Let's have a look at a recent discovery based on rat UT 2598. It is linked to human longevity and its unpredictable consequences.

— The 'Welfare State', healthcare and education for everybody and a retirement pension from 65 years old.

— At the time, life expectancy of Europeans was 67 years. Nowadays in Europe, the average is 80 years.

— The tests with rat UT 2598. At the Health Science Center of the University of Texas in San Antonio, an achievement due to the discovery of a compound named rapamycin.

— An average life expectancy of 142 years.

— Should the concept of working until 60/65 be extended, let's say, until 90?

— What about retirement economically sustainable?

— The USA and China invest in scientific research more than the European Union.

— Science is closely conditioned by what is happening beyond our limits.

We say that the Middle Ages lasted 800 years, the Industrial revolution 200 and the digital era skips stages every two years.

Nothings is more palpable than the staggering pace of scientific achievements in the past few years, which have been crucial in the hatching of worldwide globalisation.

Globalisation is the consequence of cutting-edge technology, in particular of computing.

Humanity has crawled forward in terms of technology for thousands of years.

* Vice President, Royal Academy of Economic, Sciences and Finance of Spain; WAAS Fellow

It wasn't, however, until two thousand years ago that we made a big leap forward. The Greeks in the Classic Era and later the Arabs in the Middle Ages, with their astonishing successes in the fields of mathematics, geometry, astronomy, architecture, philosophy, and literature, laid the foundations of our civilisation and the basis for modern technology.

However, it was not until a few decades ago that scientific investigation started to make advances that were unthinkable a century ago.

The space race, computing, biology, are shaping the world at an almost uncontrollable speed and they are making the future unpredictable. And we are starting to feel this unpredictability.

Let me, as an example, show you what is coming in the multiple fields of scientific investigation. Let's have a look at a recent discovery based on the famous rat UT 2598. It is quite an unknown subject. Only recently, have some publications appeared.

It is linked to human longevity and its unpredictable consequences from an economic, sociological, and also political perspective.

Keep in mind that in our western world during the Middle Ages, human life expectancy was of 35 years, 59 years in 1925, 70 years in 1955, 75 in 1985, and 80 years today. Just in the past 90 years, human life expectancy has increased by 20 years.

In 1946, the Labour Party in United Kingdom won the elections. British people did not re-elect Winston Churchill, the national hero who had led them towards victory.

The new government was mainly made up of intellectuals coming from the 'Fabian Society'. Prime Minister was Attlee who surrounded himself by a formidable group: Morrison, Bevin, Sir Stafford, Cripps, Barbara Castle, Callaghan, Wilson, and Lord Weaverbrook.

The last one was the promoter of the 'Welfare State', a pioneer in the world. Healthcare and education for everybody, and most importantly a retirement pension from 65 years old. A true revolution adopted in the following years by most European states.

But… at the time, life expectancy of Europeans was 67 years. The whole pension system covered only a period of two years.

Nowadays in Europe, the average is 80 years. The issue is how to finance these pensions. Germany is fighting to convince their citizens that it is necessary to work until the age of 70. At the beginning, and gradually till 2020, it should be 67. The electorate is not in favour.

Finally, we have the tests with rat UT 2598. At the Health Science Center of the University of Texas in San Antonio, they have increased the rats' life expectancy from two, three years up to four years.

Miracle or scientific breakthrough? Obviously, an achievement due to the discovery of a compound named rapamycin. By extrapolating the results to human beings, we obtain an average life expectancy of 142 years.

Rapamycin slows the aging process of cells. Liver and heart stay younger for longer. Tendons are stronger and more flexible than expected. It is definitely an achievement with unimaginable consequences.

Together with the trials performed with rat UT 2598, new discoveries appear, reducing the percentage of tumours related to aging, of cardiologic dysfunctions, and brain degradation such as Alzheimer. It all focuses on aging slower and in better conditions.

We are facing the challenge of how to convert a world conceived for young people into a society shaped around a population who will live over a hundred years on average.

Let's think about how transport, infrastructures, hospitals, education, designed for a society based on three generations, will cope with five generations. Great-grandfather, grandfather, father, son and grandson living at the same time.

Should the concept of working until 60/65 be extended, let's say, until 90? Will women's fertility, nowadays reaching 40/45 years old, be extended to 80 years old?

Science and technology are the root of this dramatic step forward in life expectancy. Science and medicine have opened the door to limits being pushed much further in the future.

How could a system of pensions that would spread out several decades be financed?

Will children be able to look ahead and see themselves in health and comfort in a hundred years' time?

What about retirement? The age until which we will have to work will have to be determined.

We will have to build a world where people will live for an additional 50 years or more in good physical and mental conditions, while continuing to be economically sustainable.

Originated in the USA, this simple exercise about the impact of science on longevity will certainly have unthinkable effects in Europe, cradle and epicentre of the Welfare State.

The world has become too small to say that science is a dimension of European identity. It is, but within a larger frame. This is a globalised world. We belong to it and are more interlinked with it every day. The USA and China already invest in scientific research more than the European Union.

So, we may assert that science is one of our dimensions but is closely conditioned by what is happening beyond our limits, and is so with an ever-increasing influence.

Saulo José CASALI BAHIA*

MULTICULTURALISM (TECHNOLOGY, VALUES AND SOCIETY)

Abstract: 1. Introduction; 2. Cultural universalism (monoculturalism, cultural integrationism or assimilationism); 2. a. Exogenous cultural universalism or universalism by colonization; 2. b. Endogenous cultural universalism; 3. Pluriculturalism, interculturalism or multiculturalism at the broad sense; 3. a. Cultural relativism; 3. b. Multiculturalism (strict sense); 4. The crisis of multiculturalism; 5. Conclusion: Multiculturalism and mankind.

Key words: *cultural universalism — monoculturalism — cultural integrationism — cultural assimilationism — pluriculturalism — interculturalism — cultural relativism — cultural isolationism — multiculturalism — migration*

INTRODUCTION

Migrations and communications produce contacts between different civilizations and cultures, values, languages, customs, phenotypes, economy systems and various levels of human development.

Migration implies that contact between different cultures are given in the same physical environment, while communications (trade and all technological means of transmitting information such as television, movies, books, radio, internet etc) do not necessarily require physical contact.

These two phenomena have been increasing every day in the contemporary world.

As for migration, there has been an increase in forced or voluntary displacement of individuals and populations, caused by the search of a better way of life and work, by the facilities brought about by open markets (including eventual formation of free trade zones or common markets), by the availability of more affordable means of transportation (faster and cheaper), by the incentives that some countries with low vegetative growth or low population density afford, seeking to avoid

* Law Professor (UFBA, Brazil). Federal Judge (SJBA, Brazil). PhD, Law (PUC-SP, Brazil); WAAS Fellow

the negative impacts of an aging resident population, by economic globalization, by climatic changes, by wars etc. Many are the causes, and a study about them is not the object of this work.

As for communication, it must be said that the technological means of information transmission have today a reach and an immediacy never before checked. Communication technology does not find spatial barriers, penetrating the most recondite places of the state and reaching each person.

It is a fact that these contacts bring huge problems, since they require a definition of how to relate to local culture with foreign culture, caused by the migrant or technologically transmitted from one to another country.

Then, we have three ways of relationship between cultures: the cultural universalism, the cultural relativism and the multiculturalism.

CULTURAL UNIVERSALISM (MONOCULTURALISM, CULTURAL INTEGRATIONISM OR ASSIMILATIONISM)

Cultural universalism means, briefly, the solution of cultural conflict by the overall submission of some cultural values of an individual or group of individuals to the cultural standards of another group.

The cultural universalism is also called monoculturalism, cultural integrationism or cultural assimilationism, inasmuch there is the domination (sway) of one culture over another. That one becomes universal (cultural universalism), single (monoculturalism), integrated with other (cultural integrationism) or by this assimilated (cultural assimilationism).

a) EXOGENOUS CULTURAL UNIVERSALISM OR UNIVERSALISM BY COLONIZATION

The first situation is when the migrant culture (or even the transferor of information from the outside) is imposed on the local culture.

The consequence of this sort of domain is the destruction of local culture, a process that can be explained because the new culture was imposed by force, conquering the armed resistance that the locals could hold. Sometimes this domination or rule is not done only by force of arms, but by also voluntary acceptance of new technological solutions for everyday life and everyday solutions such that people contacted took as essential for themselves, embracing new customs and abandoning old habits.

An example of exogenous cultural universalism occurred with indigenous peoples who inhabited the coast of Brazil on the time of the European discovery in the sixteenth century. After the course of several decades, local people began to lose any traces of their primitive culture, and ended up to assimilate the way of life brought by Europeans to the New World, that is, the native disappearing culture took on the features of the colonizers. There is no doubt that the monoculturalism prevailed, aided also by the numerical decrease of indigenous populations due to disease and wars.

Only recently in Brazil, the indigenous policy evolved into an understanding that contact between cultures with a so distinct civilizational level (there are tribes that still live in the neolithic age) could hardly preserve the integrity of the indigenous as a cultural group, and it passed to promote the isolation of indigenous groups who were still not deeply reached. It will be seen more comprehensively about cultural isolation in the item 3. a.

What happened to the Brazilian indigenous ethnical groups, it also came about to some already missing Andean cultures, relative to other Andean peoples and especially to the peoples of Europe, keeping the missing cultures weak and a caricature of that once has been cultural identity. If features of the previous culture were significant, it has been not referred to as monoculturalism, but any of the following forms discussed in section 3: cultural relativism and multiculturalism in the strict sense.

b) ENDOGENOUS CULTURAL UNIVERSALISM

Returning to the Brazilian indigenous issues, which are also common to many other countries, the demographic situation has been reversed a couple of centuries later, when the Brazilian local culture held a domain on the remaining minority indigenous groups and even on new immigrants whose stream was accentuated from the seventeenth century on (as Africans) and from the nineteenth century on (as the Europeans of different nationalities). The state policy adopted by Brazil becomes the universalism or endogenous cultural assimilationism.

This state policy aimed to establish the total assimilation of individuals and income groups into the local culture of the majority, as a way to promote national development and public and social security. In other words, the assimilationist or assimilation policy believes in the idea that the presence of different cultural groups within the country arises difficulties to military recruitment activities, generates resistance to various state actions, hampers social cohesion and population control, disrupts the project and consolidation of the National State, encourages separatism, brings always disputed the policy related to promote specific demands of minority groups, and even removes the solidarity between the people of the country.

Indeed, contemporary studies and researches show that solidarity between people has a direct relationship on the inversion of roles and availability of state means to provide for common needs claimed. If individuals lose confidence in what they can get, relatively to the other who can stay in advantage, it can bring about extinction of solidarity and empathy. The other will be harassed because it overuses others scarce public resources, blots out common benefits such as job offer and social benefits, meanwhile the other (minority, foreigner etc) becomes a factor of disturbance of social harmony.

The endogenous cultural assimilationism as policy, corresponded to the era of formation of national States, which afforded the central government the capability of meeting all the country's resources to act on behalf of the entire community, allowing a significant economic leap and a better position in international concert, increasing the outer defense. Patriotism accompanied the idea of „one state, one nation", where common values, shared among its citizens, imposed collective defense of the equals in the nation.

In Brazil, the myth of the formation of unified nation led to the creation of a common and convergent historiography for the construction of the Brazilian universal character. The Portuguese tongue was established as the compulsory official language taught in all indigenous communities, even prohibited the teaching of other languages of some European communities who installed themselves mainly in the South region of the country (in the municipalities of Italian or German majority, only the Portuguese language were allowed).

Endogenous cultural universalist politics have never sounded very acceptable in the face of minority communities, who saw themselves forced to integrate into the local culture. Hence theories have been arosen that sought to explain that the integration is disassociated of the state policy, but inherent to the circumstances.

Among the theories that speak assimilation as a natural and voluntary result of coexistence in a larger cultural environment, there is the „Melting Pot Theory", disseminated in the US academies. It is been said to exist an amalgam in society that receives foreigners, that works without State interference. Such amalgam preserves the national identity, which — in the words of the „founding Fathers" — is a design of providence. Of course, the United States monitors this integration and the „freedom" is only apparent. Even when it is said that each migrant brings with them new values that are absorbed into the American society, never it is ceased to say that the foreigners always absorb the core values of the American society, although naturally (the „American way of life").

The US, like Brazil, in order to promote further cultural assimilationism, established a policy of granting of nationality by local birth (*ius soli*), principle indeed prevalent in countries receiving migration.

The extreme of cultural universalism is the total intolerance of divergent, as witnessed in some moments in History that ethnic cleansing has become the homogenizing policy practiced by the state.

PLURICULTURALISM, INTERCULTURALISM OR MULTICULTURALISM AT THE BROAD SENSE

The idea of forming a unique culture no longer exists in many States, and for several reasons.

There are countries where the National State is already understood by consolidated, and the presence within it of various cultures (long-time arrived or not) inspires ways of coexistence and tolerance, even with appreciation of cultural expression as a human right. Some of these States are, even from its origin, polinational.

The first way to deal with cultural diversity (pluriculturalism, interculturalism and multiculturalism in the broad sense) is through cultural relativism. The second way is through the multiculturalism strict sense.

a) CULTURAL RELATIVISM

According to cultural relativism, the state policy becomes the total tolerance for minority cultural expressions.

In some situations, this tolerance takes aspects of indifference and isolationism. The cultural isolationism can produce the creation of ghettos or the isolation of communities, situations in which the State even doesn´t attempt to impose hegemonic cultural patterns or a culture defended to other segments of the population.

Examples of cultural isolationism were the laws of the US or South African apartheid, or the spatial isolation of indigenous groups which were not reached in Brazil (in the deep Amazon). In this case, the cultural isolation is so sharp, that no rule of Brazilian Criminal Law it is applied there, being allowed — according to indigenous customs — infanticide and death penalty by decision of the village chiefs or councils. This isolation, is even seen by the National Indian Foundation in Brazil (in Portuguese FUNAI, Fundação Nacional do Índio) as an essential policy for the preservation of the cultural identity of these people, it would be easily lost if they were to have contact with the „white man". Today, there are a few hundred still uncontacted tribes living in the Amazon.

Of course, isolationism is justified only within a few extreme situations, and it is not fitting where communities settle entails with economic or social nature. In this case, the isolation will produce a serious exclusion in disfavor of some national communities, depriving certain groups of the access to goods and services, which were so reserved for the non-isolated population. Just remember the Jewish ghettos and restrictions on its inhabitants, or of modern laws in Europe that keeps excluded local citizenship to children born on European soil, but whose parents are from other countries and cultures.

The outcome of this segregation, is the failure of social solidarity, social exclusion disturbing public order and insurrection in relation to the dominant values by those who feel themselves excluded.

b) MULTICULTURALISM (STRICT SENSE)

If isolationism is not the solution, it can only be admitted a strict-sensu multiculturalist policy.

Here, tolerance is relative, because there is no complete indifference to the cultural groups present in the state.

The reason is that community life requires that the rights of any group are not absolute. The total permissiveness to strange customs creates many problems because lower social cohesion removes the possibility of living together in the same spaces and reduces the solidarity that must permeate life in society.

In a study on multiculturalism that has been held for ten years, the Harvard Professor Robert Putnan, using data collected from 26,200 people in 40 communities, found that the more racially diverse is a community, it exists less solidarity, there is less confidence in institutions and politicians, and lower social altruism.

On the other hand, the more homogeneous is a social group, more public spending will be made for the community in general.

This research, rather than to take a hasty and erroneous conclusion that racial homogeneity corresponds to the basis for progress, should be used to the understanding that only by building common national values it will be possible to remove any idea of relativism and segregation in order to meet the goal of a solidary community.

The strict-sense multiculturalism is a kind of cultural universalism mitigated because it preserves the idea of basic or national common values that can unite all members of the community, while respecting certain diversity, if and while differing values do not compromise what is essential to the life in the society.

It is seeking diversity in equality, or equality in diversity, in a necessary balance, because it can be tolerated only a part of what is different, and another part will be not. There are no absolute rights or total cultural expression, and each cultural group, including the foreign community and the minorities, and even the majority, must give up what is required for the sake of integration to common core values.

An example can shed light upon this idea: in Brazil, the African religions practiced public sacrifice of animals. Now, the practitioners living in common areas with no-practitioners, especially in urban environments, share the common understanding that animal sacrifices harmed health and common values on public hygiene and the protection of animals. It arose because, as a model for coexistence, it was required the abstinence from the practice of animal sacrifices, and the rite was replaced by other kinds of offerings in a solution that preserved superior common values to the whole community.

Someone may refuse to allow the military service because of cultural reasons. However, many countries admit that this objection can always be replaced by an alternative provision of public character, which reconciles the opposition with the idea of proportional social charges and re-creates interpersonal solidarity.

Today, the great world problem is that the degree of tolerance is variable in time and place, depending on circumstantial wealth of the country. The tolerance depends on how the available social resources will be shared, and on the consensus on what is essential to share. That is, what are the common, basic and essential values to choose.

THE CRISIS OF MULTICULTURALISM

The presence of a growing contingent of Muslims in Europe and other Western countries raises the question of conceptualizing and the possibility of construction of basic and common values, which are necessary to a strict-sense multiculturalist perspective and tolerable coexistence between all members of the population. Even for maintenance of the essential solidarity and social altruism.

Between Western and Muslim, it seems there to be a major point of divergence: equality between genders. While French Muslims require segregated public pools, doctors of both sexes in all specialties, permission to unrestricted use of the veil in schools or absence of female physical activities in public spaces, at the same time France (the State) responds with the impossibility of give solution for these demands, because there are huge economic costs involved and especially because there is the unacceptability of the assumption that the sexes can — in health and education aspects — enjoy the desired differentiation. This segregation-oriented policy is referred by Sarah Song, of the University of Berkley, in her article *Multiculturalism*, in which she points out that „some group-differentiated rights are held by individual members of minority groups, as in the case of individuals who are granted exemptions from generally applicable laws in virtue of their religious beliefs or individuals who seek language accommodations in schools or in voting. Other group-differentiated rights are held by the group qua group rather by its members severally; such rights are properly called group rights, as in the case of indigenous groups and minority nations, who claim the right of self-determination." Further on, it will be said that these integration policy of minorities into the larger civilian and cultural framework of a nation, will bring about critics, one of them is certain privileges afforded to the minorities members or even stimulus of raising conflicts of minorities within other minorities.

The example shows how the French society as a whole does not enjoy yet a balance on an essential point „non-negotiable" for most of the French, but absolutely „certain" to the Muslims under penalty of mischaracterization of their cultural expression and social life.

But after all, what society we are talking about? An entirely-indifferent society to others' cultural values, segregationist and isolationist? Or a multiculturalist society, in which basic and common social values must be constructed and accepted as a basis for social coexistence in a single inclusive space? Is there chance of acceptance of common values by both sides?

This seems to be a matter of great importance in the nowadays world, which is plagued by intolerance, fundamentalism, radicalism and terrorism. And the difficulty in achieving the necessary balance and setting up a common-core values seems to be generating a critique of the concept of strict-sense multiculturalism as State policy. For some, there would be no chance of success in this policy, because it will always remain the radicalism and intransigence of certain minorities.

Criticism of multiculturalism earned academic forum in 1992, with the release of the article — converted in 1997 in the book *The clash of civilizations and the remaking of the world order*, by Samuel Huntington, for whom multiculturalism is an anti-Western ideology. However, the Islam will continue to maintain contact with the Western civilization. Globalization, trade, communications, migration, internet etc., insist on opening the doors to a world of values from the other world.

In *The Contemporary Arab Reader on Political Islam*, a collective book organized by Ibrahim Abu-Rabi, It is possible to draw out a general conception that western capitalism and liberalism created a segregation model, becoming Islam an alternative to capitalism and to the West. It is known that many western advertising, books, music or cinema can destroy much of the traditional values and way of life in Islamic society; and that economic and social segregation reinforced this religious identity, because it grouped together those common conditions of segregation and relative poverty. Despite the Muslim fundamentalism is able to gather only 50,000 of the 1.5 billion Muslims in the world, a significant percentage of Europeans see it as a threat to national identity. Nationalist and xenophobic movements abound in politics in several European countries.

Undoubtedly, multiculturalism as state policy in the West, goes through a widespread crisis, because many do not know how to overcome the difficulty of respecting such as intended by migrant communities (with demands that occur in the name of the affirmation of national and cultural identities).

Countries considered multiculturalists such as Canada, support the need to build common values, according to the implemented policy in 1971, under the title „Just Society", or under the Canadian Multiculturalist Act. But the Netherlands has been criticized for having abandoned multiculturalism and returned to the cultural universalism, after the declaration in 2011 of its first minister that „culture, norms and Dutch values should be dominant". The „National Front" in France, the „One Nation Party" in Australia and many other examples mean for many a crisis of multiculturalism.

CONCLUSION: MULTICULTURALISM AND MANKIND

It´s necessary to make a self-criticism to certain models of multiculturalism.

First of all, the group identities are not natural categories. They are not innate but learned, so it implies that they may be abandoned or changed. As to nationalism, these identities are useful, but only under certain circumstances, for certain purposes, for a certain time.

When you think of a new international context where the interactions between communities is a reality, and identities are destroyed and rebuilt incessantly before the inevitable technological, spatial and commercial contacts, it must now be searched another sort of identity with new essential common values. These new common core values will therefore be universal and based on respect for coexistence and at the belief that this is desirable and inevitable, and that there are no absolute rights. Just in what is not essential for the coexistence, differences may exist. The community of common interests and values requires a common culture in some basic aspects for the social coexistence, precisely formed by common interests and values. Then, it´s necessary to cease irreconcilable values at the same society. This is in the words of Albert Einstein a true disease: „Nationalism is an infantile disease. It is the measles of mankind".

On the other hand, any relativist, isolationist or segregationist politics deeply destroys the social tissue. The problem of European Muslim youth is not to have two cultures, but properly not to experience any of them, because there is social exclusion. They cannot follow exactly the Islam in France, and they do not feel themselves well welcomed by the West, that often keeps far from them the benefits owed by others.

The strict-sense multiculturalism is only able to take further steps when there is a possibility to identify or to perceive common-core values, as values that can bring to the community a better life, and promote solidarity and altruism. After all, as identified Paul Zak in his book *The Moral Molecule*, human development requires unselfishness. And altruism necessarily arises from the identity of individuals. This identity can only come from common values, which exceed in importance details of race, color, origin, geography. It is necessary to identify the essential traits of common mankind in each of us. After all, as Montesquieu said, „I am a citizen of humanity first and by necessity, and a citizen of France second, and only by accident". Also the Algerian Albert Camus noted: „I love my country too much to be a nationalist". Or, as predicted the British Herbert G. Wells, „our true nationality is mankind".

I would say that our true culture must be our mankind.

Neven DUIĆ*

SMART ENERGY SYSTEMS — DECOUPLING FROM RESOURCE BASED ENERGY

Abstract: European Union has started the transition of energy systems to energy sources with lower environmental impact due to conventional resource being scarce and controversial. The transition is becoming more attractive with fall of investment costs of renewables and volatile prices and political insecurity of fossil fuels. The resources are bountiful, especially wind and solar, while integrating them into current energy systems is proving to be a challenge. The limit of cheap and easy integration for wind is 20% of yearly electricity generation, while a combined wind and solar may reach 30%. Going any further asks for implementation of really free energy markets (involving day ahead, intraday and various reserve and ancillary services markets), and it involves integration between electricity, heat, water and transport systems. The cheapest and simplest way of increasing further the penetration of renewables is integrating power and heat systems through the use of district heating and cooling (which may be centrally controlled and may have significant heat storage capacity). In countries with low heat demand water supply system may be used to increase the penetration of renewables, by using water at higher potential energy as storage media, or in dry climates desalination and stored water may be used for those purposes, and reversible hydro may be used as balancing technology. Electrification of personal car transport allows not only for huge increase of energy efficiency, but also, electric cars due to low daily use may be excellent for demand side management and even storage potential. That will allow reaching 80% renewable in energy system, but the remaining 20% may be more an uphill battle without technology breakthrough. Long haul freight road transport, aviation and ship transport, as well as high temperature industrial processes, cannot currently be easily electrified. Biomass, if not used for producing electricity and heat, may cover half of those needs, but the rest will have to come from some other technology.

* Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb; WAAS fellow

University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT

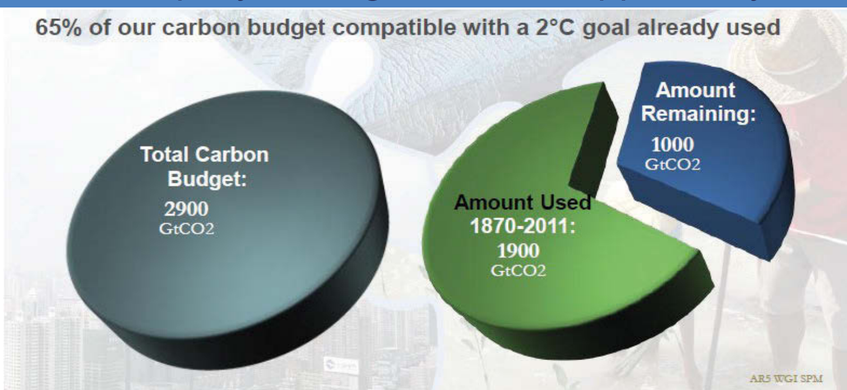
EU energy context

- Security of energy supply
  - Import dependence from 50% to 70% by 2030
- Employment and regional development policies
  - Deindustrialization and trade liberalization
  - "Boosting growth and jobs by meeting our climate change commitments"
- Mitigation of global warming
- Environmental protection
- Sustainable development

© FSB 2011 FSB

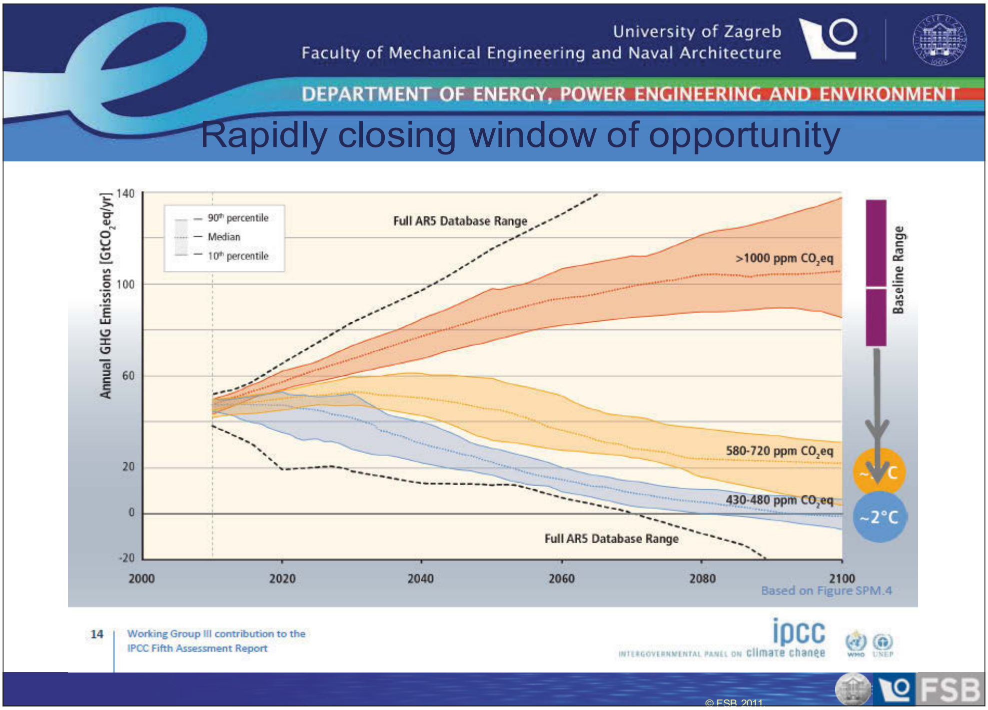
University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT

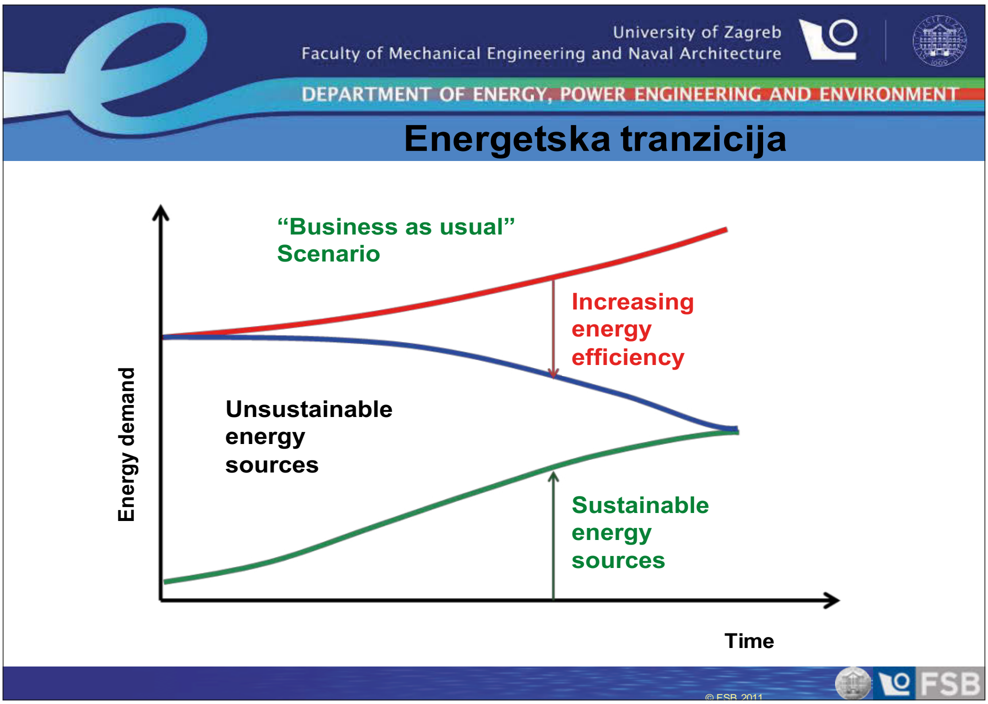
Rapidly closing window of opportunity



ipcc INTERGOVERNMENTAL PANEL ON climate change WMO UNEP

© FSB 2011 FSB


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Rapidly closing window of opportunity
Annual GHG Emissions [GtCO2eq/yr]
140
100
60
20
0
-20
2000
2020
2040
2060
2080
2100
90th percentile
Median
10th percentile
Full AR5 Database Range
>1000 ppm CO2eq
580-720 ppm CO2eq
430-480 ppm CO2eq
Full AR5 Database Range
Baseline Range
~2°C
Based on Figure SPM.4
14
Working Group III contribution to the
IPCC Fifth Assessment Report
ipcc
INTERGOVERNMENTAL PANEL ON climate change
© FSB 2011
FSB


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Energetska tranzicija
"Business as usual"
Scenario
Increasing
energy
efficiency
Unsustainable
energy
sources
Sustainable
energy
sources
Energy demand
Time
© FSB 2011
FSB

University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT

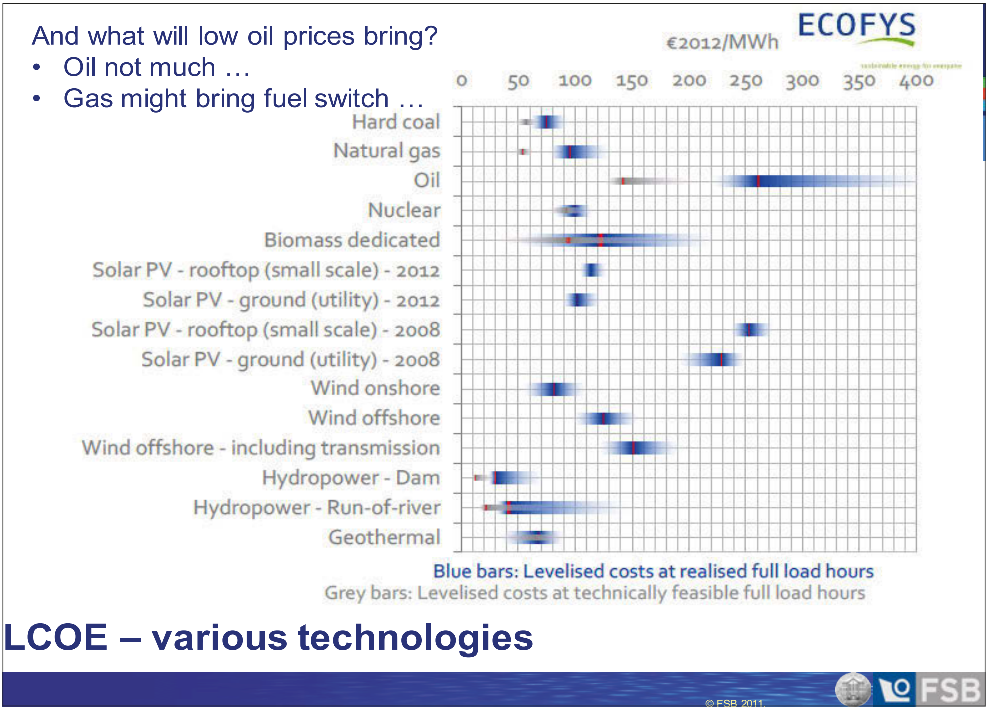
Sustainable energy resources - electricity

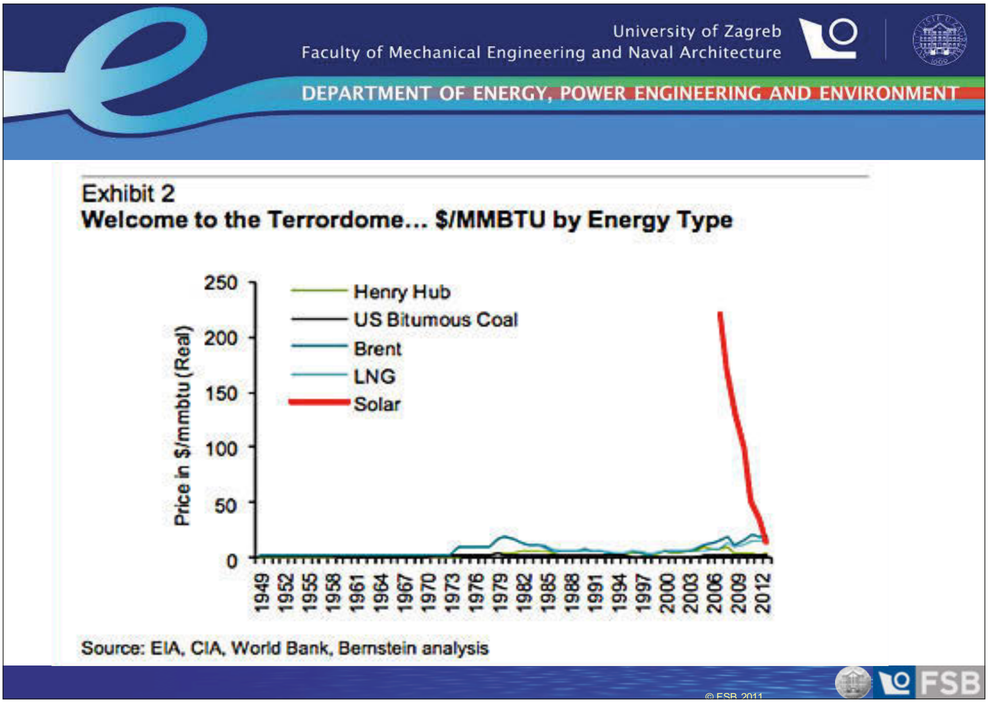
- Security of energy supply
  - Nuclear is environmentally sound but quite expensive (110 EUR/MWh), politically difficult in some countries, additionally expensive for small countries, even more for new entrants, and too late too little
  - Therefore only renewables are available to increase security of energy supply

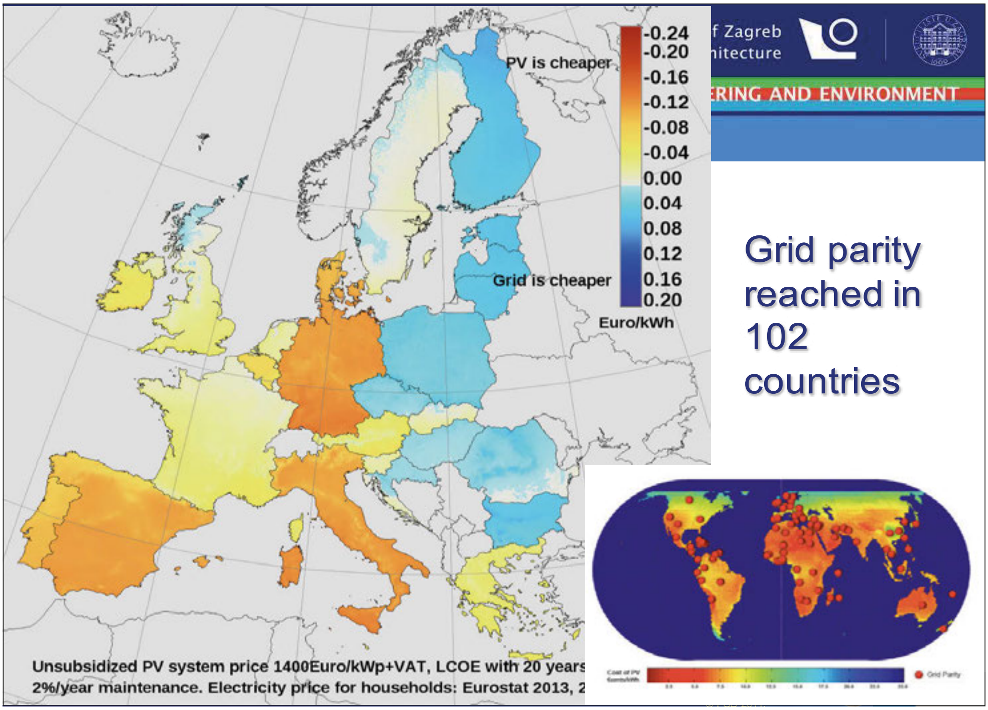
University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT

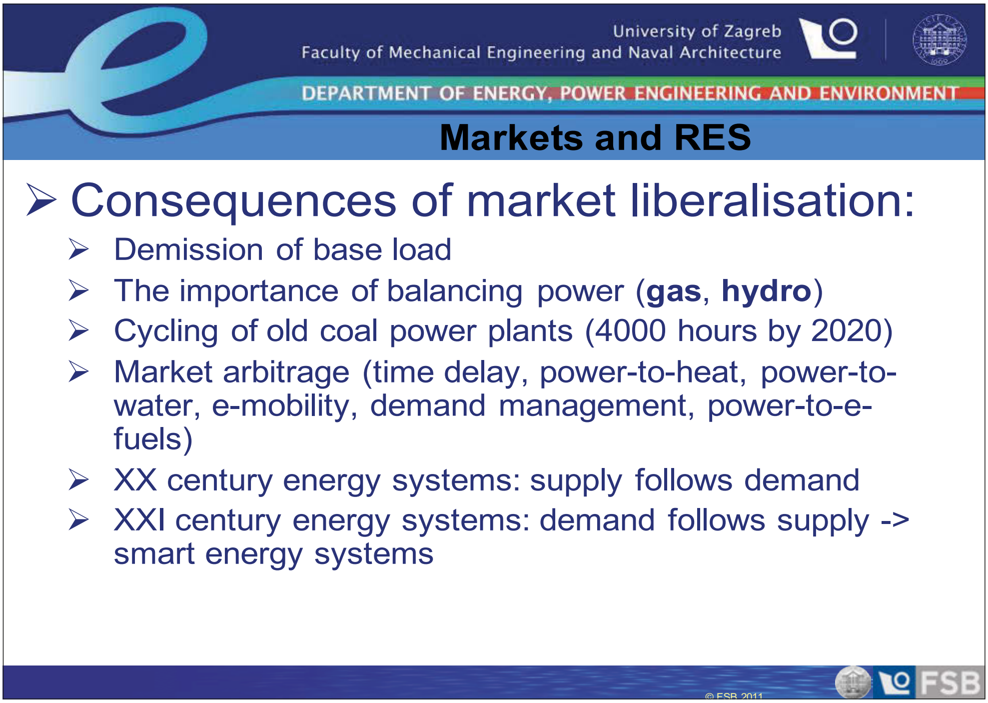
Sustainable energy resources - electricity

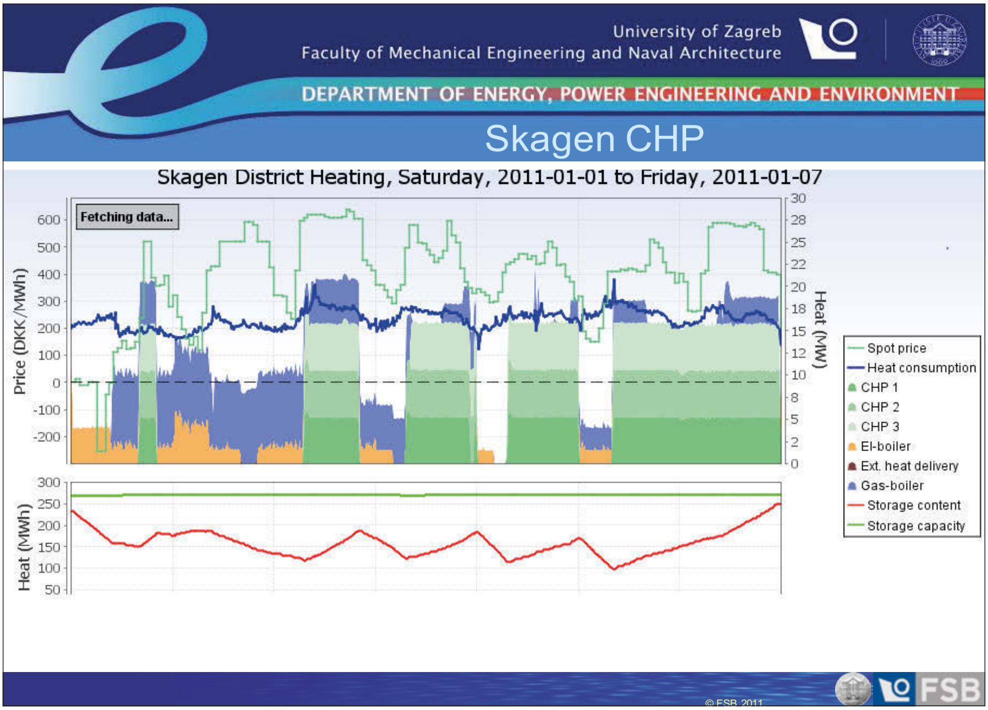
- Security of energy supply - renewables
  - Hydro – excellent but all viable projects have been built long time ago
  - Biomass – excellent but also already too much used in EU, any further increase risks food production and environment
    - Low solar to electricity efficiency (2% * 20% = 0,4%)
    - Only waste biomass and biomass from co-production is sustainable
  - Geothermal – complicated and only available in some places
  - Wind – available everywhere and cheap
  - Solar – available everywhere and now cheap


And what will low oil prices bring?
• Oil not much …
• Gas might bring fuel switch …
ECOFYS
€2012/MWh
0 50 100 150 200 250 300 350 400
Hard coal
Natural gas
Oil
Nuclear
Biomass dedicated
Solar PV - rooftop (small scale) - 2012
Solar PV - ground (utility) - 2012
Solar PV - rooftop (small scale) - 2008
Solar PV - ground (utility) - 2008
Wind onshore
Wind offshore
Wind offshore - including transmission
Hydropower - Dam
Hydropower - Run-of-river
Geothermal
Blue bars: Levelised costs at realised full load hours
Grey bars: Levelised costs at technically feasible full load hours
LCOE – various technologies
FSB


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Exhibit 2
Welcome to the Terrordome… $/MMBTU by Energy Type
Price in $/mmbtu (Real)
250
200
150
100
50
0
Henry Hub
US Bitumous Coal
Brent
LNG
Solar
1949 1952 1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012
Source: EIA, CIA, World Bank, Bernstein analysis
FSB


f Zagreb
hitecture
RING AND ENVIRONMENT
PV is cheaper
-0.24
-0.20
-0.16
-0.12
-0.08
-0.04
0.00
0.04
0.08
0.12
0.16
0.20
Grid is cheaper
Euro/kWh
Grid parity reached in 102 countries
Unsubsidized PV system price 1400Euro/kWp+VAT, LCOE with 20 years
2%/year maintenance. Electricity price for households: Eurostat 2013, 2


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Markets and RES
➢ Consequences of market liberalisation:
➢ Demission of base load
➢ The importance of balancing power (gas, hydro)
➢ Cycling of old coal power plants (4000 hours by 2020)
➢ Market arbitrage (time delay, power-to-heat, power-to-water, e-mobility, demand management, power-to-e-fuels)
➢ XX century energy systems: supply follows demand
➢ XXI century energy systems: demand follows supply -> smart energy systems
© FSB 2011
FSB

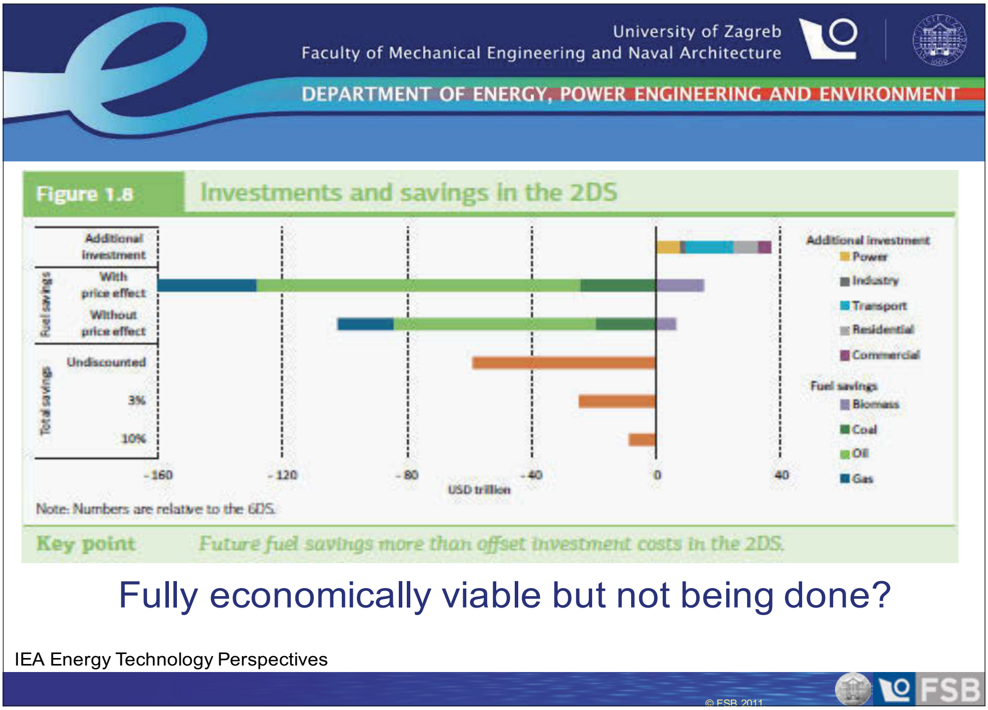


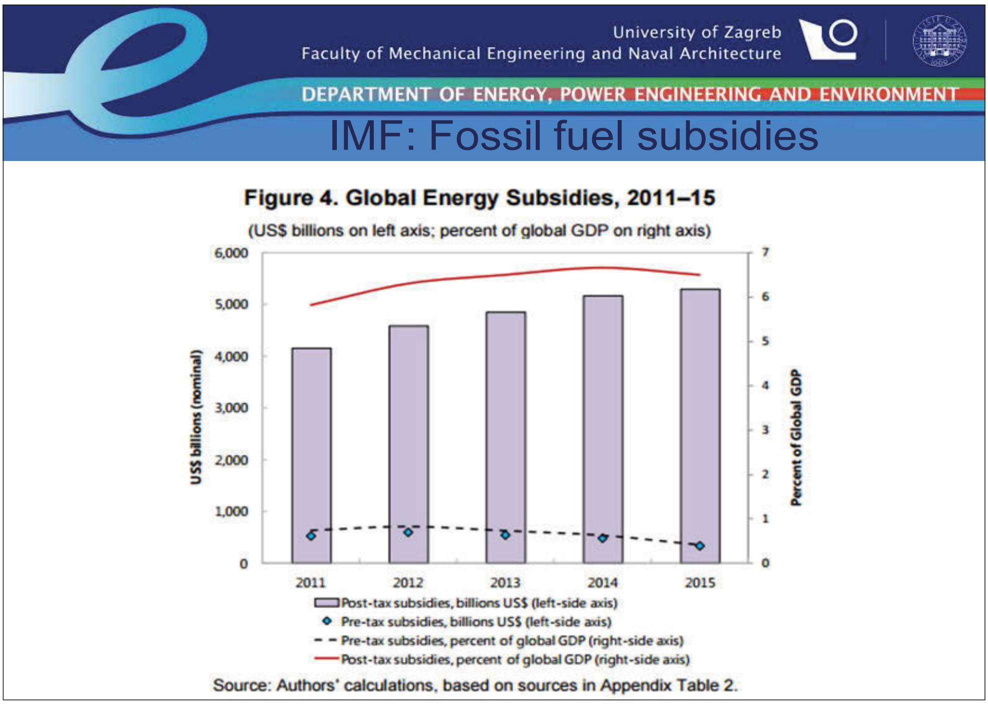
University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT

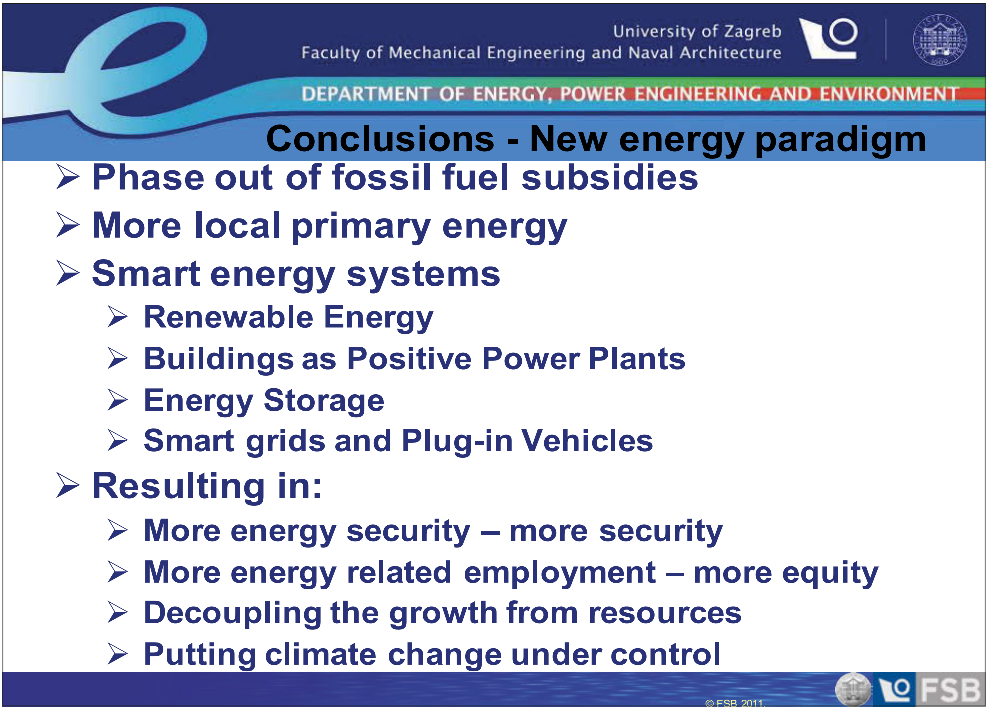
Demand management

- Electromobility
  - Only personal cars and short distance utility vehicles - 430000 PEV sold worlwide in 2015
  - If RESe 80% reduction of primary energy
  - Fast charging 70 kW – huge problem if left uncontrolled, ex AT, 4 mln cars arrives home, plugs in – 280 GW (14 GW installed cap)
  - Smart charging – market based, smoothing the demand

© FSB 2011 FSB


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Figure 1.8
Investments and savings in the 2DS
Additional investment
Fuel savings
With price effect
Without price effect
Total savings
Undiscounted
3%
10%
-160
-120
-80
-40
0
40
USD trillion
Additional investment
Power
Industry
Transport
Residential
Commercial
Fuel savings
Biomass
Coal
Oil
Gas
Note: Numbers are relative to the 6DS.
Key point
Future fuel savings more than offset investment costs in the 2DS.
Fully economically viable but not being done?
IEA Energy Technology Perspectives
FSB


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
IMF: Fossil fuel subsidies
Figure 4. Global Energy Subsidies, 2011–15
(US$ billions on left axis; percent of global GDP on right axis)
US$ billions (nominal)
Percent of Global GDP
6,000
5,000
4,000
3,000
2,000
1,000
0
7
6
5
4
3
2
1
0
2011
2012
2013
2014
2015
Post-tax subsidies, billions US$ (left-side axis)
Pre-tax subsidies, billions US$ (left-side axis)
Pre-tax subsidies, percent of global GDP (right-side axis)
Post-tax subsidies, percent of global GDP (right-side axis)
Source: Authors' calculations, based on sources in Appendix Table 2.


University of Zagreb
Faculty of Mechanical Engineering and Naval Architecture
DEPARTMENT OF ENERGY, POWER ENGINEERING AND ENVIRONMENT
Conclusions - New energy paradigm
Phase out of fossil fuel subsidies
More local primary energy
Smart energy systems
Renewable Energy
Buildings as Positive Power Plants
Energy Storage
Smart grids and Plug-in Vehicles
Resulting in:
More energy security – more security
More energy related employment – more equity
Decoupling the growth from resources
Putting climate change under control
FSB

Timi ECIMOVIC*

HOMO SAPIENS UNIVERSAL UPBRINGING, EDUCATION AND LIFE-LONG LEARNING TOWARD THE SUSTAINABLE FUTURE OF HUMANKIND**

Abstract: The only difference between the requisitely holistic1 planet Earth system from the requisitely holistic star Sun system and other countless stars and planets is the unique content of the Earth together with a Homo sapiens civilization. Earth has unique characteristics, different from all countless stars and planets within the Universe.

Homo sapiens civilization has its home in the Biosphere of the planet Earth, which is a part of star Sun system. It does not mean that other countless planets have alike or similar civilization. Nature does not plan galaxies, stars or planets but they are result of evolutionary processes and have countless possibilities to be as they are.

---

* Rector, WPF (World Philosophical Forum) University; Socratic Philosophical School and Aristotle Philosophical Academy; Izola – Isola, Slovenia

** What we are discussing in this presentation is contemporary research on Nature by a large group of researchers and scientists as follows: (By ABC names) Prof Dr Alexander Chumakov, Russia; Prof Dr Alexander Makarenko, Ukraine; Dr Ang Ban Siong, Malaysia; Prof Dr Dana M. Barry, USA; Prof Dr Fidel Gutierrez Vivanco, Peru; Prof Dr Glen T Martin, USA; Prof Dr Igor Kondrashin, Russia and Greece; Prof Emeritus Dr Dr Matjaz Mulej, Slovenia; Prof Dr Negoslav Ostojic, Serbia; Prof Emeritus Dr Raoul Weiler, Belgium; Hon Ricaardoe Di Done, Canada; Sir Prof Dr Roger B Haw, Malaysia and China; Prof Dr Shahid Siddiqi, Canada and USA; Prof Emeritus Dr Sait Kacapor, Bosnia and Herzegovina; Prof Dr Seminur Topal, Turkey; Prof Dr Timi Ecimovic, Slovenia, Prof Dr Truly Busch, Germany and many more not mentioned in this list. Some of great contributors to our work have been as follows: Late Prof Dr Avgustin Lah, Slovenia; Late Prof Dr Elmar Stuhler, Germany; Late Prof Dr George Pethes, Hungary; Late Prof Dr Helmut Metzner, Germany; Late Prof Dr Rashmi Mayur, USA and India; Late Hon Dr T P Amerasinghe, Sri Lanka. Thank you.

[1] The term „Requisitely holistic" was introduced in the 20th century as one of system theori's terms for better, i. e. less one sided understanding of life and people. Mostly it was used in the world of systems theory, economics: the first introduction of requisitely holistic meaning in the nature sciences was in 21st century by a group of scientists and researchers among who I was one of. Actually, I have to express my thanks to Prof Emeritus Dr Dr Matjaž Mulej from the Slovenian University of Maribor, who enlighten me with this term.

We think humans are able to observe the present, humans are able to learn and research the past, but for humans and any other beings, future is unpredictable.

It is hard to accept the truth, which is coming from our research.2 It is hard to accept the truth without proper universal upbringing, education and life-long learning of humans to have their life within the limits of Nature.

The global community of humankind entered the 21st century in bad shape. The present society is wandering to find its proper path to assure a future for our descendants.

Discussing humans' management of the planet Earth we have to say it is *impossible*, because all our technologies have been found to be a threat for our environment — quality of biosphere, in time. Very nice description of the technology impact was stated in the book of Christopher Weramantry „Nuclear Weapons and Scientific Responsibility", ISBN: 955–599–170–07, 1987, He reported about the ability of humankind to destroy the planet Earth with its nuclear weaponry was reached by the end of the 1960s.

The most recent statement about the human management of the Earth was in Paris, December 2015. During its closure of the conference his Excellency Barack Obama, the President of the United States of America stated „We are saving the planet". In our research we find that abilities of humankind are not sufficient even to protect humans from extinction. This is all about what we are discussing here.

The truth is that „The planet Earth will spin around the Sun with or without the Homo sapiens within its biosphere". That is why we are beginning this discussion with the most contemporary content about the Homo sapiens.

Key words: *Contemporary research; Global community of humankind; Homo sapiens civilization; Living and non-living nature; Nature sciences; Nature system; Planet Earth System; Requisite Holism; Sustainable Development; Sustainable Future of Humankind; System Thinking; Technologies; Universal Upbringing, Education and Life-long Learning toward Sustainable Future of Humankind*

DISCUSSION

Humankind's global community is a large social system of 7 billion + mankind and womankind living all over the planet Earth.

The origin of the humankind has been and is sum of an evolution process of the biosphere of the planet Earth. Homo sapiens species is a part of Mammals and has a place at the top of living beings tree. Present humans prefer to distinguish the „living Nature" from the „non- living Nature". The truth is that only Nature exists and humans need to learn more about Nature.

The epic song of humanity began or has been evolved or born some 200.000 year ago. From commencement via prehistoric times and civilizations confrontations of Neanderthal man and Homo sapiens, Stone ages, great civilizations of Antiquity and times of Confucius teachings, Siddhartha Gautama Buddha philosophy, classic Greek philosophy (Socrates, Plato, Aristotle and others), horrible times of medieval ages in Europe, industrialization, information, and innovations we hu-

[2] By the end of 2015 our international informal group of researchers and scientists was closing its research on Nature. As a result the digital book „Nature 2015 (Anthology 3)", Ecimovic, Haw et al, ISBN 978–961–92378–8-5 (pdf) was published; results of our research are there. Please see www.institut-climatechange.si

mans arrived to the globalization of today. We hope the dark ages of humanity will end, and a new era of the sustainable future of global society of humankind will begin during the 3rd millennium of our times.

Philosophy of humankind is the search for knowledge and understanding of the Nature and meaning of the universe and life. The knowledge is the most important achievement of the present Homo sapiens civilization.

Philosophy of humankind, as the main treasure of the humanity, is asking for consideration of the truth. The present time of the global community of humankind as a whole of the Homo sapiens species with 7.000.000.000 + individual representatives with their 200.000 years of history of coexistence has recently opened questions about the truth and option for long-lasting of humans within the biosphere of the planet Earth.

All people of the Earth are of one kind — Homo sapiens species that is only surviving representative of the genus Homo. There are no *races* among humans, but only different looks as per evolution within the local environment-cum-culture- cum -nature and nurture. Humans as species are social creatures, and are omnivorous — meaning eating any sort of food — both animal and vegetable food. It is also part of human heritage from Nature.[3]

In Nature everything that was born may look like many different or similar things, but it is its individual characteristics that make the difference. At present, humankind's global community has 7 billion + individual members and all of them are Homo sapiens, but each and every one has his/her own characteristics. Therefore our civilization has 7 billion + individuals. This is important, because we have to accept reality that within the basic environment — the universe system — there are countless planets, but the planet Earth with its global community of humankind is the only one, which we know and live on.

At present Homo sapiens is the only representative of Homo genus within the biosphere of the Earth. There is a long story about appearance of humankind.

The oldest appearance has been recorded in the naturalist research during the 19th and 20th centuries claiming the origin of humankind has been together with the origin of the Earth. The last presentation of this kind that we know of, was in the epic digital large book „History of Earth and Man — in the light of Esoteric and Scientific data" written by the late Vardjan Velimir, ISBN 978–961–03453–1-3 (pdf), 2013.

All researchers who are discussing humankind as a part of the evolution from genus Homo and Homo sapiens are estimating their origin in million years ago. The great Albert Einstein (1879 — 1955) estimated the origin of humankind app. 500.000 years BC for first time.

In our research we stated that Homo sapiens evolved some 200.000 years ago. Humans have been and are a successful species[4] and in some 120.000 years they in-

[3] For more information please see the digital book „Nature and Social Responsibility", Ecimovic, Haw, Mulej et al, ISBN 978–961–92378–7-8 (pdf), 2015, also displayed at www.institut-climatechange.si

[4] As taught in 19th century by Charles Robert Darwin (1809–1882).

habited almost the whole of the land environments on the planet Earth, or better all inhabitable areas. People were living their life in harmony with all global and local conditions of Nature and the nature of the planet Earth.

In 73.000 BC plus minus 4.000 years the mega[5] Toba volcano on the present Sumatra, Indonesia erupted (today Toba Lake). As a result of this super-eruption 6 — 10 volcano winters occurred. The global community of *Homo sapiens* decreased and experienced a possible extinction. At Rift Valley in East Africa a group of 10.000 to 15.000 people was a new origin of humanity. In 1993 Ann Gibbons suggested *The Genetic Bottleneck Theory* in her article in *Science* (Ramping, Self, Ambrose, 1998), and together with Ramping (2000) supported this theory. The bottleneck of the human population on the planet Earth occurred some 70.000 years ago; the new rapid population increase continued from approximately 15.000 people. The contemporary gene research indicates that the above statement is correct.

Homo sapiens is an evolutionary product of Nature; till the industrial revolution in the 17th–18th centuries humans were living mostly socially responsibly and in harmony with Nature of the planet Earth. Though, the present global civilization lives in human ecological system or human eco sphere, which is in harmony with humans, while the other Nature is forgotten. The lack of humans' individual social responsibility is seen as a major fault, which needs to be reestablished.[6]

The global community of humankind or at present Homo sapiens global civilization has been influenced also by the following three social issues of recent origin:

The Sustainable Development — was the outcome of the „Our Common Future" report (1987) where the definition of sustainable development was stated as follows: *„Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".*

The Sustainable Future of Humankind — has been announced at Xiamen, China, on 25th September 2011. The short definition is „", and

The Globalization is defined in the *„Global Studies Encyclopedia", Mazour, Chumakov, and Gay, 2003: „Globalization is amalgamation of national economies into united world system based on rapid capital movement, new informational openness of the world, technological revolution, adherence of the developed industrialized countries to liberalization of the movement of goods and capital, communicational integration, planetary scientific revolution, international social movements, new means of transportation, telecommunication technologies and internationalized education".*

Unfortunately, the monopolization of the entire humankind to the benefit of one single percent must be added to the above definition; so must the level of debts that is globally close to three times volume of the world's global GDP (400% in Japan, about 220% in USA and China, etc.); only 15% of humans have more than six US$ per day, while 85% have less; 85 persons own as much as three and half billion persons combined; the nature of the planet Earth is badly damaged; its natural re-

[5] Mega vulcanos at present are also known, for instance Yellowstone in USA.

[6] Please see more at www.institut.climatechange.si Timi's small digital library, the digital book „Nature and Social Responsibility", Ecimovic et al, 2015.

sources are over-used; humankind's living conditions in its biosphere are changing. That is a frame within which the global community of humankind is wandering at present. We think it is because of the „Money Master Monster Leadership" of humans.

We have researched fundaments of Nature and humanities with intention to establish a path for longevity of humans within the biosphere of the requisitely holistic planet Earth. Of course our research has been composed of many different subjects and needs. We did not criticize, but we wished to see the truth and discuss possibilities for a better tomorrow of humanity. Our summary is as follow.

CONCLUSIONS AND RECOMMENDATIONS:

— The present representatives of the global community of humankind need understanding of the present and the possibilities for a better future.

— The important content is to prepare and work on „Universal Upbringing, Education and Long-life Learning" Concept to enable the coming generations of humans to understand their present and their future needs.

— To the best of our knowledge we are recommending universal upbringing, education and life-long learning to support humanity on the road of the sustainable development to the sustainable future.

— Our understanding of the sustainable future or sustainability of humanity in a short definition is:

— One star Sun and our planet Earth as requisitely holistic systems are the Nature's entity existing with or without humanity.

— The single human civilization on the planet Earth needs one single and socially responsible humankind's government to govern the global community of humankind as best as possible, i. e. requisitely holistically rather than one-sidedly like so far and now.

— Human affairs could be governed only by humans and the synergy of achievements should allow longevity of Homo sapiens global community.

REFERENCES

[1] „System Thinking and Climate Change System (Against a Big „Tragedy of Commons" of all of us)", Ecimovic, Mayur, Mulej, et al, 2002, ISBN 961–236–380–3

[2] „Our Common Enemy (The Climate Change System Threat)", Ecimovic, Amerasinghe, Braki, Shankaranarayana, Chumakov, Haw, Wilderer, and Martin, 2006, ISBN 961–91826–0-x

[3] „The Information Theory of Nature, and …", Ecimovic. 2006, SEM Institute for climate change, ISBN 961–91826- 1–8

[4] „The Sustainable (Development) Future of Mankind", Ecimovic, Bunzl, Esposito, Flint, Haw, Mulej, Shankaranarayana, Wilderer, Williams, and Udyavar, 2007, ISBN 978–961–91826–2-8.

[5] „Sustainable Future, Requisite Holism, and Social Responsibility", Bozicnik S., Ecimovic T., Mulej M., et al, digital books on sustainable future been number two of the trilogy, 2008, ISBM 978–961–91826–4-2.
[6] „The Climate Change System Introduction", Ecimovic T., Mulej M., English and Slovenian language version, ISBN 978–961–91826–5-9, 2009.
[7] „The Sustainable Future of Mankind III" Ecimovic, Esposito, How, Mulej, et al, digital book, ISBN 978–961–92786–2-8, 2010.
[8] „The Three Application of the System Thinking", Ecimovic, paper and digital book, ISBN 978–961–92786–0-4, 2010.
[9] „The Climate Change Introduction", Di Done, Ecimovic, in Canada English, paper and digital booklet, ISBN 978–961–91826–8-0, 2010,
[10] „Le System de changements climatiques Introduction", Di Done, Ecimovic, in Canada French, paper and digital booklet, ISBN 978–961–92786–5-9, 2010.
[11] „Zum Klimawandel — Eine wissenschaftliche Einfurung", Hamann, Ecimovic, Mulej, paper and digital booklet, ISBN 978–961–92786–4-2, 2010.
[12] „Dialectical System Thinking and the Law of Requisite Holism Concerning Innovations", Mulej et al, in print, 2010.
[13] „The Principia Nature — the Nature and Homo sapiens Global Community", Ecimovic T., 2011, ISBN 978–961–92786–7-3
[14] „The World Thinkers' Panel on the Sustainable Future of Humankind" the declaration in English ISBN 978–961–93136–1-5 (pdf), Slovenian ISBN 978–961–03136–5-7 (pdf), German ISBN 978–061–93136–2-6 (pdf), Spanish ISBN 978–961–93136–3-3 (pdf), and Arabic ISBN 970–961–93136–4.0 (pdf), digital at www.institut-climatechange.si
[15] „International Collaboration Celebration, Declaration WTP-SFH, Academic and ASRIA Awards Presentation Ceremony", 2011, ISSN 2225–9910 9 772225 991005.
[16] „The Sustainable Future of Humankind IV — Xiamen, China and after" T Ecimovic, R. Haw, et al, digital book displayed at www.institut-climatechange.si ISBN 978–961–93136–6-4, January 2012.
[17] „The Sustainable Future of Humankind — V, the Action plan", T. Ecimovic, R. Haw et al, digital book, ISBN 978–061–93136–7-1 (pdf), December 2012.
[18] „The Sustainable Future of Humankind — VI, The World Governing", digital book 146 pages, Martin, Ecimovic et al, ISBN 978–961–93135–8-8 (pdf), 2013.
[19] „Donation of the Knowledge", digital source, Ecimovic, 2013, ISBN 978–961–93136–9-5 (pdf).
[20] „Philosophy of the sustainable development and the sustainable future of humankind — survival of the humanity", Ecimovic, Haw et al, digital source, ISBN 978–961–93453–0-6 (pdf), 2013.
[21] „Filozifija trajnog razvoja i trajne prirodne budućnosti čovjećanstva — borba za opstanak", Ecimovic, Haw, Kondrashin, Weiler, Busch, Evropski Univerzitet, Brčko, BIH, bilingual booklet, ISBN 978–99955–765–7-8, 2013.
[22] „The Nature and the Requisite Holism", digital source, Ecimovic, Mulej, ISBN 978–961–92378–3-0 (pdf), 2014.
[23] „The Anthology 2 — 2001 — 2014, Ecimovic, Mulej, ISBN 978–961–92378–4-7 (pdf), 2014.
[24] „Univerzalna vzgoja in izobraževanje in filozofija trajnostne sonaravne prihodnosti Slovenk in Slovencev", Ecimovic et al, published by „Mandrač", Izola, Slovenia, booklet, 2015, and digital booklet (pdf) ISBN 978–961–92378–5-4, 2015.
[25] „Universal Education and Philosophy of the Sustainable Future of Humankind", Ecimovic et al, digital booklet (pdf), ISBN 978–961–92378–6-1, 2015.

[26] „Nature and Social Responsibility", Ecimovic, Haw and Mulej, digital booklet (pdf), ISBN 978–961–92378–7-8, October 2015.
[27] „Nature 2015 (Anthology 3)", Ecimovic, Haw et al, ISBN 978–961–92378–8-5 (pdf), digital scientific book, December 2015.
[28] Abadzic, N., „The Time of Ecology", 2001.
[29] Brown, Lester, R., „State of the World", 1993 — 1999.
[30] Brown, Lester, R., „Eco-Economy", 2001.
[31] Brown, Lester, R., „The Earth Policy Reader", 2002.
[32] Brown, Lester, R., „Plan B", 2003.
[33] Brown, Lester, R., „Outgrowing the Earth", 2004.
[34] Brown, Lester, R., Plan B 2.0.
[35] Carson, R. (1962). „Silent Spring". London: Penguin
[36] Climate Action Report — ISBN 0–16–045214–7, Washington USA.
[37] „Climate Change 2001", Watson at all, IPCC.
[38] „The Program Agriculture — Tourism — Ecology", Ecimovic et al, TJE Centre, Daleas d. o. o. Komenda, Slovenia, Agropharos d. o. o. Hvar, Croatia, six editions in Sl., Cr., Sr., En., from 1989 until 1994,
[39] „The Program Agriculture — Tourism — Ecology", Ecimovic, the article written for International Conference on in the War Destroyed Regions in Iran, University of Teheran, 1991,
[40] „The Declaration Central Dalmatian Islands Ecology Free Zone", Ecimovic et al, 1991 LA USA,
[41] „The Communal Waste and The Special Waste", Ecimovic et al, TJE Business research Centre written for The Municipalities of Hvar, Brac, Korcula, Lastovo, Vis, Kutina, Garesnica and Island Solta from 1990 until 1993, Komenda, Slovenia,
[42] „The Monitoring", Ecimovic et al, written for The Municipalities of Hvar, Brac, Korcula, Lastovo, Vis, and Island Solta, and land locked communities of Garesnica and Kutina all from Croatia, from 1990 until 1993, TJE Centre, Komenda, Slovenia,
[43] „The Integral Transport", Ecimovic et al, written for The Municipalities of Hvar, Brac, Korcula, Lastovo, Vis, Garesnica, Kutina and Island Solta, from 1990 until 1993, TJE Centre, Komenda, Slovenia,
[44] „The Alternative sources of energy", Ecimovic et al, written for The Municipalities of Hvar, Brac, Korcula, Lastovo, Vis, Garesnica, Kutina and Island Solta, from 1990 until 1993, TJE Centre, Komenda, Slovenia,
[45] „The Organic Agriculture", Ecimovic et al, written for The Municipalities of Hvar, Brac, Korcula, Lastovo, Vis, Garesnica, Kutina and Island Solta, from 1990 until 1993, TJE Centre, Komenda, Slovenia,
[46] „10 Years after the Rio Summit — Processes Towards a Sustainable Future for the Earth", Ecimovic, Mulej, Mayur, UN CSD Conference, Johannesburg, South Africa, August/September 2002,
[47] „The Climate Change System", Ecimovic, UN CSD Conference, Johannesburg, South Africa, August/September 2002,
[48] „The Climate Change System", Ecimovic, Mulej, Mayur, Ajanovic, the Third International Balkan Botanical Congress, 18 — 24 May 2000.
[49] „New World Order", Ecimovic and Haw, Global Symposium, Lucknow, India, December 2005,
[50] Feyman, R., „The Meaning of It All", 1998.
[51] „Global Studies Encyclopedia", Mazour, I., I., Chumakov, A. N., Gay, W. C., 2003.
[52] Green, B., „Wonderful Universe", 1999.
[53] Hawking, S. „The Brief History of Time", 1988.

[54] Hawking, S. „Black Holes and Baby Universes", 1993.
[55] Hawking, S., „A Life in Science", 2002.
[56] Halpern, P., „The Great Beyond", 2004
[57] Keating, M., „Agenda for Change", ISBN 2–9400970–00–8, 1992.
[58] Martin, „World Revolution through World Law", ISBN 0–975355–2-X, 2005.
[59] Mayur, R., „Earth, Man, and Future", 1996.
[60] Meadows, D. H., D. L. Meadows, J. Randers, and W. Behrens (1972), „The Limits to Growth". New York: Universe Books.
[61] Metzner, H., „From Chaos to Bios", Tubingen, Germany 1989
[62] „Our Common Future", G. H. Brundtland Report, 1987.
[63] Rees, M. „Our Final Century", 2003.
[64] Rees, R., „Before Beginning", 2004.
[65] Wilderer, P., Schroeder, E. D., Koop, H., „Global Sustainability", 2004.
[66] „Webster's New World Dictionary", Second College Edition, 1986.
[67] Hessel, S.," Indignes vous!" 2010.
[68] Werramantry, C. G., „Nuclear Weapons and Scientific Responsibility", 1987.
[69] „Philosophy of Globalization", A. Chumakov, 2010.
[70] „Agenda 21- Program for Sustainable Future of the Municipality of the Bosanska Krupa" Bosnia and Herzegovina, in English and Bosnian, Ecimovic et al, 2005.
[71] Lovelock J., „Gaia: A New Look at Life on Earth". 1979.
[72] Norman Mayers, Uma Ram Nath, Melvin Westlake, „The Gaian Atlas of Planet Management", 1985.
[73] Udyavar Yehuda R., Shah P, „Survival at Stake", 2011,
[74] „History of Earth and Man — in the light of Esoteric and Scientific Data", Vardjan Velimir, ISBN 978–961–93453–1-3 (pdf), multilingual digital epic book, 2013,
[75] „Applying the New Sciences of Networks to Planetary Agriculture — The Impact of Climate Change and Demography on food availability up to 2100", Weiler and Demuynck, ISBN 978–961–92378–9-2 (pdf), digital scientific book, December 2015.[7]

[7] Original paper has larger „Bibliography" of 107 items, which was reduced to present 75 item due to CANU instructions. Also the reference numbering is not done due to same reason. Total „Bibliography" could be seen at www.institut/climatechange/si

Garry JACOBS[*]

TECHNOLOGY, EMPLOYMENT & HUMAN WELFARE

Abstract: For more than a century futurists have envisioned a rapidly approaching era in which technology replaces human labor and makes human beings a redundant, unnecessary economic resource, resulting in rising levels of unemployment, impoverishment, and social alienation. While previous predictions in the 1890 s and 1990 s proved to be premature and exaggerated, there is mounting concern that the rapid development of robotics and artificial intelligence taking place now will profoundly impact the global demand for labor and new job creation over the next two decades. Coming at a time when socialism and state responsibility for social welfare are receding, this prospect poses serious challenges to the welfare and stability of democratic society in the 21st century. This paper examines the *historical relationship between technology, employment and human welfare* and its impact on producers, consumers, capitalists and workers. It explores the political, legal, social, economic and cultural implications of accelerated technological innovation and adaptation. It considers political, legal and economic options for regulating the development, dissemination, adoption and impact of job-eliminating technologies in an increasingly unified global economy, including tax policies on capital and labor intensive production, regulation of the working week, and guaranteed minimum income programs. It also explores various dimensions of a comprehensive human-capital intensive development social strategy for higher education and skills development.

INTRODUCTION

The world is moving at lightning speed and continuously restructuring its very foundation in mid-flight. The increasing speed is most readily perceived in the field of technological innovation in telecommunications, nanotechnology, biotechnology, robotics and artificial intelligence. Organizational innovation is taking place with similar rapidity, giving rise to new institutions, systems and processes that dramatically alter the way human beings communicate, interact, trade, learn, govern and live with one another. Civilization and culture constitute deeper layers of society which evolve much more slowly than technology and organization on the surface. They are founded on ideas, value, institutions, attitudes and ways of life

[*] CEO, World Academy of Art & Science

Table 1. Socio-Economic Indicators 1800 Vs. 2012

2012	1800
Population 7 billion	Population 1 billion
49% urban population	3% urban population
Life expectancy 67 years	Life expectancy 29 years
Mechanized & automated	Manual labour
Society-based (70% services)	Land-based (agriculture)
2-10% in OECD countries	85% employed in agriculture
World trade 27%	World trade 3% of global GDP

that are deeply entrenched and resist rapid alteration. The radical acceleration of evolutionary technological and organizational change has generated a serious mismatch resulting in tensions, upheavals and unresolved problems. The recent global financial crisis, the Eurozone crisis, the flood of refugees into Europe, Brexit, rising levels of inequality, political extremism and social unrest are symptoms of civilizational and cultural stress at deeper levels. Rising levels of unemployment and increasing pessimism about the future of work are a consequence.

The stress arising from rapid and radical social evolution is nothing new. Only this time the rate of change and geographic reach is greater than ever before. The 20th century was marked by radical transformation of society and work as depicted in Table I. The explosive growth of population, rapid urbanization, extension of life expectancy, the shift from agricultural to industrialization, the shift from manual to mechanized and automated labor, and rapid expansion of international competition arising from the growth of world trade generated considerable turmoil, uncertainty and insecurity.

The rapid shift to mechanized farm machinery in the USA led to widespread fear in the 1890 s that machines would eliminate human labor and generate perpetually high levels of unemployment. The development of mass production in the early 20th century led to a huge expansion of manufacturing and absorbed the surplus labor from agriculture.

The end of the Cold War, collapse of the Soviet Bloc and reunification of Germany were followed by similar pessimistic predictions about the end of work itself, as computerization and robotics displaced workers from manufacturing and service sector jobs. The unexpected emergence of the World Wide Web led to the

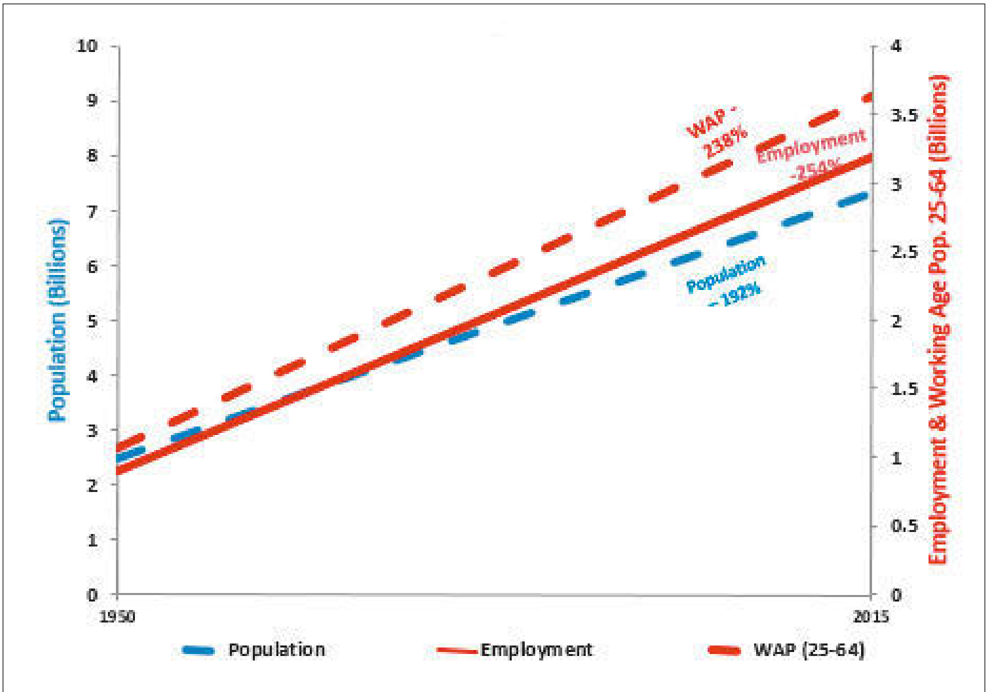


Figure 1. Growth of Population and Employment 1950–2015

founding of whole new industries and a new boom in higher end service sector employment in telecommunications, biotechnology and computing. By the end of the 1990 s, unemployment rates had fallen dramatically in OECD countries and the concerns about unemployment subsided.

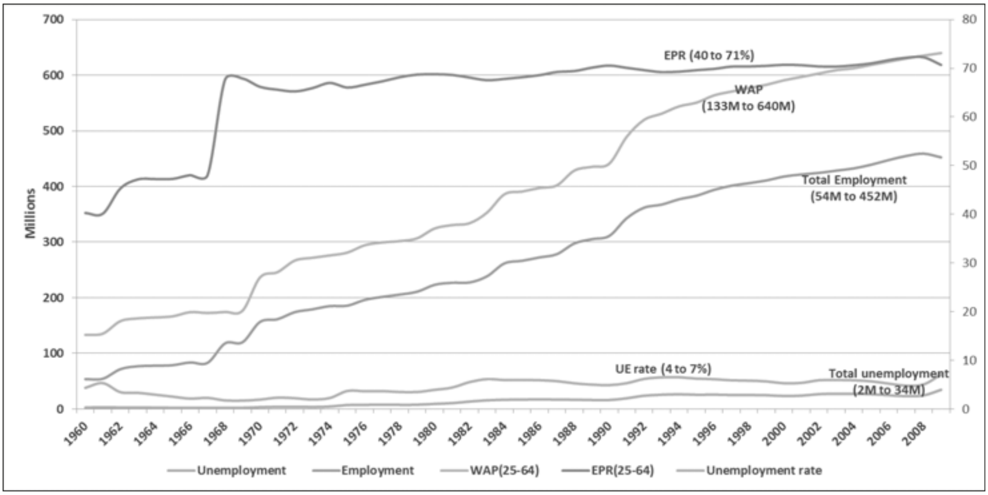


Figure 2 Employment Indicators for OECD countries 1960–2009

The second half of the 20th century experienced unprecedented rates of population growth, technological adaptation and world trade. Yet the statistical evidence does not support the view that we are headed toward a future of ever-increasing unemployment. Figure 1 shows that between 1950 and 2015, world population rose by 192% and working age population rose by 238%, while total global employment rose by 254%.

Figure 2 shows that the average unemployment rate from 1960 to 2009 in OECD countries remained relatively stable in spite of major economic and social upheavals and rising levels of instability.

FOURTH INDUSTRIAL REVOLUTION

Once again following the 2008 global financial crisis fears of permanently rising levels of unemployment have become widespread. The world economy is still in the wake of the 2008 crisis and unemployment rates, especially among youth, remain high in many of OECD members. But this time many researchers foresee perpetually higher unemployment as a result of advances in fields such as artificial intelligence, machine learning, robotics, 3-D printing, automation, computerization, nanotechnology, genetics, biotechnology and smart systems. [1] Nine out of ten workers today are in occupations that existed 100 years ago, and just 5 percent of the jobs generated between 1993 and 2013 came from „high tech" sectors like computing, software, and telecommunications. According to research by Frey and Osborne of Oxford University, 70% of jobs will be automated by the end of the century, 47% in the next two decades and 60% of the best jobs in the next ten years haven't been invented yet. They predict that in the next 10–20 years, 58% of financial advisors will be replaced by robots and AI. [2] A recent report from the Foundation of Young Australians said that between 60–70% of our students are being educated in jobs that won't exist by the time they graduate. It is also projected that 87% of highly creative workers are at low or no risk of automation, compared with 40% of jobs in the UK workforce as a whole. According to a 2016 report by World Economic Forum the 15 largest economies in the world, excluding China, will experience a net loss of 5.1 million jobs between 2015 and 2020.[3] Another study projects that 47% of jobs globally will be automated by 2035 and 70% by 2100.[4]

These disconcerting predictions are offset by counter trends in population and skill shortages. According to McKinsey, the global labor force will decline by 33% between 2010 and 2030, due to slower and negative population growth and rising levels of enrollment in higher education. As a consequence, McKinsey predicts a skill shortage of 85 million college graduates and 95 million low level workers by 2020.[5]

Historical experience compels us to regard these projections with a grain of salt, because past predictions have proven to be so far wide of the mark. Social evolution is a multi-dimensional, multi-pronged and multi-layered movement that encompasses political, economic, social, demographic, education, technological and ecological factors. Social science today lacks sufficient knowledge of the evolutionary process, the interactions and interdependencies between its components and the consequences of rapid globalization to predict outcomes with authority. Nevertheless, uncertainty regarding the outcome does not justify complacency or unpreparedness. Rather it compels us to accelerate efforts to develop a cohesive and comprehensive understanding of global social dynamics and to explore the possible policy instruments available to mitigate the temporary or long term impacts of radical social transformation.

THE DOUBLE-EDGED SWORD OF TECHNOLOGY

Employment is only one of the factors that is impacted by technology. Regardless of the prognosis for employment in coming years, rapid technological advances raise a deeper issue of immense importance to the future of human civilization. As the historical record makes evident, technology is a double-edged sword. It has the capacity to increase food production, prolong life expectancy, meet basic needs, raise living standards, disseminate information, improve the quantity and quality of education, and provide comforts and convenience far beyond the luxury enjoyed even by kings in earlier centuries.

At the very same time, technology poses increasingly serious, unprecedented and in some cases existential threats to humanity. The monstrous destructive impact of intentional or accidental nuclear war terrorized several generations after WWII and still persists. New forms of technology are being prepared to weaponize outer space and cyberspace place weapons of mass destruction in the hands of small minorities. Pollution has contaminated the soil, water and air. Desertification and climate instability resulting from unbridled application of technology have spurred massive migrations and threatened the food supplies of countless millions.

Technologists will hasten to remind us that it is not technology per se but the use to which it is put that determines whether it is benign or life-threatening. That is certainly true. But it is also true that modern society and economy have elevated technological advancement to the level of a religion — a religion that threatens to supplant the value and freedom of human beings with the value and domination of the machine. The ethical mindset of modern science has accorded a supreme status to mechanism and extends in many fields near unbridled freedom for its indiscriminate development and application, regardless of the social consequences. No matter how powerful and useful it may be when applied with intelligence and discrimination, technology and mechanistic forms of social organization are incapable of solving the fundamental problems confronting humanity today. Faith in the all-powerful beneficence of technology constitutes a mental form of barbarism that threatens to undermine the greatest achievements of world civilization and culture. Technology, like money, is only an instrument for human progress, and it only has value to the extent it actually serves to promote human welfare and well-being.

The World Academy of Art & Science was founded in 1960 by eminent scientists — a number of whom had been associated with development of nuclear weapons — concerned with the social consequences and policy implications of science and technology. Science and scientists cannot afford to turn a blind eye to the consequences of their discoveries and inventions. It is not sufficient to blame either political leaders or business for misuse and abuse of knowledge. Countless millions of scientists work in government and commercial research labs and universities whose research is funded by them. The scientific community needs to accept consciousness responsibility for the consequences of its work and impose regulations on itself or subject scientific work to close scrutiny and regulation by civil society.

IMPACT OF OTHER FACTORS ON UNEMPLOYMENT

Apart from technology, many other factors contribute to the recent rise in employment. Most notable of these is the increasing financialization of the world economy. Today global financial assets exceed $250 trillion, which is more than three times total world GDP. It is estimated that less than 20% of this capital is engaged in supporting the activities of the real economy. A large portion of it is employed in speculative investments that draw funds away from investments that create jobs and meet human needs, reducing employment opportunities and worker earnings growth, while increasing uncertainty, instability and economic inequality. International financial markets have become a global casino, an unregulated Wild West where money moves with lightning speed around the world in search of higher speculate rates of return. It has been estimated that the world needs to invest roughly $4 trillion a year in order to fulfill the UN's Sustainable Development Goals and to mitigate the threat of climate change. [6] Global regulation of international financial markets and taxation of speculative financial transactions can spur massive investments in the real economy, job creation and ecological sustainability.

The reign of neoliberal, free market economic policies has been another major contributing factor to rising levels of income inequality and unemployment. Low tax rates on capital gains and high taxes on labor, overseas corporate tax havens, increasing permissiveness of mergers and acquisitions that limit competition and destroy viable businesses, exorbitant rewards for managerial short-termism, unnecessary and unjustifiable extension of patent and copyright protection at the expense of competition and consumers, weakening of legislation protecting organized labor and social security nets are just a few of the policy shifts that weakened growth of the real economy, job growth, worker incomes and job security.[7]

At the root of the financial crisis, economic slowdown, rising inequality and unemployment lies a discredited body of economic thought founded on a Newtonian, mechanistic, fragmented world view based on universal principles divorced from human needs, aspirations and values. The world needs a new paradigm in economic thought appropriate to human beings in the 21st century. That thought must be founded on the central role and value of human beings, rather than on the all-powerful, all-important contribution of technology, money and unregulated markets.[8]

In sum a broad spectrum of economic, political and social factors impact directly or indirectly on the rates of job creation, including rates of economic growth, international trade, new technology development and dissemination, rates of population growth and life expectancy, the relative shift from agriculture to manufacturing and services, the level of education and skills in the workforce, the policy bias favoring capital-intensive and energy-intensive investments, the diversion of money from investment in the real economy to speculation, the extent of legal protection for patents and copyrights, and countless other factors.

Among these, two deserve special attention — economic inequality and social power. As Thomas Piketty has documented, rates of income and wealth inequality are at their highest level globally since before the Great Crash. Rising inequality results in lower levels of consumption, lower economic demand, lower rates of investment in the real economy and more money invested in speculation. Money is power and economic inequality is one expression of how power is distributed in society. Extreme concentration of wealth has a powerful influence on politics. An inordinate share of the power of democratic governance is directed for the benefit of business and the wealthy. In recent decades, many democracies have come to behave more like plutocracies and oligarchies. A wide distribution of power in all forms is the surest safeguard for individual freedom, innovation, increasing prosperity and continuous employment growth.

CONVENTIONAL STRATEGIES

The toolbox of conventional strategies for containing unemployment has been exhaustively utilized over the past seven years and has proven largely ineffective. Mainstream macroeconomics argues for measures to increase the rate of economic growth and leave job creation to the market. But the trillions of dollars of stimulus funds injected into the market by quantitative easing has done far more to boost asset prices on financial and real estate markets, than it has to promote investment in the real economy and job creation. The call for lower tariff barriers and freer trade, so long at the top of the policy agenda, has finally created a backlash of resentment and opposition from the working and middle class in Europe and North America, precipitating the Brexit movement in UK and increasing dissatisfaction with EU membership elsewhere. The contrary option of raising tariff barriers to reduce competition is gaining ground after two decades of support for free trade. The call of unions for shorter working days and weeks and earlier retirement, so successful in early decades, finds little political backing in these days of tough international competition.

HUMAN-CENTERED APPROACH

Rising levels of unemployment are not inevitable. Alternative theory and policies can be drawn upon to mitigate the disruptive impact of technological innovation and promote more steady, stable and socially beneficial patterns of economic development and job creation. This calls for a fundamental shift to a human-centered approach. Instead of promoting more and more capital-technology-energy-intensive investment, it calls for higher levels of investment in human capital, welfare and well-being. Investment in education and training not only eliminates skill shortages and raises productivity. It also raises the aspirations and releases the energy of people to produce and accomplish more. It is a catalyst for human energy, which is the real driver of development.

A human-centered approach is founded on the following basic premises:

— Human-capital is our most productive, creative, precious and perishable resource.

— Employment is an essential requirement for economic security, social stability and psychological well-being.

— In a market economy, employment is the economic equivalent of the right to vote in democracy.

— Government that has the power to regulate all aspects of social existence, must necessarily accept the responsibility to ensure full employment.

— The right to employment is not a privilege. It must be recognized as a fundamental human right and guaranteed by adoption of policies that accord greater importance to human well-being than mindless, ecologically unsustainable growth.

The idea that employment is a fundamental human right is neither new nor far-fetched. During the early 1940 s US President Roosevelt planned as soon as the war ended to introduce a bill of economic right which included the right to employment, but he died before he could do so. The US Employment Act of 1946 acknowledged the responsibility of government for employment generation. Articles 23 and 24 of the Universal Declaration of Human Rights (1948) and the ILO Declaration of Fundamental Principles and Rights at Work (1998) both affirm the right to work and protection against unemployment. The International Bill of Human Rights (1960 s) also affirms civil, political, economic and social rights.

A human-centered policy framework can be evolved that promotes full employment at both the national and the global levels. It must be founded on the primacy of human-dignity, economic security, welfare and well-being, not markets, money, technology or growth for their own sake. It must introduce policies to redirect financial resources from speculation into the real economy, including massive investment in human and social capital. It should be founded on a value-based, human-centered theoretical framework that promotes a true democratization of social power. Employment is not a matter to be left to the whims and fancy of unregulated markets. It is a matter of human choice. We have the power to create full employment, if only we decide to do so.

THE ALTERNATIVE

Full employment is not the only viable option for humanity nor in the long term is it necessarily the best. Over the past few centuries, society has progressed enormously in its capacity to meet human needs. World economic product has multiplied more than 80-fold since 1800. In spite of a more than seven-fold growth of population, real per capita income has growth 12-fold. The fundamental role of technology is to elevate the living standards and quality of life of every human being. Technological advances are also based on the cumulative achievements of global society at-large dating back millennia. The latest digital technologies are founded on the invention of the Hindu numerals, zero and the decimal point by Indian mathematicians more than 15 centuries ago. A fair and equitable distribution of the gains from technological innovation can reduce and eventually eliminate the compulsion of work. That requires an evolution of our political and legal system and social values commensurate with our technological advancement. This should naturally and inevitably lead to progressively shorter working hours and working weeks and proportionately more time for education, self-development, culture and leisure.

The policy framework to support this alternative is already well known. It is based on the principle of providing every citizen a minimum guaranteed income independent of the work they do. The earliest known implementation of this idea can be traced back to Abu Bakr, the first Muslim Caliph in the 6th century AD. Similar programs were advocated down through the ages by Thomas Paine, Napoleon Bonaparte, Bertrand Russell, Martin Luther King, and economists Milton Friedman, Paul Samuelson, James Tobin and John Kenneth Galbraith. Napoleon argued that man is entitled by birthright to a share of the Earth's produce sufficient to fill the needs of his existence. Russell believed that a certain small income, sufficient for necessities, should be secured for all, whether they work or not, and that a larger income should be given to those who are willing to engage in some work which the community recognizes as useful. Friedman advocated a minimum guaranteed income via a „negative income tax." In 1968, James Tobin, Paul Samuelson, John Kenneth Galbraith and another 1,200 economists signed a document calling for the US Congress to introduce in that year a system of income guarantees and supplements. In 1973, Daniel Patrick Moynihan wrote *The Politics of a Guaranteed Income*, in which he advocated the guaranteed minimum income and discussed Richard Nixon's Guaranteed Annual Income proposal. In 1994 classical liberal Friedrich Hayek wrote that he has always been in favor of a minimum income for every person in the country.

The idea resurfaced this year when Switzerland considered but rejected a proposal to introduce a minimum income program in a national referendum. Finland is also drawing up plans for a similar basic income program. Studies show that basic income programs can reduce inequality, raise consumption, ensure human security, promote welfare and enhance well-being. The real barriers are conceptual rather than economic. New theory is needed to provide the intellectual underpinnings for a new approach to human well-being.

REFERENCES

[1] Mertin Ford, *The Rise of Robots* (New York: Basic Books, 2015) and Erik Brynjolfsson and Andrew McAfee, *The Second Machine Age* (New York: W. W. Norton & Company, 2014)

[2] Carl Benedikt Frey and Michael A. Osborne, „The Future of Employment," September 2013; http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

[3] *Future of Jobs Survey* (Cologny: World Economic Forum, 2016) http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf
[4] Brynjolfsson and McAfee, *Second Machine Age*
[5] Richard Dobbs, James Manyika and Jonathan Woetzel, *No Ordinary Disruption: The Four Forces Breaking All the Trends* (New York: PublicAffairs, 2015) http://www.mckinsey.com/mgi/no-ordinary-disruption
[6] Stefan Brunnhuber, „How to Finance our Sustainable Development Goals (SDGs): Socioecological Quantitative Easing (QE) as a Parallel Currency to Make the World a Better Place," *Cadmus* 2, no. 5(2015): 112–118 http://cadmusjournal.org/article/volume-2/issue-5/how-finance-our-sustainable-development-goals
[7] Rana Foroohar, *Makers and Takers: The Rise of Finance and the Fall of American Business* (New York: Crown Publishing, 2016).
[8] Garry Jacobs, „Contours of New Economic Theory," *Cadmus* 2, no. 4 (2015): 139–161 http://cadmusjournal.org/article/volume-2/issue-4-part-3/contours-new-economic-theory

Gheorghe DUCA*

SCIENCE FOR SUSTAINABLE DEVELOPMENT OF SOCIETY

Abstract: The proliferation of the role of science in Moldova is related to the answer of the simple question „How will we build the future?" A question frequently asked by public officials and politicians in the current political crisis. The problem of power, a stringent problem nowadays, cannot be answered alone; it has to be regarded in relationship to science and education. The question can always be answered by a following question „What kind of science and education do you need?"

From the late 20th (twenty) century, a special commission of the United Nations has been calculating the so called Human Development Index, which includes the level of education of population, development of health services and economical development of the country.

In its classical sense *science — is the process of obtaining new knowledge about the laws of nature and society.* In reality, science is *multifunctional.* It has three functions — *sociocultural* (science — part of the culture of the society), *educational* (impact on the level of education) and the function of the *influence on the economy.* The performance of each of these functions require different amounts of funding. Moreover, to achieve a permanent impact at least *1.5–2% of GDP is required.* It is for this reason, the European Union decided to bring the level of funding of up to *3% of GDP* to achieve the goal of becoming the leader of the world economy. At a lower level of funding there is no relevant direct influence of science on the economy, such an impact will be indirect, because the level of development of science determines the level of education in the society and the level of general knowledge.

In order to give the correct course of action the Code on Science and Innovation of Moldova, adopted in 2004, installed a rate of funding from the state budget to 1% of GDP. Indeed, in the period from 2005 to 2008, there was a constant increase in funding, but it only managed to bring up to 0.75% of GDP. After 2009, this figure declined steadily.

It seems clear that this level of funding does not allow hope for the ability to perform the functions of the Moldovan science to impact the economy. For this, the Moldovan research community has aspired to associate to the EU Framework Programme on Reasearch and Innovation.

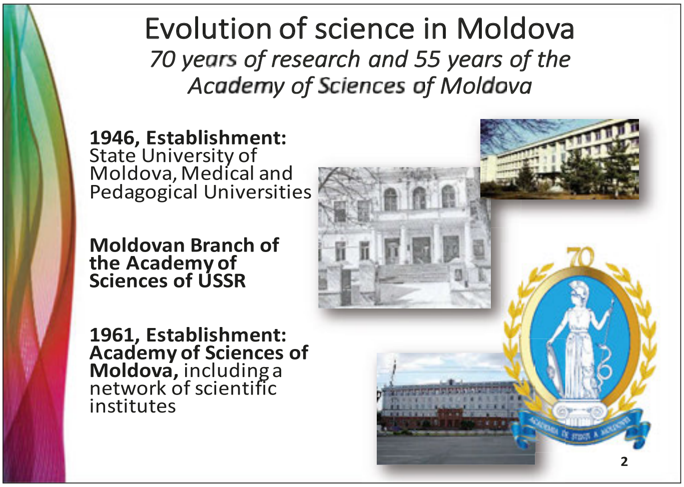
Following the aforementioned association, the Academy of Sciences of Moldova has drafted a new law in order to amend the Code on Science and Innovation, which provides for reform of the current management of the area of science and innovation, by adjusting its legal status to the rigors of the European Research Area.

* President of the Academy of Sciences of Moldova

President acad. Momir Djurovic,

Dear presidents of academies, fellow academicians and professors,

My report will follow the slogan of UNESCO for 2015 – ***There can be no development without science*** and will mark the importance of research for Moldova.



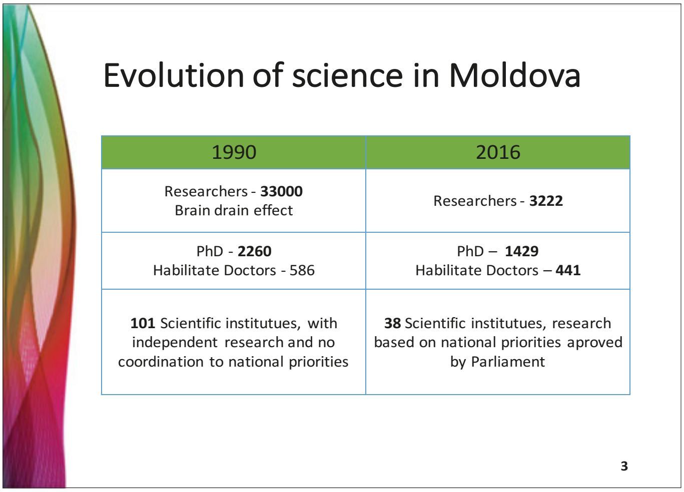
In contrast to Europe and Russia, where science and higher education originate much earlier, in Moldova, the beginning can be attributed only to the period after the Second World War.

The creation of the Moldova State University, medical and pedagogical institutions, the Moldavian branch of the Academy of Sciences of the USSR, and later in 1961 the Academy of Sciences of Moldova and a network of research institutions have served as the foundation, which provided the development of the economy, culture and health of Moldova.

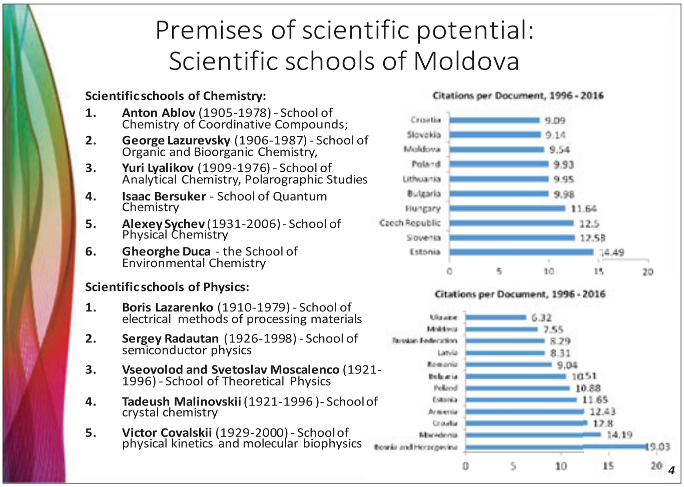
This year marks the 70 year aniversary for research and 55 years of the Academy of Sciences of Moldova.

In this period the infrastructure of the scientific community was optimized, which corresponds to the possibilities of the country.

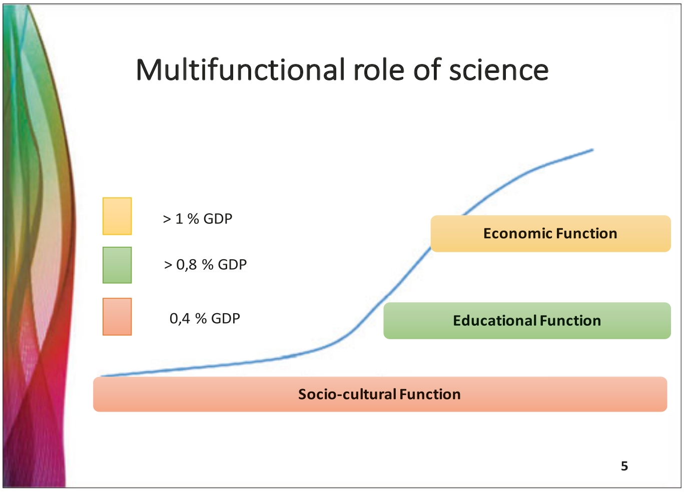
The scientific community was affected by brain drain and the number of researchers decreased, as presented on the slide.



In retrospective, along with the establishment of the first research institutions, the continuation of scientific schools has been one of the strong points of Moldovan research. Many of the scientific schools are represented by former and current members of the Academy of Sciences of Moldova.

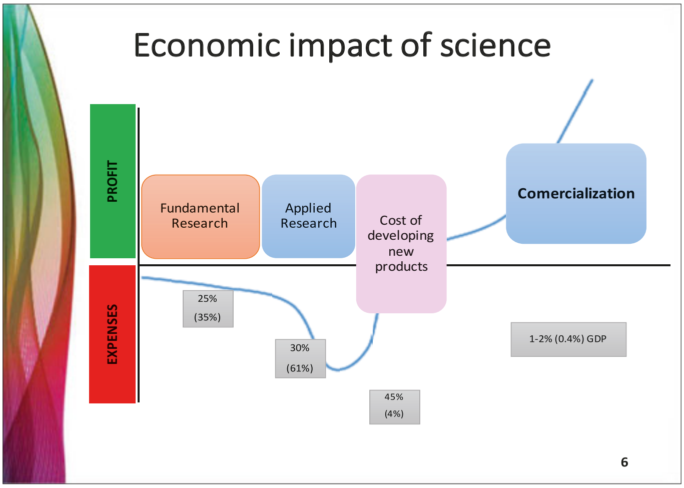


The contribution in the field of chemistry and physics, 7th and 13th, respectively, in the Eastern and South-Eastern Hemisphere Countries has been at a high level.



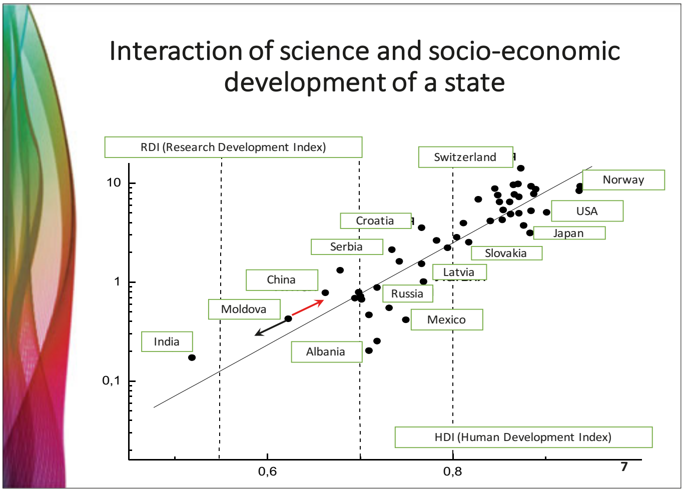
In its classical sense **science – is the process of obtaining new knowledge about the laws of nature and society.** In reality, science is **multifunctional**. It has three functions – **sociocultural** (science – part of the culture of the society), **educational** (impact on the level of education) and the function of the **influence on the economy**.

The performance of each of these functions require different amounts of funding. And to achieve a permanent impact at least **1.5-2% of GDP is required.**



In order to obtain economic effect, funding has to be distributed to fundamental and applied research as well as into technology transfer for developing new products.

In this paradigm science can have a direct effect on society.



At a lower level of funding there is no relevant direct influence of science on the economy, such an impact will be indirect, because the level of development of science determines the **level of education in the society and the level of general knowledge**.

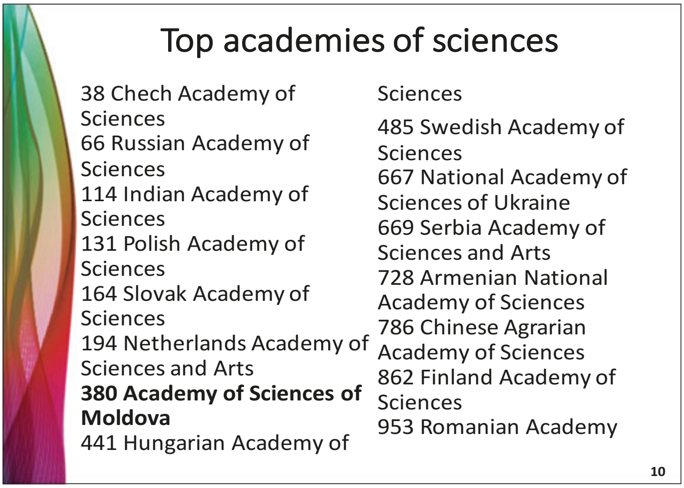
Following this model and in order to give the correct course of action **the Code on Science and Innovation of Moldova**, was adopted in 2004. The Academy of Sciences of Moldova offered its infrastructure for the scientific community and became coordinator of science in the country.

Under the Code on science and innovation, the Academy had to reform in order to become relevant for international competition. What was the role and impact of the Academy of Sciences of Moldova?

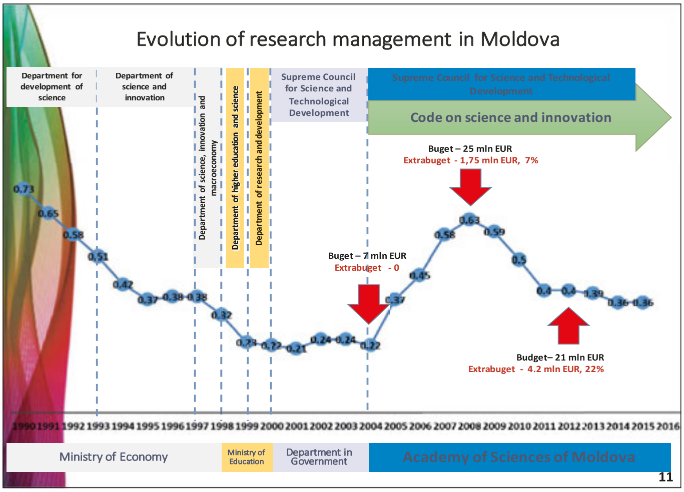
History has established many models for managing research by academies. **The Learned Society** — The original academy of Plato), **the Adviser to Society and the Manager of Science**

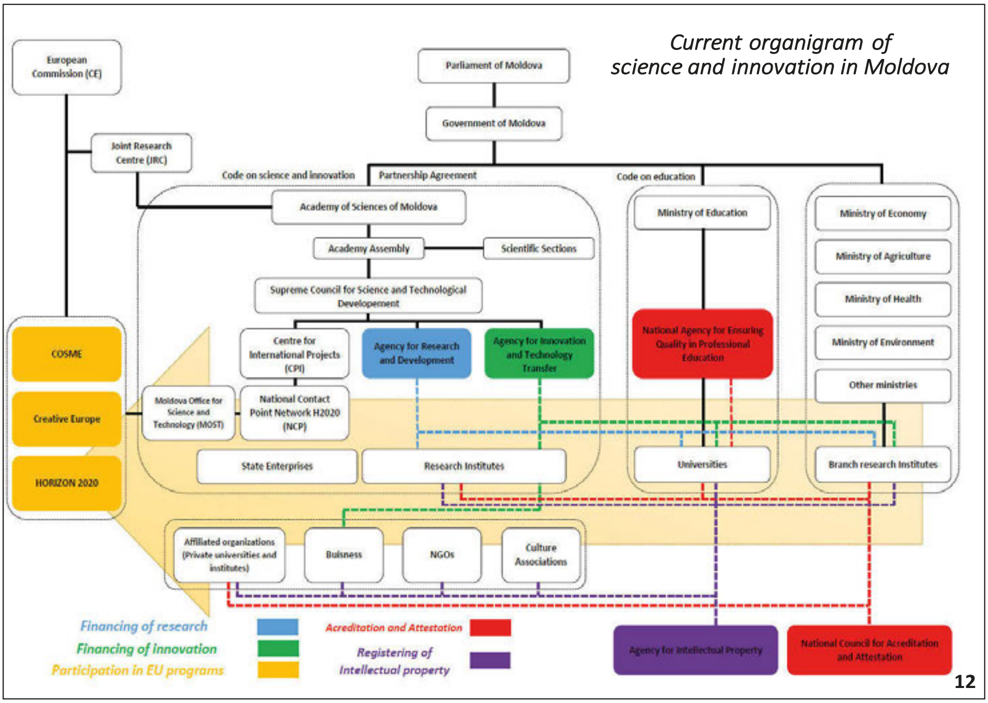
The Academy of Sciences of Moldova under the code of science and innovation created a new innovational model of managing science by a strategic partnership with Government.

The new model became relevant and according to webometrics is rated 380 in the world.



The viability of the current model can of science management can be seen on the slide. Science in Moldova had many administrators but the result was the same – decrease in funding. Following the adoption of the Code on science and adoption of the new model this paradigm was reversed.

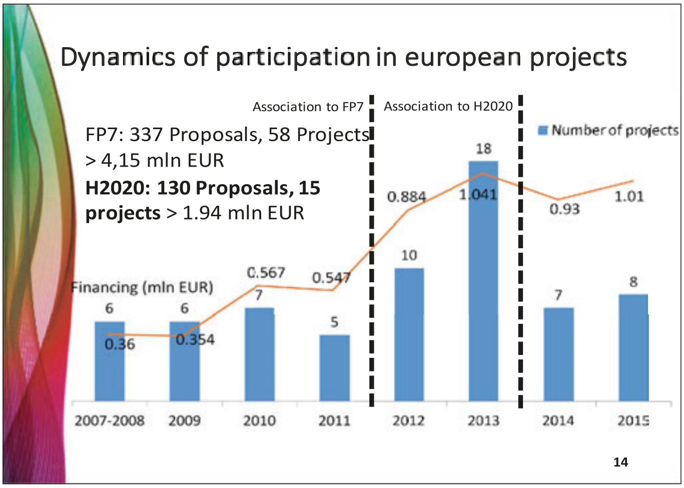




On the slide you can see the current science and innovation organigram.

The new model of science managment permitted the association of Moldova to the European Research Area. On the slide you can see the association to FP 7 and Horizon 2020.

What are our results in european projects? In total, more than 300 research proposals were submitted, 53 of them were accepted, total funding of 3.7 million euros. In H 2020 we submitted more than 130 proposals, 15 were accepted, total funding of almost 2 million euros.



Being stimulated by the European Research Area, the Academy of Moldova has asked for an international peer review exercise from the European Commission., that will help bring Moldova closer to european research.

What are the results that we are expecting? They are based on the following priorities:

Research performance;

Atracting talented youth into research;

Ensuring a positive financing trend for research, 1% of GDP untill 2020.

Next, I will present shortly the main reform actions.

Establish the National Agency for Research and Innovation which will be the central authority responsible for elaboration and realization of research, development and innovation policy and will distribute financing in project based competiton.

The Agency will organize the whole proces of selection, evaluation and financing of projects in public competitions.

Create the National Council for Research and Development will be a consultative entity of the Prime-minister, that will have three main tasks:

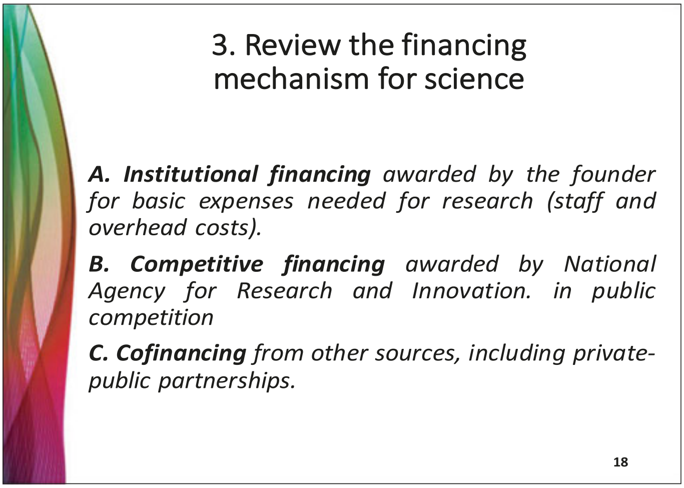
1. Examine research, development and innovation policy
2. Propose Government amount of financing for research
3. Ensure communication and cooperation among main research policy makers: government, buisness and scientific community.

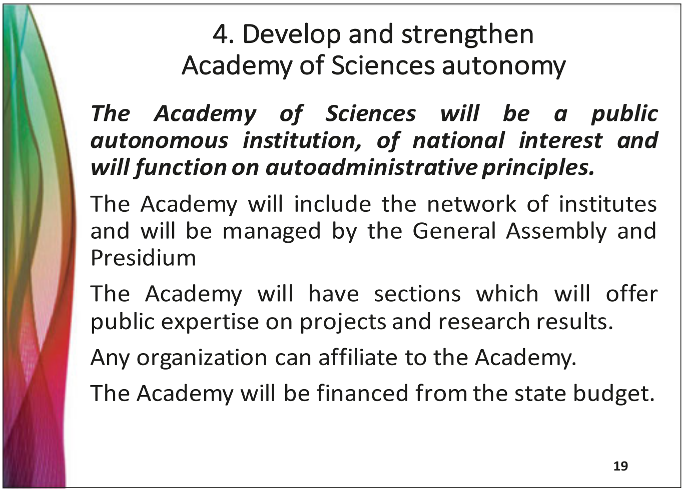
Review the financing mechanism for science:

A. Institutional financing awarded by the founder for basic expenses needed for research (staff and overhead costs).

B. Competitive financing awarded by National Agency for Research and Innovation. in public competition

C. Cofinancing from other sources, including private-public partnerships.

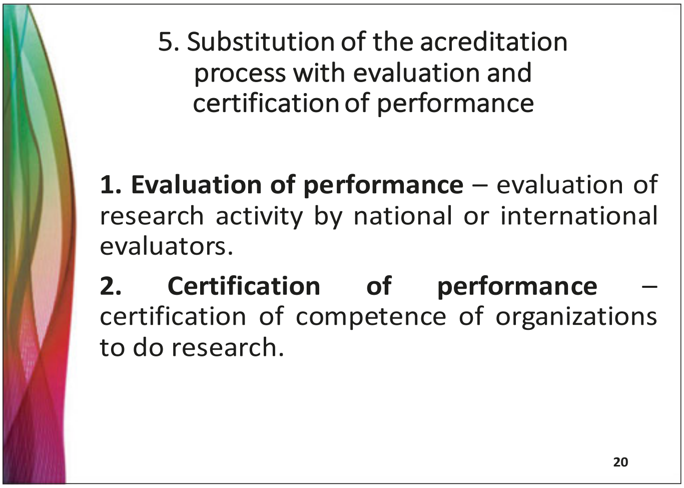




The Academy of Sciences will be a public autonomous institution, of national interest and will function on autoadministrative principles.

The Academy will include the network of institutes and will be managed by the General Assembly and Presidium. The Academy will have sections which will offer public expertise on projects and research results.

Any organization can affiliate to the Academy. The Academy will be financed from the state budget.

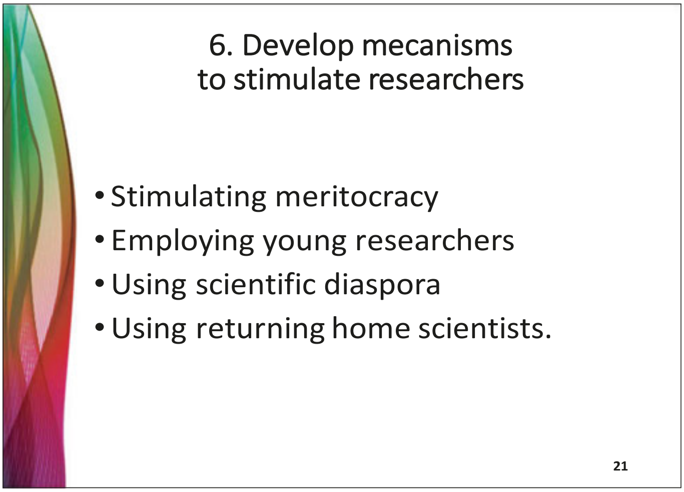


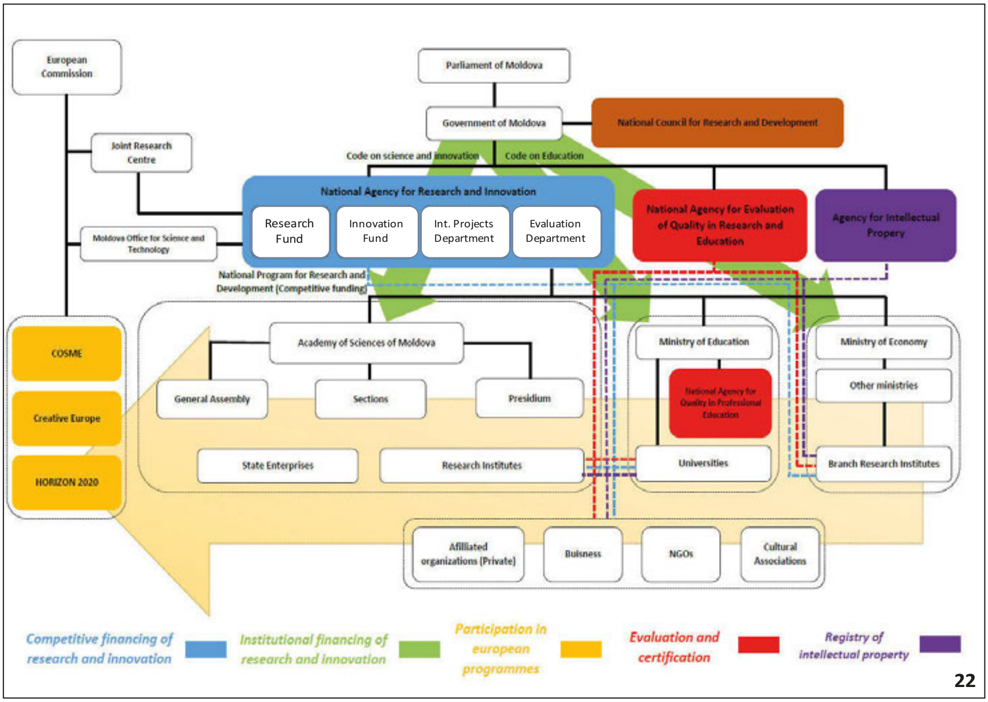
5. Substitution of the acreditation process with evaluation and certification of performance

1. Evaluation of performance – evaluation of research activity by national or international evaluators.

2. Certification of performance – certification of competence of organizations to do research.

And last, develop mecanisms to stimulate researchers by stimulating meritocracy, employing young researchers, using scientific diaspora, using returning home scientists.





Following the reform the scientific community of Moldova will have the organigram presented on the slide.

We hope to achive succes in this reform in the benefit of the scientific community and society and not in its detriment. I hope to recieve your opinion and support for this reform. Thank you for your attention.

Carlos ALVAREZ-PEREIRA*

A NEW CONCEPTUAL FRAMEWORK TO PREVENT TECHNOLITARIAN FUTURES

Abstract: This contribution explores in a provocative way the shortcomings of our current understanding of Science and Technology (S&T) and their role in modern, complex societies. It identifies some social blind spots which seem to be key in preventing the emergence of a new framework of interpretation, required to ensure that the extraordinary achievements of further S&T could be exploited for the common good of humanity, life and the planet at large.

INTRODUCTION

Although ignored by the mainstream currents of our societal thinking and behavior, alarms have been raised since a very long time about the challenges that humankind is facing as a consequence of its own actions and development. Those alarms trace back at least to Robert Malthus at the end of the 18th century and received a strong impulse in the 60 s and 70 s of past century, due to research promoted by the Club of Rome and other farsighted institutions and individuals ([16], [23]).

Nowadays, the awareness about the challenges and risks of our civilization is certainly higher than ever: issues such as the deepening of social inequalities, the over-exploitation of resources, the loss of biodiversity, and diverse forms of pollution and large-scale climate destabilization, to name just a few, are mentioned explicitly in the public agendas. In this context, it is taken for granted that Science and Technology (S&T) are key to find social and technical solutions to those and other dramatic challenges.

This of course is a strong paradox, since S&T have been indeniably not only central elements of the development model followed by human societies in the last two centuries, but often (and still today) very effective instruments used for mass destruction, environmental degradation and social exclusion. This paradox (S&T as part of the problem and as core of the solution) is grounded in some implicit assumptions, namely that the evolution of human societies is mainly driven by tech-

* President, Innaxis Foundation; Full Member, Club of Rome

nological change and that S&T are essentially beneficial and neutral with respect to their practical applications, which depend on human decisions.

Although increasing human knowledge may certainly be a source of benefits for humankind, it can be argued that the processes and rules through which scientific discoveries and technological innovations are promoted and produced are not neutral at all, but rather reflect a particular organization of society and therefore embody certain values and interests, explicit or not, which of course have a strong impact on the outcomes of S&T activities. This paper explores in a provocative way some of the issues around the challenge of ensuring that S&T produce benefits for humanity and its sustainability.

THE ILLUSION OF TECHNOLOGY

Technological innovation is the „deus ex machina" invoked to solve all challenges. In many senses we praise science and technology today as much as we revered ancient gods. We consider them to be the source of modern truth, since scientific knowledge is labelled with the prestige of objectivity and neutrality per se. And science and technology (S&T) feed our dreams since their secular success has made feasible many crazy wishes of human imagination, like flying, travelling to the outer space or chatting with other people wherever they could be on the planet. Not least, precisely because of that success, we easily extrapolate the future of S&T to bring us omnipotence, an infinite capacity to break the physical limits which restrain us and, who knows, even that of time and death.

In other words, the wonders made possible by S&T in the last centuries are not enough, we add to them an extra layer of enthusiasm which goes much beyond their actual capacity. All the technological miracles we take now for granted have required huge efforts, a lot of patience, large investments over long periods and a good amount of serendipity. And, most important, they are based not on breaking the physical limits but on better understanding them and finding ways to build on our limitations: we do not fly by ourselves as birds, we mobilize our knowledge and resources to create artifacts which transport us in the air while still respecting physical laws. Of course this is an extraordinary achievement but it is bounded by reality, something we easily forget.

Somehow we deal with the rationality of S&T in an irrational, almost religious way, which is nothing but the expression of our emotional nature. We are driven by a complex perception of reality and so many times by our fears, and we need some kind of belief. For three centuries the driving belief has been in the progress of humanity, of course reinforced by the success of S&T. But, while for generations born before the 1980 s changing the world for the better would require also (or primarily) political and social innovations, now it seems that S&T has even displaced every other source of hope. The launching of the latest digital artifact creates a widespread frenziness, but also a true and exciting entrepreneurial spirit is mobilized by the potential of technologies to address human challenges. In a sense, we put *S&T at the core of societal evolution*, or to say the least we do not conceive any transformation without them playing a significant role, and this is also why we think they should rescue us from all disasters, even those provoked by ourselves.

This is ironical, since science and technology (S&T) have been not only central to the development model followed by human societies in the last centuries but often (still today) very effective instruments of mass destruction, environmental degradation and social exclusion. *S&T have been definitely part of the problem*, a key component of our model of economic development, and not only an exogenous factor as considered by mainstream economics, which anyway recognize their crucial role to improve productivity and sustain long-term growth. But they are also deeemed to be the core of the solution, a paradoxical vision grounded in the mentioned beliefs, and in the idea that finding a technical fix is a good way to avoid the less comfortable question of how power and wealth are distributed in society and with what consequences.

Of course, the essential role of S&T cannot be denied. On the contrary, in their capacity to shape human perceptions their role is even greater than their actual abilities to change our relationship to nature. But are not we being unrealistic in expecting them to solve every relevant challenge?

FACING THE CHALLENGES

Let us have a quick look at how S&T are used, intentionally or not, in human responses to some of the large-scale challenges that we face today: global governance, economic growth, social inequality and environmental challenges.

Regarding governance, let us recognize first that there is a strong historical record to state that one of the primary uses of S&T (and in many cases the driver itself of their development) has been their capacity to provide more effective instruments of destruction to fight wars against other humans. Is it so different today? Could we ensure that further S&T developments are building up peace and preventing wars?

Of course the answer is complex and mixed, but the latest technologies have definitely been used to redefine warfare in a double way: by limiting almost to zero the losses of tech-savvy armies (to conciliate public opinions in Western countries), and by pretending a high precision in killing only the „bad guys". But instead of deterrence of wars, the effect has been to relegitimate them after the fiasco of Vietnam (and actually that was the political intention). So, has this been good to build up a peaceful global governance or rather a sure bet for further violence and destabilization?

Also, along with deep demographic trends like the progress of literacy and the change in status of women, S&T have contributed to make people more autonomous and more connected, and therefore to increase the complexity and uncertainty of our societies: now, everybody could be the initiator of a trend of worldwide impact, and we are getting farther and farther away of what could be a „controllable system" [19]. That could be good news, and in a boast of technnological optimism we could even imagine that this would bring us to a new era of planetary „collective intelligence" ([1], [24], [28]) but for the time being this is still just an aspiration and not yet an effective tool of governance. It is pretty clear that S&T could contribute to build new, higher ways of governance but this would require both a re-examination of their role and a long road of collective learning.

Regarding economic growth, mainstream economics expects S&T to deliver „external" shocks in order to produce high growth rates which are needed to keep the system running, but is that what really happened in the last decades? This is a controversial topic, and different types of evidence could be found, but it seems pretty clear that S&T, and in particular information and communication technologies (ICT), have been central to the ultra-sophisticated financialization of the economy and the artificial, debt-driven growth model in which we have been living. Further progress in S&T is now subject to an *endless stream of speculative bubbles* on financial markets [20]. Their logic is short-term obsession, to cash in now on future and fully uncertain realizations of innovative ideas, which is a good recipe for inflating an already huge amount of fictitious capital and actually preventing that enough investments are made at the right pace over enough time to ensure that the benefits of S&T are reaped for the common good. S&T could be part of a sustainable model of development but not in the way their relationship with the economy works today.

Regarding social inequalities, the role of S&T is definitely ambiguous. Yes, the benefits of knowledge can be distributed evenly, but they can also be used to concentrate more power and wealth in few hands. This is what typically happens in activities with high network externalities, like software business or the commercial exploitation of telecommunications and the internet, and so are created private monopolies like Microsoft, Google or Facebook. And last but not least, S&T will certainly be fundamental to address the environmental challenges but today this is not what we are using them for, or only in a marginal way. Instead, they are used to produce a continuous flow of new and more things, in disregard of the many environmental threats this creates. Our culture praises innovation, a magic word omnipresent in our mass media, but it generally translates to a high-speed consumerist stream of instantly obsolete artifacts for which we put in danger the supply of rare earth minerals [29] while it is the fuel of wars being fought in Africa. And on a larger scale, we consistently ignored over the last decades the opportunity to increase resource productivity [30], because our policies ensured that wasting non-renewable resources imported from the other side of Earth makes more economic sense than using the potential of local labour.

FRAMING S&T IN SOCIETY

All in all, increasing our knowledge and applying it into new artifacts have for sure a strong potential to benefit humankind, but the processes and rules through which scientific discoveries and technological innovations are promoted and produced are not neutral at all. It is legitimate to ask on which factors does it depend that S&T could contribute *to overcome or to aggravate the challenges* we face [18]. Of course this question has much to do with the key players in the domains of scientific research and technological innovation. Under the dominant view of who should have the leading role in the evolution of society, we almost forgot that the state has been the most consistent player in research and innovation, with a unique capability to mobilize and orient public and private efforts through its multi-faceted capacities: as the nº 1 client in every country and as such able to drive large-scale innovative demand, as the regulator pushing companies to invest heavily in R&D effort (f. i. in pharma and biotech sectors) and, not the least, as an entrepreneur able to bear the burden of uncertainty and long-term planning much better than private corporations [15]. In the last decades we have been unlearning this historical experience and vision acquired in the second half of 20th century [5] which was so successful in the USA and other countries to produce a long-term gigantic leap forward.

As a consequence of relying more and more on private initiatives, the agenda of S&T itself is deeply changed. While the public agendas of research and innovation include „societal challenges" as part of their targets (as f. i. in the Horizon 2020 programme of the European Union), most of the innovation really happening is driven not by the type of concerns exposed above, but by the existence or not of short-term profitable demand which businesses could exploit (as is coherent with their logic). And if the demand does not exist yet, it is created by bubbles of speculative investments and the pressure of fashion.

In this context, a very specific role is being played by ICT, for most simply a synonym of „technology", the paradigm since the 1980 s of technological innovation „changing the world". No doubt, their impact is huge, but do we fully understand it? And do we harness it for the common good? Nothing is less sure. The digital industry is brilliant in producing a succession of fast-moving *rhetoric waves* which are tuned to our most irrational beliefs in the omnipotence of S&T. For instance, intangibility and dematerialization are used as a call to get free from limits, as is implicit in terms like „zero cost" or the „cloud", while this is made of huge material infrastructures and, of course, we still are physical beings living in a physical (and finite) planet with physical costs. A different, real kind of dematerialization should certainly happen, enabling human development to be free from the accumulation of material artifacts, but this is not what the digital industry is doing.

And the disruptive power of digital technologies is often used as well to change the social fabric by pretending a capacity to reduce costs (cf the illusion of „zero marginal costs") while they actually change the structure of prices, i. e. the distribution of power. So for instance taxi drivers, presented as if they were abusing of a monopolistic position, are in risk of dispossession by Uber, which intends to avoid the full costs of transport (including social charges and the fulfilment of public regulations) in order to create a new brand, not a publicly owned service but, this time for good, a private monopoly. Yes, the „sharing economy" could be real and full of hope for humanity [12], but using that label as a mechanism to create capital accumulation in monopolistic hands is simply a false metaphor and a fraud.

Moreover, digital innovation is increasingly focused on the *disposability of humans*, on replacing them by automated machines, potentially threatening every single job on Earth, skilled or not, up to that of President of the USA for which the IBM Watson software has been proposed, and the campaign is not a joke. Even analysts of stock markets are at risk of being replaced by automated machines in the ultimate self-devouring pirouette of financial capitalism [21], pointing to the true dystopia of a world owned by the happy few and operated by machines, while the 99% of us would have to struggle for the crumbs. Instead of falling into the messianic *illusion of „digital solutionism"*, we should pay serious attention to how it is practiced today and to its contingent nature ([14], [17]), since it could pave the way to full dehumanization, „technolitarian" futures in which human and environmental purposes would be secondary to the logic of technological innovation. „Transhumanism" and the quest for „singularity" are examples of an arrogant techno-utopianism full of metaphoric promises which are just vaguely related (or not at all) to the challenges mentioned above and could instead aggravate the risks of collapse.

When facing this contradiction between the potential benefits of innovation for humanity and its practical outcomes, one cannot help remembering TS Eliot, as he asked almost a century ago where is the knowledge lost in so much information and, worse, where is the wisdom lost in so much knowledge. Drowned as we are by an endless deluge of gossip, our minds get lost in the „trending topics" of the day and thinking in perspective becomes extremely difficult: if we connect to everyday reality we are not able to think; if we disconnect from it, will our thinking be valuable or even heard? Of course alternative thinking exists and is probably richer and stronger than ever but we do not pay much attention to it. We live in a constantly accelerated time [25] and we are not so interested in learning relevant knowledge when it is contrarian to the high-speed mainstream. Conversely, we are able to unlearn easily some wise lessons acquired at high cost in the past (f. i. that of a strong regulation of financial markets). And while the active participation of stakeholders (actually, the whole planet) would be key to reap the benefits of S&T for the common good in an „innovation democracy" [27], we look at what happens as if it was a show. Debord was right, we live in the „société du spectacle" and thus in a *gridlock of thinking*, in which our lives are entertained as much as to block genuine humanity [22] and to avoid a real impact of modern art and creation on our conformist mass-media culture.

The combination of scientific knowledge and technological sharpness has a strong generative capacity, which could lead either to old-fashioned accumulation in very few hands or to the emergence of vibrant ecosystems for the benefit of sustainability and diversity of humankind. But right now innovation is obsessed with speculation, not driven by societal challenges, focused on „solutionism" rather than on specific contexts and produced without the stakeholders. So, we cannot take for granted that it will drive our course away from socio-ecological disasters. It could be (it is right now) doing the opposite. Overcoming this situation requires making explicit the processes, rules and motivations driving S&T, as an expression of our social organization, and developing the appropriate conceptual framework and criteria to assess the relevance of new inventions for the course of humanity.

A COMPLEX VIEW OF SOCIETY AND ITS BLIND SPOTS

Society is a complex system of systems in which a multitude of autonomous agents, individuals and organizations, play a central role. It is always evolving, and its evolution depends on how people live and dream for them and their children, how they are inspired and motivated, how they perceive and grasp opportunities of fulfilment and how they deal with the frustration of hard presents and uncertain futures. Neither human society nor any of its parts can be reduced to a mechanistic artifact with well-defined boundaries: they are but parts of a much more complex living system, whose meaning and purpose, yet to be resolved, may be just the persistence of life itself. And do we know enough about life to be sure that we are not destroying the very conditions of its human variant?

The more we know, the less we know. Scientific discoveries often provoke dramatic changes in the foundations of what we thought we knew. Suddenly we discover that plants have mechanisms enabling them to communicate and learn [2]. And now we know that we have a „second brain" in our stomach, hundreds of millions of neurons active in our guts amid billions of bacteria which not only do the digestive work but influence our moods and perceptions [9]. What we call the „brain" is not a biological equivalent of the central processing unit of our computers, but an extremely complex network of networks fully intertwined with our corporal ecosystem and beyond, thru the zillions of sensors which make us perceptive of our environment. Dualism, our reductionist view of mind and body, is dead for good. But now that we are getting more and more aware of the complexity of life, and of the amplitude of our ignorance, how could we claim that we live in the „knowledge society", or that we will reach it by using the current conceptual frameworks, or even that we are able to act in a way consistent with the degree of knowledge we think we have?

The more we know, the less we know. Our world is becoming more predictable and less predictable, at the same time. On one side our advances help to have a better understanding of partial phenomena and to produce sophisticated artifacts, which we design to be effective and predictable (although we succeed less and less in that). And at the same time the outcomes of our actions make the world more difficult to apprehend: the societal dynamics produce more autonomy for individuals, groups and organizations of many kinds, and the connections between them do nothing but grow. Autonomy and connections are what makes society a complex system that is much more than the sum of its parts, and as such also truly, intrinsically unpredictable, even more when we destabilize our environment beyond what it can deliver in a sustainable way. The balance between both trends, towards predictability and the opposite, is pretty obious. We who hate uncertainty, we actually excel in producing more and more uncertainty on a massive scale. As a result of our dreams coming true, we live in a small world in which the distant flap of a butterfly can produce a tornado next door, in which details and macro-behaviors are connected and the center of the world is everywhere. The more we know and act, the more uncertain is our future.

The more we know and act, the less we are able to understand and control. Fortunately, this also brings the opportunity of unexpected emergent behaviors, of new capabilities of self-organization for the sake of life [11]. And it could create as well the feeling that we are all together, of any origin, language or color of skin, in the same adventure, and that the best ideas may come, why not, from a remote place in Africa, where the whole story began. But who could ensure that our course will be happy? How could we think and work for a better future? How could we pursue any kind of relevant reflection about life, society and the future?

We could try to assume the gap between our anxiety to control and the fact that living systems are complex, autonomous, self-referring and self-constructing, but not controllable. And who said anyway that life should or could be controlled? We are emotional beings, in spite of consciousness we do not control our intelligence, which for the most of it is unconscious. Modern neuroscientists have at last rediscovered what poets know since the beginning of times: that we do not take any decision without emotions, that emotions are an integral, irreducible part of what we call intelligence [7]. But again, if the behavior of our social systems relies on human intelligence and most of it is unconscious, how could we consciously work for a better future? Let us try a crude extrapolation, the crazy hypothesis that we have *social blind spots*, which respond to deep emotions widely shared and could create, when facing the contradictions of life, the kind of hysterical behaviour which could drive us to collapse, in spite of our high degree of achievements in S&T.

Let us dare to name some of those blind spots on which we build our societal systems.

Fantasy of exclusion, denial of bonds. There is a subtle but critical difference between distinction and exclusion, which we override all the time. The first principle of social organization is still to establish who are „Us" and „Them". Heritage is still based on kinship, and we indulge ourselves with the concept of the individual as a microcosm, while alone we are strictly nothing. But of course this is useful to ground a moral superiority of „Us" over „Them" and to build up artificial boundaries, on which we practice zero-sum games, avoiding responsibility and recognition of unpaid labor and ecological externalities, on which ultimately we base exploitation of the many weak by the few strong, of helpless natural resources, of future time as the scarcest resource.

Fantasy of omnipotence, denial of limitations. Again, there is a subtle but critical difference between inquiring into our limitations and ignoring them, it is the difference which separates art and science, on one side, and the bulimia of instant consumerism and void entertainment to death. While in our natural instincts for drink, food, sex and fertility, sufficiency is the rule (and excess is a sign of disorder), we are insatiable in looking for material gratification at a growing speed and we feed with it our weird dreams of unlimited growth, control over the universe and insane eternity.

Fantasy of measurability, denial of complexity. The obsessive act of measuring embodies our values much better than our public discourse. When we strive to translate everything into quantitative figures, we forget that life at large but also the value of ecosystems or the performance of human organizations are complex, diverse, infinite-dimensional realities, so that they are not commensurable with a scalar, one-dimensional magnitude, whatever it is. In spite of that, we try to reduce the value of companies or the ecological impact of our actions to money, and the welfare of nations to GDP. Somehow, we have not yet abandoned the habits of slavery, when we used to do the same with humans.

Fantasy of capital, denial of potential. A prosperous future is of course built on the best we can get from past generations, infrastructures and resources, and especially the non-computable: cultural and artistic heritage, scientific knowledge, institutions and „social capital". But at a point capital can disconnect from the productive economy and from reality itself, when it becomes a pure abstraction in computerized systems where it reproduces itself in a fictitious way without the backing of any human labor creating authentic value. At that point we start taking for granted that the past should have greater rights than the future, because the yields of fictitious capital absorb more and more resources and finally inhibit the potential for further progress, until overwhelming debt is simply repudiated, as it happens once and again.

Fantasy of power, denial of learning. Entitled by tradition or as a reward to the heterogeneous distribution of skills and capacities, we accept the existence of inequalities and hierarchies, and the right of a minority of people to take decisions on behalf of the rest, even in the most democratic of regimes. In many senses this is a practical solution to organize societies, until power forgets the contingent nature of its position, originated in history and certainly some capacity and tenacity but also pure chance, and maitains itself over time through self-preservation and inheritance. At that point, power becomes „the ability not to have to learn anything" [26].

Fantasy of certainty, denial of time. Our imagination is the most powerful of tools but when coupled with fear, it makes us hate the uncertainty of future, as much as we avoid the certainty of our own death. So it is no surprise if we appreciate so much the determinism of classical mechanics and its capacity to predict, which we would like to imitate in every other discipline, and in particular in economics. And looking for relief we implicitly assume, as a social taboo of our time, that money cannot lose value, that it has a natural right to reproduce itself whatever happens to society, whereas the second law of thermodynamics ensures that value does nothing but erode with time, unless we learn and work to create new possibilities.

Needless to say, the understanding of distinctions, the impetus to overcome (not override) our limitations, the capacity to measure, the accumulation of useful assets, the organisation of society and the will to create some certainties are valuable drives without which social life would simply be a nightmare. But they easily fall into the blind spots we have described because these are deeply rooted in our many fears, the fear of pain and hardship, the fear of loneliness and irrelevance and of course the ultimate one, „the fear to rule them all and in the darkness bind them", that of our sure death. We feel that we are increasing the contradictions between our human drive and the future of life as a whole, on a planet whose biophysical limits have been reached, whose climatic stability is endangered by human activity, whose living and mineral resources are being exhausted at great pace, all of that without eliminating human hardship. And afraid as we are of this permanent conflict with the world, we invent self-delusions to alleviate our fears. We observe social status and practice individual accumulation to protect ourselves not from need but mainly from the feeling of personal irrelevance and the anxieties we face everyday in our eternal quest for meaning. And we rely on S&T to imagine a future of omnipotence where all challenges would be solved. Is that the right response to our fears?

FOUNDATIONS OF A NEW FRAMEWORK

We cannot take for granted that S&T will necessarily drive our course away from socio-ecological disasters. On the contrary, as they are mainly practiced today, they could pave the way to „technolitarian futures" in which human and environmental purposes will be secondary to the fulfillment of the current logic of technological innovation. „Digital solutionism", „transhumanism" and the quest for „singularity" are just examples of a techno-utopianism full of metaphoric promises which is not connected properly (or not at all) to the challenges mentioned above and could instead aggravate the risks of collapse. In view of the simultaneous growth of inequalities and unsustainabilities in the last decades, who could ensure that S&T developments will prevent a dystopia like that of the movie „Elysium" [4]?

Overcoming this situation requires building a different conceptual framework, starting by recognizing that we live in a *complex system of systems* which pertains to the domain of „post-normal science" [8], which means that *uncertainty* about the future is not a limitation of our knowledge but an intrinsic and irreducible characteristic we cannot escape (fortunately). And the challenges we face to avoid collapse are themselves complex, multidimensional and incommensurable and they need new ways of coordination, involving all kinds and dimensions of human intelligence, both individual and collective. For that we need the holistic paradigms of 21st century science [10], in order to acquire a higher level of consciousness. Our proposal is that new processes have to be created to assess the role of S&T in society in a participatory way, driven by true societal challenges and with the active involvement of all stakeholders, to address the impact of S&T in the most comprehensive way, not only for citizens but also for living beings and the planet at large.

In order to do so, the social blind spots mentioned above have to be taken into account. The way out of them is still unknown, „one makes the way by walking", but some principles and rules can be proposed to illuminate how to advance step by step. One is that, at the level of complexity of societal life, ontology (what things are), epistemology (how we understand them) and ethics (how they should be) are not separate but inevitably entangled [13]. Another principle relevant for the future of S&T could be that of *Material Sufficiency and Exuberant Creativity,* which is exactly what life teaches. Instead of dreaming with omnipotence and applying innovation to produce more artifacts, we could realize there is one unlimited game to which we can direct our human drive in harmony with the environment, that of learning and experiencing together in the infinite variety of disciplines of knowledge, of sports and crafts, of art and science, of beauty and truth. Unleashing human potential is another way of ensuring the universal right to beauty while avoiding burning the planet. And if we were able to transform education away from reproducing social hierarchies and selecting narrow elites towards the realization that everybody has the same right and obligation to achieve personal fulfilment, it could lead us to a *World of Symmathesies,* to use a term recently invented to think beyond individuality and exclusion, to emphasize that there is no difference between living and learning, that we are always experiencing contextual mutual learning through interactions [3].

Of course that would be part of a bold claim, that of *Opening the Space of Possibilities*. Instead of suffering from our limitations, we should realize that what binds us to others, human or not, is also what makes us free, what opens new possibilities for desirable futures [6]. The obligation to do good is not separate from recognizing the complexity of life and our connection to every other part of the universe, exactly the contrary of exciting the bulimia of individualism which is so frequently associated to modern innovation. These could be some of the starting points to rethink the role of S&T in society and to ensure that, out of the many gridlocks into which we are entangled today, we could bifurcate towards more holism and richness, co-creating with citizens of all over the world, through a combination of top-down, bottom-up and cross-generational approaches without which no future will be desirable.

CONCLUSION

The paradox is that while we praise so much, and for good reasons, the achievements of science and technology, their role in society is definitely ambiguous, due to the same blind spots which drive our perception of what societal life is. In view of the challenges we face, most of them created by ourselves, we are entitled to ask if we understand that there is no difference between living and learning, if we are not committing suicide of the human species at the same time that we destroy many others, and in the end, if bacteria are not more resilient and therefore more intelligent than humans. To give hopeful answers to these questions, the processes, roles and outcomes of S&T have to be fundamentally reassessed, to ensure that societal evolution continues towards desirable futures.

REFERENCES

[1] Attlee T. (2008) „Collective Intelligence: Creating a Prosperous World at Peace". Earth Intelligence Network.
[2] Baluska F., Ninkovic V. (2010) „Plant Communication from an Ecological Perspective". Springer.
[3] Bateson N. (2015) „Symmathesy, A Word in Progress. Proposing a New Word that Refers to Living Systems". Private communication.
[4] Blomkamp N. (2013) „Elysium". Movie featuring Matt Damon, Jodie Foster et al. TriStar Pictures.
[5] Bush V. (1945) „Science, the Endless Frontier". US Govt Printing Office.
[6] Ceruti M. (2004) „Taches aveugles, écologies du changement, dynamiques d´auto- organisation". Conférence ACX-APC & AFSCET, Paris, Campus Jussieu, 26/10/2004.
[7] Damasio A. R. (2005) „Descartes´ error: Emotion, reason and the human brain". Penguin.
[8] Funtowicz S., Ravetz J. (1993) „Science for the Post-Normal Age". Futures, volume 25, number 7, September 1993, 739–755.
[9] Gershon M. (1998) „The Second Brain". Harper.

[10] Healey R. (2009) „Holism and Nonseparability in Physics". Stanford Encyclopedia of Philosophy, Stanford University.
[11] Jantsch E. (1980) „The Self-Organizing Universe. Scientific and Human Implications of the Emerging Paradigm of Evolution". Pergamon Press.
[12] Kostakis V., Bauwens M. (2014) „Network Society and Future Scenarios for a Collaborative Economy". Palgrave Pivot.
[13] Kunneman H. (2010) „Ethical Complexity" in „Complexity, Difference and Identity: An Ethical Perspective" (Cilliers P., Preiser R., editors). Springer.
[14] Lanier J. (2010) „You Are Not a Gadget". Penguin Books.
[15] Mazzucato M. (2013) „The Entrepreneurial State: Debunking public vs private sector myths". Anthem Press.
[16] Meadows D. et al (1972) „Limits to Growth. Report to the Club of Rome". Signet, 8th edition.
[17] Morozov E. (2013) „To Save Everything, Click Here". Penguin Books.
[18] Muñoz E. (2009) „The Science Policy Crisis: Degenerative pathologies and regenerative therapies". Arbor, CLXXXV 738, 837–850.
[19] Naim M. (2013) „The End of Power". Basic Books.
[20] Pérez C. (2002) „Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages". Edward Elgar Pub.
[21] Popper N. (2016) „The robots invading Wall Street". The International New York Times, 27/2/16.
[22] Postman N. (2005) „Amusing Ourselves to Death: Public Discourse in the Age of Business". Penguin Books.
[23] Richta R. et al (1966) „Civilization at the Crossroads: The Social and Human Context of Scientific-Technical Revolution". International Arts and Sciences Press, 3rd edition.
[24] Rodríguez M. A. (2004) „Advances Towards a Societal-Scale Decision Support System". University of California at Santa Cruz.
[25] Rosa H. (2005) „Une critique sociale du temps". La Découverte.
[26] Schein E. H. (2002) „The Anxiety of Learning". Interview by Diane L. Coutu. Harvard Business Review, March 2002, 100–106.
[27] Stirling J. D. (2014) „Towards innovation democracy? Participation, responsibility and precaution in the politics of science and technology". UK Government Office of Science.
[28] Sunstein C. R. (2008) „Infotopia: How Many Minds Produce Knowledge". Oxford Univ Press.
[29] Valero A., Valero A. (2015) „Thanatia. The Destiny of the Earth´s Mineral Resources". World Scientific.
[30] Weizsäcker E v. et al (2010) „Factor 5: Transforming the Global Economy through 80% Improvements in Resource Productivity". Routledge.

Nebojša NEŠKOVIĆ*

IMPORTANCE OF BASIC RESEARCH FOR TECHNOLOGY ADVANCES

Abstract: This paper is devoted to the importance of basic research for advancement of applied research, innovation and technology. Transfer of new knowledge along the chain of research and development is often successful only if it includes direct interactions of well-trained scientists and engineers all along the chain. However, the primary responsibility for advancement of basic research lies with the scientific community. The essence of basic research will be illustrated with the brief descriptions of two theories. The former theory is the astronomical theory of climate change, developed by Milutin Milanković. It has had a paramount importance for development of astronomy and physics. The latter theory is the theory of crystal rainbows, developed by us following the research desire of the former theory's author.

Key words: *Basic research, climate change, crystal rainbows*

INTRODUCTION

The subject of this paper is the role of basic research in advancement of applied research, innovation and technology. The importance of this role will be explained in the second section of the paper. Then, in the third and fourth sections of the paper, we shall illustrate the essence of basic research with the brief descriptions of two theories. The former theory is the astronomical theory of climate change, which provides a description of the long-term climate change in time on each planet of the solar system, caused by the change of its position relative to the Sun. The latter theory is the theory of crystal rainbows. It enables one to explain the rainbow effects appearing in propagation of charged particles along crystal channels and nanotubes, which are analogous to the meteorological rainbow effect, occurring in scattering of sunlight from water droplets. The former theory is much more general than the latter one and has had a paramount importance for development of astronomy and physics. The latter theory was developed following the research desire and determination of the former theory's author — to find an uninhabited area and

* Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

acquire a humble scientific property. In the fifth section of the paper, we shall draw several conclusions from the discussion in the previous sections.

RESPONSIBILITY FOR BASIC RESEARCH

As it is well known, basic research is theoretical and experimental activity undertaken with the aim to advance knowledge without a specifically envisaged application in practice [1]. It is the exploration of the unknown. There is no clear dividing line between basic and applied researches. In fact, they are inextricably intertwined. Most of research, whether in academia or in industry, is a combination of new knowledge generation and its subsequent exploitation. Usually, if the extent of basic research is diminished, the same will happen to the results of applied research. The ideal situation is to have strong basic research and strong applied research that are strongly interconnected.

New knowledge is essential for fostering innovation, technology and production, but also as a stable foundation of education and training as well as of other activities that should contribute to development of a society [1]. It is sometimes naively argued at a national level that, since we live in a global society, investment in science should be concentrated primarily on applied research, with the necessary basic scientific information acquired indirectly, *e. g.*, via the internet. However, new knowledge is more than a set of results of basic research. It also includes developed cognitive capabilities of the involved teams of scientists. Therefore, transfer of new knowledge along the chain of research and development is often successful only if it includes direct interactions of well-trained researchers and engineers all along the chain. There have been numerous examples in which the objective of a crucial scientific experiment was attained only upon the realization of a severe technological requirement.

One of the necessary conditions for sustained growth and inclusive development of a country is to have a thriving scientific community capable of generating new knowledge and using it [1]. This condition can be met only with an appropriate strategy of scientific and technological development complemented with an adequate long-term investment plan, which must be applied consistently and continuously, even in the periods of economic crises.

But how will the government of a country make an appropriate strategy of basic research and the corresponding long-term investment plan? It can do that only on the basis of proposals made by the scientific community of the country, *i. e.*, by its independent scientific institutes and such institutes within its universities and industry. This means that the primary social responsibility for maintaining, actualizing and enhancing basic research lies with the scientific community individually and collectively, *i. e.*, with those who have committed themselves to the exploration of the unknown. This includes the responsibility of scientific institutes in the country to communicate and collaborate with each other as well as with similar institutes in other countries worldwide.

ASTRONOMICAL THEORY OF CLIMATE CHANGE

The astronomical theory of climate change was formulated by Milutin Milanković, a Serbian astronomer, climatologist and geophysicist. He was born in 1879 and died in 1958. The idea from which that mathematical theory emerged was to connect the motion of a planet around the Sun with the long-term change of its climate [2–5]. He used the theory, which is known as the Milanković theory, to predict the present climate conditions on Mars, Venus and Mercury as well as on the Moon. These predictions have been proven. But, his most important contribution was the explanation of the glacial and interglacial periods within the present ice age on the Earth, on the basis of the calculations of the insolation variations at the geographical latitudes at 55, 60 and 65 north in summer for the past 1 million years.

Milanković began his work with a detailed analysis of the components of the Earth's motion, which is governed by the gravitational forces it experiences from the Sun, the other planets of the solar system and the Moon. These motions are: (i) the revolution of the Earth around the Sun, (ii) its rotation around the axis defined by the north and south poles, and (iii) the nutation and precession of its rotational axis. His attention was concentrated on the cyclical characters of those motions. As a result of existence of these cycles, the Sun's radiation reaching the Earth's surface varies, inducing the change of its climate, and, thus, impacting the advance and retreat of the ice sheets on the surface.

The Earth revolves around the Sun along an elliptical orbit. This is shown in Fig. 1. Looking from above the orbit, the revolution is counterclockwise. The average distance of the Earth from the Sun is about 150 million km. It moves along the orbit with the speed of about 30 km/s and makes a revolution in about 365 days. The eccentricity of the orbit is the relative difference between the largest and smallest distances of the Earth from the Sun. The larger the eccentricity, the orbit is more like an ellipse, *i. e.*, less like a circle. The eccentricity changes between 0 and about 5% with a cycle of about 95,000 years. Today, the eccentricity equals about 2%.

With respect to the Sun and in average during the year, the Earth rotates once in 24 hours. This is illustrated in Figs. 1 and 2. Looking from above the Earth, the rotation is counterclockwise. The Earth's rotational axis is tilted from the normal to the plane of the orbit. The nutation of the rotational axis, in

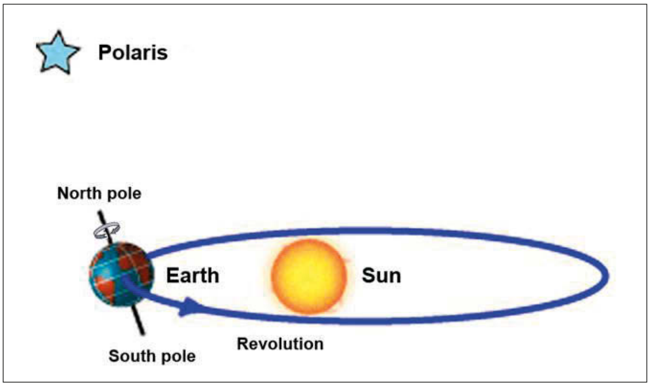


Figure 1. Illustration of the Earth's revolution around the Sun and of its rotation around the axis defined by the north and south poles. Currently, the rotational axis is very close to pointing toward Polaris.

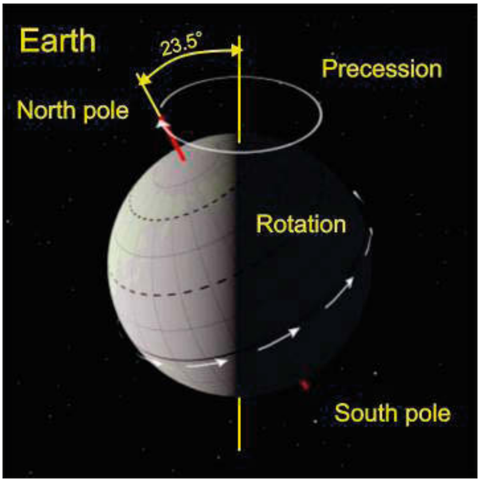


Figure 2. Illustration of the Earth's rotation around the axis defined by the north and south poles and of the precession of the rotational axis. Currently, the rotational axis is tilted from the normal to the plane of the orbit for 23.5°.

which its tilt angle changes, goes on between 22.1 and 24.5° with a cycle of about 41,000 years. Today, the tilt angle equals 23.5°. The precession of the rotational axis goes on in a way that the axis traces a circle on the celestial sphere determined by the positions of the stars Polaris and Vega. Looking from above the Earth, the precession is clockwise. The cycle of this motion is about 26,000 years. Today, the rotational axis is very close to pointing toward Polaris.

Thus, if the eccentricity of the Earth's orbit and the position of its rotational axis at a moment in the past or in the future are known, the Milanković theory enables one to determine the temperatures at that moment at various points on the Earth's surface. It should be noted that we live in an interglacial period that began about 12,000 years ago and belongs to the ice age that started about 2.6 million years ago. The previous glacial period started about 110,000 years ago. It has been anticipated that the next glacial period will not began in the forthcoming about 50,000 years [6].

The first proof of the Milanković theory was obtained in 1976, within a project in which the sediments at the bottom of the Indian Ocean were analyzed [7]. The research team of the project concluded that over the past 500,000 years, the climate on the Earth had changed depending on the position of its rotational axis. That happened 18 years after his death. Among other things, it was shown in 1999 that the variations in the isotopic composition of oxygen in the ocean bottom sediments follow the Milanković theory [8]. Today, it is accepted that the astronomical factors play the key role in the climate change on the Earth.

THEORY OF CRYSTAL RAINBOWS

Each of us has seen many times a rainbow in the sky, coming after the rain. This is a part of the meteorological rainbow effect, which occurs as a result of scattering of sunlight from the water droplets that remained in the air [9]. Which are the main characteristics of this effect? Usually, one observes a bright circular line at an observation angle of 42°, separating the bright and dark regions below and above it, respectively. This is the principal primary rainbow, which occurs as a result of one reflection of sunrays within the droplets. It is accompanied with several bright lines on its bright side, which appear as a result of interference of the sunrays generating the primary rainbow. These are the supernumerary primary rainbows. Sometimes, one can see another bright circular line, at an observation angle of 50°, separating the bright and dark regions above and below it, respectively. This is the principal secondary rainbow, which occurs as a result of two reflections of sunrays within the droplets. The circular shape of the rainbows is attributed to the spherical shape of the droplets. It should be noted that sunlight is polychromatic. This means that its different components, having different colors, refract for different angles at the droplet boundaries. As a result, instead of one principal rainbow and its supernumeraries, one sees a composition of violet, blue, green, yellow, orange and red principal rainbows and their supernumeraries. In other words, if sunlight were monochromatic, *e. g.*, if it had red color, one would see only a red principal rainbow and its red supernumeraries.

Rainbows also occur and play important roles in nucleus-nucleus collisions, in atom or ion collisions with atoms and molecules, in electron-molecule collisions, in atom, ion or electron scattering from crystal surfaces, and in ion or positron channeling in crystals or nanotubes.

Let us now concentrate on the last of the above mentioned cases, in which ions or positrons are transmitted through axial crystal channels or nanotubes. But what is a crystal? What is an axial channel? A crystal is a three-dimensional periodic arrangement of atoms. However, the crystal can also be viewed as a two-dimensional periodic arrangement of atomic strings, being parallel to each other. In this case, the part of the crystal in between the neighboring strings is called an axial channel. It was discovered in 1963 that an ion can long move through the channel, staying close to its axis [10]. This motion is called ion channeling.

The rainbow effect in ion channeling was predicted by us in 1983 during a longer stay in the Oak Ridge National Laboratory, Tennessee, USA [11, 12]. Soon after that, it was experimentally observed in the same laboratory [13, 14]. For us, who sincerely believed in the research desire and determination of Milutin Milanković, that event meant the finding of an uninhabited area in the field of condensed matter physics. We decided to try to inhabit it and acquire a humble scientific property. As a result, about 14 years after that, a group from the Vinča Institute of Nuclear Sciences, Belgrade, Serbia, led by us, formulated the theory of crystal rainbows [15, 16], which has proven to be the proper theory of ion channeling in crystals [17, 18]. The idea from which that mathematical theory emerged was to analyze in detail the mappings of the initial ion transverse position plane to the final transverse position plane or the transmission angle plane.

We have used the theory of crystal rainbows to explore in detail the classical and quantum mechanical propagations of ions and positrons along axial crystal channels and nanotubes. Among other things, we have shown that crystal rainbows can be used to extract from high-resolution experimental results very accurate information on the forces acting in the channels. The approach was morphological — we assumed that the crucial information on those forces was embedded in the shapes of crystal rainbows. Figure 3 gives the high-resolution experimental angular distributions of protons of energies of 2.0, 1.5, 1.0 and 0.7 MeV transmitted through a 55 nm thick (100) silicon crystal, obtained at the National University of Singapore, together with the associated rainbow patterns, generated using the theory of crystal rainbows [18]. The incident proton beam radius was about 0.5 mm. In

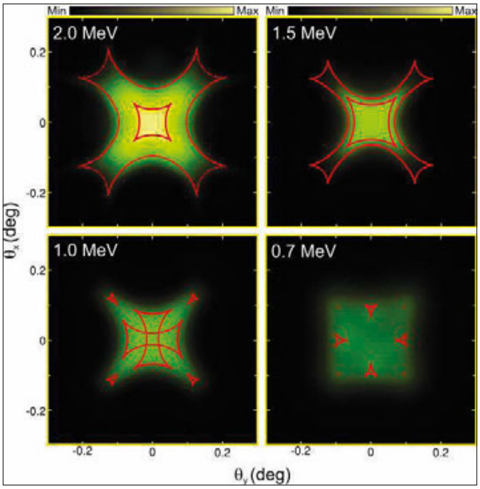


Figure 3. Experimental angular distributions of 2.0, 1.5, 1.0 and 0.7 MeV protons transmitted through a 55 nm thick (100) silicon crystal and the associated theoretical rainbow patterns (red lines).

order to perform the experiment, it had been necessary to develop the method of making ultrathin silicon crystals with negligible surface roughness, the method of preparing submicrometer proton beams, and the method of producing highly-sensitive scintillator screens. For an energy of 2.0 MeV, there are two rainbow lines, a cusped square and a line with four pairs of cusps, and the situation is similar for an energy of 1.5 MeV. For an energy of 1.0 MeV, there are two crossed cusped rectangles and four cusped isosceles triangles, while for an energy of 0.7 MeV, there are four cusped isosceles triangles and four points. The symmetry of all these patterns is explained by the square symmetry of the channel under consideration. In all these cases, the inner side of each rainbow line is the bright side of the rainbow while its outer side is the dark side of the rainbow. It is clear that the theoretical patterns fully determine the experimental distributions — they appear as the „skeletons" of the distributions. That agreement was reached after a careful adjustment of the parameters of the forces acting in the channels, the result being a precise extraction of these parameters from the experimental results.

We have also found that a proton beam entering an axial crystal channel can be focused to a radius of several picometers, *i. e.*, considerably below that of an atom [19–21]. The effect, designated as the superfocusing effect in ion channeling, occurs when a rainbow line, defining the beam, reduces to a point. Thus, if a foreign atom is inserted in the channel, one can use the superfocused beam to probe it. This is illustrated in Fig. 4. The scanning of the interior of the foreign atom is performed by changing the beam incident angle. This idea is the basis for possible development of a measurement technique with subatomic resolution — the rainbow subatomic microscopy. The technique could be used for more precise measurements of atomic and nuclear reactions than so far and, consequently, for deducing detailed new information on atomic and nuclear structures. However, its practical realization requires a lot of additional research and development. On the other hand, if the technique is successfully carried out, one will also obtain a well-developed method of preparation of picometer ion beams, to be employed in other fields.

And what are nanotubes? They can be described as the sheets of atoms rolled up into cylinders. They were discovered in 1991 [22]. Nanotubes have remarkable physical properties and have begun to play an important role in the field of nanotechnology. It was predicted that they could be used to channel positively charged particles [23]. Upon that, we have used the theory of crystal rainbows to show that rainbows occur in ion channeling in nanotubes as well [24]. In one of our studies, it was shown that a carbon nanotube of a length of 7 mm could ensure the effective bending of the proton beam of an energy of 1 GeV for an angle of 0.25 mrad [25]. It must be emphasized that the bending power of such a nanotube coincides with that of a dipole magnet with the magnetic induction of 330 T. This means that it is about 40 times higher than the bending power of the superconducting dipole magnets within the most powerful accelerator in the world, the Large Hadron Collider, in the European Organization for Nuclear Research (CERN), Geneva, Switzerland. Thus, in principle, it is possible that very small and cheap passive elements composed of nanotubes substitute very big and expensive dipole magnets within accelerator facilities. However, experimental investigations of ion channeling in nanotubes are still in the initial phase, and one cannot anticipate if and when this exciting prediction will be realized in practice.

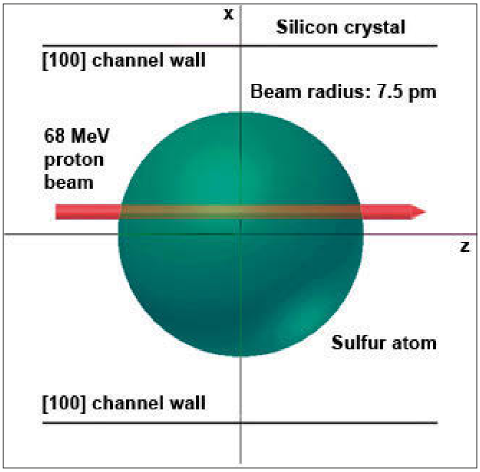


Figure 4. Illustration of the interaction of the 68 MeV superfocused proton beam with a sulfur atom inserted in a [100] crystal channel. The beam radius is 7.5 pm.

Let me also mention our investigations of quantum rainbows occurring in positron channeling in carbon nanotubes [26, 27]. As the rainbows occurring in scattering of sunlight from water droplets, a quantum rainbow is composed of the principal and supernumerary rainbows. We have disclosed and described a full quantum mechanical mechanism of generation of these rainbows, which comprises the effects of wave wrinkling, concentration and coordination.

CONCLUSIONS

It has been said here that new knowledge is essential for fostering innovation, technology and production, but also as a stable foundation of education and training as well as of other activities that should contribute to sustained growth and inclusive development of a country. However, it is more than a set of results of basic research. It also includes developed cognitive capabilities of the involved teams of scientists. We have concluded that the government of a country can make an appropriate strategy of basic research and the corresponding long-term investment plan only on the basis of proposals made by the scientific community of the country. This means that the primary social responsibility for maintaining, actualizing and enhancing basic research lies with the scientific community — individually and collectively.

We have demonstrated the essence of basic research with the brief descriptions of the astronomical theory of climate change and the theory of crystal rainbows.

The former theory is valid on the planetary level — it provides a description of the long-term climate change in time on each planet of the solar system. The latter theory is applicable on the atomic level — it enables one to explain the rainbow effects appearing in propagation of charged particles along crystal channels and nanotubes. The former theory has had a paramount importance for development of astronomy and physics. The authors of the latter theory were among those inspired by it. The two theories have been chosen to be presented here since they have one thing in common — they represent the exclusive scientific properties of their authors acquired on the previously uninhabited areas.

ACKNOWLEDGMENT

We acknowledge the support to this work provided by the Ministry of Education, Science and Technological Development of Serbia through project *Physics and Chemistry with Ion Beams*, No. III 45006.

REFERENCES

[1] International Council for Science Position Statement: „The value of basic scientific research", December 1994.
[2] M. Milankovitch: „Théorie Mathématique des Phénomčnes Thermiques Produits par la Radiation Solaire" (Gauthier-Villars, Paris, 1920).
[3] M. Milankovitch: „Kanon der Erdbestrahlung und seine Anwendung auf das Eiszeitenproblem" (Königlich Serbische Academie, Belgrad, 1941).
[4] W. Schwarzacher: „Cyclostratigraphy and the Milankovitch Theory" (Elsevier, Amsterdam, 1993).
[5] M. Milanković: „Canon of Insolation and the Ice-Age Problem" (Agency for Textbooks, Belgrade, 1998).
[6] A. Berger and M. F. Loutre: „An exceptionally long interglacial ahead?", *Science*, Vol. 297. No. 5585, August 2002, pp. 1287–1288.
[7] J. D. Hays, J. Imbrie, and N. J. Shackleton: „Variations in the Earth's orbit: Pacemaker of the ice ages", *Science*, Vol. 194, No. 4270, December 1976, pp. 1121–1132.
[8] J. A. Rial: „Pacemaking the ice ages by frequency modulation of Earth's orbital eccentricity" *Science*, Vol. 285, No. 5427, July 1999, pp. 564–568.
[9] J. A. Adam: „The mathematical physics of rainbows and glories", *Physics Reports*, Vol. 356, Nos. 4–5, January 2002, pp. 229–365.
[10] M. T. Robinson and O. S. Oen: „Computer studies of the slowing down of energetic atoms in crystals", *Physical Review*, Vol. 132, No. 6, December 1963, pp. 2385–2398.
[11] N. Nešković: „The effect of transverse correlations in ion channeling in very thin crystals", *Oak Ridge National Laboratory Report* 6004, September 1983, pp. 203–206.
[12] N. Nešković: „Rainbow effect in ion channeling", *Physical Review B*, Vol. 33, No. 9, May 1986, pp. 6030–6035.
[13] H. F. Krause, S. Datz, P. F. Dittner, J. Gomez del Campo, P. D. Miller, C. D. Moak, N. Nešković, and P. L. Pepmiller: „Rainbow effect in axial ion channeling", *Physical Review B*, Vol. 33, No. 9, May 1986, pp. 6036–6044.
[14] H. F. Krause, J. H. Barrett, S. Datz, P. F. Dittner, N. L. Jones, J. Gomez del Campo, and C. R. Vane: „Angular distributions of ion axially channeled in a very thin crystal: Ex-

perimental and theoretical results", *Physical Review A*, Vol. 49, No. 1, January 1994, pp. 283–299.
[15] S. Petrović, L. Miletić, and N. Nešković: „Theory of rainbows in thin crystals: The explanation of ion channeling applied to Ne $^{10+}$ ions transmitted through a <100> Si thin crystal", *Physical Review B*, Vol. 61, No. 1, January 2000, pp. 184–189.
[16] N. Nešković, S. Petrović, and L. Živković: „Rainbows with a <111> Si thin crystal", *European Physical Journal B*, Vol. 18, No. 4, December 2000, pp. 553–558.
[17] M. Motapothula, S. Petrović, N. Nešković, Z. Y. Dang, M. B. H. Breese, M. A. Rana, and A. Osman: „Origin of ringlike angular distributions observed in rainbow channeling in ultrathin crystals", *Physical Review B*, Vol. 86, No. 20, November 2012, pp. 205426(6).
[18] S. Petrović, N. Nešković, M. Ćosić, M. Motapothula, and M. B. H. Breese: „Proton-silicon interaction potential extracted from high-resolution measurements of crystal rainbows", *Nuclear Instruments and Methods in Physics Research B*, Vol. 360, October 2015, pp. 23–29.
[19] Yu. N. Demkov and J. D. Meyer: „A subatomic microscope, superfocusing in channeling and close encounter atomic and nuclear reactions", *European Physical Journal B*, Vol. 42, No. 3, December 2004, pp. 361–365.
[20] N. Nešković, S. Petrović, and D. Borka: „Superfocusing of channeled protons and crystal rainbows", *Nuclear Instruments and Methods in Physics Research B*, Vol. 267, No. 16, August 2009, pp. 2616–2620.
[21] S. Petrović, N. Nešković, V. Berec, and M. Ćosić: „Superfocusing of channeled protons and subatomic measurement resolution", *Physical Review A*, Vol. 85, No. 3, March 2012, pp. 032901(9).
[22] S. Iijima: „Helical microtubules of graphitic carbon", *Nature*, Vol. 354, No. 6348, November 1991, pp. 56–58.
[23] V. V. Klimov and V. S. Letokhov: „Hard X-radiation emitted by a charged particle moving in a carbon nanotube", *Physics Letters A*, Vol. 222, No. 6, November 1996, pp. 424–428.
[24] S. Petrović, D. Borka, and N. Nešković: „Rainbows in transmission of high energy protons through carbon nanotubes", *European Physical Journal B*, Vol. 44, No. 1, April 2005, pp. 41–45.
[25] N. Nešković, D. Borka, S. Šopić, and S. Petrović: „Rainbows in channeling of 1 GeV protons in a bent very short (11, 9) single-wall carbon nanotube", *International Journal of Nonlinear Sciences and Numerical Simulation*, Vol. 11, No, 12, December 2010, pp. 1131–1143.
[26] S. Petrović, M. Ćosić, and N. Nešković: „Quantum rainbow channeling of positrons in very short carbon nanotubes", *Physical Review A*, Vol. 88, No. 1, July 2013, pp. 012902(11)
[27] M. Ćosić, S. Petrović, and N. Nešković: „Quantum primary rainbows in transmission of positrons through very short carbon nanotubes", *Nuclear Instruments and Methods in Physics Research B*, Vol. 373, April 2016, pp. 52–62.

Saša POPOVIĆ*

FINANCIAL INNOVATION AND TECH-NO-LOGICAL PROGRESS

Abstract: Technological progress can be perceived as a sequence of micro revolutions, in term of speed and scope of change produced. With such characteristics, technology constantly challenges economic and societal values. Sustainability is a dominant development paradigm of contemporary world. But policy makers at national, regional as well as global level usually overlook the fact that sustainable development assumes sustainable financing. This point is of crucial importance in order to prevent mismanagement of future economic and social development. Old financial practice cannot be appropriate response to the underlying risks.

Some globally recognized financial experts argue that financial innovation could be appropriate answer. Robert J. Shiller [1], considered radical financial innovation as „the development of new institutions and methods that permit risk management to be extended far beyond its former realm, covering important new classes of risks." This quest for radical change in financial innovation came out only four years before global financial crisis exploded, just because of „too innovative" financial product known as subprime mortgages. Thus, financial innovation has two sides — bright side is creation of new tools to mitigate risk in economic system, and dark side — potential for creation more troubles in that system.

The aim of this paper is to analyze whether financial innovation, supported by rapid technological change, mitigate the existing risks in economic and social system, or simultaneously induce new risks and potential for new financial crisis.

Main methods are studies of the available relevant literature, regulation frameworks, and the best practices which could be of use in formulating some proposals which will make products and market more safe means of value creation and distribution.

Finding of this paper confirm that there are still unidentified threats connected with financial innovation process and it's unclear influence on future economic prospects of contemporary world.

Key words: *financial innovation, technological progress, information, financial markets*

* University of Montenegro, School of Economics

INTRODUCTION

Technological progress has seen as a main driver of economic and societal development. This factor drastically changed the shape of modern societies, and contributed their global interconnectedness. That radical change affects not only societies, but also individuals, companies, governments, institutions, etc. As Lerner and Tufano [2] noted these innovations may have broad implications for households, enabling new choices for investment and consumption, and reducing the costs of raising and deploying funds. Similarly, financial innovation enable firms to raise capital in larger amounts and at a lower cost than they could otherwise and in some cases (for instance, biotechnology start-ups) to obtaining financing that they would otherwise simply be unable to raise.

Sustainable development as a dominant developing paradigm must lean on dynamic and sound financial system capable to produce sustainable finance for future economic growth. Since finance is an inevitable input for all forms of production as well as consumption, every innovation in financial sector will have direct influence on economy and society.

This paper deals with the socio-economic interpretations of interaction between the financial innovation and technological progress. Heaving in mind that both processes have their inherent positive effects on economic and societal values, here is emphasized less visible, risk bearing side of intricate interplay between finance and technology. Traditionally, profit-maximizing entrepreneurs who spring up to commercialize new technologies were considered as a main drivers of economic growth. But Levine, Laeven, and Michalopoulos [3] argue that growth is also driven by the financial entrepreneurs who develop new ways to screen and fund the technologists. So, the flow of influence between technological progress and financial innovation can be seen as bi-directional process.

Frame and White [4] in their review paper provide a survey of the literature on financial innovation, with a special emphasize on the empirical articles. They find that descriptive aspects dominate academic research on financial innovation. The authors urge financial regulators to undertake more surveys of financial innovation and to make the survey data more available to researchers in order to foster empirical research on financial innovation and to better understand its economic and social effects.

From the regulatory point of view, Lumpkin [5] argue that regulators of financial system start from a premise that financial innovation are a natural outcome of a competitive economy. They are neither inherently good nor inherently bad. Innovation have the potential to provide for a more efficient allocation of resources and thereby a higher level of capital productivity and economic growth. Many financial innovation, Lumpkin note, have this effect and for that reason policymakers may wish to adopt a positive attitude towards innovative activities; that is, to start from a presumption of benefit until detriment is proven as opposed to the reverse construction.

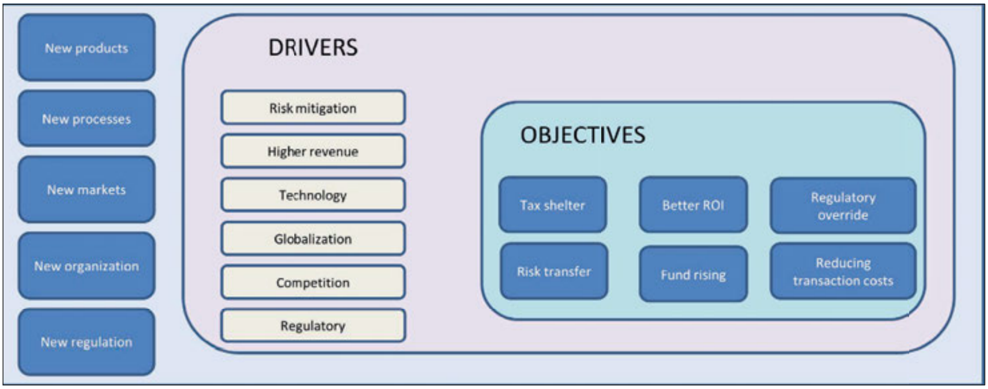
One more controversy concerning financial innovation comes from different perception regarding its place of occurrence. Some authors, led by Schumpeter, consider that the bulk of an economy's innovation was likely to occur in relatively large firms that possess significant market power (Schumpeterian hypotheses). Among other arguments, greater size of an enterprise allows it to benefit the economies of scale inherent in R&D facilities, which are necessary to yield innovations. Opposite perception comes from the Scherer and his followers who suggest that smaller firms, with (at most) only modest levels of market power, may be more likely to be rapid innovators, because of the competitive pressures that are absent in the world of monopoly.

As I noted in my earlier work [6], globalization means not only breaking barriers that lags international capital flows but also breaking ones that block transmission of financial crises. As globalization becomes more extensive, the spillover effect of the financial crisis is intensifying more than ever before. We need to rethink the hidden causes and paths of financial crises and their terrible consequences on economies and societies worldwide. Yes, the answer to this question is very close to the financial innovation and their role in creating additional systematic risk. 2008 global financial crisis raised fundamental question about the nature of financial innovation and their role in financial and economic stability on a global scale.

WHAT IS FINANCIAL INNOVATION?

According to Tufano [2] financial innovation is a process of the creation and diffusion of new financial products, services, processes, techniques and institutional forms. Viewed in this context, a financial innovation represents something new that reduces costs, reduces risks, or provides an improved product, service, instrument that better satisfies participants' demands.

In order to propose definition of financial innovation from different perspective I would say that financial innovation are socially and economically acceptable solutions to financial problems, based on creative use of financial theory and practice. Defining financial innovation this way I offer more generalized approach and value neutral definition which avoid numeration of aspects that financial innovation contribute.



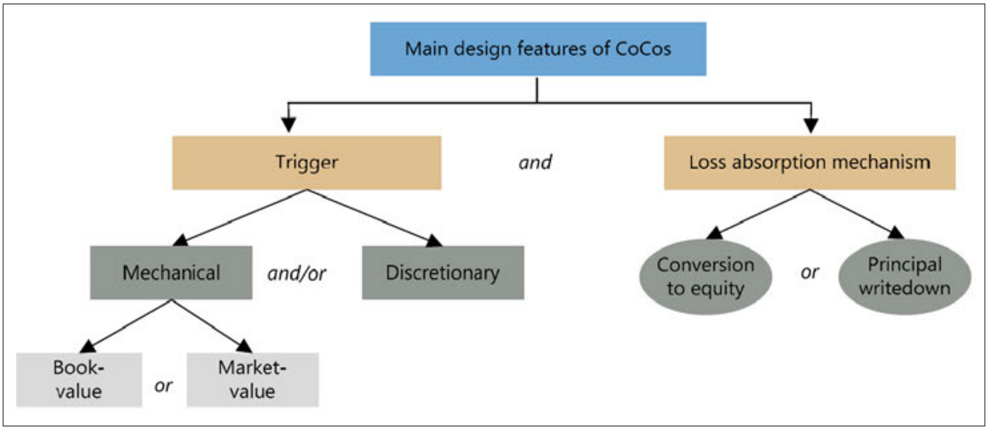
Picture 1. Classification, drivers and objectives of financial innovations [7]

The factors that encourage financial innovation are mainly connected with advances in underlying technologies, i. e. telecommunications and data processing, macroeconomic conditions, regulation, taxes and other influences.

In order to classify financial innovation we use Sanaj Banka [7] graphical presentation (Picture 1) which shows three aspects of financial innovation: classification according to functional approach, list of the main drivers of financial innovation, and the objectives one can accomplish by appropriate financial innovation.

Classification of financial innovations adopted by most researchers has a functional approach [8]. The most common classification of financial innovations includes the categories of:

1) New products. Contingent Convertible bonds (CoCos), are good example of an innovation-generated financial instrument that convert debt to equity during financial turmoil. Unlike traditional convertibles, which have predetermined con-



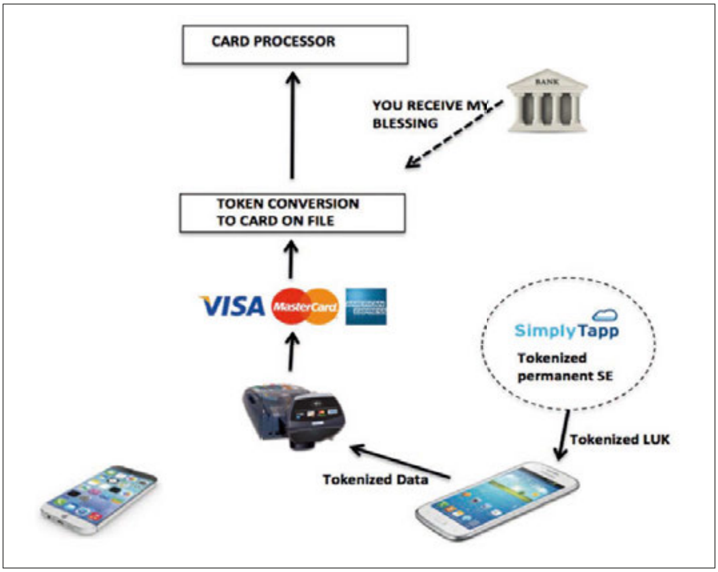
Picture 2. Structure of CoCos [9]

version date, CoCos are bonds that convert debt to equity, or are written off, after some triggering event such as a decline in a bank's capital below a threshold. Main characteristic of this newly invented credit derivative instrument is transfer of responsibility for bearing the costs of poor bank's performance from the taxpayers to the bondholders. The conversion process makes an interesting metamorphosis of a bondholder — form bondholder to a troubled-bank holder. At the very beginning, the CoCo market was relatively small, but it continue growing. Banks have issued approximately $70 billion USD worth of CoCos since 2009. CoCo's volumes have increased to grow with issuance in 2014 projected to be in the range of $75 billion to $100 billion. According to Moody's Investors Service[1] CoCo issuance peaked

[1] https://www.moodys.com/research/Moodys-Global-issuance-of-contingent-capital-instruments-drops-by-44--PR_335214, accessed on 18th January 2016, 8: 08 PM.

in 2014. Some expert expect issuance for the full year 2015 would total about $106 billion on an annualized basis, compared with USD 175 billion the previous year.

2) New processes. The highest-profile technology to hit the market is Apple Pay, which works with the iPhone 6 s. It lets shoppers store their credit card information on their iPhone and pay for goods by tapping the phone on an in-store receiver. Because of a technology called „tokenisation" experts say it is more secure than



Picture 3. Tokenization process

current card systems. With tokenisation, merchants receive data that obscures the shopper's actual credit card number, reducing the chance that hackers can steal usable data from merchants' internal systems. Because iPhones use fingerprint recognition to verify shoppers' identity, it is also nearly impossible for a thief to steal an iPhone and make a purchase (Picture 3).

3) New markets. Carbon markets are new infrastructure based on financial innovation, which helps financing reduction of greenhouse gas emission in developing countries since 2005, when the Kyoto Protocol came into effect. Emission reductions associated with projects that are used to generate financial assets known as „carbon credits" that are tradable in newly created carbon markets.

4) New organizations. Looking back to history, the transition from a sole proprietorship to a limited liability company was the silent revolution of the organizational forms of companies enabling the mortal beings — natural persons — to establish legal entities in the form of joint stock companies. This organizational innovation allowed that lifetime of such companies no longer depend on the lifetime of their founders. Theoretically, a joint stock company can last indefinitely. Hence, in financial theory we need to model and to evaluate infinite stream of cash flows, which we call perpetuities.

5) New regulations. Many large banks suffered from deep losses of capital during the 2008 financial crisis. As catastrophic consequences confirmed later, many of them had inadequate capital levels. Such hard experience of bailing-out those who were „too big to fail" forced governments to increase level of resistance of commercial banks to external shocks as well as level of confidence in banking sector. As Pennacchi *et al*. [10] noted with the goal of avoiding such bailouts in the future, regulators have raised banks' capital requirements and reconsidered what debt-like instruments should qualify as capital. Basel III was supposed to strengthen bank capital requirements by increasing bank liquidity and decreasing bank leverage.

Next important aspect of financial innovation refers to the need for their quantification in order to measure financial development. Innovation in the manufacturing industry has focused mostly on patents, research and development expenditures (R&D), or share of research staff as indicators of innovative activity. The need for measurement of financial innovation opens up a number of practical problems. Unlike the manufacturing sector, in the financial sector patents and other copyright methods rarely exist. That is the reason why intensity of financial innovation cannot be directly measured. The indicators (the proxies) of financial innovation intensity practitioners usually use are as follows:

1) Private sector credit to Gross Domestic Product (PSC/GDP) ratio. The ratio of private sector credit (PSC) to Gross Domestic Product (GDP) is the most popular measure of financial innovation intensity. The Basel Committee on Banking Supervision in 2010 has issued a proposal to incorporate this approach into the regulatory system, by using the deviation from long-run trend of the PSC/GDP ratio (the 'credit gap') to calibrate a countercyclical capital buffer. In the first instance, this method uses the ratio of credit to GDP, thus allowing credit to grow naturally in line with overall economic activity. Trending techniques are then employed to generate a long-run mean for the ratio and the actual position is then contrasted with this mean. [11]

2) Financial R&D intensity (value added). This indicator can be calculated by collecting data on R&D expenditure in the financial intermediation industry from the Analytical Business Enterprise Research and Development database (ANBERD) of the OECD [12]. Most R&D data in financial sector are derived from retrospective surveys of the units actually carrying out or 'performing' R&D projects, and collected from enterprise surveys via the OECD/Eurostat International Survey of Resources Devoted to R&D from 32, mostly high-income, nations in the world from 1987 to 2006. This indicator are calculated by using financial R&D intensity relative to the value added in the financial intermediation sector.

3) Financial R&D intensity (cost). This indicator can be calculated the same way a as the previous one (value added), but here the intensity of the financial innovation is measured by standardizing financial R&D with total operating cost of banks. The information is drawn from OECD Banking Statistics.[2] Operating cost refers to total non-interest expenses. [12].

TECHNOLOGICAL PROGRESS AND FINANCIAL INNOVATION

Let me briefly comment some contradictory findings which are directly or indirectly connected with financial innovation in the context of technological progress. These findings provide evidence for both the innovation-growth and innovation-fragility hypotheses.

Let me start with discrepancy between theoretical and empirical research on financial innovation. Frame and White [4] find that descriptive aspects dominate academic research on financial innovation. There is still evident need for empirical research and more innovative empirical measures of financial innovation. What is contradictory in this fact is that measurement process of financial innovation is dominantly based on proxies of financial innovation intensity. Although financial innovation are achieved by innovative solutions, no innovative solutions in measuring that process in financial markets.

Apart from that gap between theoretical and empirical research, implementation of high-end theoretical innovative models and methods, have not always produced positive outcomes. On the contrary, Nobel prize (1997) theoretical financial innovation known as the Black-Scholes model for derivative pricing, caused enormous loss in US financial system just couple of years later. 1999 fall of Long Term Capital Management (LTCM) hedge fund management firm, whose board of directors were 1997 Nobel prize laureates Myron Scholes and Robert Merton initiated total loss 4.6 billion USD in six months.

Contradictory conclusions we find following even the single author considerations on financial innovation. Mishkin and Strahan say „Innovations in computer and telecommunications technologies (that) reduced both transactions costs and asymmetric information problems…" [12]. The same authors argue that „Financial intermediaries now function to unbundle risks, permitting more assets to be funded by less informed investors, thereby enhancing liquidity." [12]. Are investors, gaining ICT innovation, getting more or less informed, relative to their scope of choices? Technological progress in ICT, according to Mishkin and Strahan, reduces asymmetric information problem, which means investors are more informed and that way exposed to less risk. By broadening investment menu, investors use powerful diversification tool to reduce their investment risk, but the same time they are usually more puzzled by greater choices they need to take into consideration. From the diversification standpoint, „…the amount of risk that investors bear is reduced, as a consequence of the availability of a broader menu of assets, allowing greater diversification and risk sharing (Merton [1987], Mendoza

[2] Source: OECD Statistics 2010, OECD Banking Statistics, BankScope.

et al. [2008]). Some authors argue that financial development has made the world riskier and subject to „excessive risk taking" (Rajan, 2005) (Shin, 2009).

Financial innovation give investors new tools for diversifying portfolios and sharing risks, so it should make markets safer. But the theory that new financial products will make markets less dangerous doesn't always stand up. Consider these arguments taking into account mega process such as globalization of financial industry. Financial institutions are getting global and it size grew enormously, giving them opportunity to benefit economics of scale and scope. But growing size of the financial institutions becomes more problematic causing regulators selective law enforcement („too big to fail" principle).

Some authors [13] find more contradictory aspects of financial innovation. They find that countries where financial institutions spend more on financial innovation are better able to translate growth opportunities into GDP per capita growth. No doubt that industries that rely more on external finance and more on R&D activity grow faster in countries where financial institutions spend more on financial innovation. But such industries also experience more volatile growth in countries where financial institutions spend more on financial innovation. They also experience more volatile growth and more fragility. In countries where banks spent more on financial innovation before the crisis, they suffered greater reductions in their profits, relative to both total assets and equity.

CONCLUSION

Financial innovation have made a significant contribution to the economic development of the modern world. They are reflection of creativity, based on financial theory and practice, which offers solutions and opens up new possibilities for various financial entities. The expansion of new technologies, especially ICT, contributed to the significant growth of financial innovation, which enhanced efficiency of financial markets, enforced global flow of financial information and reduced cost of financial intermediation. The financial transactions became faster and more reliable, including lower cost associated with funds transfer.

Schumpeter's phrase „creative destruction" which acknowledges the erosion of value that established companies experience when another company introduces a radical innovation explains the role creativity play in innovation generating process. Creativity is a result of effective mixing knowledge and imagination. In our education systems we usually underestimate imagination, making huge effort only to enhance knowledge. This is one of the conclusions we seriously must take into account in reforming contemporary educational systems.

Culture of innovation in another dimension worth mentioning in the context of societal implication of innovation. If not enough innovative, a society must quickly adapt to innovations made worldwide. Not investing in *know-how*, every society, sooner or later, will ask itself *now how?*

Technological innovation can make huge contribution to unification of people (e. g. social networks) as well as their separation (digital divide). Biasness toward positive side of technological progress, make us blind to fact that enormous number of people suffer from informational poverty. According to *ICT Facts&Figures*, published by International Telecommunication Union in May 2015, globally 3.2 billion people are using the Internet by end 2015, of which 2 billion are from developing countries. However, 4 billion people from developing countries remain offline, representing 2/3 of the population residing in developing countries. Of the 940 million people living in the least developed countries, only 89 million use the Internet, corresponding to a 9.5% penetration rate.

At the personal level ICT has dramatically changed a form of our identity. Real identity becomes digital identity — a chain of binary digits. „I am who I am" doesn't work anymore. I am what the intelligence authorities think I am, based on my digital identity. All that process is conducted by sophisticated technology, which allows their user to browse through digital data recorded based on our activities and stored into digital archives. Today, we are witnesses of a slow transformation of „virtual reality" into „real virtuality". I coined syntagma „real virtuelity" to raise awareness of time people, especially children, spent with electronic devices such as TVs, computers, cell phones, etc. Use or misuse of technological innovation, especially financial innovation, is our responsibility. By concluding this paper with word responsibility, just want to recall that the roots of this word come from word response. Appropriate response to these conclusions is our future imperative.

REFERENCES

[1] R. J. Shiller, Capitalism and Financial Innovation, *Financial Analysts Journal, Volume 69, Number 1, 2013, p. 21*

[2] J. Lerner and P. Tufano: „The Consequences of Financial Innovation: A Counterfactual Research Agenda", *National Bureau of Economic Research, Working Paper 16780, 2011, p.*

[3] L. Leaven, R. Levine and S. Michalopoulos: „Financial innovation and endogenous growth", *Journal of Financial IntermediationVolume 24, Issue 1, January 2015, Pages 1–24*

[4] W. S. Frame and L. J. White: „Empirical Studies of Financial Innovation: Lots of Talk, Little Action?" *Federal Reserve Bank of Atlanta, Working Paper 2002–12, July 2002.*

[5] S. A. Lumpkin: „Regulatory Issues Related To Financial Innovation" *Financial Market Trends, Vol. 2009, Issue 2, preliminary version December 2009.*

[6] S. Popović and A. J. Martinez: „A Brief Overview of the Bubble: Some Important Features of Current Global Financial Crisis We Need to Bear in Mind", *Belgrade Stock Exchange International Conference*, November 13–14, 2008.

[7] S. Banka: „Financial Innovation: India's Prowess", *CFO Connect, February 2013. p. 36.*

[8] D. T. Philippas and C. Siriopoulos: „Is the progress of financial innovations a continuous spiral process?" *Investment Management and Financial Innovations, Volume 9, Issue 1, 2012, p. 20–31.*

[9] S. Avdjiev, A. Kartasheva, and B. Bogdanova: „CoCos: a Primer", *BIS Quarterly review, September issue, 2013, p. 45.*

[10] Pennacchi, G., Vermaelen, T., and Wolff, C C. P. (2014) Contingent Capital: The Case of COERCs, *Journal of Financial and Quantitative Analysis*, Vol. 49. No. 3, 541–574.

[11] R. Kelly, K. McQuinn and R. Stuart: „Exploring the steady-state relationship between credit and GDP for a small open economy the case of Ireland", *European Central Bank, Working Paper Series, No. 153, April 2013, p. 4.*
[12] F. S. Mishkin and P. E. Strahan: „What will Technology Do to Financial Structure", National Bureau of Economic Research, Working paper 6892, 1999. pg
[13] T. Beck, T. Chen, C. Lin and F. M. Song: „Financial Innovation: The Bright and the Dark Sides", *Hong Kong Institute for Monetary Research, Working Paper No. 05/2012, p. 45, 47*

Dragoljub MIRJANIĆ*

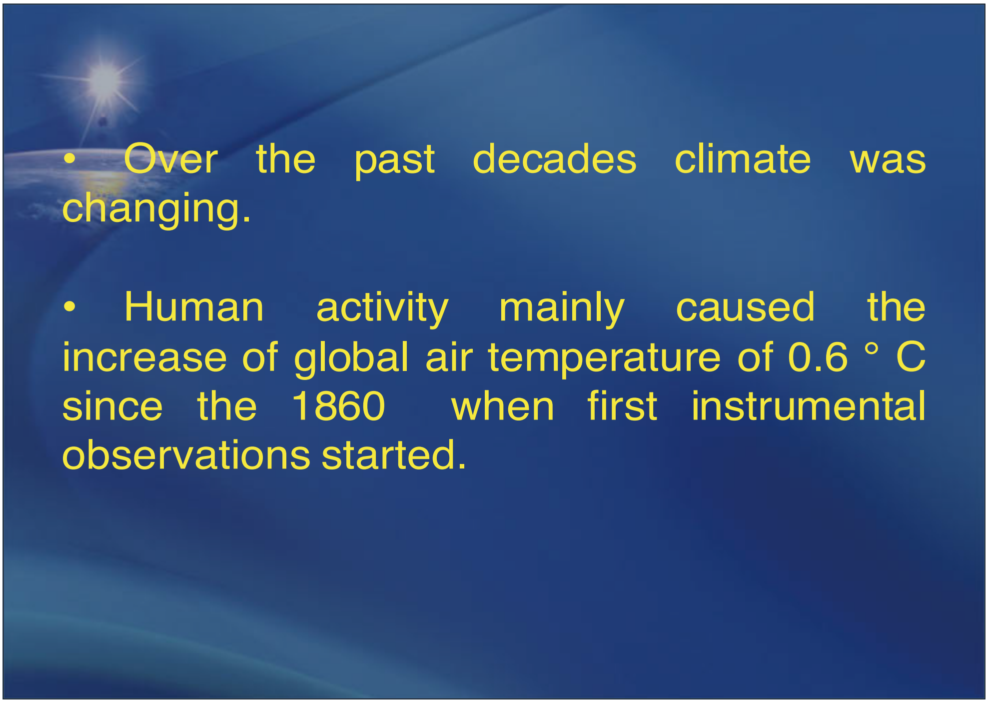
THE INFLUENCE OF RENEWABLE ENERGY SOURCES AND CLEAN TECHNOLOGIES TO THE CLIMATE CHANGES IN THE UNDEVELOPED COUNTRIES. OVERWIEV OF REPUBLIC OF SRPSKA AND B&H

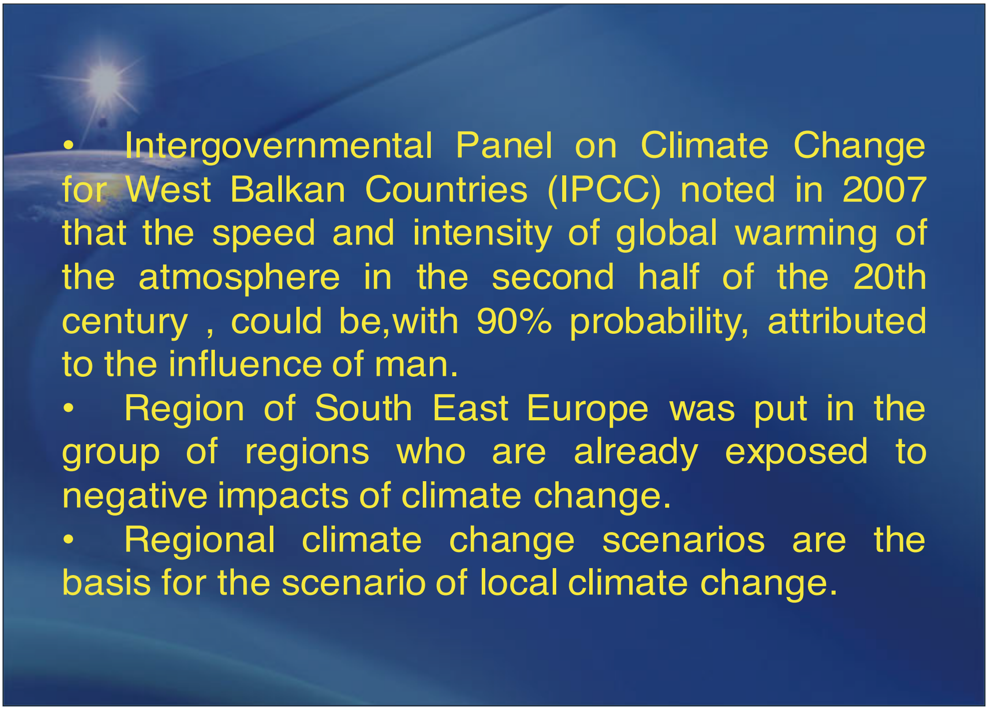
Abstract: World public, experts, politicians, scientists for many years, especially the last decade, occupies the problem of climate change on Earth. Years of research led to the irrefutable conclusion that the impact of greenhouse gas emissions is a major factor of climate changes and environmental pollution. This is a problem that affects all countries and nations, and the struggle to overcome this problem requires equal involvement of developed as well as undeveloped countries. Developed countries have a certain advantage, having in mind the fact that they are economically more powerful, the new technologies are more accessible to them, have more options of investing in energy sector, primarily on renewable energy sources, which should take the leading position in ensuring the energy for industry. Climate change has an impact on all spheres of life and work — on the economy and quality of life. The agriculture, water, energy, health of population, forestry, bio-systems, tourism, construction and many other fields are affected. The small and undeveloped countries, instead of that are not major polluters, are equally affected by climate change as well as developed. There is a reason to conclude that they have an opportunity to create their own development, based on „green" technology and in that way contribute in reducing greenhouse gas emissions and protecting of environment. Therefore, it is necessary to start building institutional capacity and raising awareness on the use of renewable energy sources and their impact on climate change. The starting point is the adoption of a strategy on climate change and defining the potential that should be developed. In the case of Bosnia and Herzegovina and the Republic of Srpska, it is clear that biomass, hydropower, wind energy and solar energy could be used for production of energy from renewable sources. The particularly attractive is a potential of solar energy. This paper is going to present the options for the use of renewable energy sources which have a direct impact on environmental protection and climate change. It is also going to define the key research needs and next steps that should be taken in the Republic of Srpska and B&H in order to be fully included in European and world trends.

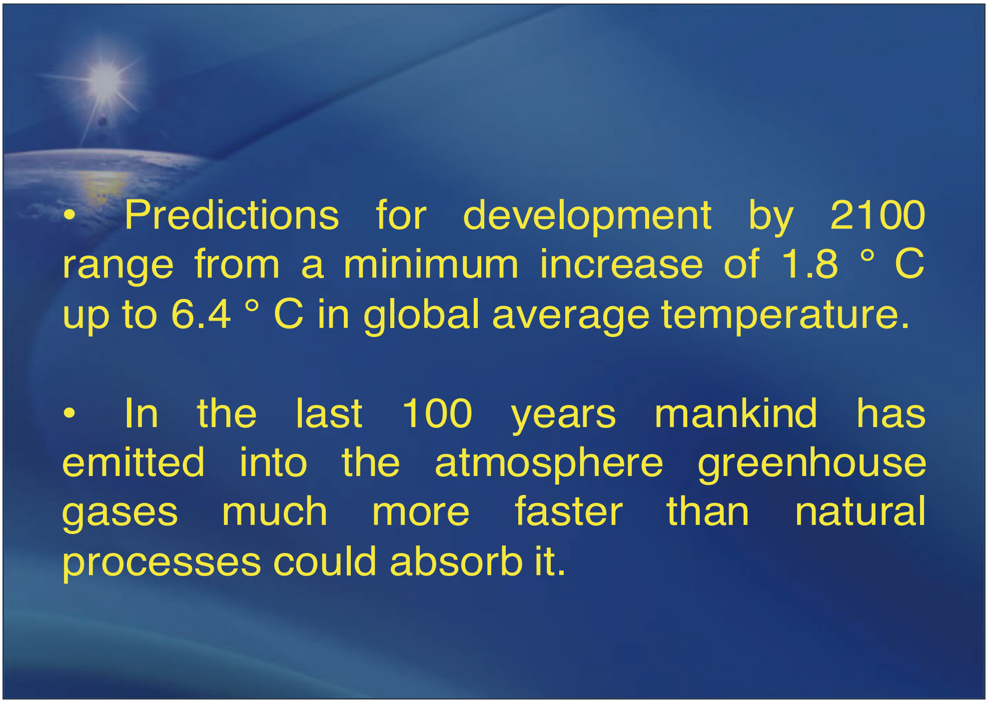
Key words: *climate changes, renewable energy sources, „green" technology, environment*

* Secretary general, The Academy of Sciences and Arts of Republic of Srpska

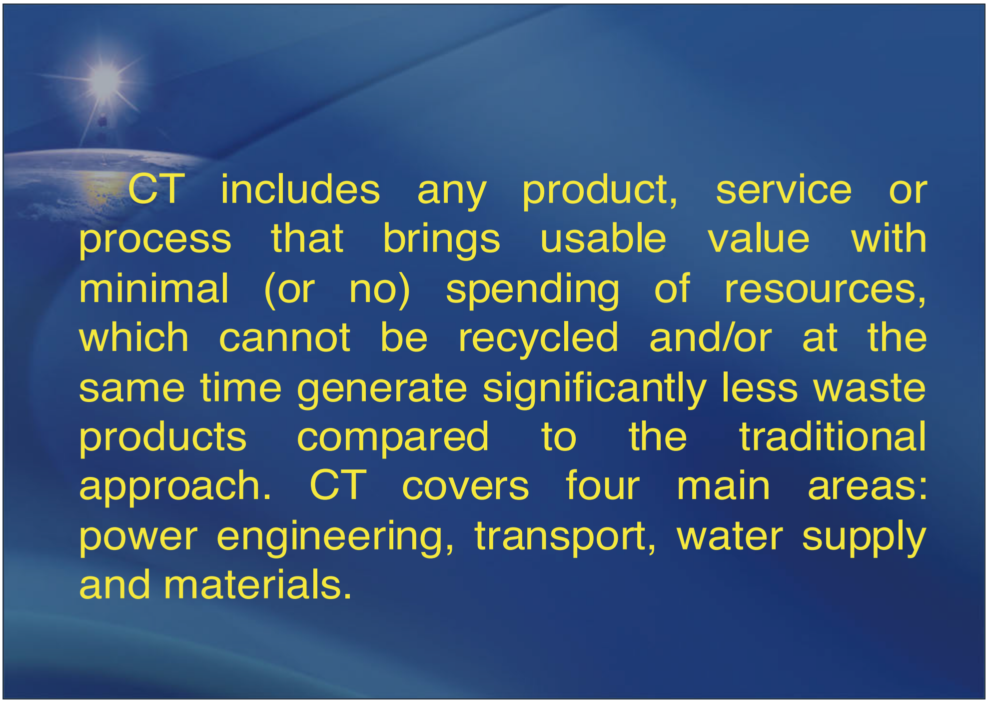

The influence of renewable energy sources and clean technologies to the climate changes in the developing countries / overview of Republic of Srpska and B&H
Academician Dragoljub Mirjanić
Academy of Sciences and Arts of Republic of Srpska

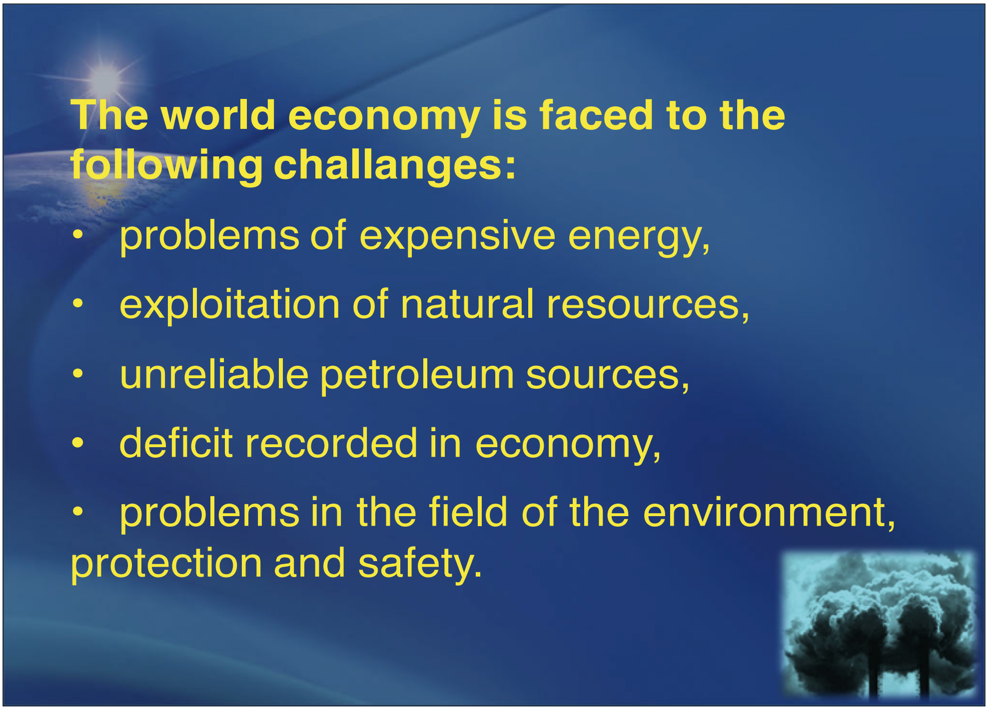

• Over the past decades climate was changing.
• Human activity mainly caused the increase of global air temperature of 0.6 ° C since the 1860 when first instrumental observations started.


• Intergovernmental Panel on Climate Change for West Balkan Countries (IPCC) noted in 2007 that the speed and intensity of global warming of the atmosphere in the second half of the 20th century , could be,with 90% probability, attributed to the influence of man.
• Region of South East Europe was put in the group of regions who are already exposed to negative impacts of climate change.
• Regional climate change scenarios are the basis for the scenario of local climate change.


• Predictions for development by 2100 range from a minimum increase of 1.8 ° C up to 6.4 ° C in global average temperature.
• In the last 100 years mankind has emitted into the atmosphere greenhouse gases much more faster than natural processes could absorb it.

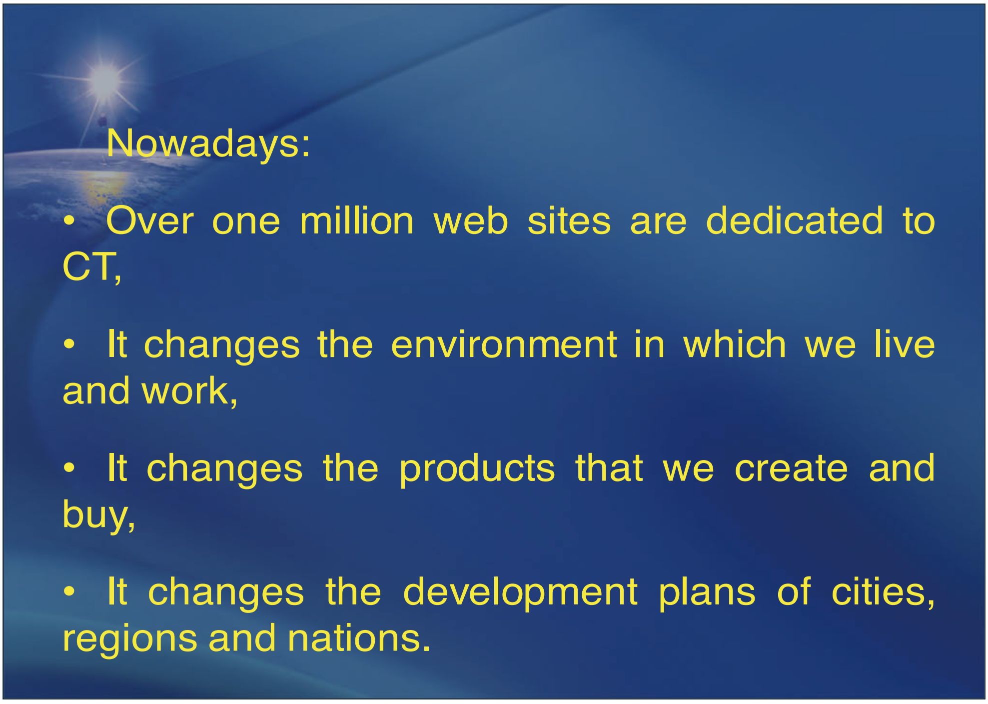

CLEAN TECHNOLOGY
• Clean technology (CT) are primarly global social problem, and future of mankind depands on it. Why?
• CT can provide a new production growth and successful economy.

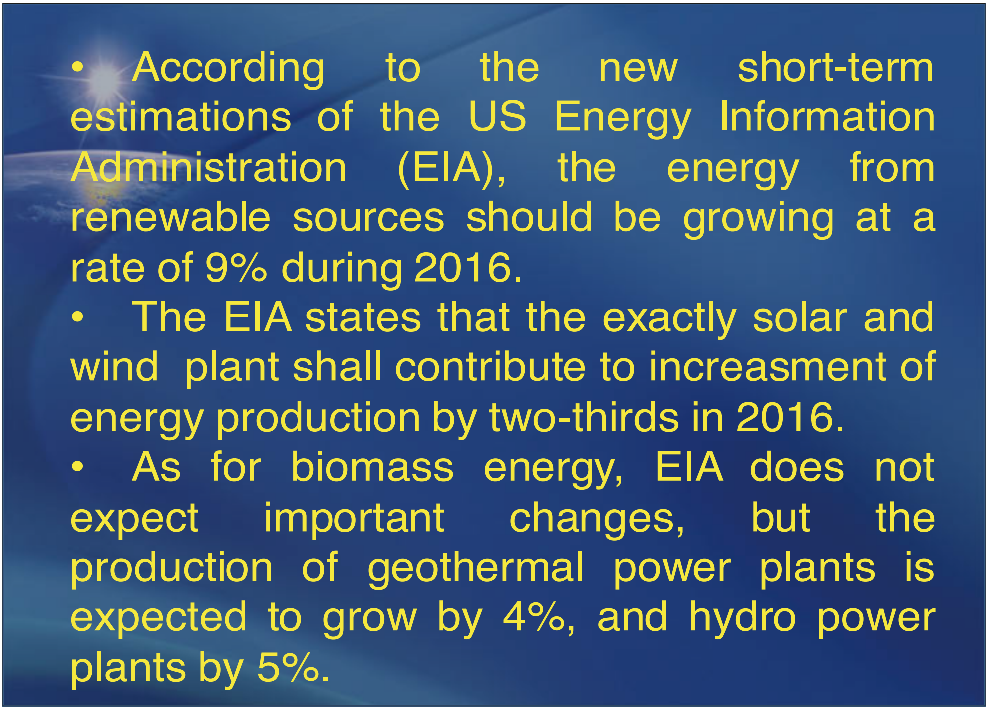

CT includes any product, service or process that brings usable value with minimal (or no) spending of resources, which cannot be recycled and/or at the same time generate significantly less waste products compared to the traditional approach. CT covers four main areas: power engineering, transport, water supply and materials.

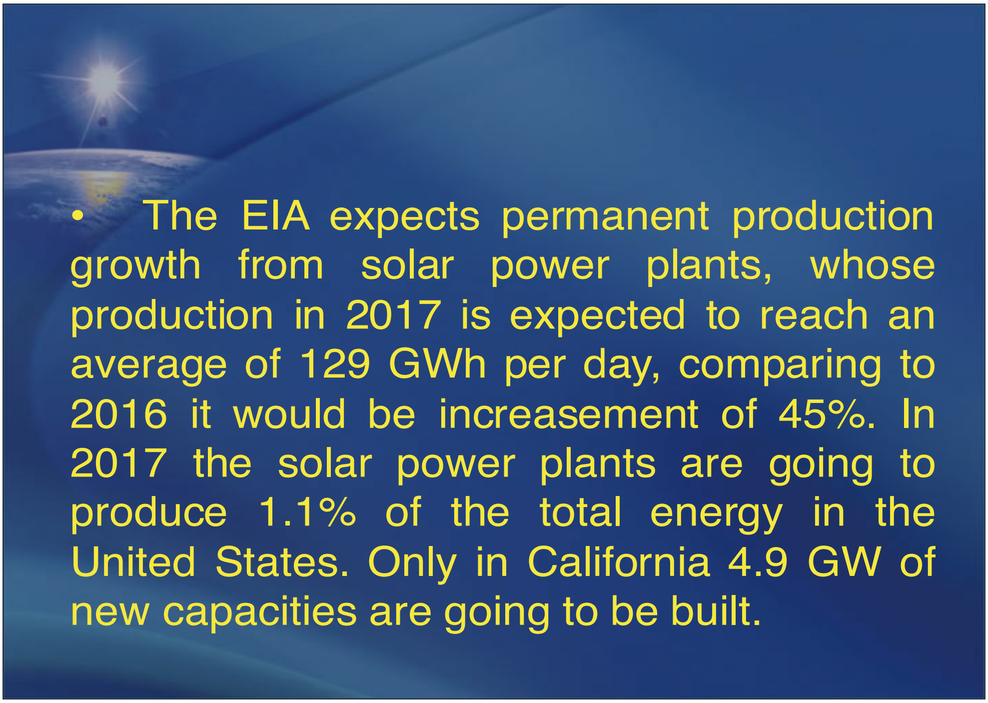

The world economy is faced to the following challanges:
• problems of expensive energy,
• exploitation of natural resources,
• unreliable petroleum sources,
• deficit recorded in economy,
• problems in the field of the environment, protection and safety.


These technologies ensure:
• Using of recyclable materials and energy sources, or decreasing of the use of natural resources, based on their more efficient or more productive use,
• lessen or eliminate pollution and toxic waste,


• offer the same or identical performances compared to classical technologies,
• provide faster turnover for investors, companies and consumers, as well as lower expenses and costs,
• create new jobs in the fields of management, production and development.


Nowadays:
• Over one million web sites are dedicated to CT,
• It changes the environment in which we live and work,
• It changes the products that we create and buy,
• It changes the development plans of cities, regions and nations.

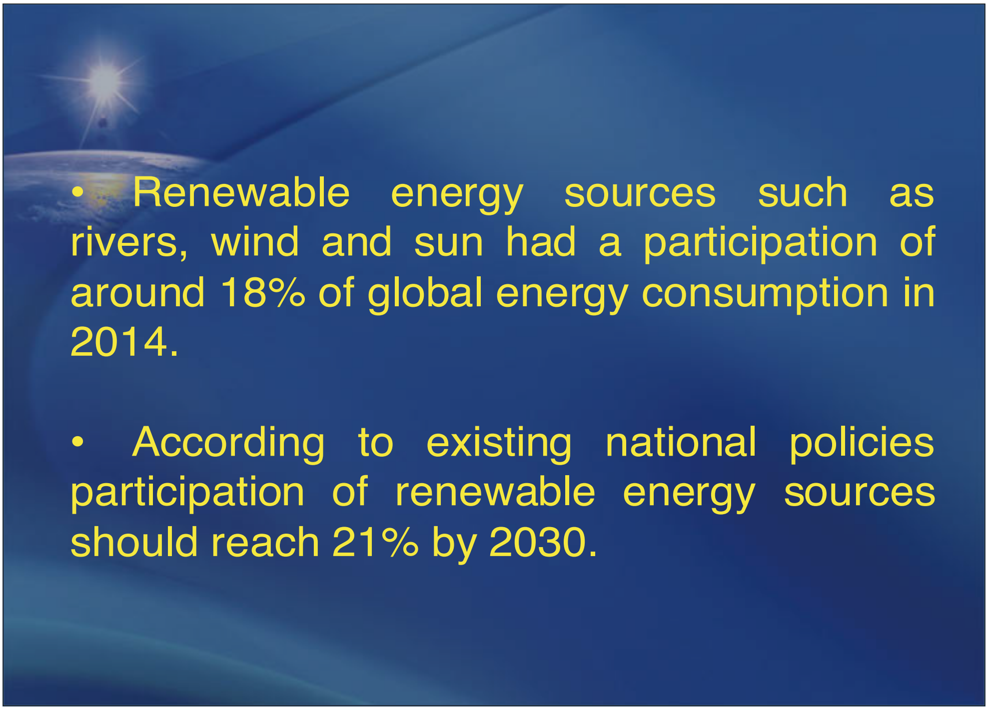

• According to the new short-term estimations of the US Energy Information Administration (EIA), the energy from renewable sources should be growing at a rate of 9% during 2016.
• The EIA states that the exactly solar and wind plant shall contribute to increasment of energy production by two-thirds in 2016.
• As for biomass energy, EIA does not expect important changes, but the production of geothermal power plants is expected to grow by 4%, and hydro power plants by 5%.

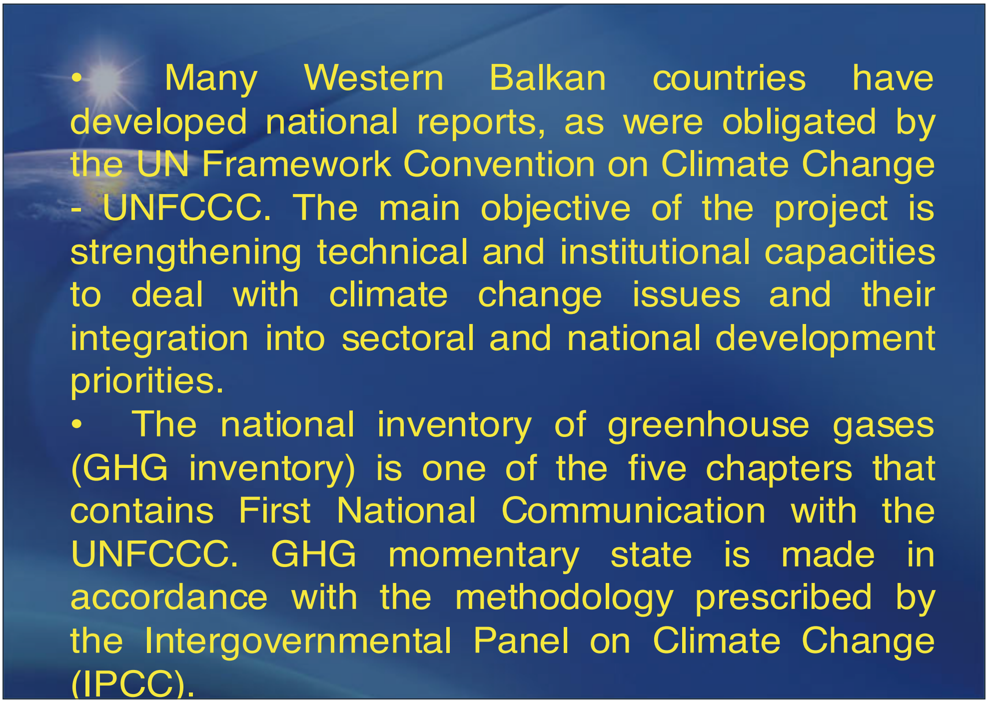

• The EIA expects permanent production growth from solar power plants, whose production in 2017 is expected to reach an average of 129 GWh per day, comparing to 2016 it would be increasement of 45%. In 2017 the solar power plants are going to produce 1.1% of the total energy in the United States. Only in California 4.9 GW of new capacities are going to be built.

- All major future energy scenarios forecast a key role for photovoltaic solar energy (PV). PV has a huge European and global potential, making it an important building block for secure and sustainable energy system.
- In several European countries PV already provides more than 5% of the annual electricity demand, a level originally anticipated to occur only after 2020.
- Based on current market trends, Solar Power Europe estimates that PV has the potential to meet 8& of the EU electricity demand in 2020 and 15% in 2030.
- If achieved, this would result in a considerable contribution to the reduction of CO2 emissions, since the carbon foot print of PV systems is at least 10 times lower than that of fossil fuel-based electricity, with no CO2 emissions during operation.

- According to a research results of the International Renewable Energy Agency (IRENA), doubling the participation of renewable energy sources in global production to 36% by 2030 could benefit the world economy with up to 4,200 billion dollars per year.

- That will contribute to the creation of more new jobs, it will save millions of lives because of reduced air pollution and will set us on the pathway of restrictions of global temperatures up to two degrees, as was agreed at the climate summit in Paris.


• Renewable energy sources such as rivers, wind and sun had a participation of around 18% of global energy consumption in 2014.
• According to existing national policies participation of renewable energy sources should reach 21% by 2030.


• Many Western Balkan countries have developed national reports, as were obligated by the UN Framework Convention on Climate Change - UNFCCC. The main objective of the project is strengthening technical and institutional capacities to deal with climate change issues and their integration into sectoral and national development priorities.
• The national inventory of greenhouse gases (GHG inventory) is one of the five chapters that contains First National Communication with the UNFCCC. GHG momentary state is made in accordance with the methodology prescribed by the Intergovernmental Panel on Climate Change (IPCC).

• Table 1. shows potential of global warming of individual gases. The potentials are related to a period of 100 years..

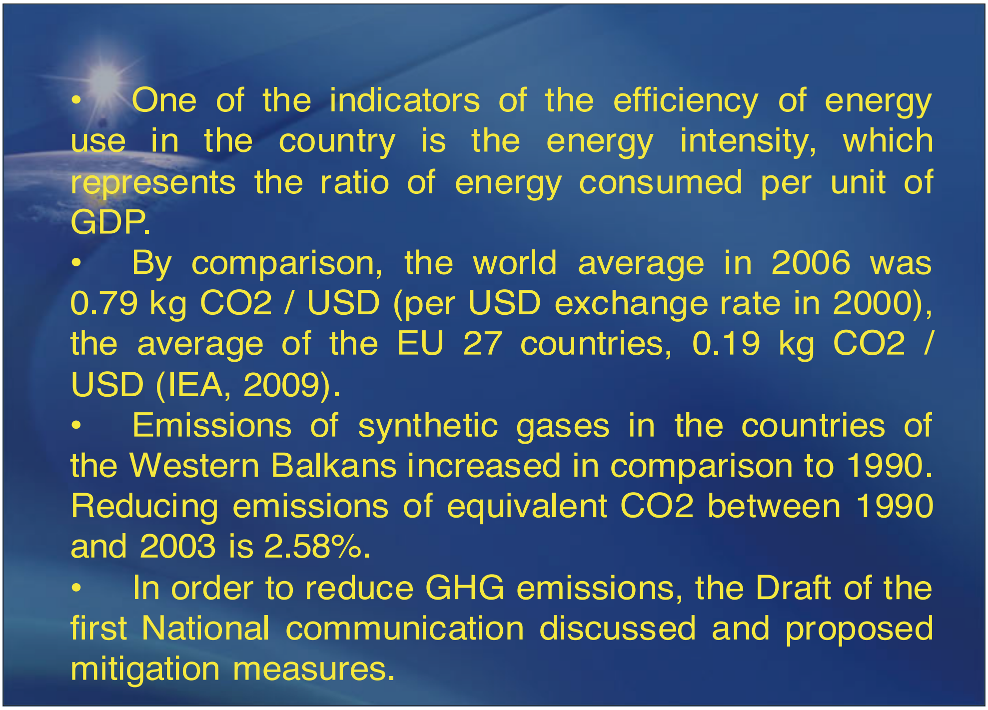
Gas	GWP
CO_2	1
CH_4	21
N_2O	310
CF	6500
C_2F_6	9200
SF	23900

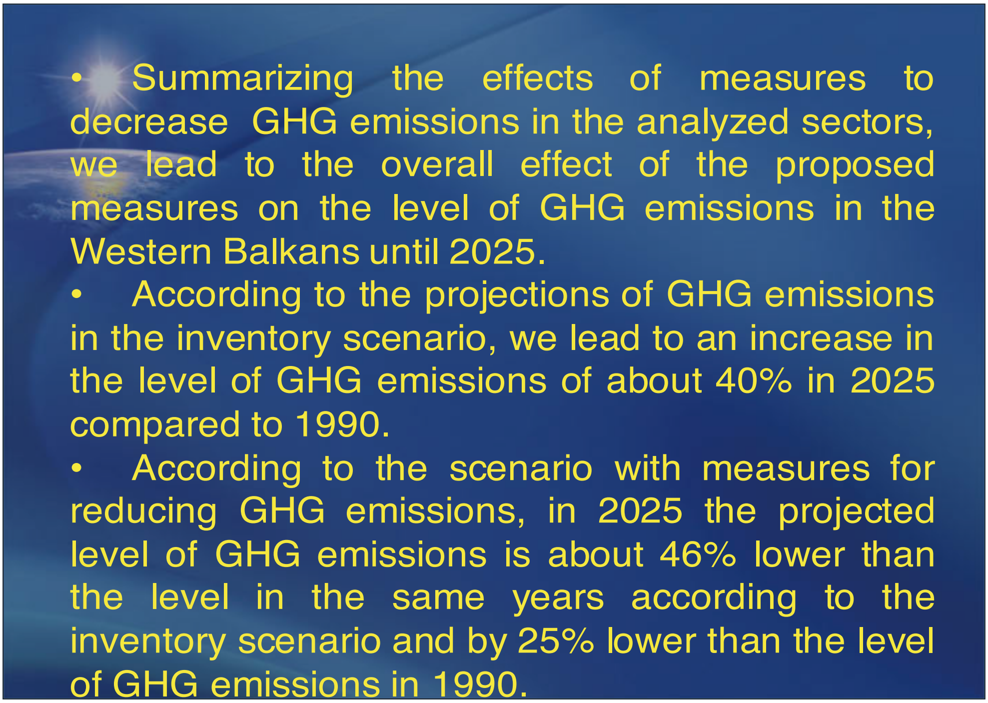
Table 1. Potential global warming certain gases (GWP) of SF6

• Total equivalent C02 emissions per capita, taking into account the census from 1991, is 7.7 t CO2 eq / capita.

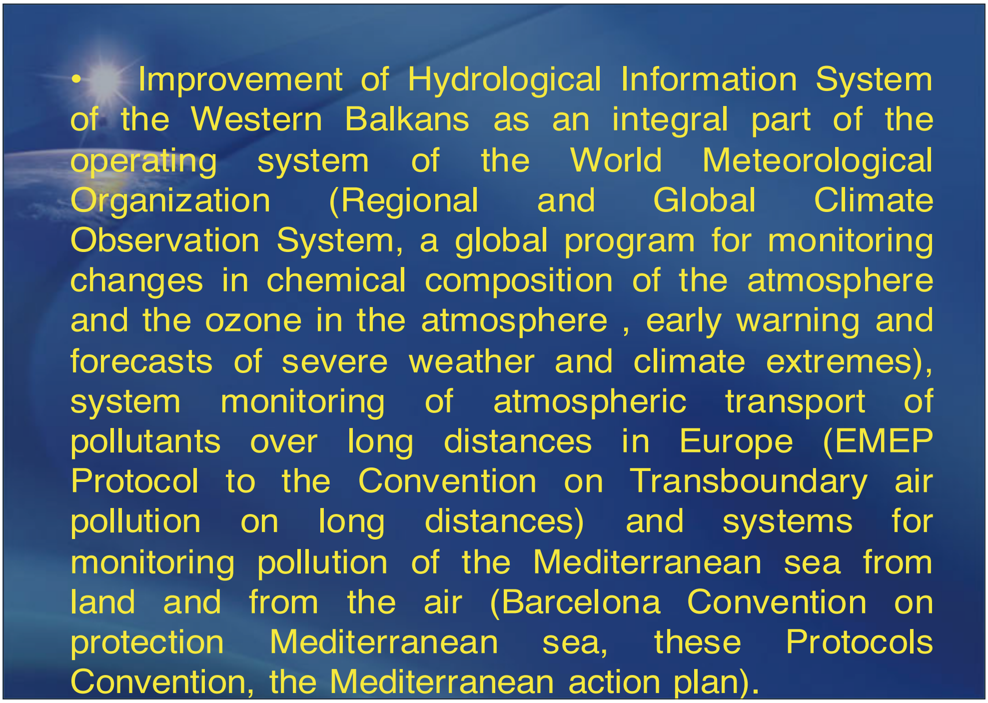
• If we consider CO2 emissions only due to the combustion of fossil fuels, without participation of synthetic gasses in total emissions, this ratio is lower and amounts 4.55 t CO2 eq / capita.

• According to that, CO2 emission in the Western Balkan countries in 1990 was lower than emissions in the developed countries, but for 35% greater than those in developing countries.

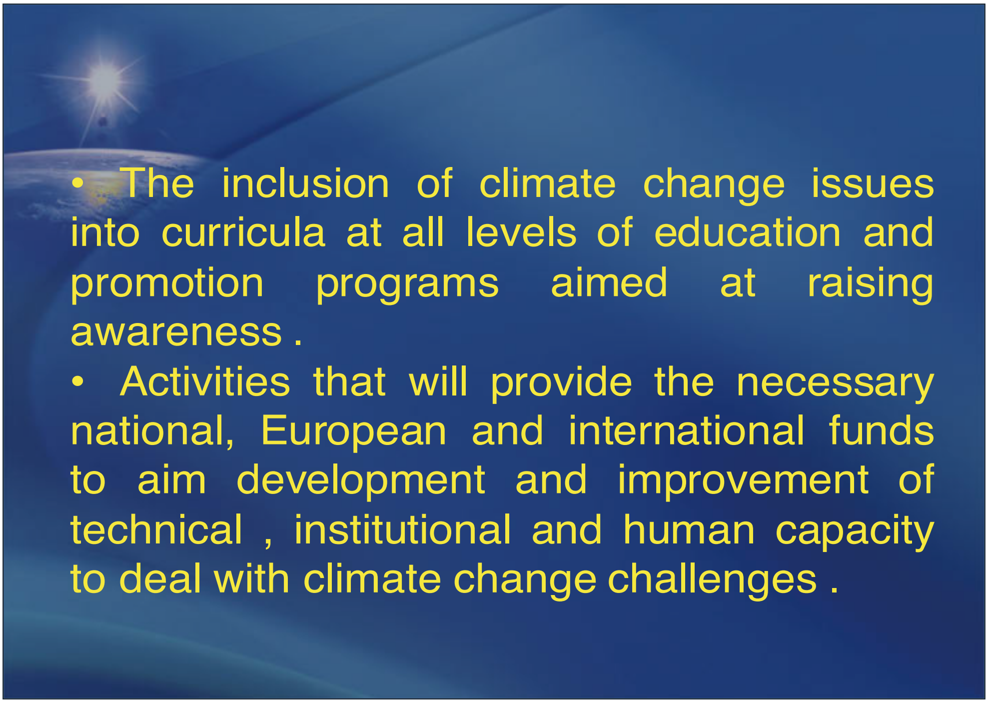

• One of the indicators of the efficiency of energy use in the country is the energy intensity, which represents the ratio of energy consumed per unit of GDP.
• By comparison, the world average in 2006 was 0.79 kg CO2 / USD (per USD exchange rate in 2000), the average of the EU 27 countries, 0.19 kg CO2 / USD (IEA, 2009).
• Emissions of synthetic gases in the countries of the Western Balkans increased in comparison to 1990. Reducing emissions of equivalent CO2 between 1990 and 2003 is 2.58%.
• In order to reduce GHG emissions, the Draft of the first National communication discussed and proposed mitigation measures.


• Summarizing the effects of measures to decrease GHG emissions in the analyzed sectors, we lead to the overall effect of the proposed measures on the level of GHG emissions in the Western Balkans until 2025.
• According to the projections of GHG emissions in the inventory scenario, we lead to an increase in the level of GHG emissions of about 40% in 2025 compared to 1990.
• According to the scenario with measures for reducing GHG emissions, in 2025 the projected level of GHG emissions is about 46% lower than the level in the same years according to the inventory scenario and by 25% lower than the level of GHG emissions in 1990.

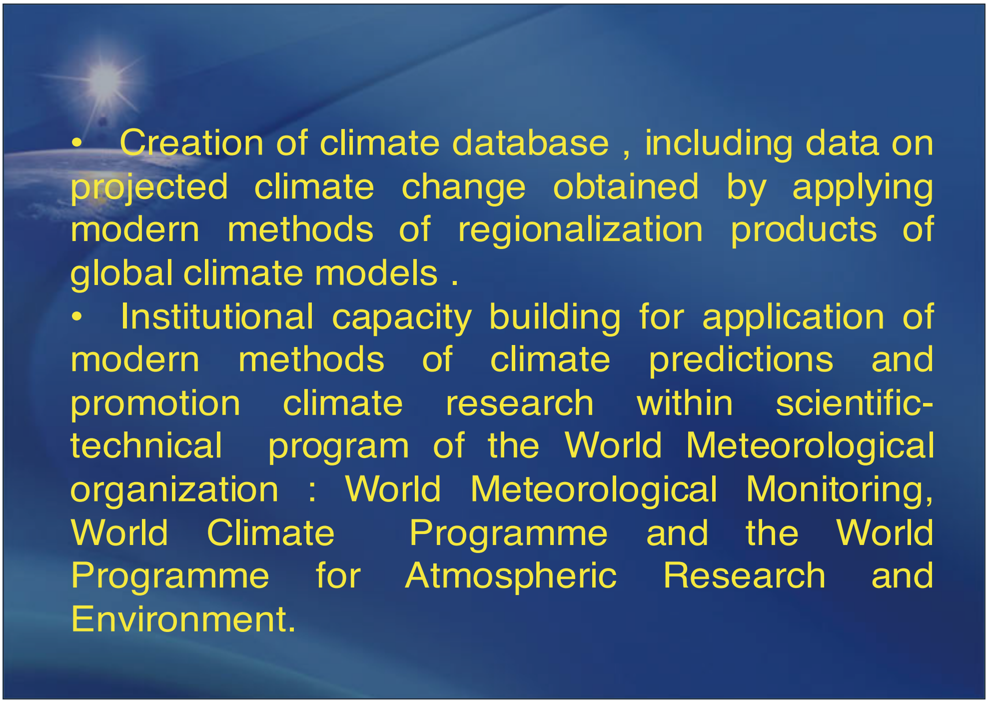

PROPOSALS FOR POSSIBLE DIRECTIONS OF DEVELOPMENT
• Short term goals for the Western Balkan Countries:
• Creating a National Policy on Climate Change.
• The preparation of the Western Balkan countries for a global climate regime in accordance with Kopenhagens agreement from 2009
• It is necessary to strentghen institutional and capacity building for activities in the field of climate change under the auspices of the UN Framework Convention on Climate Change and its Kyoto Protocol , the World Meteorological Organization , the Intergovernmental Panel on Climate Change, United Nations Environment Programme , the United Nations development program and the European Union with financial support of the international community.


• Improvement of Hydrological Information System of the Western Balkans as an integral part of the operating system of the World Meteorological Organization (Regional and Global Climate Observation System, a global program for monitoring changes in chemical composition of the atmosphere and the ozone in the atmosphere , early warning and forecasts of severe weather and climate extremes), system monitoring of atmospheric transport of pollutants over long distances in Europe (EMEP Protocol to the Convention on Transboundary air pollution on long distances) and systems for monitoring pollution of the Mediterranean sea from land and from the air (Barcelona Convention on protection Mediterranean sea, these Protocols Convention, the Mediterranean action plan).


• Research of the impact of climate change on human health, water resource , agri - economy , forest ecosystems and biodiversity, energy , transport, tourism and other economic activities which directly depend on climatic conditions .
• Inclusion of climate change in the broader process of sustainable development planning and sectoral development plans , zoning , planning and design of buildings and settlements , standards for projecting hydraulic and buildings and structures.


• The inclusion of climate change issues into curricula at all levels of education and promotion programs aimed at raising awareness .
• Activities that will provide the necessary national, European and international funds to aim development and improvement of technical , institutional and human capacity to deal with climate change challenges .


Medium-term objectives:
• Creation and implementation of Development Strategy based on low emitting carbon technologies (Low Carbon Developmnet Sreategy) .
• Reduction of the total GHG emissions by 20 % compared to 1990 levels .


• Creation of climate database , including data on projected climate change obtained by applying modern methods of regionalization products of global climate models .
• Institutional capacity building for application of modern methods of climate predictions and promotion climate research within scientific-technical program of the World Meteorological organization : World Meteorological Monitoring, World Climate Programme and the World Programme for Atmospheric Research and Environment.


• Long-term and permanent strategic goal of the Western Balkan countries represents active participation in European and international activities on the protection of global climate for present and future generations , as well as the harmonization of legislation with EU standards in the field of climate change.

Anita ETALE*, Sabelo D. MHLANGA*

ETHICAL ISSUES IN NANOTECHNOLOGY RESEARCH: PERCEPTIONS OF RESEARCHERS AT THE UNIVERSITY OF SOUTH AFRICA

Abstract: Nanotechnology research in South Africa is progressing rapidly. However, as with other regions of the world, less is known about researchers' perceptions and understanding of the ethical issues related to nanotechnology (EIRNT). We mapped the views of nanotechnology researchers (graduate students, postdoctoral scholars, technicians and professors) at the University of South Africa, on the ethical aspects of their work. Information was collected on factors including interest in, and perceptions of the importance of ethical issues, ethics in laboratory conduct and in communication (hype or downplaying of risk), as well as the willingness to learn more about EIRNT. We found that although a majority of researchers were sensitive to EIRNT and believed that these were important to consider, some disagreed with this view while others were unsure. Furthermore, most students did not consider themselves well informed about EIRNT but were willing to invest time in learning more. Interestingly, only 50% of respondents thought the use of hype was completely or somewhat unethical.

Key words: *Nanoethics, laboratory safety, hype, nanotechnology risk perception, ethical issues related to nanotechnology research (EIRNT)*

INTRODUCTION

Nanotechnology (NT) refers to technologies that involve the manipulation of matter at the nanometre (nm) scale (1–100 nm). It is projected to revolutionize the 21st century with among other things, smaller, lighter and faster devices that use fewer raw materials and less energy. NT has already enabled a number of commercial products including dust and sweat-repelling mattresses, biocidal wound dressings, water and dust resistant sprays used in the building industry as well as cosmetics personalized according to race, age and physical activity[1]. Despite all these and other potential benefits, nanotechnologies also have negative human

* Nanotechnology and Water Sustainability Research Unit, College of Science Engineering and Technology, University of South Africa

health and environmental impacts. Carbon nanotubes have been shown to have asbestos-like effects on human lung cells [2,3] and Song et al. [4] reported pulmonary inflammation and granulomas amongst female workers exposed to polyacrylate nanoparticles for 5–13 months. There are also concerns over „Trojan-horse" effects arising from their interactions with other pollutants [5,6]. Baun et al. [7]reported that in the presence of carbon nanotubes, phenanthrene was 60% more toxic to daphnids. As such, the practice of NT brings to bear important ethical issues ranging from environmental and personal protection to the manipulation of biological life and concerns over individual privacy [8,9]. Suggestions have also been put forth of a „nano-divide" i. e. where nanotechnology intensifies the gap between the rich and the poor and questions regarding who will benefit or lose out from global advancements in NT [10]. There are also issues regarding (i) access to knowledge and possible limitations from broad patents taken out by researchers in developed nations where more research takes place due to greater funding, (ii) the affordability of crucial NT-enabled solutions especially in the medical domain, and (iii) the diversion of investment from low-tech solutions [11].

There is therefore increasing consensus that NT researchers need to be aware of the ethical issues around their work. Dowling et al. [11] in the Royal Society report (2004) recommended that due to the potential for benefit and risks posed by NT, researchers should give thought to the wider implications of their work and research students should be able to demonstrate an awareness of the ethical issues associated with their research. Despite this, a recent U. S study found that most (80%) of NT researchers in U. S universities and NT research centres felt they were not well-informed about ethics in NT [12]. On the ethics of laboratory conduct e. g. conducting hazardous procedures and taking prohibited shortcuts, the study found that 72% of respondents thought it was unethical to perform hazardous procedures without informing their bench-mates. However, only ~19% would report shortcutting behaviour to management and 24% would not take no action such as trying to dissuade the offending member from taking the prohibited shortcut. Nonetheless, almost three fifths of respondents believed that clear ethical guidelines were necessary for responsible conduct of nanotech research.

NT research in South Africa has progressed rapidly in the last 10 years, especially in the fields of water treatment, energy and drug delivery [13–17]. However, as in other regions of the world, far less is known about researchers' perceptions of the ethical issues around nanotechnology. Using measures from the U. S. study, this investigation mapped the views of NT researchers at the University of South Africa (UNISA) on issues including:

1. The ethical aspects of NT and of their research e. g. in laboratory conduct;

2. How well informed on ethical issues in NT researchers considered themselves;

3. Whether researchers were willing to learn more about the ethical issues in NT.

METHODS

Data for this study were collected using paper and pencil surveys in March and April 2016. The survey was made up of two parts: the first (Part A), probed respondents' general and specific views of ethics in NT research, and the second (Part B) collected demographic, educational and occupational information. Thirty five (35) respondents were researchers from the Physics and Chemistry departments as well the Nanotechnology and Water Sustainability Research Unit (NanoWS) at the University of South Africa. They consisted of graduate students, postdoctoral scholars, technicians and academic staff (doctors and professors).

The first four questions of the survey, (Questions A 1 to A 4), probed general attitudes towards ethics in NT research using Likert-type responses *e. g.* strongly disagree, somewhat disagree, agree as much as disagree, somewhat agree, strongly agree. Question A5 probed attitudes on specific issues including ethics in laboratory practice, the use of hype to influence decisions and the responsibility to anticipate and alert authorities on unethical downstream applications. Other issues that were probed include ethics in research and development e. g. the role of commercial interests, the responsibility to report on the possibility of dangerous downstream applications by various practitioners, ability for self-regulation and necessity for clear ethical guidelines for practitioners.

NOTEWORTHY FINDINGS

This section presents some of the results of this study, in particular, the levels of awareness and interest in EIRNT, general attitudes towards and interest in EIRNT, and, finally ethics in laboratory conduct and communication (hype).

(i) Levels of interest in and awareness of EIRNT

Levels of interest in and awareness of ethical issues in nanotechnology research were probed directly using the following questions:

— How interested are you in ethical issues related to NT?

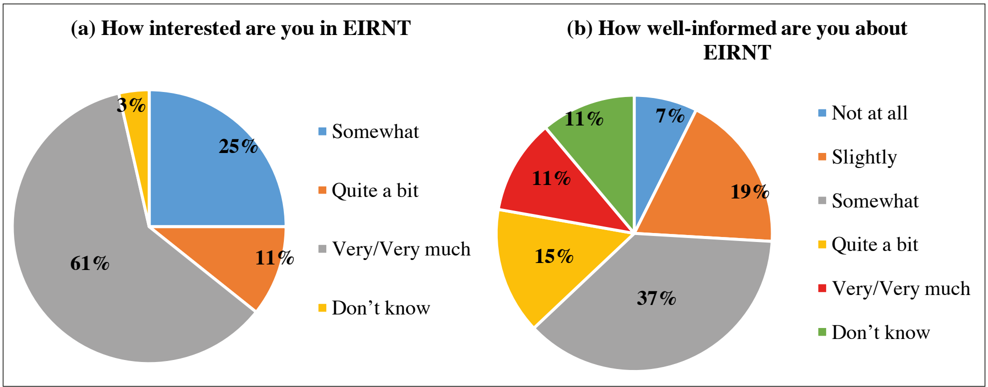


Figure 1. Levels of interest in and awareness of EIRNT amongst survey respondents

— How well informed do you believe you are about ethical issues related to NT?

The responses showed that up to 97% of respondents were interested in EIRNT (Figure 1 a). Despite this, only 26% felt they were sufficiently informed about EIRNT; most felt they were either somewhat or only slightly aware if these issues. As most respondents were students, this finding provides a glimpse of future nanotechnology professionals with respect to awareness and consideration of ethical issues. If there is consensus that researchers need to consider EIRNT around their work, then ways of inculcating ethics in their training are worth looking into. Fortunately, such an exercise is likely to be positively received because 81% of respondents were willing to invest time in learning more about EIRNT and up to 97% believed, strongly or somewhat, that the study of ethical issues needed to be a standard part of the education of future scientists and engineers.

(ii) General attitudes towards and interest in EIRNT

The following four questions were used to gauge general attitudes towards and interest in EIRNT among respondents:

A1: „'There are significant ethical issues related to nanotechnology." To what extent do you agree or disagree with this statement?"'

A2: „How interested are you in ethical issues related to nanotechnology?"

A3: „How important do you believe it is that ethical issues related to nanotechnology be considered?"

A4: „In your opinion, how does the importance of the ethical dimension (E) of the nanotech field compare with the importance of the scientific dimension (S) of the nanotech field?"

Sixty one percent (61%) of the respondents felt strongly that there were significant ethical issues related to nanotechnology while a further 7 and 14 % agreed somewhat or were „on the fence" regarding the issue. On the other hand, 14% disagreed somewhat or strongly, and a further 4% were not aware of any ethical issues (Figure 2a). Interest in ethical issues was recorded to be high: 57 % of survey re-

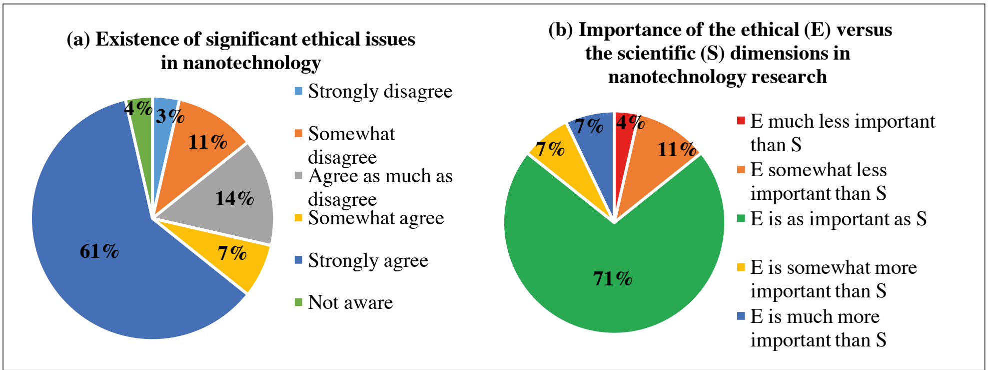


Figure 2: Respondents' views on (a) the existence of significant ethical issues in nanotechnology and (b) the relative importance of ethical and scientific dimensions in NT research

spondents were very interested, while 18% were quite interested and a similar fraction somewhat interested. Nearly two thirds of the respondents regarding felt that it was very important for ethical issues be considered in NT research while a further 18 and 11% felt that ethical issues merited quite some or moderate consideration, respectively. The final question in this introductory section (A 4) attempted to gauge how nanoscientists weighed ethical issues against the scientific issue which were more central to their everyday practice. Seventy one percent (71%) regarded ethical ad scientific issues as having equal importance but 15% felt that the former was of either somewhat or much less importance than the latter (Figure 2 b).

These results give a preliminary picture of the views of survey respondents on ethical issues in NT and lay the background to views on specific issues. The fact that most respondents had a personal interest in EIRNT is encouraging because it implies that the surveyed NT researchers give thought to the wider implications of their work and not just the scientific aspects of it. It also means that fertile ground exists for further sensitization and inculcation of EIRNT.

(iii) Ethics in laboratory conduct

Ethics in laboratory conduct were assessed by several questions including A 5 A and D below. The former question addressed ethics by researchers in managerial positions i. e. those that direct work / productivity in the laboratory while the latter spoke to individuals' conduct in laboratory processes.

A5(A) A nanotech scientist demands that her/his research assistant produce the results the scientist expects, quickly and at any cost.

A5(D) An experienced nanotech researcher, never involved in a lab accident, plans to carry out in the lab for the first time what s/he realizes is a potentially hazardous procedure, and to do so without informing the workers who share her/his bench.

Sixty five percent (65%) of survey respondents thought it was either completely or somewhat unethical for a laboratory manager to demand that an assistant produce specified results at any cost (Figure 3 a). This finding was encouraging because it showed that despite the fact that a major proportion of respondents were students, they understood what could or could not be demanded of them. Of interest, however, is the demographic that thought that such a demand was either completely ethical (4%) or that ethics was irrelevant to the action. Perhaps the latter group would be swayed otherwise if they were sensitized on ethical issues. Eighty six percent (86%) of respondents reported that they had never taken an ethics course.

On the other hand, three quarters of respondents thought that conducting a potentially hazardous experiment without informing other researchers on the same bench was completely unethical, even if the person conducting the experiment had no record of lab accidents to their name (Figure 3 b). Once again, a small minority felt that this was ethical or that ethics was irrelevant to the action and while this is a cause for concern, it serves to further strengthen the argument for ethics education.

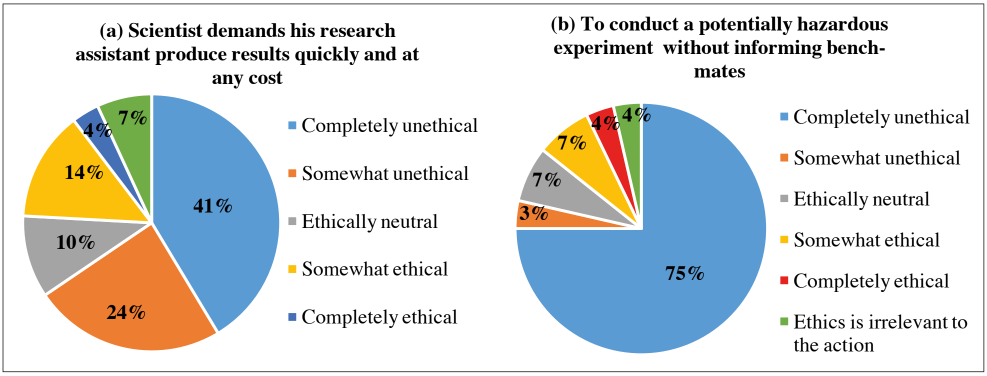


Figure 3: Respondents' views on ethical issues around laboratory conduct

Question A 7 was then asked to gauge laboratory culture and approaches to unsafe laboratory practice i. e.

A 7: For several weeks, a nanotech lab researcher has been taking a relatively safe, timesaving shortcut in doing her/his work. This shortcut clearly violates published laboratory procedures. So far, no unfortunate results have occurred because of this behavior. Other lab users know that s/he is taking the shortcut.

Which of the following do you think would be the two most likely responses to this situation by users in your nanotech lab? (Place „1" in front of the most likely response in your lab and „2" in front the second most likely response in your lab.)

_______A Users would report the individual to lab management.
_______B Users would cease having professional contact with the individual.
_______C Users would approach the individual and try to persuade her/him to stop taking the shortcut.
_______D Users would start taking rule-violating shortcuts of their own.
_______E Users would take no action and the situation would continue unchanged.
_______F Users would make this situation a matter of public debate at the lab.

Respondents were thus being asked to expose the general culture of their laboratory with respect to unsafe practices by nominating actions they thought fellow laboratory members would take. The question was qualified by the mention of factors which would resonate with many laboratory researchers i. e. that the procedure was relatively safe and that it was taken to save time. Respondents were given several options and asked to choose the most likely and the second most-likely action that they would take.

Most respondents felt that the offending researcher would be persuaded to change their ways as a first measure and that reporting the individual was only a second option, perhaps if the offender would not be persuaded. An interesting finding was the demographic that felt that nothing would be done about it and or that other members in the laboratory would start taking their own shortcuts (Figure 4).

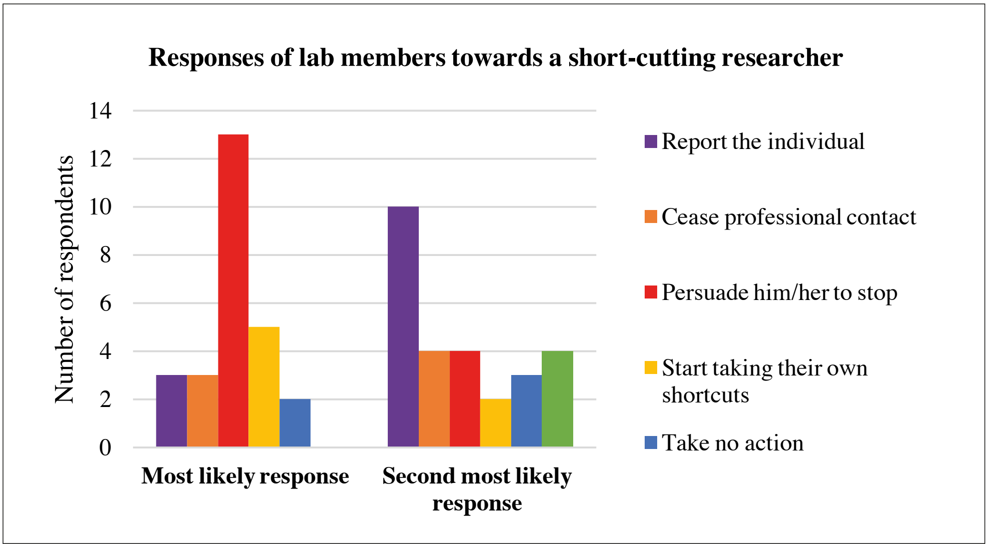


Figure 4: Responses of laboratory members towards a short-cutting researcher

This is of concern because these two actions particularly would only act to entrench the shortcutting behaviour because then „everyone is doing it". These results are similar to those reported in the McGinn study [18] where persuasion was the most likely first response (43.8% of respondents) but a substantial fraction (24%) reported that the culture was such that no action would be taken. Only 19% felt that the offender would be reported to management. Perhaps therefore, the overriding response offenders, despite the differing settings, would be to avoid confrontation.

(iv) Hype in communication

Hype in communication may be applied in various scenarios e. g. in funding proposals or to convince member of institutional and parliamentary committees of the merits of an application or proposed project. Such claims as „being able to transform life as is currently known" and „being used to cure currently incurable diseases" have been associated with NT. While there may be some truth to them, the time frames sometimes linked to them may make these claims hype. We asked respondents whether the use of statements that may be considered more of hype that actual fact was ethical. Question A 5 (J) interrogated the whether it was ethical for a researcher writing a funding proposal to describe the benefits of her/his project as greater than s/he expects them to be. Only 18% of respondents thought that such an action was completely unethical. The majority (32%) felt that it was only somewhat unethical and 25% felt that the issue could be looked at either way *i. e.* ethically neutral. The rest (24%) felt that such action was somewhat or completely ethical. Perhaps such a result speaks to (i) how researchers view ethical issues when project funding is at stake; some may be willing to say anything to secure funding and (ii) how researchers respond to questions on ethical issues when the risk of harm is indirect *i. e.* as opposed to a dangerous procedure in the laboratory. Researchers, however, need to be persuaded that both issues carry significant ethical weight.

CONCLUSIONS

In conclusion, this survey of NT researchers yielded encouraging results especially in terms of their receptiveness to EIRNT. Thus, despite not being particularly well informed about EIRNT, NT researchers at UNISA believe that these should be a standard part of their training and are willing and eager to learn more. This should be seen as an opportunity for action in order to ensure that well-rounded NT researchers.

Instruction on EIRNT is also likely to convince those who are currently neutral concerning certain ethical issues as well as those who hold improper views e. g. not informing lab bench mates about dangerous procedures or taking one's own shortcuts in response to others' shortcutting. We hope that this work lays a foundation for the inclusion of some form of instruction to NT researchers at UNISA and nationwide.

REFERENCES

[1] J. Wolfe: „Top 10 Nanotech Products of 2004" *Forbes/Wolfe Nanotech Rep. vol. 3. 2004. p. 1–3.*

[2] Y. Hiraku, F. Guo, N. Ma, T. Yamada, S. Wang, S. Kawanishi and M. Murata: „Multi-walled carbon nanotube induces nitrative DNA damage in human lung epithelial cells via HMGB 1-RAGE interaction and Toll-like receptor 9 activation" *Part. Fibre Toxicol. vol. 13. 2015. p. 16.*

[3] K. Donaldson, C. A. Poland, F. A. Murphy, M. MacFarlane, T. Chernova and A. Schinwald: „Pulmonary toxicity of carbon nanotubes and asbestos — Similarities and differences" *Adv. Drug Deliv. Rev. vol. 65. 2013. p. 2078–2086.*

[4] Y. Song, X. Li and X. Du: „Exposure to nanoparticles is related to pleural effusion, pulmonary fibrosis and granuloma" *Eur. Respir. J. vol. 34.2009. p. 559–567.*

[5] K. A. D. Guzmán, M. R. Taylor and J. F. Banfield: „Environmental risks of nanotechnology: National Nanotechnology Initiative funding, 2000–2004" *Environ. Sci. Technol. vol. 40. 2006. p. 1401–7.*

[6] R. D. Handy, F. von der Kammer, J. R. Lead, M. Hassellöv, R. Owen and M. Crane „The ecotoxicology and chemistry of manufactured nanoparticles: *Ecotoxicology vol. 17. 2008. p. 287–314.*

[7] A. Baun, S. N. Sørensen, R. F. Rasmussen, N. B. Hartmann and C. B. Koch: „Toxicity and bioaccumulation of xenobiotic organic compounds in the presence of aqueous suspensions of aggregates of nano-C (60)" *Aquat. Toxicol. vol. 86. 2008. p. 379–387.*

[8] boycottgillette. com.

[9] J. Nikkinen: „On the relationship between social ethics and environmental nanotechnology", *1st ed., Elsevier, 2010.*

[10] N. Invernizzi and G. Foladori: „Nanotechnology and the Developing World: Will Nanotechnology Overcome Poverty or Widen Disparities" *Nanotechnol. Law Bus. vol. 2. 2005. p. 294–304.*

[11] A. Dowling, R. Clift, N. Grobert, D. Hutton, R. Oliver, O. O'neill, J. Pethica, N. Pidgeon, J. Porritt, J. Ryan, A. Seaton, S. Tendler, M. Welland and R. Whatmore: „Nanoscience and nanotechnologies: Opportunities and uncertainties" *2004. p. 1–116.*

[12] R. McGinn, Ethics and nanotechnology: „Views of nanotechnology researchers" *Nanoethics. vol. 2. 2008. p. 101–131.*

[13] A. A. Farghali, M. Bahgat, A. Enaiet Allah and M. H. Khedr: „Adsorption of Pb (II) ions from aqueous solutions using copper oxide nanostructures", *Beni-Suef Univ. J. Basic Appl. Sci. vol. 2. 2013. p. 61–71.*

[14] A. Etale, H. Tutu and D. C. Drake: „Application of maghemite nanoparticles as sorbents for the removal of Cu (II), Mn (II) and U (VI) ions from aqueous solution in acid mine drainage conditions" *Appl. Water Sci. 2014.*

[15] A. Etale, H. Tutu and D. C. Drake: „The effect of silica and maghemite nanoparticles on remediation of Cu (II)-, Mn (II)- and U (VI)-contaminated water by *Acutodesmus sp.*", *J. Appl. Phycol. vol. 28. No. 1. January 2016. p. 251–260.*

[16] K. Mphahlele, M. S. Onyango and S. D. Mhlanga: „Efficient preparation of greener N-doped carbon nanotube composites for water treatment by the microwave polyol method" *Environ. Chem. Lett. vol. 11. No. 4. 2013. p. 353–358.*

[17] A. Pouris: „Nanoscale research in South Africa: A mapping exercise based on scientometrics" *Scientometrics. vol. 70. 2007. p. 541–553.*

[18] R. McGinn: „Ethics and nanotechnology: Views of nanotechnology researchers" *Nanoethics. vol. 2. No. 2. 2008. p. 101–131.*

Rajendra K. PACHAURI*

CLIMATE CHANGE AND ITS TECHNOLOGICAL IMPLICATIONS

Abstract: The paper highlights the structural strengths of the Intergovernmental Panel on Climate Change (IPCC) and the manner in which it functions to create a link between scientific assessment and policy making. Results and findings are presented from the Fifth Assessment Report (AR 5) of the IPCC to highlight the current knowledge on climate change and projections for the future. Technology is shown to be a major driver of changes that are currently taking place, and the potential of future technologies highlighted in the context of solutions that would need to be implemented for reducing the risks from the future impacts of climate change. A transformation is advocated for the development and use of science and technology, so that the survival of species and health of natural ecosystems can be ensured on the basis of knowledge which already exists in the AR 5 of the IPCC.

* Former Chairman, Intergovernmental Panel on Climate Change (IPCC), 2002–2015; Trustee, World Academy of Art & Science

Science, robust knowledge and government policy

Sitting at the interface between science and politics, the IPCC assessment process has sustained a working dialog between the world's governments and scientists since its inception in 1988. Representatives of 194 participating governments agree on the scope of the assessment, elect the scientific leaders of the assessment, nominate authors, review the results, and approve the summaries written for policymakers.

Communicating the results of IPCC assessments is challenging because of the range and complexity of climate science and response options and the increasing need to speak to audiences beyond scientists and governments.

The IPCC is unique in the way it combines an intergovernmental form with scientific objectives. Representatives of participating governments (the Panel), in consultation with members of the Bureau, determine the scope of the assessment and review and accept the reports, and thousands of scientists from all over the world devote their professional expertise to carry out the assessment. This combination of responsibilities has yielded a landmark series of global assessments related to climate change and sustained the interest and support of governments on a critical set of policy-relevant climate issues.

Key Messages

➜ **Human influence on the climate system is clear**

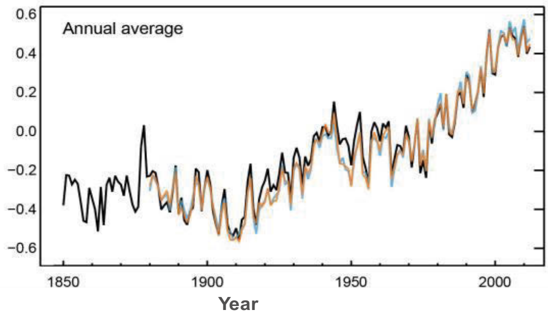
➜ **The more we disrupt our climate, the more we risk severe, pervasive and irreversible impacts**

➜ **We have the means to limit climate change and build a more prosperous, sustainable future**

AR5 WGI SPM, AR5 WGII SPM, AR5 WGIII SPM

Humans are changing the climate

It is extremely likely that we are the dominant cause of warming since the mid-20th century

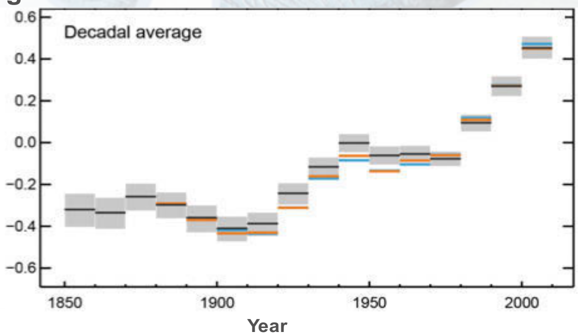


Globally averaged combined land and ocean surface temperatures

AR5 WGI SPM

Temperatures continue to rise

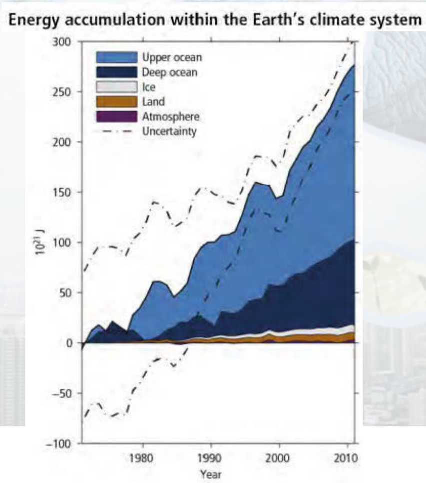
Each of the past 3 decades has been successively warmer than the preceding decades since 1850



Globally averaged combined land and ocean surface temperatures

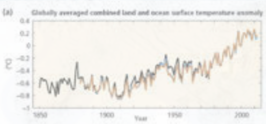
AR5 WGI SPM

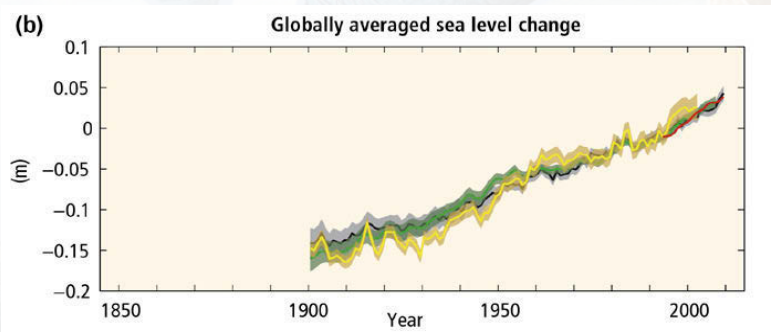
Oceans absorb most of the heat



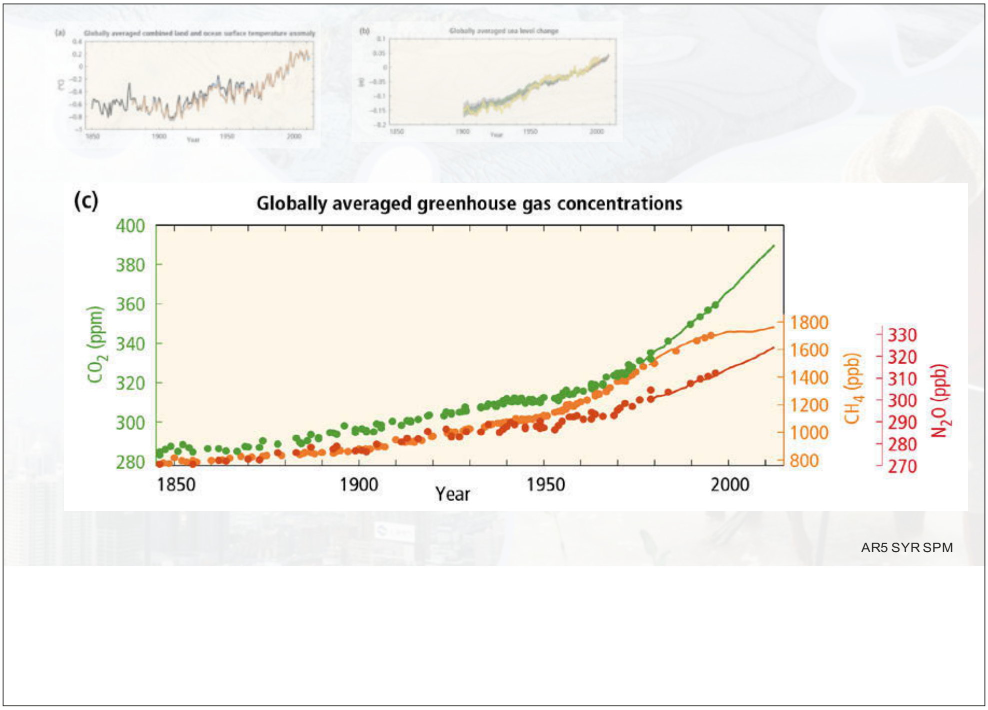
- More than 90% of the energy accumulating in the climate system between 1971 and 2010 has accumulated in the ocean
- Land temperatures remain at historic highs while ocean temperatures continue to climb

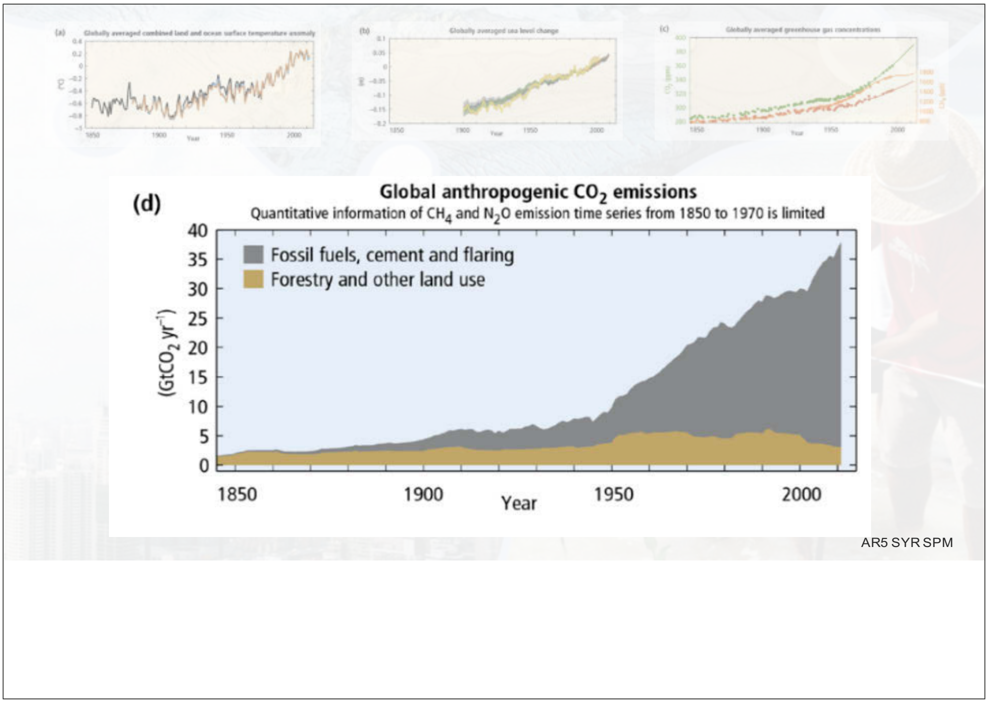
AR5 SYR

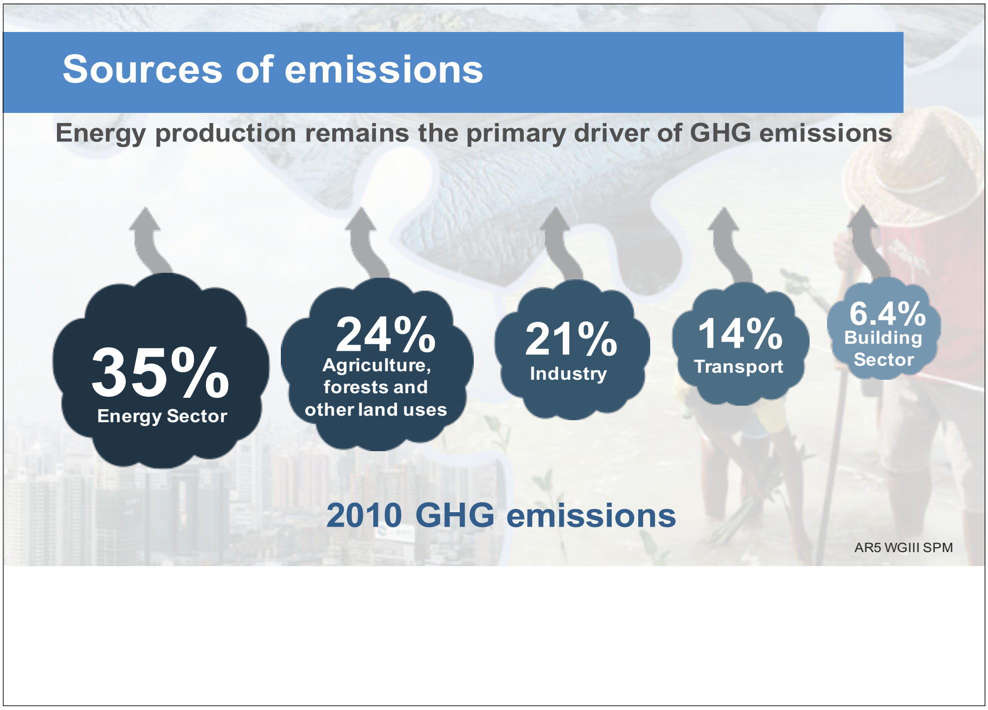




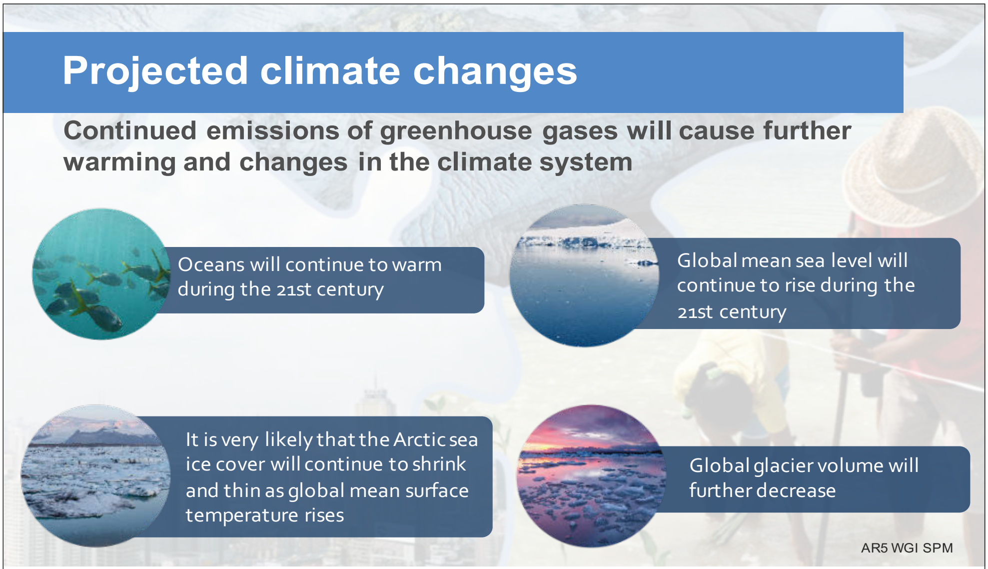
AR5 SYR SPM

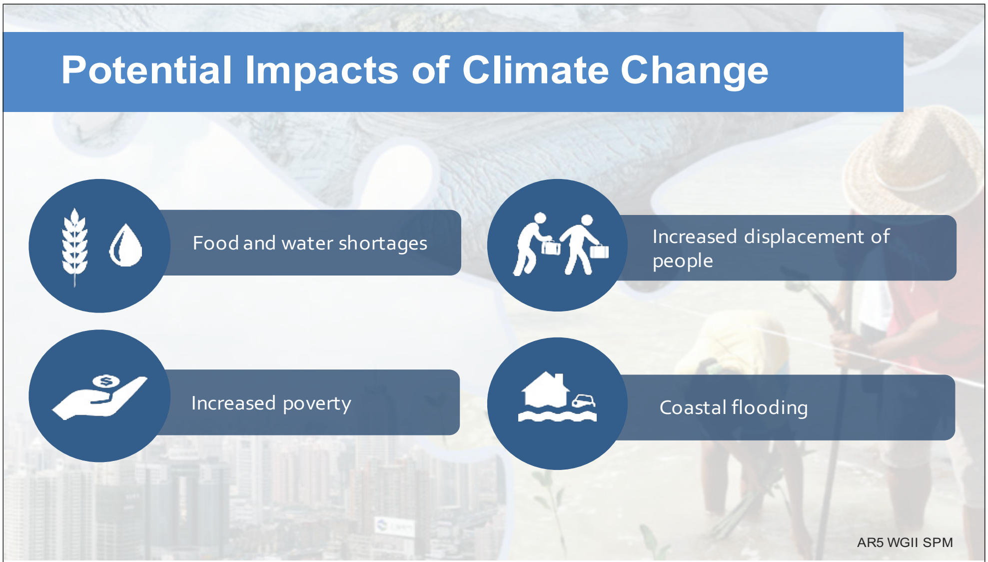

(c)
Globally averaged greenhouse gas concentrations
CO_2 (ppm)
400
380
360
340
320
300
280
1800
1600
1400
1200
1000
800
CH_4 (ppb)
330
320
310
300
290
280
270
N_2O (ppb)
1850
1900
Year
1950
2000
AR5 SYR SPM

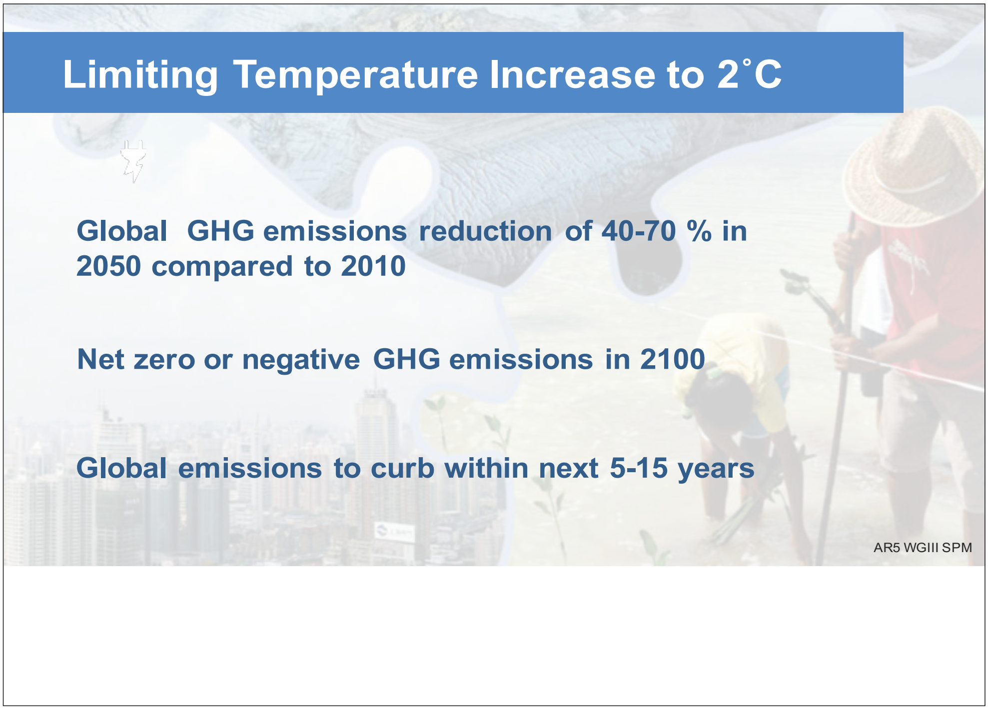

(d)
Global anthropogenic CO_2 emissions
Quantitative information of CH_4 and N_2O emission time series from 1850 to 1970 is limited
Fossil fuels, cement and flaring
Forestry and other land use
($GtCO_2$ yr^{-1})
40
35
30
25
20
15
10
5
0
1850
1900
Year
1950
2000
AR5 SYR SPM

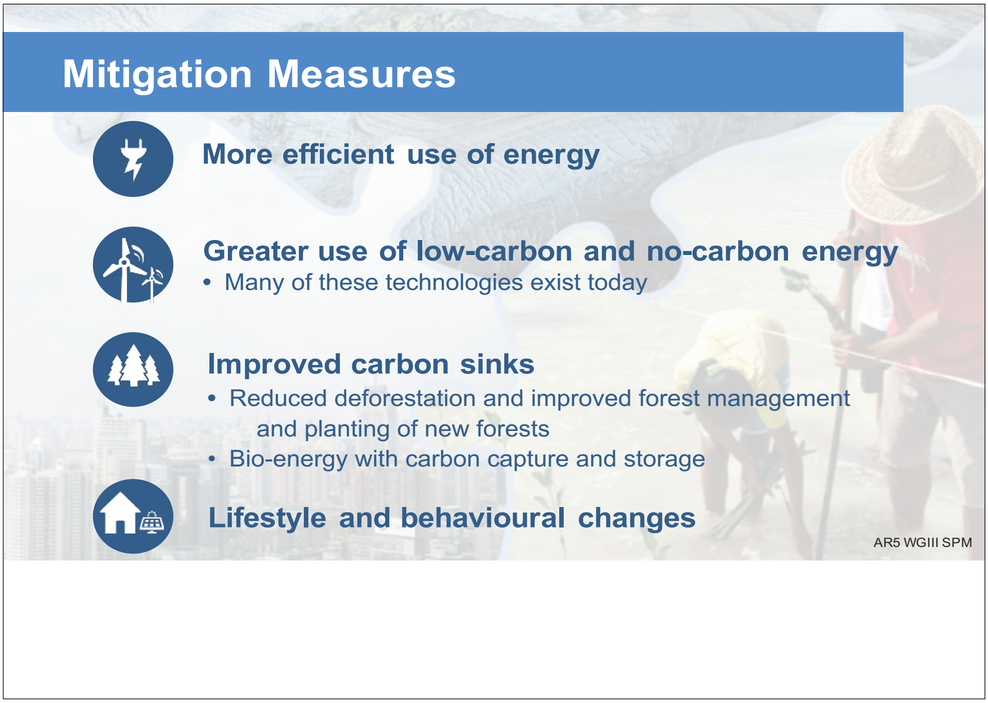

Sources of emissions
Energy production remains the primary driver of GHG emissions
35%
Energy Sector
24%
Agriculture, forests and other land uses
21%
Industry
14%
Transport
6.4%
Building Sector
2010 GHG emissions
AR5 WGIII SPM

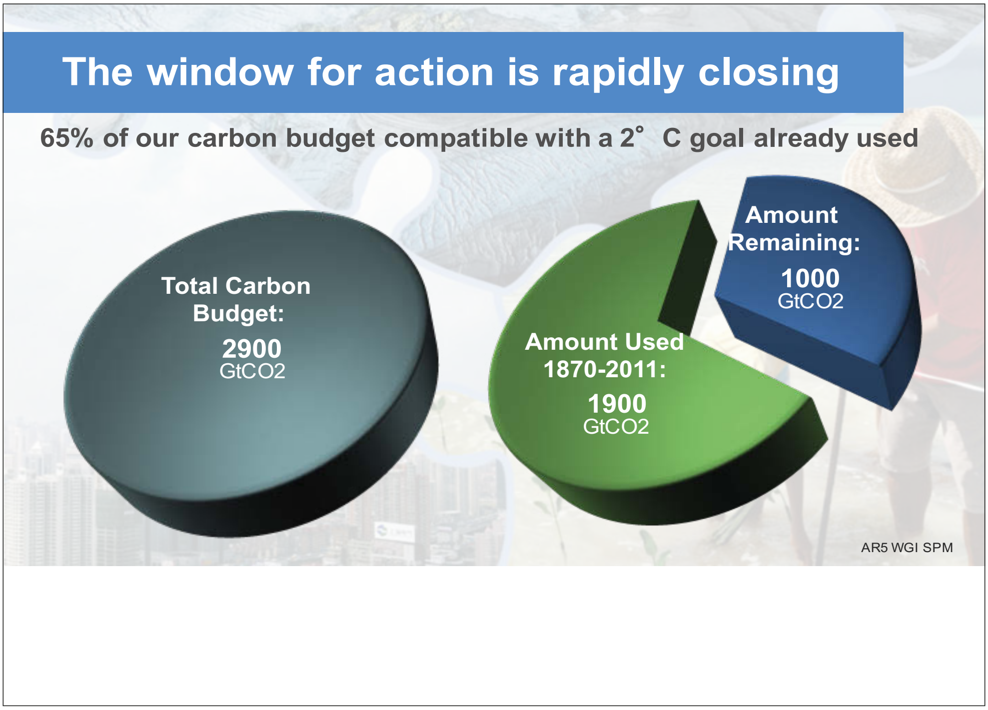

Some of the changes in extreme weather and climate events observed since about 1950 have been linked to human influence
AR5 WGI SPM

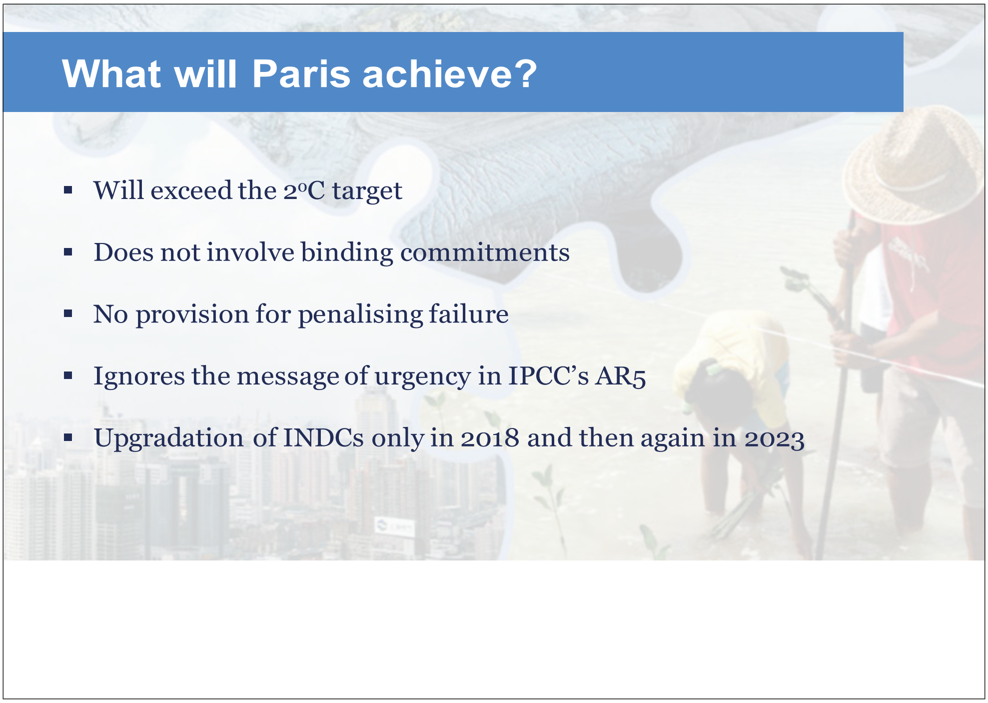

Projected climate changes
Continued emissions of greenhouse gases will cause further warming and changes in the climate system
Oceans will continue to warm during the 21st century
Global mean sea level will continue to rise during the 21st century
It is very likely that the Arctic sea ice cover will continue to shrink and thin as global mean surface temperature rises
Global glacier volume will further decrease
AR5 WGI SPM


Potential Impacts of Climate Change
Food and water shortages
Increased displacement of people
Increased poverty
Coastal flooding
AR5 WGII SPM


Limiting Temperature Increase to 2˚C
Global GHG emissions reduction of 40-70 % in 2050 compared to 2010
Net zero or negative GHG emissions in 2100
Global emissions to curb within next 5-15 years
AR5 WGIII SPM


Mitigation Measures
More efficient use of energy
Greater use of low-carbon and no-carbon energy
• Many of these technologies exist today
Improved carbon sinks
• Reduced deforestation and improved forest management and planting of new forests
• Bio-energy with carbon capture and storage
Lifestyle and behavioural changes
AR5 WGIII SPM


The window for action is rapidly closing
65% of our carbon budget compatible with a 2° C goal already used
Total Carbon Budget:
2900
GtCO2
Amount Used 1870-2011:
1900
GtCO2
Amount Remaining:
1000
GtCO2
AR5 WGI SPM


What will Paris achieve?
Will exceed the 2°C target
Does not involve binding commitments
No provision for penalising failure
Ignores the message of urgency in IPCC's AR5
Upgradation of INDCs only in 2018 and then again in 2023

All stakeholders on board

- Essential for governments, businesses and research organisations to evaluate compliance with 2°C limit
- Greatest assurance of 2°C limit lies in RCP 2.6 scenario
- Hence, essential for global society to constantly evaluate commitments against RCP 2.6 as a pathway
- INDCs dependent on level of ambition in different societies
- Hence, crucially important to raise the level of ambition worldwide

What is the POP Movement?

- Addresses the Urgent Need to Share Information and Knowledge Among Youth About Solutions to:
  - ➜ Achieve Sustainable Development Goals
  - ➜ Mitigate Climate Change
  - ➜ Adapt to the Impacts of Climate Change

POP PROTECT OUR PLANET

Why the POP Movement?

- Current Lack of Knowledge, Awareness and Inertia to Implement Climate Change Solutions are a Major Gap in Action
- The POP Movement Will Create and Serve the Massive Demand for Action That Can Be Implemented in Schools, Colleges and Communities Worldwide
- Knowledge About Climate Change Solutions Will Be Provided as Part of the POP Movement

POP PROTECT OUR PLANET

What Does POP Do?

- **The POP Movement:**

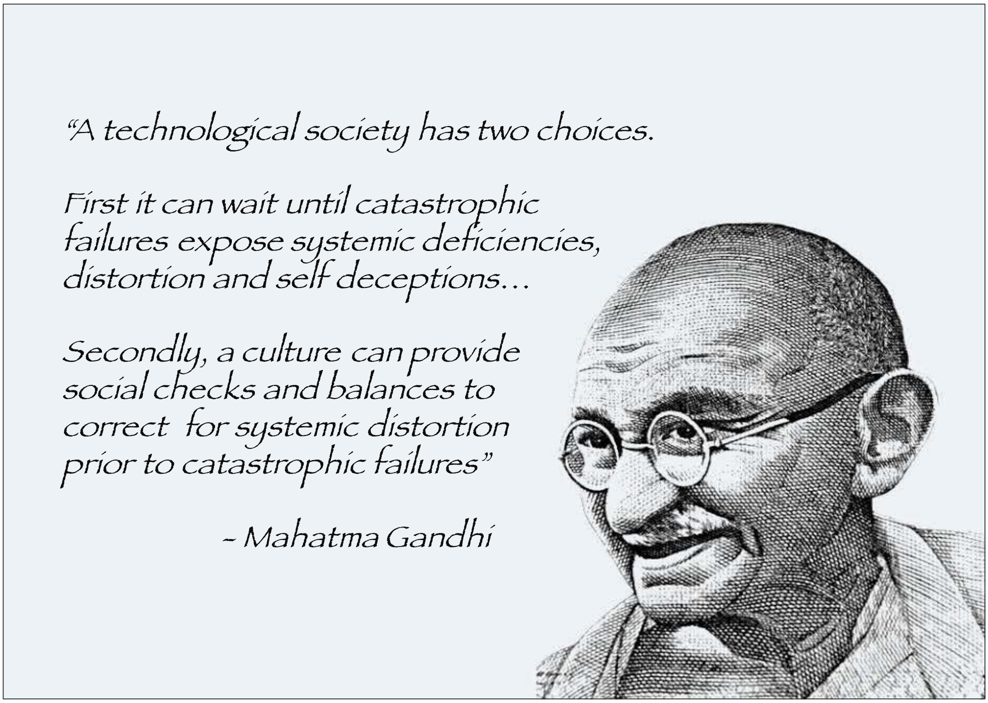
❖ Mobilizes Young People Globally to Protect Our Planet

❖ Promotes Collective Action, Especially Among Youth to Implement Solutions Needed to Mitigate Climate Change

❖ Recognizes and Reward Youth-Led Actions, Exemplary Initiatives, and Success Stories

POP PROTECT OUR PLANET


POP Festival in New York, 2016
POP Will Host a Festival in New York
➜ Showcase Youth Action to Protect Our Planet
➜ Launch US Partnerships
➜ Support Networking and Cross-Learning
BROADWAY


"A technological society has two choices.
First it can wait until catastrophic failures expose systemic deficiencies, distortion and self deceptions…
Secondly, a culture can provide social checks and balances to correct for systemic distortion prior to catastrophic failures"
- Mahatma Gandhi

Tibor TÓTH*

GLOBAL REGIMES OF WEAPONS AND TECHNOLOGIES OF MASS DESTRUCTION (WTMD): IS SCHRÖDINGER'S CAT DEAD OR ALIVE? WILL WIGNER'S FRIEND SPEAK OUT?

Thought experiments applied to diagnose the state of health of WTMD regimes and their external environments:

— **Schrödinger's cat** https://en.wikipedia.org/wiki/Schr%C3%B6dinger%27s_cat
— **Wigner's friend** https://en.wikipedia.org/wiki/Wigner%27s_friend

Question No 1: Super-positioned realities? Is Schrödinger's cat (WTMD regimes and their external security environment) **dead or alive**?

Question No 2: Will Wigner's friend (**scientists**) **speak out** whether Schrödinger's cat is dead or alive?

	CAT ALIVE	CAT DEAD
REGIMES & REGULATIONS	Adequate	Suboptimal
WEAPONS & TECHNOLOGIES ENVIRONMENT	Managed	Out of control
„BIG PICTURE" ENVIRONMENT	Muddle through	Tension, arms races and major wars

Weapons and technologies of mass destruction: a short primer
— Chemical
— Biological
— Nuclear

WTMD **regulations:** a short primer
— Global regulations

* Ambassador, Executive Secretary Emeritus (CTBTO)

— Global regimes
— Global regulators
— Timelines and trends

A WTMD regulator **revisiting** global regulations
— Chemical: revisiting after 20 years
— Biological: revisiting after 15 years
— Nuclear: revisiting after 3 years

Regimes and regulations context: **old vectors**
Diminishing military stockpiles
WTMD eclipsed by climate change and sustainability issues

Regimes and regulations context: **new vectors**
— Steady growth of industries and sciences: chemical and bio
— Unfulfilled promises: nuclear
  — Nuclear renaissance and 2008 crisis: financing dichotomies
  — Fukushima
  — Sustainable energy: complementarity or competition
  — Still investing in nuclear? How to justify rationals
    — profitability,
    — safety/security
    — energy cost
— Latency increase
  — Defense embedded
  — Industry (and R&D) embedded

Regimes and regulations context: **triple fatigue**
— Regulation fatigue
— Intergovernmental organizations (and NGO) fatigue
— Cooperation fatigue

Shifting interest from more regulated **towards less regulated** technologies & areas
— from more regulated (chemical) to less regulated (biological)?
— With stockpile reduction (chemical and nuclear) interest shifting from weaponized stockpiles towards less regulated, industry-based capabilities (so-called latency)
— From technologies covered to varying degree by global regulations (chemical, biological and nuclear) interest shifting towards unregulated domains (ICT, robots)

Governance shifts: **global** governmental organizations **eclipsed**?
— New state-level governance framework: „major league" renaissance
  — UNSC,

  - — G 7/8
  - — G 20
  - — G 40 plus
- — Topics
  - — Nuclear security
  - — Terrorism & weapons and technologies of mass destruction
  - — diseases
- — new competing models
  - — bottom-up: Médecins Sans Frontičrs;
  - — mixed (private/public): The Global Fund to Fight AIDS, Tuberculosis and Malaria
  - — top-down: nuclear security summit
  - — mass-collaboration (mixed): International Panel on Climate Change (outside)

Moving from **microscopic to macroscopic**
— regimes looked upon in isolation? Not enough.
— WTMD looked upon in isolation? Not enough.
— macroscopic „big picture" view imperative

„Big picture" environment: **old drivers** — more relevant than ever
— Terrorism & security
— Irrational state behaviour?
— Geopolitical tectonic shifts

„Big picture" environment: game-changer **new drivers** ?
— home-grown terrorism / uprisings
— civil wars
— drifting towards major (power) wars
— isn' t it just Déjà vu?

„**Big picture"**: beyond WTMD environment and beyond WTMD regimes
— From the 2008 Great Recession towards a **Faith Depression**?
— Are we engulfed in a **Mindustrial Revolution**?
— Both at the same time? Mutually complicating synergies?
— Implications of their joint intersection with
  - — Collective psyche
  - — International security and
  - — Weapons and technologies of mass destruction
  - — Are we sleep-walking towards a **Great Security Depression:** an all-out major (powers) global conflict

Faith Depression: risk of collective emotional hijacking?
— Continued economic and distribution malfunctions?
— After the economic bubble the collective psyche bubble to burst?

— frustration, fear and anger
— impacting collective unconscience and conscience
— preeminence of collective raw emotions
— risk of ideological extremism and societal polarization
— Collective emotional hijacking by „savor" thought leaders: a historical déjà vu?
— populism
— antagonization
— trivialization of wars
— XXI century „emperors" a push of a finger away from weapons and technologies of mass destruction

Mindustrial Revolution
— A new age
— advances in computer and related sciences and technologies, machine learning, data mining, networking, robotics, cybernetics, enhanced human intelligence and artificial general intelligence
— reaching critical mass
— Unseen opportunities and new productivity paradigm
— new complexities
— enhanced tensions within society: old and new divisions
— safety, security and non-proliferation implications of new tensions

Parallel worlds
— Are we living at the same time in both, 1930 s and 2030 s?
— Superpositioned realities?

Are there **viable tools** to keep Schrödinger's cat („Big picture" security environment) alive?
— Invisible hand of market: self-correction historically had not worked at times
— 1900 s
— 1930 s
— 1900 s and 1930 s exit strategies: find the culprits outside of the economy (and the country) escaping into forging tension and massive armament programmes
— Quantitative Easing (QE) exhausting its potential? Any other viable financial or economic tool?

Déjà vu? The **pen-ultimate** „market correction"?
— antagonize, create tension and arm the nation
— „Qualitative Tension" replacing QE

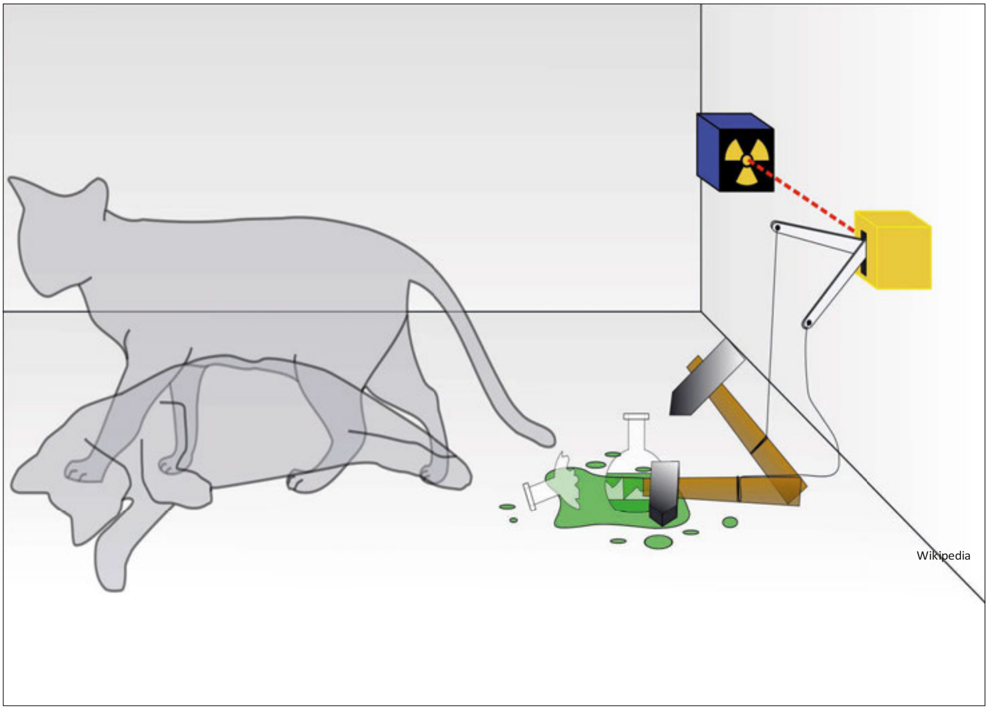
Ultimate „market correction": major power wars (again…)?
— Does not work in age of WTMD!!!
— This time is different: sending humanity back to the Middle Ages?

Will Wigner's friend (scientists) **speak out**? Resolve super-positioned reality?
— Schröder's cat is more and more alive
— while more and more dead?

Concerned scientists no more?
— Scientific rigor puts bonus on mainstream cautiousness
— Political correctness dictates no hyping and no alarmism ?
— Evidence-based science vs. policy-based evidence?
— Industry interests define narrative?
    — No risk-shadow or no image-shadow should fall on industry
    — Regulation fatigue: overall pushback on all type of risks
— Scientific community sleep-walking?
— Scientists emotionally hijacked and drifting with the rest of their society?
— Back to the 1950? Scientists eventually speak out?
— Or, back to the 1930 s or 1900? Scientific great divide?
    — Joining national causes
    — some justified, others wrong
    — some of self-preservation others of conquest and annihilation?

Quo Vadis? — „Eo Romam iterum crucifigi (I am going to Rome to be **crucified again**)".
— Que vadis, regimes? — Not enough!
— Quo vadis, weapons and technologies of mass destruction? — Not enough!
— Que vadis, scientists?
— Quo vadis, humanity?

Fool me once, shame on you.
Fool me twice, shame on me.
Fool ourselves thrice, shame on science and humanity.



Question No 1:

- Super-positioned realities?
- Is Schrödinger's cat (WTMD regimes and their external security environment) **dead or alive**?

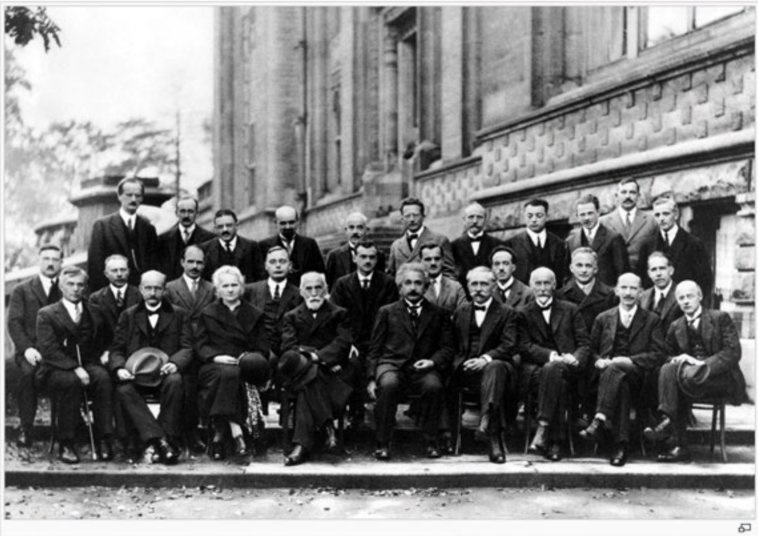
Question No 2:

- Will Wigner's friend (**scientists**) **speak out** whether Schrödinger's cat is dead or alive?

In the hindsight of a decade, did they speak out the right way and early enough?

Photograph of the first conference in 1911 at the Hotel Metropole. *Seated* (L-R): W. Nernst, M. Brillouin, E. Solvay, H. Lorentz, E. Warburg, J. Perrin, W. Wien, M. Skłodowska-Curie, and H. Poincaré. *Standing* (L-R): R. Goldschmidt, M. Planck, H. Rubens, A. Sommerfeld, F. Lindemann, M. de Broglie, M. Knudsen, F. Hasenöhrl, G. Hostelet, E. Herzen, J.H. Jeans, E. Rutherford, H. Kamerlingh Onnes, A. Einstein and P. Langevin.

In the hindsight of a decade, did they speak out the right way and early enough?



Piccard, E. Henriot, P. Ehrenfest, E. Herzen, Th. de Donder, E. Schrödinger, J.E. Verschaffelt, W. Pauli, W. Heisenberg, R.H. Fowler, L. Brillouin;

P. Debye, M. Knudsen, W.L. Bragg, H.A. Kramers, P.A.M. Dirac, A.H. Compton, L. de Broglie, M. Born, N. Bohr;

I. Langmuir, M. Planck, M. Skłodowska-Curie, H.A. Lorentz, A. Einstein, P. Langevin, Ch.-E. Guye, C.T.R. Wilson, O.W. Richardson

Fifth conference participants, 1927. Institut International de Physique Solvay in Leopold Park.

	CAT ALIVE	CAT DEAD
REGIMES & REGULATIONS	Adequate	Suboptimal
WEAPONS & TECHNOLOGIES ENVIRONMENT	Managed	Out of control
"BIG PICTURE" ENVIRONMENT	Muddle through	Tension, arms races and major wars

"Big picture" environment: **old drivers** – more relevant than ever

- Terrorism & security
- Irrational state behaviour?
- Geopolitical tectonic shifts

”Big picture” environment: game-changer **new drivers** ?
- home-grown terrorism / uprisings
- civil wars
- drifting towards major (power) wars
- isn’ t it just Déjà vu?

”**Big picture”**: beyond WTMD environment and beyond WTMD regimes
- From the 2008 Great Recession towards a **Faith Depression**?
- Are we engulfed in a **Mindustrial Revolution**?
- Both at the same time? Mutually complicating synergies?
- Implications of their joint intersection with
  - Collective psyche
  - International security and
  - Weapons and technologies of mass destruction
- Are we sleep-walking towards a **Great Security Depression:** an all-out major (powers) global conflict

Faith Depression: risk of collective emotional hijacking?

- Continued economic and distribution malfunctions?
- After the economic bubble the collective psyche bubble to burst?
  - frustration, fear and anger
  - impacting collective unconscience and conscience
    - preeminence of collective raw emotions
- risk of ideological extremism and societal polarization
- Collective emotional hijacking by ”savior” thought leaders: a historical déjà vu?
  - populism
  - antagonization
  - trivialization of wars
- XXI century ”emperors” a push of a finger away from weapons and technologies of mass destruction

Mindustrial Revolution

- A new age
- advances in computer and related sciences and technologies, machine learning, data mining, networking, robotics, cybernetics, enhanced human intelligence and artificial general intelligence
- reaching critical mass
- Unseen opportunities and new productivity paradigm
- new complexities
  - enhanced tensions within society: old and new divisions
  - safety, security and non-proliferation implications of new tensions

Parallel worlds

- Are we living at the same time in both,
  - 1930s and
  - 2030s?
- Superpositioned realities?

Are there **viable tools** to keep Schrödinger's cat ("Big picture" security environment) alive?

- Invisible hand of market: self-correction historically had not worked at times
  - 1900s
  - 1930s
  - 1900s and 1930s exit strategies: find the culprits outside of the economy (and the country) escaping into forging tension and massive armament programmes
- Quantitative Easing (QE) exhausting its potential? Any other viable financial or economic tool?

Déjà vu? The **pen-ultimate** ”market correction”?

- antagonize,
- create tension and
- „arm the nation”
- ”Qualitative Tension” replacing QE

Ultimate ”market correction”: major power wars (again...)?

- Does not work in age of WTMD!!!
- This time is different: sending humanity back to the Middle Ages?

Will Wigner's friend (scientists) **speak out**?
Resolve super-positioned reality?

- Schröder's cat is more and more alive
- while more and more dead?

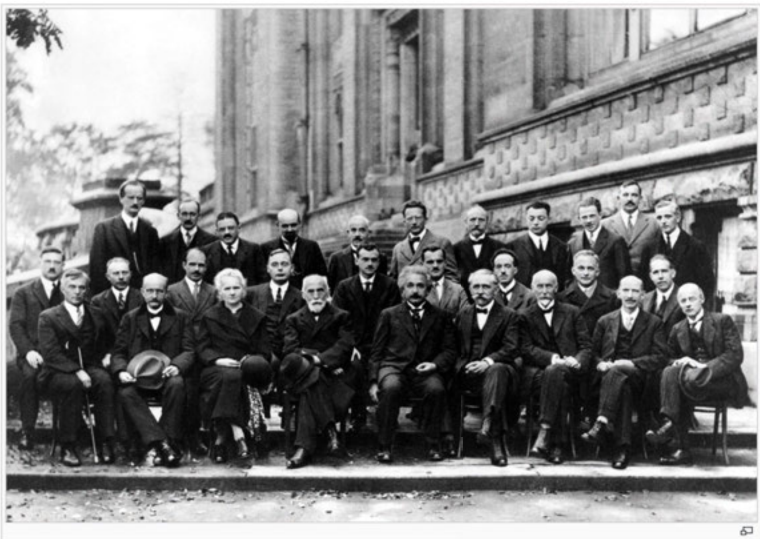
Concerned scientists no more?

- Scientific rigor puts bonus on mainstream cautiousness
- Political correctness dictates no hyping and no alarmism ?
- Evidence-based science vs. policy-based evidence?
- Industry interests define narrative?
  - No risk-shadow or no image-shadow should fall on industry
  - Regulation fatigue: overall pushback on all type of risks
- Scientific community sleep-walking?
- Scientists emotionally hijacked and drifting with the rest of their society?
- Back to the 1950? Scientists eventually speak out?
- Or, back to the 1930s or 1900? Scientific great divide?
  - Joining national causes
  - some justified, others wrong
  - some of self-preservation others of conquest and annihilation?

In the hindsight of a decade, did they speak out the right way and early enough?

Photograph of the first conference in 1911 at the Hotel Metropole. *Seated* (L-R): W. Nernst, M. Brillouin, E. Solvay, H. Lorentz, E. Warburg, J. Perrin, W. Wien, M. Skłodowska-Curie, and H. Poincaré. *Standing* (L-R): R. Goldschmidt, M. Planck, H. Rubens, A. Sommerfeld, F. Lindemann, M. de Broglie, M. Knudsen, F. Hasenöhrl, G. Hostelet, E. Herzen, J.H. Jeans, E. Rutherford, H. Kamerlingh Onnes, A. Einstein and P. Langevin.

In the hindsight of a decade, did they speak out the right way and early enough?



Piccard, E. Henriot, P. Ehrenfest, E. Herzen, Th. de Donder, E. Schrödinger, J.E. Verschaffelt, W. Pauli, W. Heisenberg, R.H. Fowler, L. Brillouin;

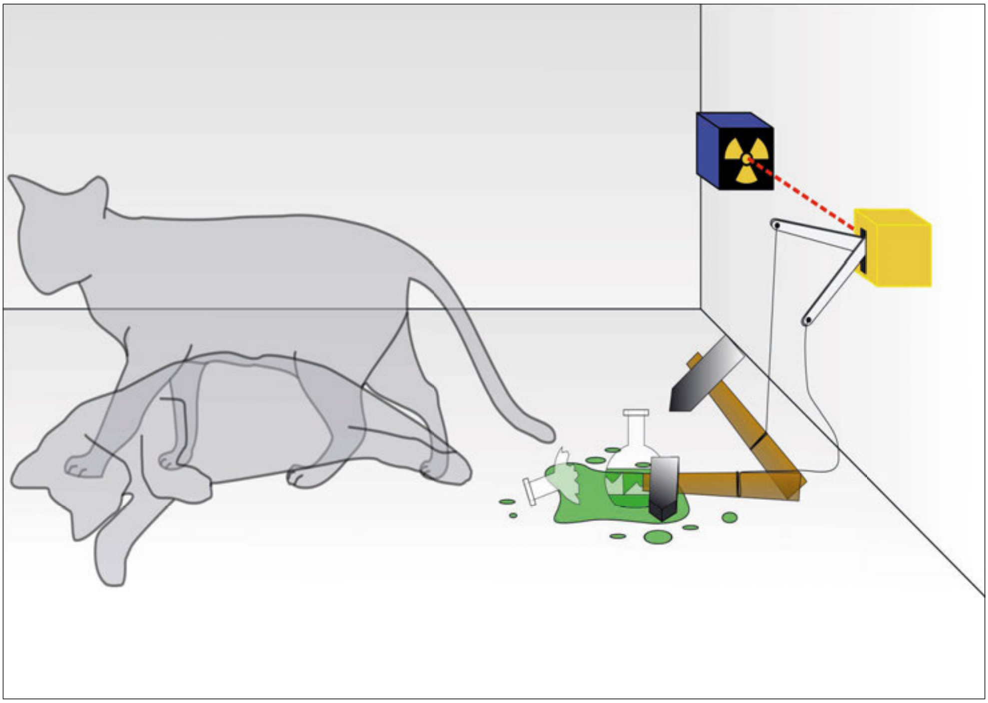
P. Debye, M. Knudsen, W.L. Bragg, H.A. Kramers, P.A.M. Dirac, A.H. Compton, L. de Broglie, M. Born, N. Bohr;

I. Langmuir, M. Planck, M. Skłodowska-Curie, H.A. Lorentz, A. Einstein, P. Langevin, Ch.-E. Guye, C.T.R. Wilson, O.W. Richardson

Fifth conference participants, 1927. Institut International de Physique Solvay in Leopold Park.

Quo Vadis? (Peter asks Jesus)
“Eo Romam iterum crucifigi
(I am going to Rome to be **crucified again**)”

- Que vadis, regimes? – Not far enough!
- Quo vadis, weapons and technologies of mass destruction? – Too far!
- Quo vadis, scientists???
- Quo vadis, humanity???



Ulric FAYL v. HENTALLER*
Gilbert FAYL**
Ivo GRGA***

SCIENCE + SOCIETY = POLICY-ADVICE

„…We are deeply convinced that sound, independent scientific advice largely improves the quality of policy- making. We welcome recent global trends for the more pronounced use of science in policy-making and the efforts to bridge the difficulties inherent in the roles of scientists and policy makers…

…We call on all scientists to monitor and assess policy areas and provide, in a pro-active manner, independent and timely science advice even when its application is not guaranteed or not expected…"

Final Declaration,
World Science Forum 2015, 7 November 2015, Budapest

Abstract: The paper is a response to the „Final Declaration" issued at the 2015 World Science Forum [1] that assembles some of the World's most prominent scientists and science advisers every second year. Alas, the comprehensive Declaration generally neglects the role of civil society.

The paper looks in more detail at the assertions by structures that argue to have the capability to provide scientific advice, as well as at the means by which the European Union obtains independent scientific advice. The paper aims to bring science down from its „ivory-tower" and more approachable and relevant to humanity.

Key words: *civil society participation, policy advice, early identification, evidence-based research*

INTRODUCTION

The usefulness of scientific advice to policy-making has been recognised for some time [2].

---

* Director, The Global Round Table / Personal Adviser to the Chairman, Hares Group.

** President, The Global Round Table.

*** Secretary General, The Global Round Table Croatia / President, European Movement, Split.

It is increasingly evident that, in view of the unprecedented challenges facing humanity and the environment, scientific advisory structures need to be improved – chiefly through strengthened interaction with civil society. This will increase the relevance and value of public research and thereby make it more useful to society in general. By the same token this approach will also strengthens one of the cornerstones of Western democracy: the system independent checks-and-balances of political structures by civil society – especially in the face of rising social instabili ty, fragmentation and even dissolution of societies, values, human rights and dignity.

According to a recent OECD policy paper [3]: „*The scientific community is increasingly being called upon to provide evidence and advice to government policy-makers across a range of issues … The rapid evolution of information and communication technologies and moves towards more participative democratic decision- making … What used to be 'private' debates between different scientific viewpoints over areas of uncertainty have now become public disputes that can be exploited by different stakeholders to confirm or deny entrenched positions …*"

Participative, democratic decision-making must include civil society in full. Its voice is indispensable. Particularly in a time when the World is moving towards a new Global Order [4] and the „European way of life" is being questioned from both in- and outside.

Our paper [5] takes a significant look at the foremost structures that claim to have the capability to provide scientific advice, as well as the approach by which the European Union obtains independent scientific advice.

Not included in this assessment are the diverse arrangements of individual government chief scientist who are „*willi ng recipients of the advice and the challenge is to collate the evidence and present it in the most effective way*" to the relevant senior government member (s). [6]

CAPACITY TO FORMULATE ADVICE

There are a wide range of bodies with the potential to formulate scientific advice in Europe, as well as worldwide.

Broadly speaking, these bodies can be classified in three groups depending on the authority of their initiators. Main examples are:

(i) The most perceptible advisory bodies are those that have been formally set-up on the basis of high-level political accord. Their potential influence is unquestionable. These bodies include:

— Under the United Nations and other Inter-Governmental agreements: a multitude of high-level advisory bodies;

— Within the European Union: European Economic and Social Committee, Committee of the Regions, European Parliament's own Science and Technology Options Assessment (STOA), European Commission's newly established High Level Group of Scientific Advisors, etc. In addition, the EU is annually spending many milli ons of Euros for supporting studies;

— Under National Governments: National Science Academies, governmental- and parliamentary advisory bodies, etc. As a rule, at least one National Science Academy exists in each developed country.

(ii) A second group of formally established bodies includes those that have been set-up by individual political parties, industry associations, societal actors, professional organisations, interest groups, education establishments, etc. Their focus is wide-ranging and they often combine advice formulation and targeted lobbying.

In Europe, a large number of these bodies operate in Brussels in the vicinity of the EU Headquarters; but without any formal link to the European Institutions, or any privileged access to them.

(iii)) The third group includes the bodies that are voluntarily set-up by:

— National Science Academies such as European Academies Science Advisory Council (EASAC), Federation of All European Academies (ALLEA), etc.;

— Government Science Advisors working together with National Science Academies such as International Network for Government Science Advice (INGSA), etc.;

— Non-governmental organisation with global membership of national scientific bodies and international scientific unions such as the International Council for Science (ICSU);

And,

— Individual civil society members such as: The Club of Rome, World Academies, European Academies (e. g. Academia Europaea, Académie Européenne des Sciences des Arts et des Lettres, European Academy of Sciences and Arts), scientific networks (e. g. Euroscience), various think tanks, etc. And of course, *The Global Round Table*. The list is long and ever growing.

Individuals determined to be recognised as 'science adviser' are often driving them; new structures are popping-up while others are phased-out.

The focus of the voluntary bodies is widespread and often combines formulating advice and targeted lobbying.

Experience has shown that political leaders prefer advice from sources that are recognised as 'generator of innovative ideas' that can be realised within their own political agenda and legislative horizon (say 4-5 years).

Therein lays the inherent risk of becoming too close to Party-politics.

As a general trend, both the formally established advisory bodies and the informal ones encompass disturbing shortcomings, in particular insufficient interface to- and representation of civil society, poor gender balance and limited, if at all, participation of youth. Due to these shortcomings, there is a realistic risk that these voluntary bodies are easily becoming self-entertaining 'academic discussion clubs' of older men. Indeed, this has- and is happening in numerous cases.

NEED FOR TRUSTWORTHY ADVICE

Formally established bodies have their own inherent quality control: the high-level users (who are usually also funding providers). Redundant and unreliable structures are abolished and closed down.

For *voluntarily established bodies* the situation is somewhat different in that they are often kept alive by a few (if not a single) ambitious individuals. Quality control and feed-back mechanism concerning their usefulness are rarely in place. There are also cases when more academic self-restraint would be helpful by ambitious promoters as they don't possess the necessary relevant international- / EU policy-making experience.

Optimally, trustworthy and useful advice necessitates strict fulfilment of a set of key requirements, viz.:

— Documented methodology to formulate advice: *what to look for and how?*

— Reliable provider: *has the receiver confidence in the provider*? And of course,

— Intellectual and moral openness of the receiver: *is he / she ready- and able to listen?*

— Communication opportunity: *does the provider have direct access to the receiver?* The receiver could be a political leader or his / her science adviser, e. g. government chief scientist.

In the absence of any of the above requirements, there is the likelihood that recommendations remain unexploited or, even worse, misused or misinterpreted.

This is exactly what happened in the recent past when – in spite of the massive advisory potential of various kinds that existed in Europe and Worldwide – the financial crisis took the World community by surprise.

And all the while other important challenges increasingly reared their head on the European political scene, namely large-scale uncontrolled migration into the EUs territory, as well as its main causes, the unstable situation in the Middle-East (war) and Northern-Africa (poverty). In addition, long-term energy supply and global warming are remaining other strategic challenges. The „Sword of Damocles" is hanging above Europe.

Critical observers must raise several thought-provoking questions: How could the recent financial crisis arise almost „un-noticed" and develop to the magnitude it did? Where were the EU's political leaders and key policy advisers? What else could this apparent laissez-faire approach lead to? Are we going to let the global situation worsen, until it leads to inevitable disaster? [7]

There is no shortage of dooms-day scenarios. [8] Currently, the most striking ones the authors have identified include:

— The uninhibited migration into the EU territory with the manifest social friction between groups of different cultural origins and the possible resulting collapse of the European social system;

— The emergence of large-scale international terrorism such as the so-called Islamic State (IS) and its spill -over effects into Europe;

— The upheaval of the geo-political status-quo in the EU's neighbourhood, notably strengthened Russian military influence, Ukraine / Russia tension, collapsed Arab Spring, etc.;

— The possibility of a lasting deformation of the current EU structure due to rising nationalist and separatist movements, e. g. the possible UK exit from the EU (Brexit);

And,

— The looming environmental catastrophe. Here, there are promising signals following the recent UN Framework Convention on Climate Change and adoption of the Paris Agreement; [9]

Finally,

— In many experts' opinion, the financial crisis is not yet over. The forecast for 2016 is, „*massive sacrifice of savings and jobs to prop up a 'systemically risky' global banking schemes … Life savings could be wiped out in a massive derivatives collapse … Poverty also kill s.*" [10]

Unquestionably, the global situation is – to state it candidly – unclear, turbulent and remains largely unpredictable. And new challenges may soon arise.

European political leaders are well aware of the seriousness of the situation. But they also known that the main concern of 'Mrs. Papanopoulus' in Greece and 'Mr. Gonzales' in Spain, and all other Europeans surviving at close to the existence minimum, is immediate and short-term: simply food and jobs – and prospects for the future. Evidently, it all boils down to jobs – in particular for the very large number of unemployed youth without any prospect for future. Thus, leaders, to state it unambiguously clear, most often prioritize short-term and quick fixes in view of the coming election.

European political leaders have their own inherent operational restrictions: all issues must be addressed within the framework of Western democracy. But Western democracy has its limits [11]: „*…the majority of the people are not qualified to decide – they are unaware of the catastrophic consequences that would ensue if their demands were to be met…*"

The reasoning is not new [12], „*…the problem is encapsulated by the simple fact that this painful passage through the 'valley of tears' lasts longer than the average period between elections, so that the temptation is great to postpone the difficult changes for the short-term electoral gains…*"

As a consequence, it will be necessary to scrutinise EU-level advisory bodies for their compliance with the afore-mentioned requirements. Our advice is to use only the best ones.

EU STRUCTURES FOR OBTAINING ADVICE

The EU has a two-track structure for *formally* obtaining scientific advice via its:

— formally established advisory bodies; and

— open procedures for requesting advice.

Membership in the formally established *scientific advisory bodies* is largely restricted to highly educated individuals, where academic achievement has preference to hands-on li fe experience. Civil society is kept at an arms-length. More particularly insufficient attention is paid to the interface to- and representation of civil society, including gender balance and age participation.

Yet, individuals who have failed in traditional educational systems could have similar or even more usefulness in forward-looking policy making. A few well-known examples include: Thomas Edison who was called 'addled' by his teacher; Albert Einstein who failed the entrance examination to the Eidgenössische Technische Hochschule (university) in Zurich; Bill Gates who is a university dropout; and Ingvar Kamprad (IKEA founder) who admitted to be dyslexic; and there are many more.

The *open procedures* to formally request advice from civil society on issues within the Commission's mandate – including scientific research – can happen via one of the following:

— the Commission takes initiative [13]; and

— a group scientists, researchers, etc. take the initiative [14].

In either case the procedures are complex and lengthy. One might easily get the impression that they are designed for 'pro-forma' opinion gathering on issues pre-cooked at the highest political level, rather than obtaining 'grass-root' views of real concern to civil society.

Also, the European Commission is in a position to dismiss a civil society initiative if it considers that the initiative falls outside of the mandate of its power. This has already happened in several cases, including the initiative 'STOP TTIP' (Transatlantic Trade and Investment Partnership) [15], where civil society organisations and individuals have expressed concern about the ongoing trade related discussion between the EU and the USA.

It is an example of how political leaders 'bulldozer-through' issues that could deeply influence the li fe of their constituencies without any public consultation. Another striking example is the German Government's decision to let the bulk of migrants ill egally enter into its territory, indeed to Europe, and put extreme pressure on the entire EU to follow suit. A public statement by German Chancellor Angela Merkel has seemingly accelerated the ill egal mass migration to the EU. [16]

At EU level, the current structures to formally consult civil society primarily seem to suit political leaders. These often prefer to remain in their ideological shell and are seldom truly interested in a true and necessary interface with civil society.

In particular EU schemes have a critical limitation: they are inadequately equipped as a forward-warning mechanism, viz. to 'ring the bell in time when a storm is brewing on the horizon' and there is an urgent need for high-level political intervention. This could, for example be the case at the onset of disruptive technologies [17].

Of course, individuals and groups may on own initiative be able to convey advice to EU officials. The outcome and usefulness of such partisan initiatives are uncertain. In particular, as it is not always easy to appreciate what constitutes the advice value behind the self-promoting rhetoric.

BRING-IN CIVIL SOCIETY

The authors' main observations are that scientific advisory structures in general and the EU scientific advisory bodies in particular, need to be strengthened with respect to their responsiveness to unexpected development as well as interface with civil society.

Also, the EU's procedures would gain in usefulness if they were simplified and made more easily approachable by lay-persons.

For the EU system, such bold moves would increase the relevance and value of its publicly funded research making it more societally responsible and useful. In particular, it would lead to:

— early identification of scientific challenges and technological threats;
— more relevant evidence-based research, including societal research;
— open new avenues for innovation with societal relevance;
— help test new pioneering ideas for the benefit of humanity; and
— improved confidence in taxpayers' well-spent money on EU supported research.

The capacity to actively recognise at the outset unexpected developments with broader societal significance and better monitor its development – thus assist political leaders to better respond in time – would be a particularly valuable improvement.

The enhanced interface with civil society would also provide an active and democratic quality control of- and feed-back mechanism to current policy actions, and provide forward-looking input to future ones.

We recommend that one way to enhance interaction with civil society is to set-up an *independent civil society 'letter-box'* to which individuals could signal ('vox populi') significant '*deviation from expectation*' they observe / experience. Here, information should be assembled, screened and as relevant directed to the appropriate formally established EU advisory structure.

This, in turn, would assess the need and timing for scientific advice to political leaders, and if so, formulate it. Such a complementary initiative must have a light structure not to increase the already existing jungle of opaque initiatives in the field.

In the authors' opinion the afore development would also have a valuable side effect. Offering citizens the possibility of more involvement in EU matters would boost attention to the *Core Values* adhered to in Europe.

Here the role of younger generation is particularly important now and even more in future, for example when these fundamental values are being questioned, if not directly attacked, from inside and/or outside.

The Core Values adhered to in Europe are practised through the European way of life, viz.:

— Primacy of the individual human being;
— Equality between men and women;
— Dignity and human rights;
— Democracy and secular governance;
— Rule of law and equality under the law; and
— The endeavour to achieve environmental sustainability with full respect for the ecosystem.

More attention to these Core Values would be a most welcome development as the EU is facing an immediate double challenge: how to respond to the emerging new

Global Order, while grappling with an uncontrolled large-scale migration into its territory.

Moral fortitude may well be Europe's ultimate guardian of the European way of li fe.

It would also reinforce EU's moral responsibility and commitment to:

— Its historic minorities, where following various rounds of international political bargaining during the 20 th Century, millions of people in Central-East- and South-East Europe have found themselves in new countries as a consequence of the movement of national borders; .

— The newly arriving migrants, where moral responsibility towards migrants must be balanced with moral and political responsibilities towards constituencies; and

— The countries / regions of migrants' origin mustn't become deprived through loss of its youth, best educated individuals and most active entrepreneurs.

All in all, we suggest that our recommendation would strengthen one of the key foundations of Western democracy: the independent checks-and-balances in our political system by civil society.

CONCLUSIONS

The unprecedented challenges facing humanity and the environment necessitates that scientific advisory structures need to be upgraded. In particular, the interaction with civil society must be strengthened.

Such bold decisions will make science more useful to policy-making and more relevant to humanity.

This approach will further strengthens one of the cornerstones of Western democracy: the system independent checks-and-balances of political structures by civil society – especially in the face of rising social instabili ty, fragmentation and even dissolution of societies, values, human rights and dignity.

Eventually, development in this direction will help better identify emerging issues of societal relevance and formulate in time related scientific advice for political- and societal leaders.

Providing advice to political- and societal leaders isn't the privilege of selected elite in an „ivory tower".

REFERENCES

[1] The World Science Forum is an international conference series on global science policy since 2003. It calls together some of the World most prominent scientists and has the ambition achieving the same global strategic impact on science and science policy as the World Economic Forum in the field of global economic policy. http://www.sciforum.hu/

[2] A prominent example is the „Manhattan Project", which led to production of nuclear weapons. http://www.atomicarchive.com/History/mp/

[3] „*Scientific Advice for Policy Making: The Role and Responsibility of Expert Bodies and Individual Scientists*", OECD Science Technology and Industry Policy Paper, No 21, OECD, 25 March 2015. http://dx.doi.org/10.1787/5js33l1jcpwb-en

[4] The transition to a new Global Order with a disproportionally enhanced power of finances has been in progress for some time. According to Roman Herzog, President of Germany (1994-1999), at the global scale the EU is experiencing four particularly prominent challenges:
(i) The evolution of a multipolar world with superpowers and larger blocks of states rather than the traditional national states that play key roles;
(ii) The need to give European values such as the value of the individual resonance in the world insofar as is possible, and to secure their continuance in Europe against threats from within and without;
(iii) To stabilize the influence of Europe in the world to the extent that Europe can sit at the negotiating table with equal rights and equal weight when the Americans, Chinese and Russians discuss the future world order;
(iv) Increasing and mostly cheaper, economic competition from developing countries.
The statements were made before the onset of the current massive uncontrolled migration into the EU territory.
Roman Herzog, „We Ought To Be EU-Sceptic", Spiegel Online International, 23 May 2014.

[5] The paper draws on the authors' own publications:
(i) Gilbert Fayl, Ulric Fayl v. Hentaller, „*The Glory and Misery of Academic Workshops of Prof. Antoni Kuklinski*". Contribution to a publication in preparation, 2016, Warsaw.
(ii) Ulric Fayl v. Hentaller, Gilbert Fayl, Ivo Grga; Agni Vlavianos Arvaniti; Dóra Görög, „*Morality – the Ultimate Guardian*", contribution to „*Towards the Global Order — or Disorder? Disunity as an Existential Threat*" edited by Prof. Anton Kuklinski and Dr. Jan Woroniecki. In preparation, 2016, Warsaw.
And own initiative:
(iii) „*The Global Round Table 2015 Main Event, 9th of May 2015, Budapest*".

[6] Sir John Beddington, former UK Government chief scientific adviser, giving evidence to the House of Commons Science and Technology Committee in 2012. http://www.theguardian.com/science/political-science/2013/apr/04/science-art-advice-john-beddington

[7] Paraphrased after French President François Hollande, who rhetorically asked the question at a recent news conference following an EU Summit. His comment relates to the Ukraine – Russian situation. http://www.reuters.com/article/2014/08/30/us-eu-summit-idUSKBN0GU0C220140830.

[8] For example: Gilbert Fayl & Ulric Fayl v. Hentaller, „*Back to Basics*", The Third Lower Silesian Conference – Europa Quo Vadis?, 6 – 8 December 2012, Wroclaw.

[9] Paris, 30 November to 11 December 2015. http://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf,

[10] Ellen Brown, „*A Crisis Worse than ISIS? Bail-Ins Begin*", Max Fisher Financial War Report, 30 Dec. 2015. http://www.maxkeiser.com/2015/12/a-crisis-worse-than-isis-bail-ins-begin/#GtlJU1LAveTXskEv.99

[11] Slavoj Zizek, „*The West crises is one of democracy as much as finance*", The Guardian, 16 January 2013. http://www.theguardian.com/commentisfree/2013/jan/16/west-crisis-democracy-finance-spirit-dictators.

[12] Lord Rolf Dahrendorf, The Guardian, 19 June 2009, http://www.guardian.co.uk/politics/2009/jun/19/ralf-dahrendorf-obituary-lords-lse.

[13] „*Civil Society*” – European Commission's initiative that „*aims at providing information on issues that concern the Commission's consultation and dialogue with civil society*". http://ec.europa.eu/transparency/civil_society/

[14] „*The European citizens' initiative*” — Adopted by the European Parliament and the Council of the European Union, it „*enables 1 milli on EU citizens from at least seven EU countries to call on the European Commission to propose legislation on matters where the EU has competence to legislate*". It is a right that is enshrined in the EU treaties. http://ec.europa.eu/citizens-initiative/public/welcome

[15] http://www.euractiv.com/sections/trade-industry/commission-opposes-european-citizens-initiative-against-ttip-308406

[16] On 2 Sept. 2015 Angela Merkel stated that Germany expected to take at least 800,000 asylum seekers this year. By end-2015 the figure was close to 1 milli on. http: //www.theguardian. com/world/2015/sep/02/refugees-welcome-uk-germany-compare-migration. http://www.theguardian.com/world/2015/dec/08/germany-on-course-to-accept-one-mill ion-refugees-in-2015.

[17] Technologies t shat displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry; e. g. cloud computing has been a hugely disruptive technology in the business world, displacing many resources that would conventionally have been located in-house or provided as a traditionally hosted service. http://whatis.techtarget.com/definition/disruptive-technology

Paulo ALCANTARA GOMES*

TECHNOLOGICAL ADVANCES TO IMPROVE SOCIAL CHANGES IN BRAZIL

Abstract: Brazil is one of the ten largest economies of the world, characterized by its remarkable dimensions, high population and a substantial diversity of regional differences.

It has among its greatest challenges the facing of how to transform technological advances of its industry, its research institutes and the universities into a process of increasing knowledge in certain regions, thus resulting in the generation of qualified employments and income. Among the numerous actions currently in execution, we can highlight the creation of incubators and technology parks, that interact with industries, and contribute for the increase of competitiveness of enterprises, the identification of new opportunities for installing clusters and supply chains, the stimulation of handicraft production, strong mechanism to support the social changes and, surely the most important, expand the offers of quality education at all levels.

To achieve the objectives mentioned, several organizations are performing a leading role in the Country, specially SEBRAE, the Brazilian Institution of Support for Micro and Small Companies, a nationwide organization that operates in all Brazilian states, that ensures capacity and training to the technology-based entrepreneurs, and sets up the guidelines for the development of business plans and offers several courses to facilitate the operations of the enterprises and to enhance their competitive participation in the Marketplace. Universities and research institutes are largely responsible for the implementation and supervision of incubators and technology parks. In the case of local clusters and chains suppliers, there has been a significant effort carried out to expand its quantitative, and to ensure a more balanced regional distribution. However, the main challenge of all is in the education sector, in that, over 60% of municipalities, have no access to higher education, even in distance learning education programs.

This study aims to analyze the Brazilian initiatives to use innovation as an efficient tool to improve the competitiveness of companies, whilst a mechanism of employment generation, income achievement, and for the reduction of social and regional disparity levels.

* Former Rector at Federal University of Rio de Janeiro; President of the Brazilian Society for Education and Deputy Rector for Engineering and Innovation at Candido Mendes University- Rio de Janeiro- Brazil, and WAAS Fellow.

AN OVERVIEW OF HIGHER EDUCATION AND ITS RELATIONSHIP WITH THE ENTREPRENEURIAL CULTURE IN BRAZIL

It could be said that Brazil is a late starter in educational terms, as unlike most of the countries in Latin America whose universities began emerging at the onset of Spanish colonization, such higher education institutions only began to appear towards the end of the 19th century in Brazil with the first university being founded in 1920 as a result of the merger of three independent faculties of Medicine, Engineering and Law, which came together to form the nucleus of the present day's Federal University of Rio De Janeiro — UFRJ, one of the most respected institutions of its kind in our Country.

The development policies adopted and put into practice from the 1950 s were the driving force behind the extraordinary rate of growth witnessed by the country's industrial Park, and contributed greatly to expanding Brazilian higher education, which currently boasts 192 universities and around 2900 other non-university organizations equally dedicated to higher education.

Due to the growing demand for qualified technicians at this time, a professional education policy was put together encompassing three distinct types of institution: government financed, state financed (Brazil is a Federative Republic) and institutions financed by companies from the trade and services, industry, technology and agriculture sectors. This network, which operates through mainstream educational means, offering professional courses and courses for school leavers, in addition to non-mainstream educational means, running courses which offer certificates and additional courses, has been responsible for the increasing competitiveness of Brazilian companies.

Comprehensive and in-depth reforms were necessary at three separate time periods (at the end of the 1930 s, in the 1960 s and in the latter half of the 1990 s) due to the growth witnessed at all educational levels. The first two reforms were never seen through and the current reforms are nearing completion some twenty years after the new National Education Guidelines Law was passed. This process of growth is still in need of organization, and even though it has not led to the decrease and eradication of regional and social inequalities, it has enabled many universities and schools to swiftly consolidate themselves, which has had a positive impact on the generation of an entrepreneurial culture. As a matter-of-fact, legislation from the Brazilian Ministry of Education concerning the compilation of curricula now includes structured curricula contemplating entrepreneurial disciplines in virtually all the professions.

A second important factor for encouraging the deployment of initiatives directed towards an derives from the technological development model adopted by Brazil at the end of the '60 s, whereby universities were identified as the main sources of technological development, in line with Spanish and Portuguese tradition, with exceptions existing in the agricultural sector, due to the presence of the Brazilian Agricultural Research Corporation (**EMBRAPA**), and in the energy sector, due to large state-owned companies like **PETROBRAS and ELETROBRAS** or

EMBRAER, in the aeronautical sector. However, in all of the above cases there is a profound interaction with the universities.

In particular, the technology largely developed by **EMBRAPA**, was the main reason for the growth of agribusiness. It enabled the management of external debt and the accumulation of a significant amount of reserves. Also contributed to supplying the domestic market and boosted exports. Another important advantage from the technology developed by **EMBRAPA** was the great reduction in the cost of the „basic basket" (the main ingredients for meals), whose main beneficiary was the most poor, who spend most of their earnings on food purchases. During the period February 1976 to July 2012, the cost of the basic „basic basket" had accumulated an impressive reduction of 79.42%. This reduction ensured the success of income transfer programs for the poor population. Basically, the modernization of agriculture meant major redistribution of income and very important social changes.

The interaction between universities, Institutes of Research and these important Brazilian companies was one of the main responsible for the increase of graduate studies in Brazil. From the 1970 s public funding intended for Brazilian technological development and innovation was concentrated on providing masters and Ph. D. courses, in programs linked to the public and private universities. Today, are graduates in the country more than 45 000 teachers and 15 000 doctors each year. However, and unfortunately, only a small number of professionals graduating from these masters and Ph. D. courses switched over from scientific activity to other involving innovation and technological development in industry, resulting in

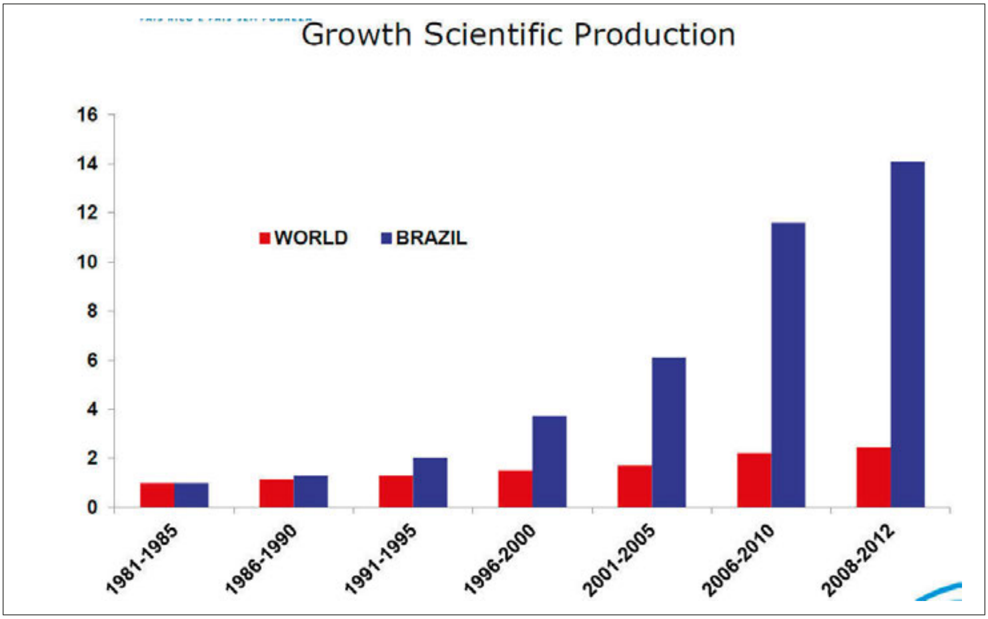


Figure 1

Table 1. Comparative Scientific Prodution, 2008–2013

Rank	Country	Articles	Citation	Impact	% Doc Cited	World %
1	USA	1.761.542	13.434.826	7,6	72,3	28,5
2	CHINA	724.568	3.100.154	4,3	62,4	11,7
3	GERMANY	458.907	3.374.761	7,4	71,9	7,4
4	ENGLAND	416.797	3.233.679	7,8	72,7	6,8
5	JAPAN	383.900	2.070.597	5,4	69,1	6,2
6	FRANCE	328.439	2.237.464	6,8	70,3	5,3
7	CANADA	284.794	1.985.068	7,0	71,6	4,6
8	ITALY	266.606	1.780.950	6,7	71,9	4,3
9	SPAIN	235.228	1.407.728	6,0	68,6	3,8
10	INDIA	215.311	766.141	3,6	59,4	3,5
11	AUSTRALIA	209.489	1.358.739	6,5	71,0	3,4
12	SOUTH KOREA	208.052	897.073	4,3	62,9	3,4
13	**BRAZIL**	**167.292**	**569.540**	**3,4**	**57,8**	**2,7**
14	NETHERLANDS	159.935	1.343.801	8,4	75,8	2,6
15	RUSSIA	140.970	395.494	2,8	48,4	2,3

the number of papers being published in journals growing significantly (Figure 1 and Table 1), but disappointing performance with respect to the registration of patents. It also contributes to the difficulties in the fostering of innovation the differ-

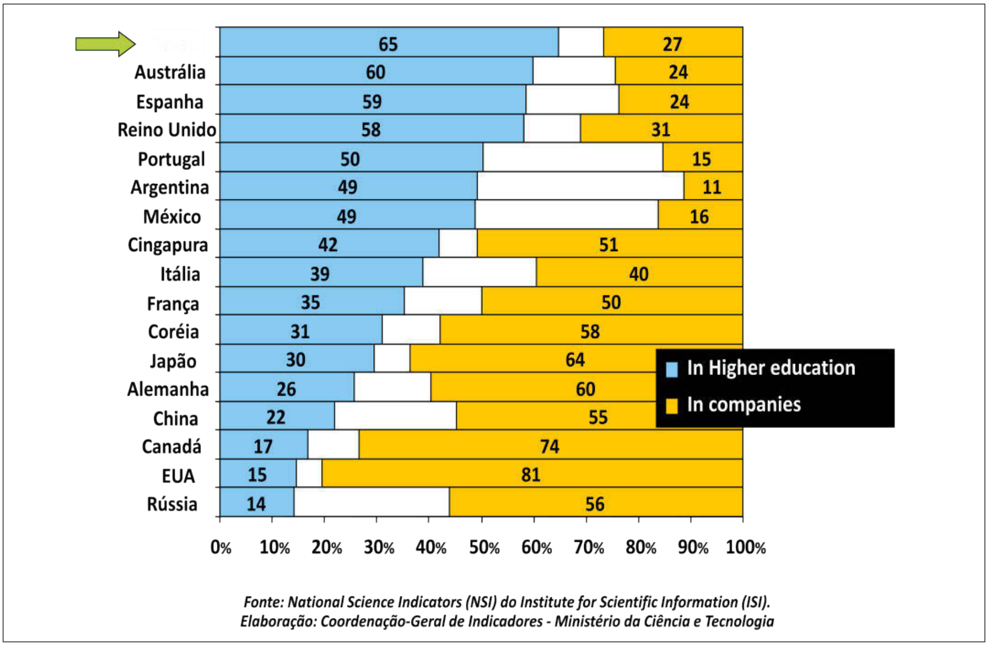


Fig. 3. The intellectual capital in wealth creation

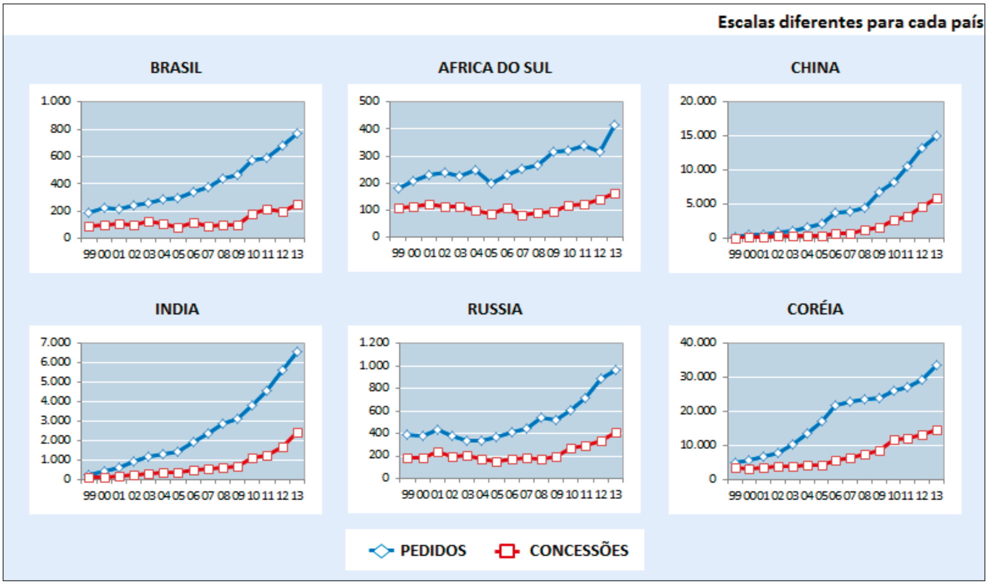


Fig. 4. Patents Requested and Granted (different scales for different countries)

ences in language and in the respective work environments observed in Universities, Research Institutes and Industry and the difficult interpretations, often contradictory in optics from the university and the company, especially on the expectations of industrial property. Thus, few masters and doctors migrated from scien-

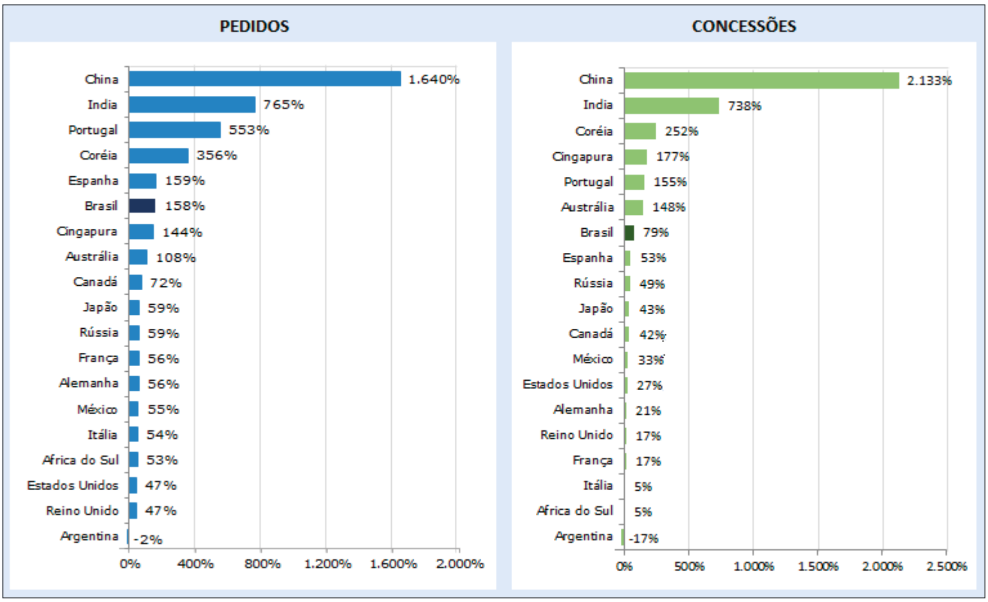


Fig. 5. Variation of Requested and Granted Patents 2000–2011

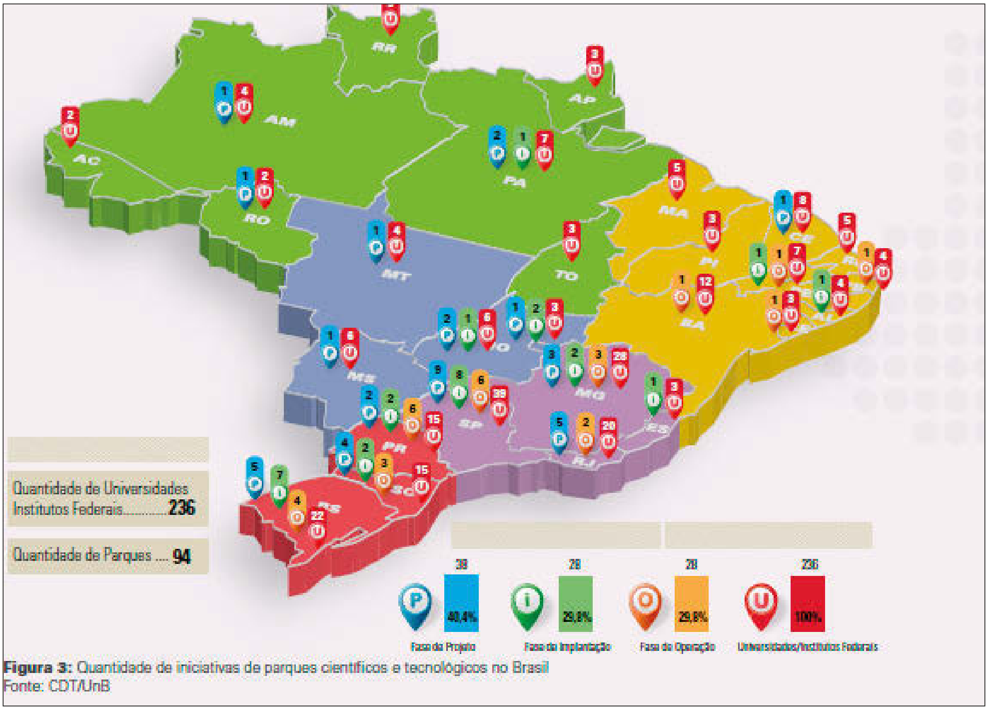


Fig. 6. Distribution of Technological Parks

tific activity to the innovation and technological development in the industry (Figure 3, 4 and 5).

Whilst we have achieved good results in scientific research, as a result of the model adopted we have been unable to meet the requirements of demands of Brazilian companies. This is why South Korea, which at the beginning of the 1980 s invested approximately the same amount of funds in science technology and innovation, which was geared towards companies, registered approximately 26 000 patents in the United States in 2013, whereas Brazil registered a mere 204. Figure 4 denotes the numbers of patents requested and granted by countries belonging to „BRICS”. Recent figures gave Brazil a discreet 65^{nd} place in the international competitiveness ranking.

Thus, since early of the 2000 s there has been a pressing need to redirect the University-Company interactive processes, creating mechanisms which increase Company competitiveness and speedup the entry into the international market. Generating an is now essential for the success of initiatives enabling results to be achieved both in local development and for meeting the new requirements thrown down by globalization. Getting academics to work on entrepreneurial initiatives is one of today's priorities for achieving technological and industrial development.

Thus, policies fostering the generation of technological parks and company development agencies and the installation of „” adopted by universities are now re-

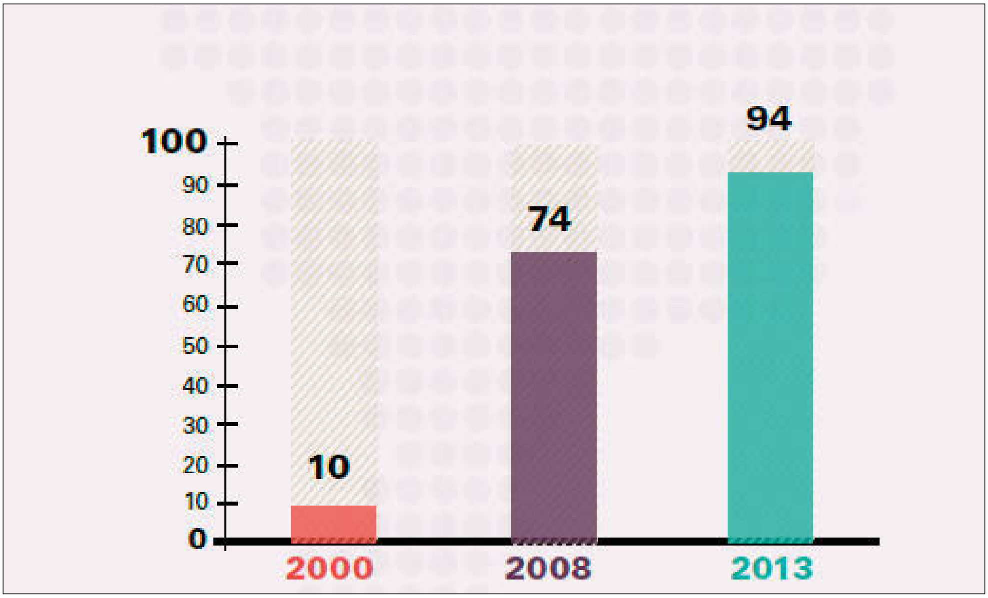


Fig. 7. Evolution of Technological Parks

ceiving substantial support from the agencies that foment science, technology and innovation, as well as and from the SEBRAE System (Brazilian Micro and Small Business Institute).

Brazil has 2,640 companies incubated in 384 incubators. The annual turnover of these incubated companies totaled R$ 933 million and that the jobs generated in incubated firms totaling 16,394 jobs. *Figures 6 and 7* give an indication of the evolution and the regional distribution of technological parks. (remember that Brazil has more than 8,5 million of square kilometers of surface).

The Local Clusters are also very important. The support for the development of productive clusters involves a number of challenges, such as the awareness and cooperation of the participants; the articulation of the various agents; identifying necessary improvements; and development of a „development plan" arrangement and establishing a transfer mechanism of resources.

Experiences in Latin America have shown that micro and small enterprises clusters face unfavorable economic conditions and serious bottlenecks that prevent improving the skills and entrepreneurial dynamism. Its potential competition is limited. In most cases, however, support measures can be taken to improve the survival of these clusters, provided they are important in creating employment opportunities. This effort should be aimed at breaking a vicious cycle of low investment. In a way, more growth and differentiation of mass producers have flourished in the era of import substitution, but the small, medium and even large producers are suffering enormous pressure with the transition to open economies. In clusters of developing countries, the challenge is to create an environment that stimulates and supports learning, innovation and, in general, to the sustainable economic and social development.

In Brazil, there are 677 local clusters (APLs), in 2,175 Brazilian municipalities, and responsible for more than *3 million direct jobs in 59 sectors of the Brazilian economy.* The data are from the Production Development Secretariat (PDS) Ministry of Development, Industry and Foreign Trade (MDIC).

APLs are intended to assist in the development of the regional economy. Since 2001, the federal government encourages and works for companies in the same industry or part of the same. The process of setting up development bodies has proven to be high important for generating an effective entrepreneurial culture. These organizations came into existence at the end of the 1990 s and have furthered the migration of researchers to the private sector, while simultaneously broadening the activities to help entrepreneurs of very small and small businesses.

Brazil currently has around *9,0 million very small and small businesses, including „MEI" (Individual Micro Entrepreneurship),* which account for:

— 48% of the national production, corresponding to 21% of GDP;

— 98.5% of the total number of companies in Brazil;

— 62% of the existing jobs;

Alongside these companies, some *10 million of the so-called* companies are in activity which, as is the case of those existing in other countries, are also responsible for providing a large amount of jobs. *Generating an entrepreneurial culture* within micro and small companies must be a pursued priority, in view of the following points:

a. Most of these companies carry out *incremental innovations;*

b. The majority of entrepreneurs do not have the experience nor the knowledge carry on the business they have elected or the area which they have chosen to operate in. Thus, more often it is not the issue of contents, but rather to have training capacity to perform entrepreneurial activities;

c. Moreover, entrepreneurs undertake their activities without having well structured business plans. It is quite commonplace (especially in modern-day Brazil) for businesses to be started up due to necessity and not as the result of a clearly defined proposal.

d. Entrepreneurs set up their businesses without the assurance of getting venture capital. Venture capital companies only provide financing to a small number of companies. Most business undertakings in Brazil started-up with family, angel or private capital, whereas venture capital is only obtained later on, when it is necessary to

Recently, FINEP (Brazilian Innovation Agency) started a financing program for innovative technology-based companies and companies operating in the sector of the creative economy In Rio de Janeiro, for example, the network of micro and small companies has been consolidating itself via their clustering with or chain participation with other local larger industries, which already account for a significant part of the State's GDP.

Based upon the above points, the universities and organizations working with Entrepreneurial activities and micro and small companies have been carrying on actions with the intention of amplifying the offer of „entrepreneurial education", seeking to provide courses to students of all levels of education, businessmen, co-operatives, trade unions and other representative bodies.

CHALLENGES AND ONGOING PROGRAMS- SOME EXAMPLES OF ACTIONS

To meet today's challenges, has been carried out numerous actions that include projects in the area of entrepreneurship, education for citizenship, and construction of curricular bases to ensure a supply of good quality education, to allow better results in international assessments and to ensure the employability of graduates of technical courses and high school.

a) IMPROVING THE QUALITY OF BASIC EDUCATION

In what has been called the „Age of Knowledge", the low quality of education reflects directly on the development of nations, putting in great disadvantage those that present worst performances in this aspect, when compared to others that already offer their citizens more and better educational opportunities.

In the last 20 years Brazil has made an important conquest: democratization of access to Fundamental School. Today 97.2% of the children between 7 and 14 years of age are in school — and in Rio de Janeiro this percentage reaches about 98.1% of the school-age population. Nevertheless, in the age bracket between 15 and 17, close to *15%* have already dropped out of school. As a positive factor, it must be emphasized that according to the Census of 2015, 47% of the economically active population have over 11 years of schooling, against 28% in 2000.

On the other hand, repeating grades and dropping out in Basic Education remain quite significant, resulting in an expressive rate of age-conclusion lag. Also worrisome is the performance of Brazilian students in the evaluation examinations organized by the Ministry of Education and by international organizations such as the *Programme for International Student Assessment* (PISA). These students placed far below the ideal level, principally in public schools: in the subjects Portuguese Language and Mathematics,

In this sense, actions aimed at improving the quality of Basic Education are indispensable and urgent in order to effectively ensure the sustainable development the country. Among such actions, the following deserve special mention:

— Strengthening the initial and continued training of teachers;

— Valorising teachers, especially in the scientific areas and those related to the environment and sustainable development;

— Updating school infrastructure;

— Effectively incorporating new educational technology;

— Developing entrepreneurial culture.

Such programs are being constructed in agreement with the regional development goals, stimulating social innovation and the association with the peculiarities of each region. Thus, for example, they are being created numerous training centers for crafts and for the training of qualified professionals for demands of local clusters.

SEBRAE recently inaugurated the Reference Center of Brazilian Handicrafts, designed to train craftsmen and to promote craft insertion in international trade flow

b) PROMOTING TECHNICAL AND HIGHER PROFESSIONAL TRAINING CONNECTED WITH THE ECONOMIC POLES.

Professional training is a crucial factor in improving the quality of life and economic development, fulfilling as it does a fundamental role, namely that of transforming knowledge into an asset applicable to productive and technological processes.

The contingent of enrolments in middle-level technical training courses is still small if compared with the number of enrolments in Middle School. With the advance of growth programs, this leads to the sectors of commerce and services, industry, agribusiness and technology suffering from the lack of qualified technical professionals, especially in the municipalities in the interior, where many companies have moved to in the last few years.

With regard to Higher Education, data gathered from the Ministry of Education (MEC) point out that only 14% of young Brazilians between the age of 18 and 24 are enrolled in this level of education, considerably lower than Argentina (32%) and the USA (50%). Besides this, information from the Center of Information and Data (CIDE) reveal that in the last few years about 45% of enrolments were directed to Applied Society Science courses and 16% to Health Science courses, whereas in Engineering and technology-linked areas this figure amounted to a mere 9%.

With this context in mind, the expansion and interiorization of initiatives aimed at technical and higher professional training, in tune with regional potentials and vocations, constitute decisive factors in the socio-economic development of the State. Implementing these measures will potentialize employability as well as technological innovation and higher levels of qualification.

c) USING THE TECHNOLOGICAL ADVANCES TO REDUCE SOCIAL AND REGIONAL DISPARITIES

One of the biggest challenges today is Brazil is the reduction of social and regional disparities. Each year the Brazilian public sector collects a considerable amount of taxes and, despite this does not offer quality services. Comparison with some other countries shows that the inefficient use of the resources collected, rather than any scarcity of same, explains the key disorder that lies at the root of the chronic problems faced in various essential areas such as Health and Labor Justice. Lack of transparency in the use of public resources is one of the main factors that produce the inefficient public management and corrupt practices from which no public instance is exempt. If society has no clear notion of the destiny of the taxes it pays, how can it appeal for results in a more energetic manner.

Ensuring transparency, facilitated access to information concerning budget matters is therefore of vital importance for development. A more involvement of organized civil society in public policies is indispensable in order to strengthen the position of the Brazilian States in the scenario of the Federation, to the extent that the elected representatives do not always have precise information about certain matters so that they can deliberate in a fair and efficacious fashion. The absence of such participation, together with the lack of articulation among our elected representatives, has led to significant losses in terms of State development.

It is imperative to qualify high contingent of the population to the opportunities that are being opened with the generation of employment and income in the environment enterprises, and in the national development programs, comprising housing projects, basic sanitation, infrastructure and logistics, use of wind and solar energies, abundant in the country and health.

Such challenges are demanding training programs, many of them carried out by SEBRAE, technological extension, to add value to products, development of handicrafts, benefit from diversity seen in the country and supporting regional development. Each year the Brazilian public sector collects a considerable amount of taxes and, despite this does not offer quality services.

SOME PROGRAMS IN DEVELOPMENT

a) THE SEBRAE PROGRAMS

SEBRAE has shown itself to be an organization which is dedicated to entrepreneurial education, both with respect to the vision of the entrepreneur as set forth by John Milton Smith and to foster and support the establishment new very small and small companies. In accordance with its strategic planning, which was updated in 2011, SEBRAE has five main objectives:

— To free micro and small companies from the legal and bureaucratic hurdles which hinder and discourage them from legalizing and formalizing their activities;

— Help guarantee the survival of micro and small companies, offering them the appropriate support and assistance, whilst they are establishing themselves. (to get an idea, in 2001, „mortality index" in 2 years was 75% and today is less than 23%);

— Make it possible for companies to increase their competitiveness, both in technical terms and in terms of management practices;

— Ensure greater access for micro and small companies to credit and the other measures for achieving economic- financial feasibility;

— Introduce micro and small companies into the international market;

In addition to these strategies, all of which are appropriate and suitable to the realization of SEBRAE objectives and purposes, other strategies have also been adopted, which can enable companies to participate in the development of Brazil, such as:

— Offer the network of very small and small companies the necessary means for them to access and retrieve relevant information, as well as for the appropriate strategic management of knowledge;

— Foster actions directed towards bringing together relations between the supply and demand of technologies, products and processes, both concerning the government sector, and further cooperation between companies in the same or differing sectors;

— Further relations with municipalities and the state, so as to help to ensure that public policies encourage the consolidation and success of very small and small companies.

The presence of entrepreneurial education is an essential part of all the above items, and is provided by some 30 programs, some of which deserve a mention, as follows:

— *„Projeto Brasil Empreendedor" (Brazil Entrepreneur Project),* with the aim of offering the basics of entrepreneurial activities to potential entrepreneurs by means of short on-site courses

— *Empretec,* which is undertaken in partnership with the United Nation Development Programme (UNDP) and the Brazilian Cooperation Agency — ABC, of the Ministry of Foreign Affairs, which has the objective of identifying and increasing entrepreneurial potential and develop the entrepreneurial characteristics of businessman already working in the entrepreneurial area or who intend to start up a business. Using the concept of workshops, interviews and shared experience, the program aims to encourage changes to the way people conduct themselves, which, in turn, will be reflected in the entrepreneurial field

— *„Líder Cidadão" (Leadership and Citizenship)* — The objective of this program is to train community leaders, with the aim of sustaining local and sector SEBRAE actions in areas with a low human development index.

This project makes it possible for SEBRAE to work in low-income and impoverished areas, in which there are opportunities for economic development and, therefore, the chance to fulfill its mission of proactively participating in the development of Brazil. Potential community leaders are the target public of the course. Literacy is not sine-qua-non requisite for the candidate to take part participating in the course.

The following subjects are addressed:

- Leadership and citizenship
- Communication
- Community meetings
- Planning of community projects
- Negotiation of projects

— „Saber Empreender" (Learn How to Become an Entrepreneur) — The objective of this course is to find out the entrepreneurial skills of people living in areas with a low Human Development Index (HDI), sustaining local and sector action by SEBRAE and disseminating the entrepreneurial culture and contributing for job generation and income. Businessmen, potential businessmen, those doing business in the informal economy, the self-employed and travelling salesmen make up the target public;

— Desafio Sebrae (the Sebrae Challenge) — An Educational solution with the objective of disseminating entrepreneurial culture amongst university students.

This simultaneously employs the methodology of business games, encourages widespread use of the Internet and facilitates face-to-face meetings and business rounds, and is geared towards effective interaction between universities and university students, promoting the importance of understanding cooperative work, how to become flexible in light of adverse or unexpected conditions and stimulating creativity in professional work;

— Jornada de Casos- Knowledge Management — The goals of this project is a development of cases study to show the scenery of very small and small businesses. The methodology used along the project includes the writing of a „case", the discussion about the solutions, with the involvement of students and their teachers, and the build of a data bank, relating experiences.

b) THE BASIC AND TECHNICAL EDUCATION PROGRAMS

— *The FIRJAN Mathematics Program*

Launched in 2012 and aligned with the MEC national curriculum, SESI Mathematics program is an initiative of FIRJAN (Federation of Industries of the State of Rio de Janeiro), through SESI Rio, and aims to improve the teaching of mathematics among students high school across the country, starting with the state of Rio. This is because currently the performance of our young people places Brazil far from the top positions in the world ranking of mathematics (PISA 2012), and the practical consequence of this poor performance is reflected immediately in the labor market. A survey of the FIRJAN System, held in 2011, points out that the lack of mathematical competence and logical reasoning are deficiencies presented by current workers, which results in the lack of qualified professionals to work in companies.

The Mathematics SESI is a methodology that combines modern educational practices to technology, to break the resistance and old prejudices of students and teachers, and thus contribute to the training of young critics and best enhanced logical reasoning. This initiative leads to a radical change in the teaching and learning of mathematics. The approach is to be friendly, exciting and attractive, making it more interesting mathematical and hence facilitating their learning.

SESI Mathematics will be taken to all schools SESI and SENAI of Rio and also to all state public high schools in Rio de Janeiro. Thus hopes to contribute in the formation of young people prepared for the competitive job market.

— *The STEM Methodology*

Both in technical schools and high school public it is important to overcome the weakness of students in the fields of science and technology. For this, the industries Federation system is already applying the STEM (Science, Technology, Engineering and Mathematics) methodology, building programs that combine applied form all disciplines through „workshops" which include planning, writing, study of subjects related to pre-selected themes, activities preparation and implementation, participation in school competitions and drawing conclusions.

— *The Construction of a New National Curriculum for High School*

The Ministry of Education is completing a new curriculum based for all high school students, to ensure mandatory guidelines in part of the subjects, reserving a percentage for courses that meet local peculiarities and dimensions and vocations of each region.

— Technical Education Reform Considering the New Needs of the Productive Sector,

Since 2012, this has been one of the biggest challenges of the Brazilian education, which should seek to bring students to the advances of sciences and technology. For this, a new national program was implemented, the PRONATEC, which is designed to enable students to full use of new technologies, to promote continuing education for technicians already working in industry, trade and services sector, in agribusiness and technology, and modernize laboratories to ensure better training of engineers and technologists.

CONCLUSIONS

The Brazilian effort in order to promote social and economic development has depended much on the participation of micro and small enterprises, that have In SEBRAE, the Brazilian Institute of Support for Very Small and Small Business, a strong partner. It is also important to note the presence of productive sector by their federations and the biggest national companies. It should also be noted that those actions, initiated about 20 years ago, mainly these projects of the Ministries of Science and Technology, and Development, Industry and Commerce, were decisive for such advances. It highlights the incubators companies and technologycal parks, that were born with the academic support of the Universities and the Research Institutes. They allowed the generation of employment and income, and increased the competitiveness of enterprises.

Gabriel BIANCHI[*]

WHAT TO DO WITH THE SPIRIT-SOUL GAP WHEN FACING TECHNOLOGY INNOVATIONS: ANOTHER CASE FOR A LIMINALITY HOTSPOT? (A SCIENCE ESSAY)

Abstract: The presentation focuses on the challenges to human coping with technology innovations, that were decades ago introduced by Konrad Lorenz in his reflections of the human spirit (Geist) rapidly overtaking the human soul (Seele). Decisions to be done concerning energy resources, transportation, application of nano/bio/info/cogno technologies for human enhancement etc., collide with traditional normative categories concerning ethics, identity, or society. We need to look for alternative ethical approaches, as well as flexible modes of experiencing the dynamics of change introduced by technology innovations. A suitable framework seems to be the concept of a liminality hotspot (Stenner) — situations where people find themselves in a long term (or even permanent) state of 'in-betweenness', 'stuck' in transition. The concept of liminality hotspot offers an exciting approach to the mutual interconnections between technology innovations, creative evolution, societal innovations and cultural evolution.

Key words: *technologies, innovations, liminality, ethics, social theory*

INTRODUCTION

In his book Der Abbau des menschlichen (The waning of humaneness) Konrad Lorenz [1] described in 1983 his worries about the future of out capacity to cope with moral and emotional challenges of our civilized life. His argument is based on a divided conceptualization of human mental capacity: on the one hand we have at our disposal the spirit, our congnitive-rational engine (Geist), and on the other hand we are equipped by our moral and emotional capacity, the soul (Seele). The athropological evolution resulted in a far more massive and rapid advancement of our spirit as compared to our soul. Our soul reached its capacity when people were still living in the tribal society and did not significantly evolve since that time. Thus, not only our emotional capacity is limited to responding to a range of + —

[*] Institute for Research in Social Communication, Slovak Academy of Sciences, Bratislava

30–50 people, but our moral competence is primarily committed to this size of social environment with a possibility of direct contact and negotiation.

The spiritual evolution since the first industrial revolution down the our early 21st century has resulted into a state where technologies are fully integrated into our everyday life and constitute objects, activities, knowledge, modes of organizations as well as sociotechnical systems [2]. These technologies are substantial in helping to adapt and control environments, solve (and create) problems, extend human forces and senses, mediate between physical and cultural world. Moreover, technologies are already modes of being and knowing, revealing and framing, and are even getting into the role of social agents. Technologies are a source of our expectations in a plentiful of areas reaching from the lowest level of our existential needs, through our social needs to the highest level — self-actualizationa and self-transcendence (intellectual and spiritual) needs. While we are eager to use them in order to facilitate satisfaction of our needs, we tend to disregard the fact that technologies are real-time experiments, with both intended and unintended consequences. And technologies are producing a broad range of massive emotional response — joy, fear, uncertainty, as well as aspirations — often inappropriate.

WHAT ARE (NEW) TECHNOLOGIES GOOD FOR?

In the context of current mass consumption of technologies, it may be inspirational to introduce at least one example illustrating positive outcomes of a critical approach to (new) technology use. The one I chose comes even from a historical period in which human civilization was still far from being overflooded by technologies. Recently I had the opportunity to admire Leonardo da Vinci's Last Supper in Milan's convent Santa Maria delle Grazie — a piece of art of undoubtedly supreme artistic/aesthetic quality. The uncompromising aesthetic level was, however, reached by rejection of the advanced technology of fresco painting (known already in Egypt in the 3rd millenium BC). Why? Leonardo actually did not reject the technology per se; he just refused the restriction that is inherently part of the advaced technology — he refused to paint fast. Declaring that he needs to contemplate in front of the large wall in order to create a piece of art appropriate to the importance of the purpose, he chose the secco technique. Actually, he got in troubles due to the extended time which the creation of the painting took — not because of delay, but because of food and wine that had to be delivered during all the time to his workers/assistants. The genius painting, unfortunately, started to deteriorate just 10 years after finishing. The tempera on gesso, pitch, and mastic „refused" to withstand demanding conditions in the refectory and since then it suffered 5 centuries of interchanging destruction and restoration. The benefit of Leonardo's rejection of an advanced technology gets even more obvious when you stand in the centre of the refectory and after admiring his art you turn around 180 degree and throw a look at the opposite wall. There you can see, but hardly admire, a painting of even larger size, produced in exactly the same period, by Donato da Montofano, an mediocre contemporary master of Leonardo´s. The picture is one of the most significant works by da Montofano and depicts „the day after" — the crucifixion of Jesus

Christ. It is monumental, it impressively fights with perspective, and it is perfectly preserved — because painted with the fresco technology. What a paradox. And what a warning: technologies do not represent values, neither does their use lead necessarily to increase of the value of the outcome.

Therefore, we may rightfully ask: What are (new) technologies good for? What kind of (new) tools do they provide? What kind of (new) practices do they enable? What kind of (new) people are they designing? What kind of (new) society are they empowering? Or what other kind of consequences do they introduce?

While deconstructing the meaning of technologies and mainly new technologies = innovations and their use, the first question that emerges is: Where do they come from? What is their source? Are they driven mainly by demand or by supply?

The demand for technological innovations may stem from certain political or governmental strategies. However, it might by driven also by value preferences, or, at least, by value-informed public decisions. The most utopic is the notion of a technological equipment commissioned by a moral standpoint.

The supply source of technological innovation is in first instance driven by human cognitive instinct. This may be, of course, endorsed by some instruments of institutionalized scientific research. Another source of technological innovations is pure profit motivation. And finally there is still — at least hypothetically — a possibility for a moral reason to create technological innovations — either based on some moral reflection, or pursuing a change in the societal moral status quo.

TECHNOLOGICAL INNOVATION AS REFLECTED BY SOCIAL THEORIES

Theorising technologies in social sciences and humanities went hand in hand with their rapid development since the first industrial revolution. First contributions may be found in Karl Marx focusing mainly on issues of labour and equality installed by the first industrial revolution of the 19th century. Next significant reflection of technologies may be found in semiotics work of Roland Barthes pursuing for nonverbal and cultural signs of everyday life. His contribution may be expressed in the paraphrase „how things are becoming their meanings". This structuralist-poststructuralist asset was further elaborated into the discursive arena by Michel Foucault who highlighted mainly the power interpretation of objects, spaces and human relations, and their substantial integration into societal systems. An important facilitator of a massive acceptance of technologies should be identified in the so called process of „reification" of human capabilities. As Wendy Stainton Rogers [3] highlights, throughout the development of psychology towards a scientific discipline, one of the central conditions to match with the positivist requirements for being accepted as science, was the „objectification" of human psychic phenomena. Our cognitive and emotional processes got „reified" in order to enable measurement, predictions, categorization of individuals, application of norms and allowing decision-making aimed at „sorting" individuals according to various societal structures, e. g. medical, educational, or legal. Finally, there is the work of Bruno Latour, integrating material-semiotic interpretation of objects and humans in networks. His actor-network method highlights the social and moral agency of objects. This approach has been subsequently explored, e. g. in the moral inscription method (Jaap Jelsma) seeking to inscribe morality into technological objects [4].

WILL THERE BE A CHANGE OF PARADIGM IN ETHICS?

This brings us to the significance of the ethical platform when reflecting technological innovation. From my view it is highly important to take into account that the moral attitudes and norms are currently catalyzed by the substantial trends in societal/cultural shift. Michel Maffesoli reminds us about three significant characteristics of the current post-modern period: tendency to reject rationality, fatigue from individualism and transformation of social stratification from horizontal to vertical. These processes cannot be detached from the technological advances imposed on us in their digital and global ponderosity. Societal tendencies towards the new forms of tribalism and consumerism jeopardize the Kantian approach focusing on the moral essence of an individual seeking to measure moralite by the good/bad ratio. Therefore new, alternative conceptualizations emerge. The most striking are the affirmative ethics conception (Rosi Braidotti) and ethics of care (Carol Gilligan). In the affirmative ethics approach the „good and bad" divide is subssituted by a less categorical „affirmation and non-affirmation" divide, presuming that this transmutation of moral content may moderate moral polarization and facilitate co-operation in an open and globalized society/culture. The ethics of care approach tries to solve the loss of interest in individual autonomy in substituting the striving for moral essence of the individual by a social-relational conceptualization of moral issues. And other alternative ethical designs triggered by current transformation of our societal and technological environment are to be expected to emerge. Clearly, this development may be seen as a „response" to the frustration expressed by Konrad Lorenz: will the human soul (Geist) remain stuck in the prehistory of our development? Or will it find a new form in which it would be able to assist our decisions about our future?

CONSEQUENCE: PEOPLE IN LIMINALITY HOTSPOTS?

Recently, the work of the anthropologist Van Gennep, focusing on rites of passage and crossing limits of life-stages, was reintroduced to social science. Monica Greco, Paul Stenner and Arpad Szakolczai [5], [6] use it as inspiration for introducing liminality anew — this time, however, not focusing on crossing limits, but on remaining in a liminal situation. The argument is that people still more frequently and in number of contexts enter so called liminality hotspots, situations where they find themselves in a long term (or even permanent) state of 'in-betweeness' or transition. This may be well illustrated by the status of chronic disease, by the requirement of permanent/life-long education, by job instability, by the wide-spread phenomenon of patchwork families, and hundreds of our dimensions of our existence. Liminality hotspots are complex and ambiguous 'threshold zones' characterized by mixture, uncertainty and transformation and by the ambivalence associated with paradox. Liminality hotspots not only represent extreme requirements from the individual to cope with them, but at the same time exceed the limits imposed by existing institutional and conceptual structures including the legal system. As an effect, liminal experiences are affective and subjectively transformative and are like „the breakdown of order turning into permanence". If reflecting the permanent challenges from the massive stream of technological innovation, we may expect that liminality hospots will soon constitute the majority of our psychosocial environment. Thus we may expect facing a permanent transformation and transmutation of our identity, social structure, and of course, of all the normative systems regulating the public arena. Recently Miroslav Popper [7] associated the liminality challenge to the compelling issue of human enhancement due to application of nano/bio/info/congo (NBIC) technologies. Is the NBIC driven human enhancement potential significantly different from the permanent human enhancement performend during evolution? Will there be a radical change in human nature and when will it occur? What will be the consequences? And what can we do to prevent massive problems on a global scale?

CONCLUSION

The psychosocial consequences of technological innovations are beyond doubt. The current digitalized and globalized civilization, however, requires an intensive search for preventive tools. Social sciences and humanities need to develop a new paradigm. A paradigm that, instead of just reflecting technological progress and developing „adaptive" tools, would take the active role of a value driven partner in negotiating technological innovations. We should not stay in the shade of the evolutionary paradox which Konrad Lorenz helped to understand our frustrations from existence in the modernist era. Our soul (Seele) needs empowerment and inspiration to emancipate from its historical limitation to match the liminality hot (s) pot of our near future.

REFERENCES

[1] K. Lorenz: *Der Abbau des Menschlichen* (The Waning of Humaneness). Muenchen, Piper, 1987.

[2] S. Matthewman: *Technology and Social Theory.* London, Palgrave Macmillan, 2011.

[3] W. Stainton Rogers: *Social Psychology. Experimental and Critical Approaches.* Maidenhead, Open University Press, 2003.

[4] J. Jelsma: „Designing „Moralized" Products: Theory and Practice" In P. P. Verbeek A. Slob (eds.), *User Behavior and Technology Development: Shaping Sustainable Relations between Consumers and Technologies.* Dordrecht, Springer, 2006.

[5] M. Greco, P. Stenner: *„The Emotions: A Social Science Reader"* Routledge, London. 2008

[6] A. Szakolczai: „Liminality and Experience: Structuring transitory situations and transformative events" *InternationalPolitical Anthropology vol. 2, No 1. 2009. p. 5–28.*

[7] M. Popper: „Human enhancement and the concept of liminality" *Human Affairs, vol. 26, No 2. April 2016. p. 128–139.*

Alexander RUSER[*]
Amanda MACHIN[*]

TECHNOLOGY CAN SAVE US, CAN'T IT? THE EMERGENCE OF THE 'TECHNO-FIX' NARRATIVE IN CLIMATE POLITICS

Abstract: The Paris Agreement of 2015 recognizes 'that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response'. A common reaction to such a statement has been to call for emissions reduction. This, however, requires investment in energy saving technologies and the fundamental transformation of fossil fuel based economies and high-consumption life-styles. In other words, 'saving the planet' would spell the end of a concept of modernity, which has served as a vanishing point for most developing countries. The viability of this post-growth paradigm is questionable. National egoisms, vested interests of global corporations and the chronic social addiction to oil constitute considerable obstacles to address climate change.

One alternative to the post-growth narrative is centered around the 'techno-fix'. Here, technological innovation has not only instituted the problem of climate change, but will also provide the solution! Technologies such as solar radiation management and carbon sequestration are attractive precisely because they fix the problem without any lifestyle change: 'the technologist´s way tries to avoid changing peoples habits or motivations'. Critics of the techno-fix narrative, however, argue that it should be rejected as the latest attempt of liberal proponents of pro-growth positions to delay 'necessary' social, political and economic change. In this contribution we analyse the presuppositions and implications of both the 'techno-fix' narrative and its critique. Both positions, we argue, fail to grasp the socio-political intricacies of technological development. Since technology is embedded in its social context it cannot be instituted or rejected prior to political decision-making, but rather necessarily involves on-going social and political analysis.

Key Words: *Technology, Climate change, techno-fix, ecomodernism, pluralism*

INTRODUCTION

The Paris Agreement of 2015 recognizes 'that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus

---

[*] Zeppelin University Friedrichshafen, Germany

requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response'. A common reaction to such a statement has been to call for emissions reduction and an acknowledgement of 'the limits to growth' as first articulated in the report of that name published in 1972 [18]. This response, however, would require investment in energy saving technologies and the fundamental transformation of fossil fuel based economies and high-consumption life-styles. In other words, 'saving the planet' would spell the end of a concept of modernity, which has served as a vanishing point for most developing countries. This paper examines an optimistic alternative to the limits to growth narrative, centered around the 'techno-fix'. Here, technological innovation has not only instituted the problem of climate change, but will also provide the solution! Technologies such as solar radiation management and carbon sequestration are attractive precisely because they fix the problem without any lifestyle change: 'the technologist´s way tries to avoid changing peoples habits or motivations'. We delineate two different versions of this narrative; the 'ecomodernist' frame painting a bright picture of a future in which technological solutions will not only fix climate change but also help improving the Earth´s climate to support a growing population; and the 'second-best solution' frame which acknowledges that emission reduction should still be given priority but welcomes geo-engineering as a second best solution and a means of buying time.

Critics of the techno-fix narrative argue that it should be rejected as the latest attempt of liberal proponents of pro-growth positions to delay 'necessary' social, political and economic change. In this contribution we analyse the presuppositions and implications of both the 'techno-fix' narrative *and* its critique. Both positions, we argue, fail to grasp the socio-political intricacies of technological development. Since technology is embedded in its social context it cannot be instituted or rejected prior to political decision-making, but rather necessarily involves on-going social and political analysis.

THE POLITICISATION OF CLIMATE CHANGE

Climate Change ranks among the most urgent of global challenges today. The increase of global carbon dioxide emission is explicitly addressed in the United Nations Development Goals (Goal No. 7 'Ensure Environmental Sustainability'). The establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 or the launch of the European Climate Change Programme (ECCP) in 2000 underline not only an increased awareness but an apparent willingness to address the problem of anthropogenic climate change. But if, as this suggests, the fact of human influence on climate is becoming increasingly acknowledged within a variety of international bodies and agreements, why is there such delay in implementing effective climate policy? The lack of decisive action might come as a surprise to many.

For sure, the 'politicisation' of climate change has long been completed. A mere 200 years after Joseph Fourier discovered the greenhouse effect and 120 years after S. A. Arrhenius identified carbon dioxide as a 'greenhouse gas' [1] climate change has been become a key issue of national and international politics [2]. However, the ubiquity of the issue does not equate to a general consensus on the political actions to address climate change. Rather the opposite. Climate negotiations at every level have proven to be exceptionally difficult and protracted. Why might this be the case? One possible reason is that climate change was initially regarded through a 'limits to growth' narrative. According to this narrative, climate change demands dramatic deviation from the economic growth paths that lead the way to modernization since the times of industrialization. As a recent example of this understanding, in her 2014 book 'This Changes Everything' [3] famous writer and activist Naomi Klein portrays contemporary capitalism as incompatible with a sustainable climate friendly life style.

Regardless of whether one agrees with Klein´s particular politics, one has to admit that climate politics cannot be separated form economic politics. Dealing with climate change is not limited to dealing with an environmental challenge. Climate politics are located at the intersection of economic, social and security politics, for the consequences of climate change will not be limited to changes in the 'natural environment'. The unequal distribution of environmental vulnerabilities and response capacities can lead to new political challenges like mass migration and conflicts on ever more scarce resources. And neither the risks of climate change, nor the consequences of climate politics, are a matter of the distant future. In September 2015 the Bank of England issued a report on 'The impact of climate change on the UK insurance sector' [4]. This report acknowledges not only the fact that climate change will affect the economy, but shows that a changing climate is already a drain on economic profits.

The dominant response, however, is business as usual. Property owners or agricultural industry might, on average, suffer from rising insurance fees or crop failure, other industries (e. g. insurance companies) might actually benefit from a changing climate. From the perspective of classical economic theory climate change could be discounted as just another example for capitalisms capacity for 'creative destruction' [5].

Even with the economic consequences of human made climate change looming in the near future, the costs are not likely to be taken into account in business decisions under the circumstances of contemporary shareholder capitalism. In his 2014 *The End of Normal,* James K. Galbraith argues that such a fundamental change to the business model 'would require the costs of climate change to be incorporated (…) It may be petty to discuss mere economics in the face of existential ecological threats, but the fact is, business decisions are made in the here and now'. [12] Certainly, issuing warnings on the dangers of climate change is, seemingly, neither sufficient to trigger large- scale reform nor to convince decision-makers that radical changes are inevitable. Conflicts of interests, concerted media campaigns by 'climate sceptics' [11] and the substantive difficulty to solve a tragedy of the commons situation [1] continue to hamper global climate negotiations.

PREFERRING NOT TO CHANGE EVERYTHING — THE APPEAL OF TECHNO FIXES

Climate change demands nothing short of a radical deviation from established, time-honoured modes of production. Climate Politics must envision and enable a break with the past. Or so is said. In recent years an increasing number of voices offer a new narrative of global climate politics: Instead of staying within limits to protect the climate, the international community should find ways of 'fixing it'.

While the cause of anthropogenic climate change is the development, implementation and global dispersion of various technologies, for some the answer is not to give up technologies and return to a more pastoral lifestyle, but rather to develop them further. This narrative relies upon human inventiveness to come up with green technologies. Technology, so is said is not (only) part of the problem, but a vital part of the solution too. Geo-engineering or 'climate-engineering' has been criticised as an 'eclectic catch-all expression' [6] and a term that 'has come to mean a range of different things' [8] and has been described a set of technologies which could contribute to a 'Plan B' to save the planet [8]. Overall 'climate fixes' refer to technologies that do not aiming at emission reduction but on 'large-scale efforts to engineer the climate system to counteract the consequences of increasing greenhouse gas emissions' [8] We can distinguish between 'radiation management' technologies and tools for 'carbon dioxide removal'. Table 1 gives an overview of the most common technological option to fix the climate:

Table 1. Technologies to Fix the Climate

Technology	Mechanism	Description
Stratospheric Aerosol Injection	Radiation Management	Artificial injection of sulphur dioxide or hydrogen sulphur into the Stratosphere. Incoming solar radiation is reflected back into space leading to cooling effect in the lower atmosphere.
Marine Cloud Brightening	Radiation Management	Whitening of low-level clouds increases the amount of solar radiation reflected back into space. 'Cloud ships' would be employed to use spray jets of seawater to artificially increase condensation.
Urban ('roof top') Albedo	Radiation Management	The reflectivity (the so called 'albedo') of any surface depends on colour. Dark roofs for instance have an average albedo of 5%, meaning that 95% of incoming solar radiation is absorbed. White roofs in contrast have an average albedo of 75–80%. Rooftop whitening is therefore a comparatively simple way of advert 'heat island' effects and contribute to local radiation management
Carbon Capture	Carbon Dioxide Removal	Chemical 'scrubbing' of carbon dioxide out of the air and storing of carbon in deep reservoirs. Carbon capture technologies could reduce emissions of 'point sources' e. g. power plants and large factories given that suitable geological formations for storage are at hand.
Ocean Fertilization	Carbon Dioxide Removal	Oceans represent the largest carbon sink of the planet. Biochemical as well as biological processes drive carbon sequestration. One way to increase the later is to 'fertilize' oceans. Artificially adding nitrates phosphates and iron should increase algal production which in turn contributes to carbon sequestration

Source: see [6]. For 'Urban Albedo' see also [7]

The narrative of climate fixes, or 'geo-engineering' can be framed in two distinct ways: First, climate fixing technologies offer an alternative to a broken system. We call this frame the *second best solution* frame. The narrative attached to this frame can be summed up as follows: While emission reduction should still be given priority and 'greening the economy' should be the long-term objective geo-engineering should be considered as a tool to advert the most dire consequences of a changing climate. Geo-engineering might be instrumental in buying precious time to allow global climate politics to agree upon and implement effective means to lower greenhouse gas emissions? Nobel Laureate P. J. Crutzen, while being supportive of the idea of fixing the climate employs the second frame. In his view geo-engineering should be considered simply it offers a second best solution: By far the preferred way to resolve the policy makers' dilemma is to lower the emissions of the greenhouse gases. However, so far, attempts in that direction have been grossly unsuccessful (…) Therefore, although by far not the best solution, the usefulness of artificially enhancing earth's albedo and thereby cooling climate by adding sunlight reflecting aerosol in the stratosphere (…) might again be explored and debated as a way to defuse the Catch-22 situation just presented and additionally counteract the climate forcing of growing CO_2 emissions.[9]'

The second frame is more closely attached to theories of modern capitalism and paint a much more positive picture of the future. Geo-engineering is a embraced as yet another example for the efficiency of capitalist systems: While it is true, that industrialization and growth driven economic development have caused the problem of anthropogenic climate change, it is also true, that technological advancement can deliver the solution.

We call this the ecomodernist frame. 'Old' technologies increased the concentration of greenhouse gases in the atmosphere? New technologies will allow the 'scrubbing' of CO_2 out of the air. Greenhouse gases are blocking outgoing radiation thus creating a dangerous heating effect? New technologies will allow to preventing incoming solar radiation to reach the lower atmosphere hence leading to a global cooling effect! Harvard Professor David Keith is a strong advocate of stratospheric aerosol injection' (see table 1) as a means to create a global cooling effect. In his 2013 book *A Case for Climate Engineering* he makes a strong case for this particular variety of geo-engineering: 'This single technology could increase the productivity of ecosystems across the planet and stop global warming; it could increase crop yields, particularly those in the hottest and poorest parts of the world. It is hyperbolic but not inaccurate to call it a cheap tool that could green the world' [13]. Being a representative of the optimistic frame Keith goes far beyond the idea of 'fixing' the climate. New technologies will not only be able to 'put things in order' but will allow to 'improving' the climate, to customize it to human needs. This requires a rather high level of trust that feasible technological solutions to climate change will appear in time and without too much risk. In contrast to David Keith´s optimistic claim that safe and affordable technologies are already available [13] the majority of scholars, including those who are open to the idea of climate engineering 'call for active scientific research of the kind of geo-engineering' [9] and further debating possible side-effects and negative, unintended consequences of these new technologies.

Is geo-engineering a necessity given the apparent ineffectiveness of emission reduction politics or does it simply prop-up the status quo? Technology based solutions, despite the mounting problems scientists and technicians face to develop applicable solutions, appears to be a rather easy way out. Geo-engineering is attractive, of course, precisely because it fixes the problem without any lifestyle change: 'the technologist´s way tries to avoid changing peoples habits or motivations' [8]. See also [2]. The techno-fix narrative accepts that climate change is a problem, and it attempts to solve this problem through developing technology in a new, green, direction. Here, even if industrial and technological development created the problem, technological development will provide the means to fix it. The attractiveness of these kinds of interpretations stems from them being consistent with the dominant economic paradigm and political order.

The 'win-win' narrative fits within theories of green capitalism that assume that technological innovation will be both be underpinned by, and rejuvenate, a thriving green economy. The possibility that a more radical response might involve challenging the growth paradigm is undermined by the fact that markets are seen as natural and rational entities. Accordingly any substantial deviation from the model of a market economy or even a market society must inevitably disturb the harmony with nature: 'Even though there has not existed full consensus on just what sort of animal the market „really" is, the neoliberals did agree that, for purposes of public understanding and sloganeering, the neoliberal market society must be treated as a „natural" and inexorable state of mankind' [15]. The appeal of geo-engineering can therefore be explained by a shift in the boundaries between society and nature. It is the *naturalization of markets itself*, which allows to interpret technological development to fix climate change not only to be feasible (or reasonable) but also to be the logical and *natural* choice. The two frames outlined above (and in particular the optimistic frame) are then just subcategories to market optimism.

From the perspective of the proponents of techno fixes to climate change the reply to Naomi Klein´s emphatic claim 'This changes everything' is plain and simple: Climate change is not changing everything. In fact it doesn't change very much at all.

WHAT TO FIX? WHO DECIDES? THE PROSPECTS OF AN ENGINEERED CLIMATE

The idea, the vision of an engineered climate actually is tempting. After decades of cumbersome, complicated and sometimes frustrating attempts to swear the international community in to a more sustainable, climate friendly development there might be a silver lining: A Plan B to save, maybe even improve the climate. But it should have become clear by now, that not only the climate would be saved. Geo-Engineering promises to prolong a lifestyle that a majority of people in western countries have enjoyed for decades; a lifestyle that has become the vanishing point for the population in the developing world.

If emissions could be scrubbed out of the air, if carbon dioxide could be stored safely in underground deposits, and if global cooling technologies could balance global warming, wouldn't then a high carbon lifestyle become acceptable, reasonable, and sustainable for all? Aside from the feasibility of the technologies in question, geo-engineering could have major political and moral implications. The most important issues would be the problem of *liability* and the question of *authority*.

One could describe the historical developments that, over time, lead to the global, human made climate change as unintended even unwitting geo-engineering. When the first factories where built, when the trains and later the car began to revolutionize public transport, long-term consequences of rising carbon dioxide emissions where completely unknown. It was only in the mid 20^{th} century that Roger Revelle and Charles Keeling discovered and described the adverse consequences of industrial development.

Since the harmful effects of high concentrations of greenhouse gases in the atmosphere where discovered only 200 years after the industrial revolution set in, the question of 'liability' is difficult to address and is usually contested in global climate negotiations. Developed countries can argue that they can hardly be held accountable for emissions of the past for the simple fact that the negative consequences had been completely unknown.

Geo-engineering would change the situation radically. With the deliberate use of climate fixing technologies one would move form negligence to intentionality. This would raise the question of liability. Who can be held accountable for possible side effects of geo-engineering experiments? The question would be extremely difficult to answer since the attributing a singular weather phenomenon (say a flood, a drought, etc.) to a particular geo-engineering project would be very difficult. This means that geo-engineering would recreate a situation of systematic irresponsibility in which no one can be hold accountable in a particular damage case.

In a recent paper David Keith and two of his colleagues address the difficulties of designing and enforcing an system of legal liability in the case of Stratospheric Aerosol Injection (SAI):

'If a country were damaged by negative effects from SAI, should that country be compensated for its loss? If so, by what mechanism? Could such effects be persuasively linked to SAI? Who should pay for damages, and how much should they pay? The extraordinary difficulties presented by this issue have led some observers to conclude that building a just and effective system of liability and compensation for SAI would be virtually impossible' [16].

Although the paper discusses a variety of options for designing a system of legal liability the authors come to the conclusion that '[i]n the end, questions about SAI liability will be secondary to more fundamental questions about whether SAI should be deployed, and whether geo-engineering is desirable in the first place'. But liability is not just about legality. It is also has a moral meaning. Since geo-engineering would mean deliberately attempting to change climatic conditions the moral implications would be immense. Essentially geo-engineering would mean to perform a (risky) scientific experiment at the global stage. It is difficult to see any reason for why normative standards and rules of 'good scientific practice' shouldn't apply in this case. Geo-engineering experiments are likely to directly affect the wellbeing of people and its effects inevitably transgress national borders.

Relatedly, there exists the question of who can *authorize* global geo-engineering experiments. Given the complexity of the technologies involved and taking the enormous costs of such an undertaking into account the answer seems quite obvious: the most developed countries. Since geo-engineering poses not only technical questions but involves legal and moral expenses, the group of potential suspects are reduced to relatively powerful elite, within a handful of countries. Thus, while it remains doubtful whether climate fixing technologies provide the means to save the planet they could be instrumental in cementing existing power imbalances. The same industrialisation that turned the United States, China or the EU into major emitters of CO_2 enables them to take the lead in engineering the climate. The biggest polluters of the climate become its saviours. Economic development, for long seen as contributing to anthropogenic climate change becomes the necessary prerequisite for fixing the problem.

In short, what these problems reveal is that what is missing from the techno-fix narrative is any acknowledgement of the *power relations* that will condition the implementation of geo-engineering and, moreover, be reaffirmed by it. What we seek to highlight is that any decision about geo-engineering is highly political and is likely to be contested by numerous parties for myriad reasons. In its very attempt to smooth over social cleavages and difficulties in climate change policy, the techno-fix actually *exacerbates* them. Geo-engineering, however it is framed, is steeped in politics. Although advocates both presuppose and promote the idea that a technofix is a *natural* solution, we argue that this reification disguises the contingency and contestability of any implementation of technology.

REJECTING OF THE MYTH OF PROGRESS: TECHNO-WARINESS

Many have responded to the alacritous techno-fix narrative with caution and alarm. For example, so-called 'deep green' ecologists, such as Paul Kingsnorth and Dougald Hine reject the idea. Their 'Dark Mountain Manifesto' states: 'We reject the faith which holds that the converging crises of our times can be reduced to a set of 'problems' in need of technological or political 'solutions'. ' [19] It calls instead for a rejection of civilization: 'The myth of progress is to us what the myth of god-given warrior prowess was to the Romans, or the myth of eternal salvation was to the conquistadors: without it, our efforts cannot be sustained'…We do not believe that everything will be fine. We are not even sure, based on current definitions of progress and improvement, that we want it to be. ' [19]

A similar 'techno-wariness' appears in more academic sources. Peter Emberley sees the advance of the global network mobilised by of modern technology as doing nothing less than 'reorganizing our way of being in the world with a vision in opposition to what has for a long time preserved decency, stability, and moderate expectations' [20: 743]. To be sure, it is not the individual technologies that he sees as the problem, but rather the general shift in structures and discourses of the 'second phase of technological growth' which he believes is efficiently autonomous and are dissolving individual subjectivity: 'There is widespread recognition that the transitions we are undergoing have the effect of rendering the individual impotent or without the capacity to bear responsibility for action [20: 749]. It is a mistake to believe that technological progress, in the way it currently exists, is an affirmation of human progress. Rather it produces such 'relentless instability and perpetual uprooting' that we are unable to grasp its danger [20: 764].

However, such dismissal of the techno-fix stumbles on the same question of authority as its proponents. For if these technologies exist, then who decides who gets to develop and use them? Might this not result in the denial of access to resources to tackle climate change to those who need them most? The impact of climate change will not be evenly distributed. It is perhaps easier to dismiss technological solutions when one is not confronted with immediate environmental risk and damage.

To believe that technological change is radically reordering social relations today, is to forget that it has always been part of the human condition [21]. Human societies have always experienced the emergence of technologies that generate fundamental transformation. Citizens have always had to negotiate the resources devoted to research and the pattern of access to its results. What is distinct about the political negotiations of the contemporary era is that they are expected to occur democratically. But the narrative of 'techno-wariness' seems to forget this. The critique of the 'techno-fix' therefore reproduces exactly the same de-politicisation as its target.

At the very beginning of his 2014 Book *Can Science Fix Climate Change?* Mike Hulme invites the reader to imagine an Engineered Climate. Imagining and debating the likely effects, the side effects and the unintended consequences of the various climate technologies that are currently discussed is certainly of exceptional importance. But this imagining and debating is not a matter of determining an overarching strategy that be decided once and for all. The debate over these technologies must be an *on-going practice of reassessment*. The use of geo-engineering must be carefully weighed up in each particular circumstance. For sure, this risks undermining some long-term vision. But any long-term vision is likely to be rendered problematic by the numerous repercussions that cannot be known in advance.

CONCLUSION

We have identified various narratives surrounding geo-engineering. In contradistinction to the 'limits to growth' narrative, there is a 'techno-fix' narrative in which two discursive frames are employed by supporters of geo-engineering. An outright optimistic 'ecomodernist' frame painting a bright picture of a future in which technological solutions will not only fix climate change but also help improving the Earth´s climate to support a growing population. A second, more cautious 'second best solution' frame acknowledges that emission reduction should still be given priority but welcomes geo-engineering as a second best solution and a means of buying time.

While both frames are consistent with dominant views of the problem-solving ability of technology, neither is able to address the important issues of liability and authority. Reducing the question of liability to a secondary problem is not feasible liability involves not only a legal but also a moral dimension. Complying with the ethical standards of research in the developed world would be extremely difficult given the current state of knowledge in geo-engineering. Moreover, since geo-engineering would be very costly and likely to provoke protest and resistance, only wealthy and powerful countries could afford to consider the large- scale projects necessary to effectively change the climate.

The question of whether technology can save human society is often asked. So far the safety, the effectiveness or even the moral tenability of geo-engineering is questionable. But the more pertinent question asks what would be being saved? A high emission lifestyle? A capitalist mode of production which favours focusing on short term decision and immediate profits? Current power relations? On the other hand, however, rejecting such technology outright may well reproduce inequalities. Answers to these questions will not be provided by technology itself, nor by its imagined dismissal. Answers can only be determined through on-going political negotiation and difficult discussion. The only response to the issue of the way in which technology may allow human societies to respond the onset of a changing climate, is to keep asking the questions.

REFERENCES

[1] Ruser, Alexander (2012) 'Greenhouse Gases' in Anheier, Helmut, Juergensmeier, Marx (eds.) *Encyclopedia of Global Studies* Los Angeles, London, New Delhi, Singapore, Washington D. C., SAGE: pp. 773–774

[2] Machin, Amanda (2013) *Negotiating Climate Change. Radical Democracy and the Illusion of Consensus.* London and New York, Zed Books

[3] Klein, Naomi (2014) *This Changes Everything. Capitalism vs, The Climate.* Simon and Schuster

[4] Bank of England (2015) Prudential Regulation Authority: *The impact of climate change on the UK insurance sector.*

[5] Schumpeter, Josef A (1942) *Capitalism, Socialism and Democracy.* New York: Harper

[6] [6| Hulme, Mike (2014) *Can Science Fix Climate Change? A Case Against Climate Engineering.* Cambridge: Polity

[7] Gaffin, S. R., Rosenzweig, C, Eichenbaum-Pikser, J, Khanbilvardi, R, Susca, T (2010) 'A Temperature ans Seasonal Energy Analysis of Green, White and Black Roofs' *CREST Centeer & Center for Water Resources & Environmental Research, CUNY*

[8] Pielke, Roger Jr. (2011) *The Climate Fix. What Scientists and Politicians Won´t Tell You about Global Warming.* New York: Basic Books

[9] Crutzen, P. J. (2006) 'Albedo Enhancement By Stratospheric Sulfur Injections: A Contribution to Reslove A Policy Dilemma?' *Climate Change* Vol. 77 2006: 211–219

[10] Machin, Amanda (2013) *Negotiating Climate Change: Radical Democracy and the Illusion of Consensus.* London: Zed Books

[11] Oreskes, Namoi, Conway, Erik (2011) *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming.* Bloomsbury

[12] Galbraith, James K (2014) *The End of Normal. The Great Crisis and the Future of Growth.* New York, London, Toronto, Sydney, New Delhi: Simon & Schuster

[13] Keith, David (2013) *A Case for Climate Engineering.* Cambridge Mass. London: Boston Review Book

[14] Manuel-Navarrete, David, Pelling, Mar, Redclift, Michael (2012) *Climate Change and the Crisis of Capitalism. A Chance to Reclaim Self, Society and Nature.* London, New York: Routledge

[15] Mirowski, Philip (2013) *Never Let A Serious Crisis Go To Waste. How Neoliberalism Survived The Financial Meltdown.* New York: Verso

[16] Horton, Joshua B, Parker, Andrew, Keith, David (2015) 'Liability for Solar Geoengineering: Historical Precedents, Contemporary Innovations and Governance Possibilities' *NYU Environmental Law Journal* Vol. 22: 225–273

[17] Directorate-General for Research and Innovation (2013) *Ethics for Researchers.* European Union

[18] Meadows et al. (1974)[1972] *The Limits to Growth.* Pan Books.

[19] Kingsnorth, Paul and Hine, Dougald (2009) *Dark Mountain Manifesto.* Available here: http://dark-mountain.net/about/manifesto/

[20] Emberley, Peter (1989) 'Places and Stories: The Challenge of Technology'. *Social Research.* 56 (3) 741–785.

[21] Franklin, Ursula (1999) *The Real World of Technology.* Ontario: Anansi.

Angela BUSHATI*
Salvatore BUSHATI*

ENCOURAGE THE CREATIVITY STARTING AT THE EARLY CHILDHOOD: THE MOST EFFECTIVE INVESTMENTS FOR QUALITY YOUNG RESEARCHERS IN THE FUTURE

Abstract: This article focuses on the concept of creativity in education seen through a critical lens as standing between dichotomies, misconceptions and possibilities for education and the stimulation of young researchers at the early age. Children are often required in schools to stick to standardised curriculums and therefore the place left for creativity is very restricted. But what does creativity mean? The term is often associated to the arts disciplines rather than scientific subjects such as maths or physics. As a matter of fact, the concept is rather complex. This paper argues the possibilities that creativity presents in special regard to education in schools, as a tool for personal and social development.

Key words: *creativity, education, misconceptions, scientific research, play, future, problem solving, innovation, development*

INTRODUCTION

In the recent decades there is a large interest in the educational and scientific arena in breaking traditional conceptions regarding creativity. The object of study refers to these traditional conceptions that have contributed in shaping a categorisation, or a form of mind-set, which determines the ability of thinking and precisely of being „creative". Creativity as a concept has been often associated with the discipline of arts rather than scientific fields, which poses an important problematic. Creativity is multidimensional and its applications or embodiments can be found anywhere. This quintessential element might also play a crucial role in fostering the human ability to build the future and face its unpredictable challenges. Different studies, as noted by Craft [1], emphasize the value of creativity when applied to educational contexts. The notion of „creativity" might present particular interest also

* Freie Universität Berlin
** Academy of Sciences of Albania

when referring to the stimulation of young researchers in different fields of science or academic research, since it could enable individuals to exercise scientific skills in a creative way since the early age. On the other hand, this concept still continues to arise conceptual confusion around it, making it always questionable. Schools and educational institutions, as well as society in general, are deeply affected by these conceptions that need to be challenged in order to facilitate the development of creativity of the individual.

The notion of being inspired, getting an idea or being creative is anchored deep in history of different cultures. Greek, Muslim, Christian and Judaic traditions see this concept as coming from a powerful and higher source [1]. On the other hand, during the Romantic era in Europe, creativity is rather seen as coming from the creative individual. Later on, people began to question the idea of creativity and the logic behind it as Craft [1] explains. The development of research through history has contributed in framing a discourse around the concept of creativity, thus making it a *universalised concept*.

As Craft [1] notes, different studies have tried to delineate the concept. Studies in the 1950s and 1970s focused mainly on the concept of „genius" and also tests of creative ability as well as on personality and discovering ways how to stimulate creative abilities [2]. According to Rhyammar and Brolin [3], as stated in Craft, Jeffrey and Leibling [2] research in creativity in the '80 s-'90 s „became rooted in a social psychological framework in which it is recognised that social structures affect individual creativity". With the work of Gardner [4] regarding the theory of multiple intelligences, the focus was to understand the creative mind in terms of intelligence. During the 1980 s and 1990 s a shift occurred putting an emphasis on cognition, personality and the creative individual, and specifically creativity in education. As noted in Craft, Jeffrey and Leibling [2] some researchers argue that creativity presents general traits and other argue that it is rather domain specific.

Regarding education, approximately in the mid-1990 s„there has been a growing recognition from policy-makers and commentators alike that learner creativity is an extremely important aim for education. The economic imperative to foster creativity in business has helped to raise the profile and credentials of creativity in education more generally" [1]. Later on in the UK, in 1998 the National Advisory Committee on Creative and Cultural Education (NACCCE) [5] was founded in order to further investigations into cultural education and creativity. Its purpose was to „make recommendations to the Secretaries of State on the creative and cultural development of young people through formal and informal education: to take stock of current provision and to make proposals for principles, policies and practice" [5]. Nowadays, with the development of technology, the future is becoming rather unpredictable and therefore, traditional educational methods are failing to prepare children adequately for future challenges. Even though creativity has received a lot of attention, it remains a vaguely understood and equivocated concept, which is still not enough employed in social contexts.

Following this sense, using creativity becomes crucial when thinking about development, economic growth or innovation. The objective of this paper is to (i) present a general idea of the concept of creativity specifically related to education, (ii) provide an overview of some misconceptions and dichotomies related to this concept, as well as (iii) discuss critically what creativity presents in terms of possibilities when applied to educational contexts for social development and the stimulation of young researchers. Although a lot of schools around the world have started implementing creativity as part of their curriculums, there is still a big gap. Many schools continue to teach according to traditional methods and therefore, leaving no space for children to express their talents and creative powers, indirectly maybe harming their self-development. On the other hand, many schools implement creativity on curriculums only as being part of the arts discipline rather than science or other fields. A lot of children around the world, who are very creative, don't fit to the norms of traditional schooling and are often disadvantaged, because of the rigid structures and non-creative teaching. Many of these children, loose the connection to their creativity and talents due to the non-consideration of creativity as an important component of education. Creativity constitutes the baseline for inventiveness. Innovation and entrepreneurship, academic research, things which are really valuable and needed in nowadays continuously changing societies. Creativity is quite ubiquitous, it can be found anywhere and can be expressed in many different ways. It can be expressed through the arts, through business, the social sciences etc. There is no field where creativity does not apply to. Nevertheless it is rather treated according to a narrow perspective.

THE CONCEPT OF CREATIVITY AND ITS MEANING

The concept of creativity has been characterised through time by many different descriptions and definitions, but it has always been very difficult to find a precise definition of what exactly creativity means. It is quite evident that many relevant criteria exist that try to explain the nature of creativity, but on the other hand, there is no definitive, absolute and ultimate criteria.

The study of different creative people generates a broad perception and a variety of definitions. One of the most popular definitions, which, has in a way mostly influenced the perception of creativity on the past, is the definition given by Torrance (1969), mentioned in Craft [1], in which creativity is seen as a process of noticing a problem, finding solutions involving a process of testing, evaluating and concluding results. The whole process involves combining ideas together, while being original and going out of the box. This definition has been very influential, but is has been largely criticised [1]. Some of the contemporary definitions of creativity distinguish high creativity from ordinary creativity. Craft [1] makes a summary of different conceptualizations and definitions. High creativity is characterised as „an exceptional human capacity for thought and creation" [3] or as „a person's capacity to produce new or original ideas, insights, restructurings, inventions, or artistic objects, which are accepted by experts as being of scientific, aesthetic, social, or technological value" [6]. Craft [1] also mentions that high creativity may apply only to some extremely talented people and may be not of relevance when talking about education of all children. On the other hand, the ordinary, or also as described the „democratic" creativity could be more relevant to educational contexts, since it recognises that all pupils can be creative. Creativity is seen as a characteristic that everyone possesses and it can be developed.

Furthermore, another explanation of the notion is that the term is often designated as not implying any meaning on its own, but it has to be rather associated with the specificity in what this person is creative, because „the criteria of what is valuable in a certain sphere of activity differ from activity to activity" [7] Another point of view claims that the affirmation that the term „creativity" cannot be used without a specification, can also be turned down or challenged easily from cases such as Leornardo da Vinci who is a person who is creative in general and in many fields. White [7] argues that „creative still, even in this case picks out not something about a person's inner processes, but about what he publicly produces." For example, the author illustrates that „we call good artists and scientists creative, because they have produced something aesthetically or intellectually valuable" [7].

In some recent descriptions, such as the one according to the National Advisory Committee on Creative and Cultural Education — NACCCE [5], creativity is defined as imaginative activity that produces original and valuable outcomes. In this definition, both high and democratic creativity is seen as being part of the child and also society in general. Creativity is part of our everyday life and can be considered as relevant to everyone in individual and collective activities. To be creative it means to engage in ways of thinking and connections that break conventional boundaries of ways of thinking and imagining. Creativity occurs when the individual plays around with ideas, images, etc. and combines them into discovering new ideas or new ways. The imaginative activity plays an important role in the process of exploration of a variety of new and unpredicted relationships. For example, play and the imaginative activities appear as interconnected. „Playfulness can be viewed as an attitude of the mind, that survives play and becomes a personality trait of the individual thus enabling connections to be made between play, imagination and creativity" [8]. For example, children often explore new ways of perceiving the world around them through play and that's when creativity occurs.

Many teachers often also refuse definitions of creativity, because they think that this can be somehow restricting children's ability to express themselves and be creative. The definition itself of creativity is somehow a boundary to its meaning and both the definition of the notion and the notion itself stand in a paradoxical relationship. Banaji and Burn [9] argue that the definitions of creativity in general are:

> „insufficiently precise to avoid familiar binary oppositions and contradictions in this area which construct creativity as, respectively, elite or democratic; originating from nothing or generic and transformative; spontaneous or taught and learned; universal or culture specific; imaginative and intuitive or knowledge and skills-based; ineffable and instinctive or quantifiable and testable." [9]

According to the authors, these oppositions are linked to the rhetorics of creativity, which are produced from different contexts, such as for example, research, theories, policies and practice. There are many rhetorics and some of them for example, include the rhetoric of: play, technology, politics/democracy, the creative classroom, etc.

1) MISCONCEPTIONS AND DICHOTOMIES TOWARDS CREATIVITY

The development of creativity in childhood is deeply affected by the ideas about art, education, creativity and other relevant concepts. The need to reconsider the idea of creativity appears as crucial, since children are often marked of stereotypes, such as, not being creative, which obviously harms their potential, motivation and creative powers. The idea of creativity resides in many misconceptions of the notion and different dichotomous relationships. One of the first misconceptions as stated by Prentice [8] is that creativity is often associated with the artistic fields and the arts in general. Another important and main misconception is that creativity is seen as synonym of arts or being artistic. The author argues that although there is a huge range of possibilities within the arts, creativity is not exclusively just residing in the arts, as many people would assume. The discussion of the two terms „creative" and „arts" often suggests that they are rather synonyms. This misconception „contributes to a reinforcement of a false dichotomy between one field of human endeavour, the arts, in which creativity is regarded as being essential, and the other fields in which, by implication, it is not" [8].

In fields like mathematics for example, often the curriculum does not offer creative approaches to foster creativity in maths, since creativity is rather considered as being part of the „other half" such as music, art, drama etc. Mann [10] argues that the process of teaching Maths in schools „without providing for creativity denies all students, especially gifted and talented students, the opportunity to appreciate the beauty of mathematics and fails to provide the gifted student an opportunity to fully develop his or her talents." The author also stresses that behind Maths stands imagination. If creativity is not fostered, this could significantly harm the process of imagination and therefore, it also diminishes the process of thinking and being creative in finding solutions in Maths.

Another misconception regarding the notion of creativity goes back to the idea that people who are creative are rather a small amount in the population and often designating rather an elite of the population. These creative people are portrayed as bohemians, unconventional and special, making a difference from the majority of people who are usually not. Often, when someone is identified as being creative, many people associate the person as being in a different category than themselves or as being part of a state of „otherness". This is a cliché, which is often believed even in schools and therefore, many children think that creativity belongs only to the „intelligent" or to the „talented", which often blocks them to develop their own potential.

Furthermore, it is important to mention the dichotomy *work vs play*, which plays an important role in education and in defining curriculums. Usually, creativity is seen as belonging more in play, rather than in work or real subjects. This dichotomisation of the relationship between the two concepts play vs. work doesn't allow creativity to be seen as something belonging to both. „The popular distinction that has been made between „play" and „work" trivializes the issues" as Siraj-Blatchford [11] notes. It is rather crucial to emphasise the importance of the relationship between play and creativity, because it could be objectified into stereotypes that are of serious outcomes. One of these stereotypes considers play rather as something belonging to childhood and it has to be replaced by work in adulthood. The second one considers that play is less efficient learning tool in comparison with learned theory and given info [8]. These social conceptions can be found in many contexts around the world and can be very harming to the development of creativity of every child. Play is often considered as not so important, for example in comparison to „serious" subjects. The experimenting nature of play is indeed very beneficial to creativity, since children and also adults can enable new ways of thinking from existing ideas. Unfortunately, such approaches are not so expanded and schools often tend to „conform" children into strict ways of achieving new knowledge.

The prescribed ideas in schools often serve to prepare children for their future in the adult working world and these ideas often smash their self-expression and motivation in exploring new imaginative ways in achieving new knowledge. Moreover, as mentioned in Prentice [8], „a dichotomous relationship between outmoded views of work and play is no longer sustainable in a society in which the boundaries between different categories of activity and modes of engagement are becoming increasingly flexible".

Nowadays the borders between work and no work or leisure and learning are being blurred due to the social dynamic of societies and new information technologies. Therefore, boundaries between social institutions such as school or workplace are less evident and creativity can apply everywhere. Although many social policies tend to emphasize the necessity of teaching children in schools how to be creative and learn how to use it, there exists on the other hand a certain propaganda and framing of the curriculum of schools that tries to put emphasis on „important subjects" focusing more on competencies such as literacy or numeracy. This somehow contradicts the initial purpose to increase children's creativity. It rather restricts it and contributes to a very narrow and standardized curriculum.

CREATIVITY AND EDUCATION

Education in general and particularly formal education is described as constituting a basic right and need of every child, but on another level it arises many issues and restrictions when it comes to fulfilling its initial aim, which is to form future generations who are original thinkers, are capable of self-fulfilment and contribute to society. Formal education has been criticised due to its „framing powers" towards children. It has been characterised as oppressing the individual expression of children and instead favouring a rather conformist view of life. Furthermore, formal education has been mostly focused on achievements and therefore it has been often a barrier to the development of the creative potential. On the other hand, nowadays, many things have changed and it is very difficult to define what knowledge is crucial and is needed for the future, since the future itself is very unpredictable. In addition, in different parts of the world, children and also adults face different life difficulties. The knowledge and life skills that these individuals achieve in schools need to adjust and respond to the need of a specific context. Educators around the world face many challenges in preparing and educating children and a significant change in the pedagogical structure is needed. The traditional structures of education are not prepared and do not respond well to the new changes in society and restrict the roads to creativity.

Article (29), in the CRC, states that „education of the child shall be directed to the development of the child's personality, talents and mental and physical abilities to their fullest potential" [12]. Educators around the world are being constantly challenged to improve their teaching methods and approaches in order to facilitate the achievement of knowledge, the ability to learn and develop for every child. Teaching methods are often responsible of the future development of life skills in children and their self-fulfilment. Children should be in principle able to express their own potential and further it through the pedagogical and didactical help of teachers. Therefore, education plays an important role in motivating and extracting „each creative-intelligence" and talents of each child and put it to life. This demands a change in the pedagogical posture of a teacher, or educator. In reality though, many teachers don't put a big value on creativity in schools and tend often to dedicate little efforts or pedagogical strategies in order to flourish the creativity of every child. This has consequent outcomes on the development and fostering of creativity.

Pedagogies that support every child's creativity can enable many possibilities regarding learning abilities when introduced in school curriculums. These pedagogies could be used as a powerful tool to enhance the involvement of children in higher level thinking skills and can also encourage them to express better themselves. Furthermore, creativity is a process of learning. It is not separated from the achievement of knowledge as many teachers and adults would think. It does not harm learning, but rather, it promotes learning by the child through the child. Guilford [13] states that „a creative act is an instance of learning … a comprehensive learning theory must take into account both insight and creative activity".

Fostering and introducing educational reforms related in order to promote creativity is very beneficial, but sometimes it is not enough. Beside the fact that creativity could bring many beneficial outcomes for children, it can also face a lot of limits and restrictions when introduced in education. Craft [14] suggests that there are many difficulties and some potential limitations to the fostering of creativity in education, which need to be considered seriously. These limitations include difficulties of terminology and definition of creativity, conflicts that reside between policy and practice, limitations in curriculum organisation, and also limitations stemming from a centrally controlled pedagogy. Therefore, educators are faced with several professional dilemmas that need to be thought well before introducing creativity in education. Such dilemmas include for example, the fact that creativity is seen as a universal thing when in fact it cannot be applied everywhere the same way, because contexts are very different and diverse and also very specific according to the culture.

According to different literature, it is defended and argued that all children are born with different creative abilities, but only some of them develop their creative potential and are going to be capable of applying it. In order to develop this creative ability, it needs to be nurtured and it is very much depending on the context of every child. White [7] notes that „most children creative growth is checked by parents and teachers rigid insistence on following explicit rules in other areas, e. g. art." According to the author, if such rigid structures and rules are broken by teachers and parents, children will develop better their creative abilities and they will learn to use them better in practice.

Nowadays, with the increased amount of new technologies and flexible societies, creativity appears as a crucial and as one of the most needed elements for preparing new generations in solving any future problems that will arise. Creativity can prepare children with different and flexible skills that are necessary to face a future which is quite unpredictable [15]. Fostering creativity in education is meant to target many issues such as different unresolved problems in different and diverse contexts and also resist or even thrive in an uncertain environment, which is changing very fast. Furthermore, the development of creativity enhances the human capital which according to Adam Smith enhances also the wealth of nations [16]. In his book *Out of our Minds: Learning to be creative*, Robinson [17] explains the enormous need of implementing an education that opens up the mind of every child in order to develop his/her potential of creativity. The author additionally argues that it is of extreme importance that the educational system is transformed. Children cannot be prepared for the needs of the 21st century in a school system that is designed to answer the needs of previous decades and it's consequently old-fashioned for this generation of children and for the future ones. The author also stresses that nowadays creativity is crucial not only in terms of the future, but also for the self-definition and development of every child. „The challenge now is to transform the education system into something better suited to the real needs of the 21st century. At the heart of this transformation there has to be a radically different view of human intelligence and of creativity" [17]. Reconsidering creativity in education would stimulate in addition the spirit of research and critical thinking, which is fundamental when considering the future and the development of the society. Stimulating creativity since the early age can be very beneficial for „awaking" young researchers who need to use their creative skills in order to succeed in the process of exploring new dimensions and discovering new solutions. According to Abd-el Khalick and Ledermann [18] scientist employ their creativity in all the dimensions of scientific research. Every researcher needs to use his/her creativity in order to come up with new ideas and develop a scientific understanding.

Every child has the capacity to develop creative thinking. Experimenting with new ideas can develop capacities, enrich the lives of children. This contributes to a better and sustainable society. According to Mills (1959), as stated in Craft, Jeffrey and Leibling [2], „the current creativity issue has generated an empowerment culture", making possible a switch of responsibility for social change from the governments/global forces to the individual. „Empowerment is seen as essential to survival and once again the locus of creativity is seen as lying within the individual" [2] It appears that creativity and the process of creative thinking, when introduced in education, can be of great importance and could bring important changes in the society. Richard [19] notes that:

> „If we can engage each of our students passionately in genuine intellectual problems worthy of reasoned thought and analysis and continually help each student to become a more judicious critic of the nature and quality of his or her thought, we have done all we can do to make likely both the critical and the creative development of each student. It is stimulating intellectual work that develops the intellect simultaneously, as both creator and evaluator: as a creator who evaluates and as an evaluator who creates." [19]

DISCUSSION

There is a very broad range of concepts and actions that are defined as being creative and that creativity itself as a notion cannot be strictly defined. Although many people from different fields of study have tried to delineate what the concept means, there are no absolute and final criteria, but rather different approaches and analysis of the concept from different angles. Nevertheless, creativity appears as a very important human capacity that can help children develop their potential and reply to the needs and problems of the 21st century. Therefore, the role of creativity, when implemented in educational contexts, has been outlined as crucial and as beneficial in the process of stimulating creative future young researchers and individuals.

Many educational systems around the world are being constantly challenged to be reformed. But this appears as not sufficient, since schools could still continue to crash or marginalize the potential and creative talents of many children. Transformation or a change of mentality towards teaching would be a better solution and the need to reconsider creativity as real potential for communities and schools is very important. Even nowadays education continues to be considered as a firm line, following strict and linear rules that lead to the preparation for the future. This mentality often brings about a traditional and non-tolerant way of education which does not prepare children for the future and their talents. In order to support children who don't fit to the norms of traditional schooling approaches and rigid curriculums there is a need of applying new creative approaches that support creativity and diversity. Every school needs to somehow develop its own approaches to the issues that they face as one specific contexts or community. The huge challenge and difficulty is that there is no absolute and strict model of creativity to follow. Schools are different and they face different need even if they are in the same neighbourhood or same state, so approaches to creativity have to be diverse and treated differently according to children's needs. According to Durrant (2012) as presented by Davis [20], there is a big need of a counter culture to the „standardization, universalism, individualism and deficit-based nature of recent educational reforms".

Promoting creative thinking and encouraging creative capacities of every child can be used as a strong tool to engage children in learning new things and exploring their creative abilities. When children are involved in their own learning that's when creativity occurs and adults, caretakers or teachers play there an important role. Motivation and also self-esteem can be deeply ameliorated when children are stimulated to think in a creative way and are encouraged to reflect on their own actions, feelings or intuition. Torrance [21] indicates that creative learning can improve concentration, motivation and also achievements. In order to promote and support creativity there is a need to adjust the pedagogical tools and strategies that teachers use. Strategies found to be important in pedagogical approaches to creativity according to Craft [1] include:

— having adequate space and time

— fostering self-esteem and self-worth

— offering learners mentors in creative approaches

— involving children in higher level thinking skills

— encouraging the expression of ideas through a wide variety of expressive and symbolic media

— encouraging the integration of subject areas through topics holding meaning and relevance to the children's lives

Even though creativity still nowadays in many contexts continues to be largely associated to the discipline of the arts, it is not just about arts. Implementing creativity in schools it is not enough if it is only targeted into specific subjects such as art classes or painting. The change of mentality has to be done in all subjects taught in schools and it has to be evident in subjects such as Maths or Chemistry. Creativity is important in science as much as it is in arts. Children need to use creativity in every subject and there teachers play an essential role in accompanying children through this journey of creativity. According to Kampylis and Berki [22], „like a farmer sowing seeds, someone creates conditions for children to grow as creative and critical thinkers. Creativity cannot be taught „directly", but educational practice can provide the means, opportunities and a fertile environment for the creative mind to flourish".

CONCLUSION

Creativity, when nurtured and developed as an adaptable or flexible component of education, can be a very ingenious and brilliant capacity of humanity. Education can be used as a powerful tool to create conditions for individuals to discover their creative abilities and develop them. Every child should be capable through the help of education to discover their inner creativity and benefit from learned knowledge in order to be capable of flexibility and creative thinking in the uncertain future. The use of creativity can open new doors and new opportunities in a world where new problems and social changes will require new creative ways of thinking and solutions. This does not mean that anyone will be a scientist and will discover new solutions, but it is important to value creative thinking as a process which applies in different domains and spaces of life. In addition, education should be a tool to help individuals discover and be in harmony with their own element of being. Although this is often not the case, since creativity is restricted from the rigidity of school curriculums and a lot of other aspects, there is still hope left for creativity. When implementing creativity in education, teachers or educators would need to reconsider the notion from many different perspectives and also need to rethink the limits when applied to education. The role of teachers is therefore fundamental. The implementation of new creative ways of teaching and promotion for creativity, rather than supporting delimited ideas of what education or creativity should be, is crucial when looking to the future and stimulating new ways of thinking. Creativity needs to be encouraged since the early childhood and a lot more importance needs to be given to school curriculum balance among science and art education subjects. In addition, more power needs to be given to the child, more freedom in order for exploration and discovery to take place. What appears as crucial, is to try to rethink education and its priorities, how knowledge is transmitted and how could it bring out children's creativity in order to stimulate the sense of innovation, which is so fundamental for encouraging young people's interest in science and research.

There is still a lot to be done and many dilemmas need to be resolved and taken care of, but already the process of reconsidering the whole system with special regards to creativity can provide a good start.

REFERENCES

[1] A. Craft, *An Analysis of Research and Literature on Creativity in Education: Report prepared for the Qualifications and Curriculum Authority*. London: QCA, 2001.

[2] A. Craft, B. Jeffrey, and M. Leibling, (Eds). *Creativity in Education*. London: Continuum, 2001.

[3] L Ryhammar, and C. Brolin, „Creativity research: Historical considerations and main lines of development" *Scandinavian Journal of Educational Research,* vol. 43, No 3, p. 259–273, 1999.

[4] H. Gardner, *Frames of mind: The theory of multiple intelligences*. New York: Basic Books, 1983/1993/2011.

[5] K. Robinson, (Chairman) *All Our Futures: Report of the National Advisory Committee on Creative and Cultural Education*. London: DCMS/DfEE, 1999.

[6] E. P. Vernon, „The nature-nurture problem in creativity" in J. A. Glover, R. R. Ronning and C. R. Reynolds (eds) *Handbook of creativity: Perspectives on individual differences,* Plenum Press, New York, NY, 1989.

[7] J. P. White, „Creativity and education: A philosophical analysis." *British Journal of Educational Studies*, vol. 16, p. 123–137. 1968.

[8] R. Prentice, „Creativity: A reaffirmation of its place in early childhood education." *The Curriculum Journal*, vol. 11, No 2, p. 145–158, 2000.

[9] S. Banaji, and A. Burn, „Creativity through a rhetorical lens: Implications for schooling, literacy and media education". *Literacy*, vol 41, No 2, p. 62–70, 2007.

[10] E. L. Mann, „Creativity: The essence of Mathematics." *Journal for the Education of the Gifted,* vol 30, p. 236–262, 2006.

[11] I, Siraj-Blatchford, „Early childhood pedagogy: Practice, principles and research". In Mortimore, P. (ed.) *Understanding Pedagogy and its Impact on Learning*. London: Paul Chapman Publishing, p. 20–45. 1999.
[12] *Convention on the Rights of the Child* (1989). [Online] Available: http: //www. ohchr. org/en/professionalinterest/pages/crc. aspx
[13] J. P. Guilford, „Creativity". *American Psychologist*, vol 5, p. 444–454. 1950.
[14] A. Craft, The limits to creativity in education: Dilemmas for the educator. *British Journal of Educational Studies*, vol 51, p 113–127, 2003.
[15] R. Fisher, and M. Williams, *Unlocking creativity: Teaching across the curriculum*. London: David Fulton, 2004.
[16] H. Walberg, „Creativity and talent as learning. In: R. Sternberg", (Ed.), The nature of creativity: Contemporary psychologica *perspectives* Cambridge: Cambridge University Press. p. 340–361, 1988.
[17] K. Robinson, *Out of our minds. Learning to be creative*. Oxford. Capstone Publishing, 2001.
[18] F. Abd-el Khalick, and N. G. Lederman„The influence of history of science courses on students' views of nature of science". *Journal of Research in Science Teaching, 37* (10), p. 1057–1095, 2000.
[19] P. Richard„The logic of creative and critical thinking" in R. Paul, *Critical thinking: How to prepare students for a rapidly changing world*. Santa Rosa, CA: Foundation for Critical Thinking, vol 277, 1997.
[20] J. M. Davis, „Supporting creativity, inclusion and collaborative multi-professional learning." *Improving Schools*, vol. 16, No 1, p. 5–20, 2013.
[21] E. P. Torrance, „Creative teaching makes a difference." In J. C. Gowan, J. Khatena, and E. P. Torrance (Eds.), *Creativity: Its educational implications* Dubuque, IA: Kendall/Hunt. 2 nd ed., p. 99–108, 1981.
[22] P. Kampylis, and E. Berki, (2014). „Nurturing creative thinking". [Online]. p. 1–28. Available: http://www.ibe.unesco.org/fileadmin/user_upload/Publications/Educational_Practices/EdPractices_25eng.pdf

Marcelo SÁNCHEZ SORONDO*

THE MESSAGE OF '*LAUDATO SI', MI SIGNORE*' — 'PRAISE BE TO YOU, MY LORD'

'We are called to be instruments of God our Father, so that our planet might be what he desired when he created it and correspond with his plan for peace, beauty and fullness' (§ 53).

Abstract: Pope Francis' appeal in *Laudato Si'* is both profoundly religious and scientific: it begins from faith, goes on to engage in a philosophical and ethical reflection, and adopts the most precise knowledge of the natural and social sciences. He affirms that the planet in which we live is our common 'sister home' that is sick due to the harm inflicted on it by a few individuals, while the negative consequences are suffered by everyone, especially the poorest. *Ecology* comes from two words, *eikos* and *logos*, which in Greek mean 'house' and 'order', that is to say, that science orders the only home that we all live in, our common home.

Pope Francis has woken up contemporary men and women, inviting them to avoid a 'superficial ecology which bolsters complacency and a cheerful recklessness' (§ 59). Moved by the cries of the poorest caused by the climate, he returns to the heart of the gospel 23, to the Beatitudes and to Matthew 25: 40 'In truth I tell you, in so far as you did this to one of the least of these brothers of mine, you did it to me'. He inserts his new concept of „integral ecology" and to „ecological conversion" into the social thought of the Church, as well as dignity, freedom of thought, fraternity, the universal destination of goods, solidarity…Integral ecology encompasses ecological balance, social justice and spiritual responsibility.

THE RELIGIOUS VISION OF 'SISTER EARTH'

This message is profoundly religious because it considers the world as God's home, as a gift that God has given to human beings — His image — to take care of and develop according to their potentialities for the good of men and women in all times and in all places. Chesterton says in his famous 'St Francis of Assisi' that the Saint of Assisi enables us to discover the truth of heaven and earth in its profound sacredness, created by God and redeemed by Christ, whereas the Greek-Roman mentality, absorbed

* Chancellor, Pontifical Academy of Sciences, Vatican

in myth, saw in the heavens and earth, in the constellations and in life, the mere fables of the passions and virtues of the gods and demigods. 'The flowers and stars have recovered their first innocence. Fire and water are felt to be worthy to be the brother and sister of a saint. The purge of paganism is complete at last…stars stand no more as signs of the far frigidity of gods as cold as those cold fires. They are like all new things newly made and awaiting new names, from one who shall come to name them. Neither the universe nor the earth have now any longer the old sinister significance of the world. They await a new reconciliation with man, but they are already capable of being reconciled. Man has stripped from his soul the last rag of nature worship, and can return to nature' (ch. 2, cf. http://gutenberg.net.au/ebooks09/-0900611.txt).

Saint Francis' vision and message regarding the world as God's home and our common home is one that comes directly from the Gospel. 'Praise be to God for our Sister, Mother Earth, which brings forth varied fruits and grass and glowing flowers' ends almost with the words 'Praise be to God for our Sister, the death of the body'. And Pope Francis wants to act on this. As Saint Thomas said, 'in sacred science, all things are considered under the aspect of God: either because they are God Himself or because they refer to God as their beginning and end' (*S. Th.* I, 7 c). Francis joins together both dimensions in a ground-breaking approach that he calls 'integral ecology'. The home that God has gifted to men and women has to be a common home 'like a sister with whom we share our life and a beautiful mother who opens her arms to embrace us. 'Praise be to you, my Lord, through our Sister, Mother Earth, who sustains and governs us, and who produces various fruit with coloured flowers and herbs" (§ 1). The Pope carefully avoids proposing precise and technical solutions. Yet some Christians will protest: again another Pope 'playing politics'! Francis inscribes his designs in the heart of the mystery of the love of the creation. Perhaps here his inspiration comes from St. Thomas, where he writes, 'as therefore we say that a tree flowers by its flower, so do we say that the Father, by the Word or the Son, speaks Himself, and His creatures; and that the Father and the Son love each other and us, by the Holy Spirit, or by Love proceeding' (*S. Th.*, I, 37, 2.)

Concrete humanity — all peoples inhabiting our 'common home' — is invited to decrypt the message of trust that God has proposed since the beginning: 'The entire material universe speaks of God's love, his boundless affection for us' (§ 84).

DATA FROM THE NATURAL SCIENCES ADOPTED BY FRANCIS

However, according to the evidence brought forward by the natural and social sciences 'this sister land is sick and cries out from the damage caused in her due to the irresponsible use and unjust abuse of goods placed in her by God. In modern times we have grown up thinking that we are her owners and rulers, authorized to exploit her' without any consideration of her potentialities and laws, as if she were an inert material. We have forgotten that we ourselves are dust of the earth (cf. *Gen* 2: 7); our very bodies are made up of her elements, we breathe her air and we receive life and refreshment from her waters' (§ 2).

Here the Pope passes from a theological beginning centred on the Gospel to a consideration and acceptance of the most precise and current data that these sciences provide. Francis begins this analysis — for the first time in the Magisterium — by talking about the climate as a 'common good, of all and for all'. And he defines this at the global level as 'a complex system linked to many of the essential conditions for human life'. He then proceeds by making use of scientific notions and words, asserting that 'a very solid scientific consensus indicates that we are presently witnessing a disturbing warming of the climatic system'. In adopting the observations made by these disciplines, he goes on to affirm clearly that 'in recent decades this warming has been accompanied by a constant rise in the sea level and, it would appear, by an increase of extreme weather events, even if a scientifically determinable cause cannot be assigned to each particular phenomenon' (§ 23).

Arriving at the crucial point, the Pope accepts that 'there are other factors (such as volcanic activity, variations in the earth's orbit and axis, the solar cycle)' that coincide with global warming, but Francis energetically denounces the scientifically identifiable causes of this evil, declaring that: 'a number of scientific studies indicate that most global warming in recent decades is due to the great concentration of greenhouse gases (carbon dioxide, methane, nitrogen oxides and others) released mainly as a result of human activity' (§ 23).

We encounter once again the newness of the epistemology of *Laudato Si'*. Whereas the statement that the earth is our home and we ourselves are its stewards has a Biblical foundation, the view that the climatic crisis of global warming is due to human activity that uses fossil fuels is purely scientific. The Bible can tell us that human beings must preserve and develop the earth in line with the design of God but it cannot tell us the real situation of the earth today: knowledge about this situation is a domain of the natural sciences. As a consequence, faith and reason, philosophical knowledge and scientific knowledge, are brought together for the first time in the pontifical Magisterium in *Laudato Si'*.

THE INSIGHTS OF THE SOCIAL SCIENCES ADOPTED BY THE ENCYCLICAL

One of the key points sustained throughout *Laudato Si'* is the intimate relationship between the fragility of the planet and the world's poor (whether individuals or cities of people). This comes from a deep conviction that in the world everything is intricately, intimately and causally interconnected. In other words 'climate change is a global problem with serious social, environmental, economic, distributional and political dimensions, and poses one of the greatest challenges for humanity'. The encyclical is not ecological in the 'green' sense, but is primarily a social document.

The poor populations are the most severely affected even though they are the least responsible. *Laudato si'* tells us that: 'the worst impacts are reoccurring and will continue to do so even more over the following decades, particularly affecting developing countries and the poorest of the world. Many of the poor live in areas particularly affected by phenomena related to warming, and their means of subsistence are largely dependent on natural reserves and ecosystemic services such as agriculture, fishing and forestry' (§ 25).

Climate change provokes the migration of animals and plants that cannot always adapt and this in its turn affects the means of production of the poorest who are obliged to emigrate with great uncertainty as regards their future and the future of their children: 'There has been a tragic rise in the number of migrants seeking to flee from the growing poverty caused by environmental degradation. They are not recognized by international conventions as refugees; they bear the loss of the lives they have left behind, without enjoying any legal protection whatsoever' (§ 25).

The detailed explanations of our academician Ramanathan, which the Pope echoes, are convincing: 'Some forms of pollution are part of people's daily experience. Exposure to atmospheric pollutants produces a broad spectrum of health hazards, especially for the poor, and causes millions of premature deaths'. Poor people fall ill, for example, 'from breathing high levels of smoke from fuels used in cooking or heating. There is also pollution that affects everyone, caused by transport, industrial fumes, substances which contribute to the acidification of soil and water, fertilizers, insecticides, fungicides, herbicides and agrotoxins in general' (§ 20).

Pope Francis also affirms that 'The impact of present imbalances is also seen in the premature death of many of the poor, in conflicts sparked by the shortage of resources, and in any number of other problems which are insufficiently represented on global agendas' (§ 48).

In actual fact there is not sufficient awareness of the climate problems that particularly affect the poor and excluded, which consequently exacerbates both poverty and exclusion. Yet the poor and the excluded 'are the majority of the planet's population, billions of people. These days, they are mentioned in international political and economic discussions, but one often has the impression that their problems are brought up as an afterthought, a question which gets added almost out of duty or in a tangential way, if not treated merely as collateral damage. Indeed, when all is said and done, they frequently remain at the bottom of the pile. This is due partly to the fact that many professionals, opinion makers, communications media and centres of power, being located in affluent urban areas, are far removed from the poor, with little direct contact with their problems' (§ 49).

Furthermore, 'This should not make us overlook the abandonment and neglect also experienced by some rural populations which lack access to essential services and where some workers are reduced to conditions of servitude, without rights or even the hope of a more dignified life' (§ 154).

After the crimes of slavery and the colonial and totalitarian experiences of past centuries, humanity — like the idea of the intangible value of human life — is thus once again threatened in its existence, its dignity and its freedom. All these dramatic situations of poverty and social exclusion, caused or increased mainly by global warming, are the breeding ground of new forms of slavery and human trafficking, such as forced labour, prostitution, organ trafficking, drug dependency, etc. It is clear that full employment and schooling form the great defence against poverty, prostitution, drug addiction and drug trafficking.

Consequently, reducing our use of carbon energy is not a question only of the natural environment! The Anthropocene, a term proposed by our pontifical academicians to define the new geological age in which the model of development is based upon human activity that uses fossil fuels and makes the earth sick, is also 'the greatest construction site for the defence of human rights of our epoch' (Msgr. Desmond Tutu, preface to *Stop Climate Change!*).

For this reason Francis makes use of the social sciences together with the natural sciences. In a globalised world, we cannot fail to recognise that the true social approach is connected with ecology and vice versa: 'a true ecological approach *always* becomes a social approach; it must integrate questions of justice in debates on the environment'. Indeed, His Holiness concludes that we must 'hear *both the cry of the earth and the cry of the poor*' (§ 49).

Hence 'every ecological approach needs to incorporate a social — and political — perspective which takes into account the fundamental rights of the poor and the underprivileged and likewise, all socio-political consideration must have an integral ecological dimension' (§ 93).

SOLUTIONS FOR AN INTEGRAL ECOLOGY: WE ARE IN TIME TO ADDRESS THE PROBLEM

This invitation to safeguard the 'common home' expresses God's appeal to man to set to work. So what are the solutions? 'In actual fact, developing the created world in a prudent way is the best way of caring for it, as this means that we ourselves become the instrument used by God to bring out the potential which he himself inscribed in things: „The Lord created medicines out of the earth, and a sensible man will not despise them"' (*Sir* 38: 4; § 124). Caring for the earth is not like taking care of a museum, which only preserves and maintains works that have no biological life. Caring for the earth also entails developing it according to its God-given vital potentialities, in accordance with scientific discovery and activity, for the common good of man, for the sustainable development of our planet, with generational and intergenerational solidarity, leaving all progenies to inherit a healthy earth rather than a sick one. In addition, protecting an integral ecology means eradicating social exclusion and marginalisation as soon as possible, particularly poverty and new forms of slavery, which today have become the most valuable form of business for traffickers.

The Pope affirms that 'in the present condition of global society, where injustices abound and growing numbers of people are deprived of basic human rights and considered expendable, the principle of the common good immediately becomes, logically and inevitably, a summons to solidarity and a preferential option for the poorest of our brothers and sisters'. We should therefore search for the common good by forming partnerships on the planet, honour the value that God gives to each person in fighting for his dignity, embody the mercy of the Lord for those who are most threatened, transform socio-political mechanisms in order to reduce inequalities, and recognise the infinite patience and mercy of God towards men and women, nurturing faith, hope and charity.

We could cite here the golden rule, at the base of all civilisations and religious traditions: 'do not do to others what you would not like them to do to you', or in its positive formulation: 'Do to others as you would have them do to you' (Lk 6: 31).

However this rule today is not enough: it deserves to be interpreted in the light of the Beatitudes of the Gospel according to St. Matthew chapter 5, and the protocol by which we shall be judged in Matthew chapter 25, which refers to the other, the poorest and the neediest in an existential and real situation of suffering. To choose the Beatitudes and the poor, those who suffer, those who weep, those of pure heart, the meek, the merciful, and the peacemakers, those who love justice and are persecuted for its sake, is a choice that transcends the golden rule, which is too abstract to respond to the suffering of the other and those most in need. The option to follow the Beatitudes 'entails recognizing the implications of the universal destination of the world's goods' but as the Pope mentioned in 'the Apostolic Exhortation *Evangelii Gaudium*, it demands before all else an appreciation of the immense dignity of the poor in the light of our deepest convictions as believers'. Indeed, the Pope concludes: 'We need only look around us to see that, today, this option is in fact an ethical imperative essential for effectively attaining the common good' (§ 158). In definitive terms, differently from the golden rule, in the Beatitudes the other is that suffering being that the Gospel never ceases to place at its centre. Suffering is not only defined as physical suffering, as mental or moral pain, but also by the diminution or the destruction of the capacity to be and to act, to be able to do, which are felt as an attack on the integrity of the person. And, again in a different way from the golden rule, a sort of equalisation appears in the Beatitudes where suffering man is at the origin and, thanks to the shared suffering of the suffering other and oneself, the love required by the Beatitudes is not confused with mere pity, where one can be secretly happy at being rewarded. In the Beatitudes, when truly implemented, one, where the power of acting is at the outset greater than that of the suffering other, is affected by everything that the other can offer in return. From the suffering other there proceeds a gift that no longer comes from the power to act and to exist but from weakness itself. It may be precisely here that we find the proof of the love required by the Beatitudes, which, at the moment before death, lies in voices that speak to each other or the weak holding of hands.

The German philosopher Habermas, in a dialogue with Cardinal Ratzinger, said that to save today's world 'a liberal political culture can itself require secularised citizens to take part in the effort to translate the significant material of religious language into a language that is accessible to everyone'. The most significant material of religious language, the most revolutionary discourse, the most relevant, the most human and the most divine, the shortest and the most profound, that any religious man has ever pronounced during the course of history, is that of the Beatitudes, the Sermon on the Mount, of Jesus Christ. Politicians and social scientists, in particular those of Latin America, are called to reflect on the way of embodying the Beatitudes both as a law of politics and society and also as the shared concrete goods of globalised society, and lastly as a new name for the common good. Welcome will be the thinker, the academic, the economist, the worker, the politician and the religious or social leader who is able to bring the programme of the Beatitudes of Christ to contemporary globalised society!

I very much thank you for inviting me to this city of Berlin, which has given a great deal and which still has a great deal to give to the world. Thank you very much for listening to me.

Abdeslam BADRE*

LEVERAGING SCIENCE DIPLOMACY FOR SOCIETAL DEVELOPMENT ACROSS NATIONS

Abstract: The present paper interrogates how the EU-Morocco's Deep and Comprehensive Free Trade Agreements (DCFTAs), which is being currently negotiated between the two actors, is going to shape the sectorial competitiveness of the EU Mediterranean countries trading with Morocco, with a particular focus on agricultural sector. Taking a cue from the elements that contribute to the definition of the liberalization measures in the trade of agricultural product between the EU and the Kingdom of Morocco, one wonders what are currently the key elements, which characterize the agricultural trade between EU and Morocco, especially in light of the DCFTAs. On this ground, the objective is to determine whether the socio-economic agents involved in the vigorous trade negotiations have reason to be concerned about the significant divergences over the new DCFTA agreement, given the protests in many southern European regions that already drew fire on the 2012 EU-Morocco agreement that liberalized trade in agriculture and fisheries and lowered the quotas for zero or low duty imports between the two.

Key words: *EU; Morocco; DCFTA; International Relations; Trade*

* Youth, Women, Migration & Policy Development in EU--MENA; Mohammed V University; NEF Ambassador for Morocco

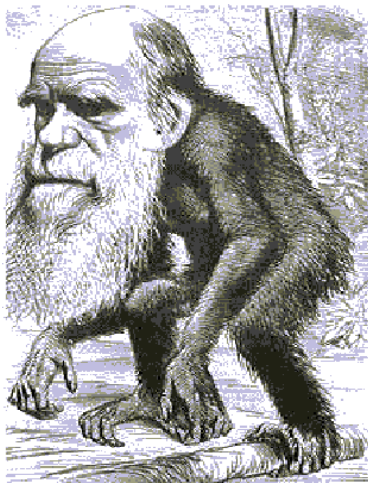
GLOBAL YOUNG ACADEMY

why did the chicken cross the road?

A. Badre 1

GLOBAL YOUNG ACADEMY

Chickens, over great periods of time, have been naturally selected in such a way that they are now genetically disposed to cross roads.



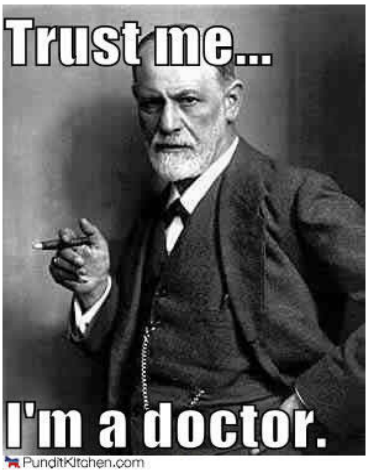
A. Badre 2

GLOBAL YOUNG ACADEMY

Who cares why? The end of crossing the road justifies whatever motive there was.

A. Badre 3

GLOBAL YOUNG ACADEMY

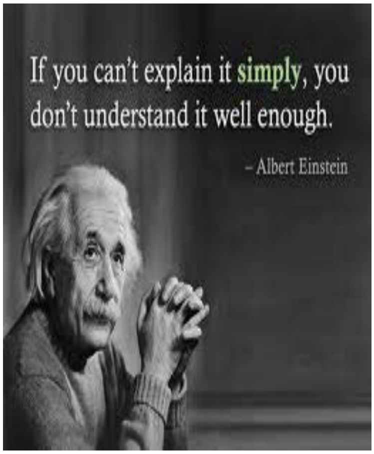


The fact that you are at all concerned that the chicken crossed the road reveals your underlying sexual insecurity

A. Badre 4

GLOBAL YOUNG ACADEMY

Whether the chicken crossed the road or the road moved beneath the chicken is a matter of relativity.



A. Badre 5

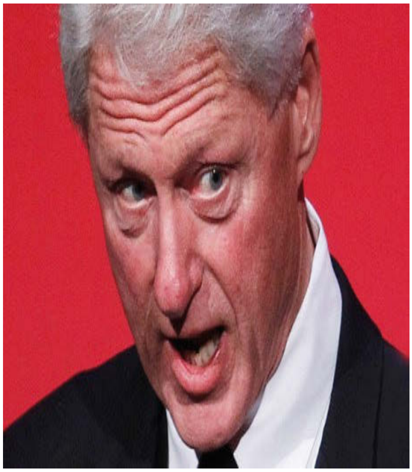
GLOBAL YOUNG ACADEMY

We don't really care why the chicken crossed the road. We just want to know if the chicken is on our side of the road, or not. The chicken is either against us, or for us. There is no middle ground here!!!

A. Badre 6

GLOBAL YOUNG ACADEMY

I did not cross the road with that chick-en.



A. Badre 7

GLOBAL YOUNG ACADEMY

Really…?!

A. Badre 8

Radovan STOJANOVIĆ*

SCIENCE AND TECHNOLOGY TRANSFER FROM RICH TO POOR — THE HELP OR A BUBBLE

To my suspicious teachers

Abstract: In this note some reflections on the role of science and technology in a society, especially, in developing countries are given. It is pointed out that beyond all expectations recent reforms in science and education in developing countries resulted in very limited and modest results. Some effects such us „publish or perish", „hyperauthorship" and bureaucracy that practically voided good intentions are detailed elaborated. At the end, several ideas, how to get out from the current situation and how to make science and technology more useful for the developing countries and their citizens are proposed.

Key words: *Science and technology, developing countries, publish or perish, science vs politics*

INTRODUCTION

In recent decades there have been very intense activities related to the development of research and scientific capacities in developing countries, which have been undertaken under various national, bilateral, EU, overseas and other programmes. These have been based on common and hypothetical reasoning and assumption, i. e. that „the developing and less developed countries will remain even poorer unless they can imitate what the developed countries have done: to incorporate science and research into their political and economic strategies". The idea to transfer science and technology policies and related measures from the developed to the developing became a winning combination for the policy makers in both groups of countries over the decades. Nevertheless, a very large gap between the desires and the achievements exists, and only tangible results of such activities are the side effects as „publish or perish", hyperauthorship, bureaucracy and abnormal growth in the numbers of researchers over the globe. On the other hand, the socio-economic

* University of Montenegro (UCG) and Montenegrin Association for New Technologies (MANT)

indicators in majority of developing countries are in strong dissonance with, sometimes, their impressive research and scientific results.

As someone, who was born and lives in a developing country and has worked in academia and research for almost 25 years and has been involved in many international, bilateral, national projects, I feel the need to write this note in order to share my reflections on the role of science and technology in a society, especially, in developing countries, which comprise 80% of the world population. Also, guided with the Aristotle's pristine academic rule „*Plato is dear to me, but dearer still is truth*", I would like to point out that beyond all expectations recent reforms in science and education in developing countries resulted in very limited and modest results. At the end, based on my own competencies and experience, I would like to propose several ideas, how to get out from the current situation and how to make science and technology more useful for the developing countries and their citizens.

SCIENCE VS POLITICS

This is the everlasting theme for both politicians and scientists. May be it can be best defined by two Aristotle's notions: „*Man is by nature a political animal*" and „*All men by nature desire knowledge*". All societies, no matter what they think of each other, claim to be „knowledge based". Also, they tend to manipulate and abuse knowledge. Science becomes a part of the political process [1]. Especially, the political elites in developing countries always use the science and technology to present themselves as reformatory and „open minded".

Growing up in former Yugoslavia, I developed dreams and good habits regarding science. Also, I got good education. Yugoslavia was truly „a knowledge based country" with an excellent education system. Then, I painfully realized that the technology and science change very fast, but human nature remains unchanged. Human nature destroyed one knowledge based country. I remembered one lesson from my childhood, when Leonardo da Vinci wrote to the Duke of Milan: „*I do not want to precisely describe my method to stay under the water for a long period because people are so ill-natured that they would use it to destroy the keel of boats and to sink the crew*". For the second time, in my middle age, I found myself again in a knowledge based society, now the EU, where I easy adapted and was relatively successful, because of good habits from youth and familiarity with the topic. The question is: what will I bring to the mankind at my old age? May be Einstein answered it at the meeting at Princeton, N. J., (Jan 1946): „*Dr. Einstein, why is it that when the mind of man has stretched so far as to discover the structure of the atom we have been unable to devise the political means to keep the atom from destroying us?*" Einstein answered: „*That is simple, my friend. It is because politics is more difficult than physics*".

Then, do scientists need to fight against politicians and human habits to fulfil their ideas? My answer is not and never. „*Human nature is potentially aggressive and destructive and potentially orderly and constructive*" as Margaret Mead said. Obviously, we cannot change it. „*The union of the political and scientific estates is not like a partnership, but a marriage. It will not be improved, if the two become like* *each other, but only if they respect each other's quite different needs and purposes. No great harm is done, if in the meantime they quarrel a bit"* [2].

Where is the problem then? Why knowledge based society of my youth was more productive than today's knowledge based society? My explanation is the following. It is because of:

— better education,
— more real verification of research and scientific results,
— more „lifelike" approach in all science activities, and
— more real „terrain" and everyday measures taken in this area by policy makers.

THE VERIFICATION OF RESEARCH AND SCIENTIFIC WORK

The „copy paste" strategy in the transfer of scientific and technological development from the developed to the developing, from „rich" to „poor" had the most negative effects in the verification process, which is mostly virtual and bibliometrically based, with many necessary implications.

„A publish or perish" effect has already derogated science not only in developing countries. The growth in the number of articles published over the last decade is enormous; from 1.3 million in 2003 to 2.4 million in 2013. The number of authorships increased from 4.6 million in 2003 to 10 million in 2013. The number of the researchers (authors of the articles) increases 5 times than the research population due to the „hyperauthorship", which has become a very profitable business. As an example, a physics paper about the Higgs boson by CERN was co-authored by more than 5,000 researchers; while a paper on the genetics was credited to 1,014 authors. To be more absurd, speaking to the Guardian (The Guardian, Friday 6 December 2013), the Nobel Prize Winner professor Higgs, said he would almost certainly have been sacked had he not been nominated for the Nobel in 1980. Edinburgh University authorities then took the view, as he later learned that he *„might get a Nobel Prize — and if he doesn't we can always get rid of him"*. Similar happened to professor Fred Sanger, a Double Nobel Laureate, about whom his friend, Sydney Brenner, also a Nobel laureate, in a fantastic article said: *„Fred would not survive today's world of science. With continuous reporting and appraisals, some committee would note that he published little of import between insulin in 1952 and his first paper on RNA sequencing in 1967 with another long gap until DNA sequencing in 1977. He would be labelled as unproductive, and his modest personal support would be denied. We no longer have a culture that allows individuals to embark on long-term—and what would be considered today extremely risky—projects."* [3]. Some of the authors warn that the bureaucracy will destroy science and education [4].

THE RESEARCH OUTPUT VS REALITY IN DEVELOPING COUNTRIES, THE CASE STUDY OF WESTERN BALKAN COUNTRIES

Western Balkan countries, where I live and work, have been very actively involved in the reform of their science and research policy for almost two decades.

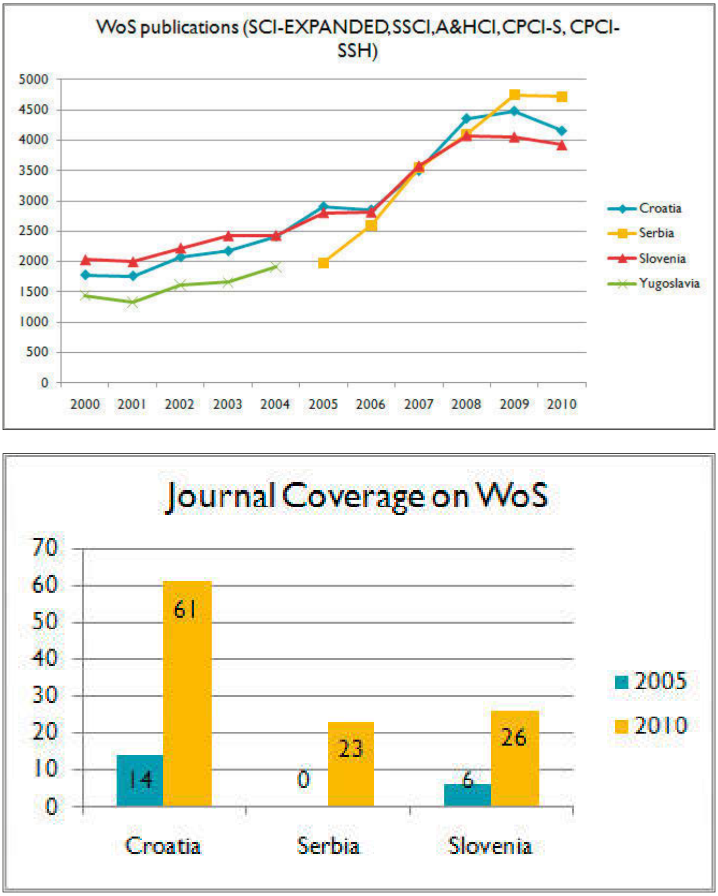


Figure 1: Web of Science published works in SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH databases by authors from Croatia, Serbia, Slovenia and Yugoslavia, 2000 — 2010 and Journal coverage on the Web of Science in 2005 and 2010 for Croatia, Serbia and Slovenia. Source http://www.herdata. org/in-focus/what-is-behind-bibliometric-indicators-from-the-web-of-science/7

Some of them have become the rising stars in the number of publications and citations, like Serbia. Figure 1 (left) shows the Web of Science published works in SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH databases by authors from Croatia, Serbia, Slovenia and Yugoslavia between 2000 — 2010. As can be seen, an impressive progress was achieved. Also, these countries significantly increased the number of the journals included in WoS, e. g. in 5 years Serbia had 23 journals included in WoS starting from 0, Figure 1 (right). On the other side, these countries are an example of how the bibliographic indicators do not influence, or do not follow the industrial production, which, in case of Serbia, experienced a very small growth (Figure 2). This confirms the thesis that even rising star countries in science and technology are still far away from the technology and science driven economy.

Figure 2: Industrial production in Serbia from 2006–2016. Source www.tradingeconomics.com

Science and technology in Western Balkan are not sufficiently oriented towards broadly defined social welfare, but they are more aimed at meeting the needs of narrow target groups.

CONCLUSIONS

First, the best conclusion of the above would be „*A good intention, with a bad approach, often leads to a poor result.*" (Thomas A. Edison). If developing countries like to achieve some tangible outcomes in the science and technology sphere, and not to waste time, as a first step, they need to stop to „copy paste" the solutions from the developed world. Then, they need to change their education system, by building one that emphasizes rational thinking and motivates people to create new values [5]. It is more useful for some of the countries with good education history to return to their old education systems and to improve them in some rational aspects [6]. Science and technology of developing countries should try to drive local economies instead of being an isolated island, self-sufficient for local scientific workers, scientific policy makers, international experts and interest groups. Scientific and research work should be merit-based in these countries. In the first phase, more with the emphasis on the contribution to the local economy and local development and in second phase, when the economy and the society becomes more advanced, by implementing the „Western" bibliographic approach.

The reforms during the initial/recovery phase can be implemented with relatively low expenditures which only depend on good intentions of local policy makers: decentralizing the decision making in the area of science and research, creating pools of trained people, creating small groups around outstanding individuals, improving the relative status of local scientists, choosing rational and useful research projects, introducing small national funding schemes, removing unnecessary bureaucracy and making the import of scientific knowledge easier. These countries need to build their own small flexible centres of excellence in science and technology that are especially relevant for their own societies and economies.

REFERENCES

[1] David E. Newton, „Science and Political Controversy: A Reference Handbook", *ABC-CLIO*, Apr 21, 2014 — Science — 332 pages

[2] Don (Krasher) Price, *The Scientific Estate* (1965), 71.

[3] Sydney Brenner, „Frederick Sanger (1918–2013)", *Science*, 17 Jan 2014: Vol. 343, Issue 6168, pp. 262.

[4] Charlton BG, „The cancer of bureaucracy: how it will destroy science, medicine, education; and eventually everything else", *Med Hypotheses*. 2010 Jun; 74(6): 961–5. doi: 10.1016/j. mehy. 2009.11.038. Epub 2010 Jan 13.

[5] Ahmed Hassan Zewail, „Science in the developing world", *TWAS Newsletters*, Vol 14. No 4. 2002.

[6] Radovan Stojanović, „Quo vadis ingeniare", *Izlaganje na tribini „Obrazovanje inženjerskog kadra u Crnoj Gori"*, 12. 12. 2013. http://www.apeg.ac.me/In%C5%BEenjerskakomorastojanovic.pdf

Neki FRASHERI*
Gudar BEQIRAJ**

THE TRAGEDY OF INNOVATION — REFLECTIONS ON INNOVATION AND DISRUPTION IMPACTS

Abstract: Fifteen years ago we carried out a study on the history of informatics in Albania and, based on an excessive study of literature reached some conclusions on how informatics and Internet are impacting the world, focusing mainly in developing countries. Some of conclusions were simple: introduction of innovative technologies has the tendency not to solve problems but to shift them in other dimensions. Actually innovations are considered an important factor for economic growth and opening of new working places — this is a key topic in different political agendas. We argue that disruption caused by innovation does not improve a-priori economic processes, instead it may led to even spectacular but local optimizations that may be problematic for the global optimization of the economy. And this phenomenon may be even tragic for small developing countries especially in conditions of globalization. Policies in small developing countries should be carefully tuned, avoiding blind exportation of ideas from great developed countries, in order to stimulate the local sustainable growth and prosperity.

INTRODUCTION

During the difficult years of the transition in nineties we were forced to reflect on the complex of relations between technology, society and politics from multiple points of view — technical, historical and political, [1],[2],[3]. The work was facilitated due to the collaboration with the IFIP WG 9.4 group and experiences from other countries in development analyzed widely and in depth by this group. The accumulated knowledge was used for an extended work paper [4] where one of conclusions was a reformulation of Kransberg Law (*technology is neither good nor bad; nor is it neutral*) [5] as „technology does not solve the problem; it only shifts it to another 'dimension'".

Actual developments are oriented towards applied research and innovation more than basic research, conditioned by economic and market requirements in

* Academy of Sciences of Albania

an accelerating [6] and globalizing world. Innovation is seen as an important factor for economic growth, included in political agendas and research programmes, and promoted in all levels of scientific collaboration and publication. But it seems that things are not so clean and beautiful and the Kransberg Law remains valid.

First, a question remains — are all countries able to exploit in proper degree results of innovation? The concept of difference of rationales is well known in scientific circles [7] but not reflected in political agendas of international collaboration characterized by import of solutions „copy — paste", a phenomenon identified in developing countries. The well-known argument that it is necessary to have the research budget over certain limit in order to have impact in the economy is widely used in political discussions, supported by statistics, but without a clear analysis how much may a developing economy may absorb the results of its own research and which are ways of that absorption depending on specifics of each country.

Second, it has to do with the concept of innovation and its specific impact in the economy and society — the disruption. In social media one may find „strong" propositions like for example social media blogs [8], [9], [10], [11], [12], [13]; but also the issue is discussed in-depth in scientific media, a short review presented in the next section of this paper.

DISRUPTIVE INNOVATION — GOOD OR BAD?

Disruption affects both the economy and the society — the way of life. In particular Information and Communication Technologies (ICT) are merging the big world in a „small" village. Following the logic of Kransberg, this impact is is positive as well as negative; and Clayton explains the latter aspect that „*a trend has emerged where the benign and correct use of ICT may unexpectedly result in social disruption and harm to others, resulting in consequential damages*" [14]. One may argue about ethics [15] and responsible innovation [16] but the problems cannot be solved simply with words:

— How far we may predict short-time and long-time impacts of innovation, and

— How we may find applicable solutions for problems conditioned by contradictory factors?

In 1980 Collingridge defined a dilemma: „*At the initial stages of a new technology, knowledge about its consequences (including undesired outcomes) is limited; Later we have more systematic knowledge about costs and benefits of technology; by this stage, change is costly and difficult to achieve; technology is entrenched; must confront powerful vested interests…*" [17]. Schomberg accepts that „*personal lives become … more constrained as more choices are offered and communication is increased*" in his report for the European Commission [18]. Negative impacts of innovation may remain invisible for a long time. For example Ferguson et al identified a hidden negative impact of the Internet: „*People are less willing to rely on their knowledge and say they know something when they have access to the Internet, suggesting that our connection to the web is affecting how we think*" [19]. Analyzing autonomous vehicles, Bonnefon et al pointed out the „*formidable challenge to define the algorithms that will guide AVs confronted with moral dilemmas*" [20]. Responsible innovation has its own limits. Robin [21] concludes that „*anticipation techno-social futures have often been disappointing extrapolated from a limited and somewhat stereotypical set of narratives …*". Rip and TeKulve consider the impact as „*even less clear — attempts to find out about them are then social science fictions*" [22]

From economic point of view, half century ago Ted Levitt pointed out that „*companies develop significant myopia over time, only seeing things that are squarely in the mainstream of their market*" [23] and as result became prey of innovations that target neglected market areas. The idea was further developed by Clayton [24] with the „*innovator's dilemma*" that „*doing the right thing is the wrong thing.*"; who defined „disruptive innovation" as selling products that initially target less profitable customers but eventually takes over and devours an entire industry, not because of missed opportunity but the velocity of history. Lepore details that disruptive innovation has not been subject to serious criticism because it's headlong and the modern concept of innovation is the idea of progress [25]. The process of innovation disruption that targets grassroots of market to explode upwards is described by Clayton in [26] — big companies that target higher levels of the market react slowly losing their market — disruption happened.

The „verdict" of King and Baatartogtokh is that „*it's not nearly as valuable as its proponents argue*" [27]

MODELING OF DISRUPTION IN ECONOMY

Innovation has been and remains the engine of the progress of human society, and negative comments towards it may sound like absurd. Nevertheless the progress is not without pains — World changes and the first key issue is how individuals may adapt in time to such changes.

The second key issue is the complexity of socio-economic relations. If we focus on specific sectors and forget the complexity of inter-sector relations, we cannot evaluate correctly the overall and long term impact of innovations. We may simplify model the socio-economic system with two circular flows of threads entangled in complex braids rotating against each other (Fig. 1) in a dynamic equilibrium.

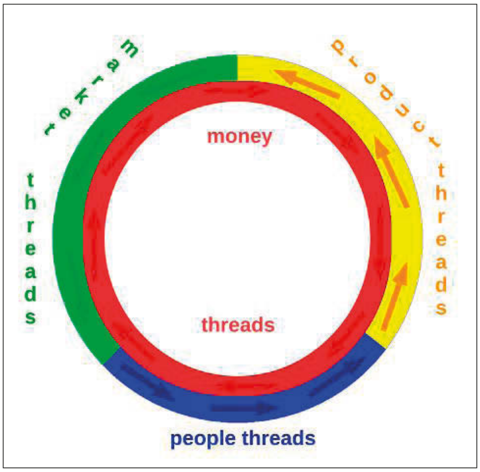
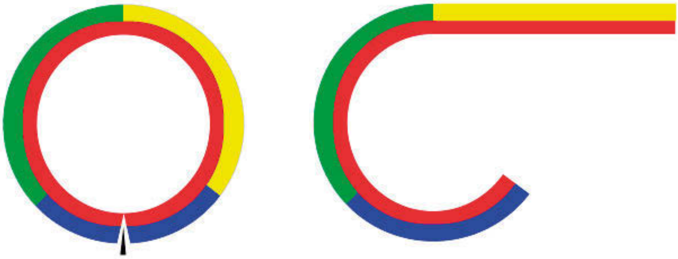


Fig. 1 — a simplified model of socio-economic complex relations

Disruption in this system happens when some threads are cut or braids reshuffled, and the crisis situation may last until a new equilibrium is achieved in the system. In the post war period the world has experienced two characteristic disruptions:

— Automation of industry, which cut part of links between people and product threads together with entan-



(a) (b)

Fig. 2 — disruption from (a) automation and (b) export of capitals

gled braids. Nevertheless all components of the system remained in local and the system somehow reached a new equilibrium (Fig. 2 a).

— Exportation of capitals, which caused significant cuts of links between people and product threads together with entangled money threads and, differently from automation it shifted cut ends of product — money braids far away (Fig. 2 b). This made impossible for the system to reach equilibrium …

In this system the component that reacts slower compared with others is people — fast changes in the production or market components are followed with difficulty by people especially aged generations. Innovation creates premises for fast changes in production and in market. Slow reaction from people and big companies creates the disruption, and disrupted companies generate an avalanche effect disrupting more people. Focusing at innovation as a"tool" to open new businesses means focusing for local improvements that on the other side create disruption and problems for the whole system. It is local optimization versus global optimization — it is well known that the probability of the former to „kill" the latter is significantly high.

Today innovation is accelerating considerably, apparently more from to concurrency instead of real requirements of people. This creates disruption and crisis situations. Local innovations may force reshuffling of braids of socio-economic relation threads, resolving one crisis with a new one. While globalization makes difficult for the system to reach equilibrium in local scale. Reshuffling of markets is also pushed by big companies „overloading" them with varieties of products and services proposed and promoted (not requested) by people. Typical examples are smartphones that come with lot of preinstalled software, part of which not used by people, locked against uninstallation, which services are less important in the hierarchy of human needs.

Risk analysis and ethical evaluation of projects impacts is requested by many development programmes. But an old proverb says „from saying to doing is a full sea". Conclusion of research (Kransberg, Clayton, Collingridge etc.) is that the real impact of innovation is very difficult to predict. Science Europe Scientific Committee for the Humanities in its report [28] emphasizes the need for taking into consideration the human dimension in innovation policies, which is missing in actual European policies.

CONCLUSIONS

Innovation is one of key topics in political agendas, strategies and development programmes. It is considered as an important factor of growth and new working places. This is correct — innovation has been the engine of development. The other side of the medal — forced / accelerated innovation creates disruption in a complex of socio-economic relations that are practically impossible to fully understand and manage. This kind of disruption impact contradicts the political goals of innovation.

We argue that disruption caused by innovation does not improve a-priori economic processes, instead it may led to even spectacular but local optimizations that may be problematic for the global optimization of the economy. We are forced to live in such world characterized by significant changes fueled by the innovation disruption and in order to evaluate and lessen global negative impacts the focus should not be simply innovation per-se but include human relations impacted by innovation.

This phenomenon may be even tragic for small developing countries especially in conditions of globalization. Big / small / developed / less developed countries have their individual specifics conditioned by their history and geographical position, and the ways of absorption of innovation results is different. Policies in small developing countries should be carefully tuned, avoiding blind exportation of ideas and tendencies of competition with big / developed countries, in order to stimulate the local sustainable growth and prosperity.

Crucial questions are related with what science and innovation we need, and how we may exploit its results. Running blindly towards „popular" topics and [*the subjective*] impact factor while having less resources compared with other countries is useless adventure. Even in case of significant innovations it may be exported for marketing abroad there where the economic and industrial capacity is suitable for its absorption and further development. At the same time we have lot of needs that require strong collaboration between politics and research, not in the form of nice written strategies and platforms but through concrete collaboration and involvement in the process of practical resolving of the needs.

REFERENCES

[1] G. Beqiraj, N. Frasheri: „Albania — contradictory story of applied information systems." *IFIP WG 9.4 International Working Conference „Implementation and evaluation of information systems in developing countries", 18–20 February 1998, Bangkok — Thailand.*

[2] N. Frasheri: „Recent IST development in Albania — new trends and new problems." *IFIP WG 9.4 Conference „Information flows, local improvisations and work practices", 24–26 May 2000, Cape-Town, South Africa.*

[3] N. Frasheri: „Reflection of policies for effectiveness of IS implementation in DCs." *Newsletter of IFIP WG 9.4 and Commonwealth Network for Information Technology, v. 8, no. 3, July 1998*

[4] N. Frasheri: „E-Governance, International Cooperation and Security — New Millennium Challenges for a Small Country." *SSRC ITIC 2001 Work Paper. SSRC ITIC Program Fellow — Summer 2001. http://arxiv.org/pdf/1312.2246.pdf*

[5] M. Kranzberg: „Technology and History: „Kranzberg's Laws"." *Technology and Culture, Vol. 27, No. 3, pp. 544–560.*

[6] B. Bimber: „The Internet and political transformation: populism, community, and accelerated pluralism." *Polity v 31, n 1. 1998.*

[7] C. Avgerou: „Recognizing alternative rationalities in the development of information systems." *EJISDC, v 3 r 7. 2000*

[8] C. Popp: „Innovation is a Dirty Word — Looking for Animation." *http://www.linkedin.com/e/v2?e=3D113lyp-i0tjtkx3–1y&t=3Dgde&m=idToken=3DAQE_rrykeGXxyQ&ek=3Db2_anet_digest&li=3D75&m=3Dgroup_=discussions&ts=3Dtextdisc-0&itemID=3D5923592223307350016&itemTy=pe=3Dmember&anetID=3D3731775 (3 Oct 2014)*

[9] W. A. Sussland: „Deadly Sins of Innovation Strategies." *http://www.linkedin.com/e/v2?e=113lyp-hv7zd1pw-4n&t=gde&tracking=eml-b2_group_digest-grouppost-textdisc-0&ek=b2_anet_digest&itemID=5872265831332741120&anetID=4427025&itemType=member (15 May 2014)*

[10] F. L. Rajas: „Is Innovation a Buzzword? Bringing down three myths about innovation." *https://www.linkedin.com/pulse/innovation-buzzword-luis-rajas-fern%C3%A1ndez [retriev. Feb 23 2016]*

[11] F. L. Rajas: „Innovation is Just an Excuse." *https://www.linkedin.com/pulse/dont-you-see-innovation-just-excuse-luis-rajas-fern%C3%A1ndez [retriev. Feb 23 2016]*

[12] P. Hobcraft: „Caught in the Headlights of Disruptive Innovation." *https://paul4innovating.com/2016/03/02/caught-in-the-headlights-of-disruptive-innovation/ [retrieved in 3. 3. 2016]*

[13] K. Drotner: „Disruptive innovation: requires humanities' input." *http://www.euroscientist.com/disruptive-innovation-requires-humanities-input/ [retrieved in 9. 4. 2016]*

[14] C. J. Pavlovski: „Information & communications technology evolution and consequential damage." *In Record of the Communications Policy & Research Forum 2007 compiled by Franco Papandrea and Mark Armstrong. ISBN 978–0-9804344–0-8. Network Insight Pty Ltd. October 2007*

[15] B. C. Stahl: „IT for a better future: how to integrate ethics, politics and innovation." *Journal of Information, Communication & Ethics in Society. Vol. 9 No. 3, 2011. pp. 140–156*

[16] R. Owen, J. Stilgoe, P. Macnaghten, M. Gorman, E. Fisher, and D. Guston: „A Framework for Responsible Innovation." *In Responsible Innovation, edited by Richard Owen, John Bessant and MaggyHeintz. John Wiley & Sons, Ltd. 2013*

[17] D. Collingridge: „The social control of technology." *Frances Pinter, 1980*

[18] R. von Schomberg: „Research and innovation in the information and communication technologies and security technologies fields." *A Report from the European Commission Services. Directorate General for Research and Innovation, 2011.*

[19] A. M. Ferguson, D. McLean, E. F. Risko: „Answers at your fingertips: Access to the Internet influences willingness to answer questions." *Consciousness and Cognition 37, 2015*

[20] J.-F. Bonnefon, A. Shariff, and I. Rahwan: „Autonomous vehicles need experimental ethics: are we ready for utilitarian cars?" *arXiv: 1510.03346 v 1, 12 Oct 2015*

[21] W. Robin: „Bridging the big divide: on the uneven gaze of science, technology and innovation studies." *Future of Science and Technology in Society: Symposium in Honour of Arie Rip. University of Twente, 16 — 17 June 2011*

[22] A. Rip and H. TeKulve" „Constructive Technology Assessment and Socio-Technical Scenarios." *The Yearbook of Nanotechnology in Society, Volume 1: Presenting Futures. E. Fisher, C. Selin and J. M. Wetmore, Springer 2008.*
[23] A. Scott: „How Understanding Disruption Helps Strategists." *Harvard Business Review 11, 2015. https://hbr.org/2015/11/how-understanding-disruption-helps-strategists*
[24] C. M. Clayton: „The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business." *Harper Business Essentials, 2011*
[25] J. Lepore: „The Disruption Machine — What the gospel of innovation gets wrong." *Annals of Enterprise. The New Yorker, June 23, 2014.*
[26] C. M. Clayton, M. F. Raynor, R. McDonald: „What Is Disruptive Innovation?" *Harvard Business Review 12, 2015. https://hbr.org/2015/12/what-is-disruptive-innovation*
[27] A. A. King and B. Baatartogtokh: „How Useful Is the Theory of Disruptive Innovation?" *MIT Sloan Management Review, Fall 2015*
[28] SESCH: „Radical Innovation: Humanities Research Crossing Knowledge Boundaries and Fostering Deep Change" *Science Europe Scientific Committee for the Humanities Opinion Paper, Dec. 2015, http://www.scienceeurope.org/uploads/PublicDocumentsAndSpeeches/SCsPublicDocs/151222_HUMAN_OP_Radical_Innovation_web.pdf*

Ivo ŠLAUS*

CONCLUDING REMARKS

I am sure I speak on behalf of all of us when I express our gratitude and congratulation to Momir Djurovic for organizing such a wonderful event, for choosing such an important and timely topic and for assuring so many excellent participants.

Global scientific output doubles in about 9 years[1], which means that the rate is now five times larger than it was at the time of Newton, Faraday, Einstein and Bohr. Comparing total scientific output with progress in only one discipline — physics, is not correct. The end of science[2] has been claimed: there are no major breakthroughs beyond quantum physics and general theory of relativity, and theory of evolution. However, less than two decades ago when physicists were concerned with The Standard model and the Higgs boson, measurement using ESA satellite Planck demonstrated[3] that our universe is composed of dark energy (68.3%), dark matter (26.8%) and only 4.9% of our ordinary matter. And we still do not understand either dark energy or dark matter. Now, major progress is witnessed in all scientific disciplines. New inter-disciplines are emerging: synthetic biology, artificial intelligence and nano-sciences, as well as new materials — not discovered, but new, genuinely new. Is it necessary to invert Hamlet words „There are more things in heaven and in the earth, my Horatio, than are dreamt of in your philosophy." or are „new materials" in one of parallel worlds of multiverses, which we are somehow imbedded in and/or connected with.

The rate of technological achievements is increasing, as it was impressively outlined by our introductory speaker L. Christophorou[4], as well as by G. McBean[5],T. Bajd[6] and P. McGrath[7]. We will address here only two technologies: artificial intelligence and beyond biology.

The Moore law[8] is the observation that a number of transistors in an integrated circuit doubles about every two years. Many studies in ICT show that performance in relation to price doubles every 18 months. It is estimated that the increase in our current technological ability will increase more than 500 times in next ten years.

---

* Dag Hammarskjöld University College; The World Academy of Art and Science

The future technology comes faster than expected. It is likely that at some point in time — not too distant — machines will be smarter than humans and that is referred as technological singularity[9]. Kurzweil anticipates humans merging with machines[10], whatever it means!? Diamandis considers the future of unimaginable abundance[11]. Consequently, economy is rapidly changing. Classical industrial production will be unnecessary, since the advanced 3-dimensional printing will allow for printing of complex products at home, so most of the distribution channels from a factory in the land with cheap labor to the supermarket store will not be necessary. Now 4 D printing is coming: products that will be able to modify themselves in time. The most important component will be the algorithm for printing. Similarly, machines would perform other daily tasks, and their performance would depend on the algorithms. Today the classical software industry amounts to about $500 billion (about 0.5% of global GDP) and is growing at about 2% — faster than the rest of the economy[12]. Almost all areas of human activity will need intelligent algorithms that will control the machines. Methods of artificial intelligence and other advanced machine learning tools are already used in many areas of life, and their applications are expanding rapidly. Significant paradigm changes in computing are forthcoming and the most promising seems to be the so-called quantum adiabatic computing. An example of a 1000-bit quantum computer based on quantum annealing was developed by D-Wave Systems[13].

Chimera: part human — part animal beings existed in folklore and fiction. Now it is reality. Chimerism within a species occurs naturally in nearly all animals. Inter-specific chimeras, rarely exist in nature due to the unlikelihood of specific conditions required. In 1989, scientists at the University of California, Davis breached this barrier and created the first artificial chimera, a sheep-goat hybrid dubbed the „geep." Such research into chimeras elicited little public attention and outcry until August 2003, when Hui Zhen Sheng at the Shanghai Second Medical University created the first human-nonhuman chimera. Sheng and his team removed the genetic material from some of the cells in a rabbit embryo and inserted human DNA, creating a human-rabbit chimera[14]. J. Craig Venter Institute transformed one kind of bacteria to another — a completely synthetic organism was created[15]. Biological research and these results prompted Lord Martin Rees to bet: „By year 2020 an instance of bio-error or bio-terror will have killed one million people." (Unfortunately, laboratory accidents happen much more frequently than the public knows! Bio-error in Sverdlovsk in 1979!)

Most technologies have dual-use, many can be misused, many have been and are misused. This prompted Ambassador Toth to address his talk here[16] Weapons and Technologies of Mass Destruction, and Aleksander Likhotal stressed that it is not science but ignorance that is responsible for misuse of science and technology[17].

The new economy is algorithm economy with sustainable abundance comprising new materials and new processes and therefore, the development of quantum algorithms and synthetic biology will have to be addressed requiring an educational paradigm change from a culture of standardization to a culture of creativity[18]. Several participants addressed the role of education (E. Hoedl[19] and A. Zucconi[20]). While most schools prefer the logical intelligence, many young people are abundant in other types of intelligence, which are often lost in schools. This challenge will magnify as we approach the singularity, because the creativity will become more important. The nature of scientific progress does not allow predicting specific discoveries, so it is difficult to direct the educational systems towards specific knowledge and skills that would be necessary in the near future. It spite of this uncertainty, it is obvious that a more creative individual will have a comparative advantage in the more advanced society. Also, it is important that each person has a chance for a creative contribution to society, which is useful both to the total economic output as well as for the psychological wellbeing of that person[21]. One can truly conclude that our contemporary society is characterized by knowledge explosion[22].

The opening sentence from the Tale of Two Cities „It was the best of times, it was the worst of times" describes our contemporary world: it is the best ever: our knowledge — possibly our understanding — tremendously increased, life expectancy increased, quality of life is higher than ever, but our contemporary world is not sustainable, it is self-destructing: natural and human capitals are being destroyed at a fast rate. Wars and violence, as well as chaotic migration are destroying human and also natural capital. Though significant results have been achieved: end of colonialism, end of the Cold War[23], many successful international treaties, we are still faced with 20,000 nuclear missiles most at hair trigger alert, with chemical and biological weapons of mass destructions, we are witnessing terrorism, chaotic migrations[24] and blatant violation of international laws.

Climate change already has huge negative consequences and it will be worse[25], as discussed here by Rajendra Pachauri[26]. Ecological footprint is 50% larger than our Earth can tolerate[27] (the stupidity of our contemporary development is best shown in Fig in ref 27 — a barely 10% improvement in HDI causes factor of 3 deterioration in ecological footprint) and while humans forgive sometimes, and God always, Nature never forgives[28]. Though humans should endeavor in colonizing space, it is important to appreciate that colonization of space is a much, much more difficult task than departure from Easter Africa was for our forefathers. Earth is our home as is beautifully emphasized in „Laudato si, mi Signor", Pope Francis Encyclica[29] presented by Chancellor Archibishop Marcelo Sanchez Sorondo[30].

Human capital — including individual and collective creative capitals — are being destroyed by us, by our current institutions and by our laws, by our ill-conceived self-interests, by our greed and by our prejudices. Just as this afternoon session closes — during its duration several thousand children have died from hunger. Th. Pogge estimates[31] that 423 million persons have died of hunger from 1991 till 2013. This is larger than the number — estimated by Rummel — of persons killed by their own governments in the 20th century — about 200 millions, or persons killed during WWII. „This economy kills!"[32]. Too many people live in slavery[33]. It is estimated[33] that close to 50 million persons today live in slavery, 30% more than a year ago. Is that a result of the fact that recovering from the recent economic crisis 95% of the gain went to the richest 1%34)? When we hear that children die from hunger and that there are slaves, we tend to push it to some distant, unknown country. Yet, though my own country and Montenegro are among the countries with smallest percentage of slavery, just 0.4% of their respective populations, it is 17,000 slaves in Croatia! Indeed: „This economy kills!" According to Oxfam 62 individuals control the same wealth as 3.5 billion poorest persons[34]. Inequality is bad for the economy: OECD study showed that the enriching the richest instead of increasing the income of the poorest slows the economy[35]. Various proposals: reduction of the taxes for the wealthiest[36] and the universal basic income[37] seems not be good „solutions". Inequality[38] and unemployment destroy human capital and suffocate economic development.

Several papers at this conference were devoted to economy, full employment and globalization (L. Gascon[39], G. Jacobs[40], and M. Vesković[41]). Six year ago World Academy of Art and Science initiated research and endeavor toward new economy — based on human dignity and sustainability[42]. The striving for and the idea of a new economy is much older. One should never forget that Adam Smith was a moral philosopher. Sinking of SS Central America in 1857 prompted John Ruskin to switch to economy. Arguing against Malthus and Ricardo Ruskin wrote „The real science of political economy, which has yet to be distinguished from the bastard science, as medicine from witchcraft, … is that which teaches nations to desire and labor for thing that leads to life." And Ruskin concludes „There is no wealth but life."[43] which foretells a recent statement by the UN „People are the true wealth of nations."[44] Putting in numbers — human and natural capital are for most of the countries much larger than the manufactured capital (we devote so much to), e. g. for the USA inclusive wealth is over 100 trillions, while manufactured wealth is less than 20 trillions[45].

The 70th anniversary of the UN is marked by two significant results: Transforming Our World — The UN Agenda 2030, also known as Sustainable Development Goals (SDGs)46) unanimously accepted by the UN GA on September 25, 2015 and the Paris Agreement on Climate Change[47], actually an important segment of SDGs. Both documents are expressions of core values necessary for survival, for human-based world. The values were addressed by several speakers at this conference (J. Engelbrecht[48], Segerstrale[49] and Lagumdzija[50]). We in the World Academy are proud that several years ago — following our work on new economy and full employment as well as our endeavor to abolish war and any form of violence — we initiated an encompassing endeavor: A New Human-based and Humanity-based Paradigm. „We realized that contemporary world has truly dangerous enemies: destruction of natural and human capital — destruction of trust, extremely high unemployment and income inequality — economic, political and above all moral crises. Building peace and prosperity is a long and slow process and considerable success has been achieved. But it only takes seconds to destroy that peace. Let us not forget the words of President D. D. Eisenhower „Every gun that is made, every warship launched, every rocket fired signifies in the final sense a theft from those who hunger and are not fed, those who are cold and not clothed. This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children." The old approach „they" and „us" does not solve anything."[51] Our endeavors are just at the very beginning. They do demand more research and much more understanding. It is not a work of one person, not even an organization, or scientific enterprise, not only of the UN. It is a joint endeavor of all of us, all 7 billion, all sovereign countries, scientists throughout the world, scholarly institutions, academies, business, laborers and trade unions. It is gigantic. It is comforting to realize that the pillar of this endeavor is deeply rooted in us — in the Golden Rule, in all major cultures, in our biology and in our history and it is the guarantor of our future[52].

REFERENCES

[1] R. van Noorden, Nature, Newsblog (May 7, 2014), Lutz Bornmann and R. Mutz, arXiv: 1402.4578 (Feb 2014)
[2] John Horgan, The End of Science, Facing the Limits of Science in the Twilight of the Scientific Age, New York, Broadway Books (1996)
[3] Planck Collaboration: Planck 2015 results XIII: Cosmological Parameters, arXiv: 1502.01589, Astronomy and Astrophysics manuscript (February 9, 2015), Joint Analysis of BICEF 2/Keck Array and Planck Data, P. A. R. Ade et al, Phys. Rev. Letters 114, 101301 (March 9, 2015)
[4] L. Christophorou, this Proceedings
[5] G. McBean, this Proceedings
[6] T. Bajd, this Proceedings
[7] P. F. McGrath, this Proceedings
[8] Moore, G. E. (1965). Cramming more components onto integrated circuits. *Electronics,* pp. 114–117, April 19, 1965. The Economist, March 12, 2016: The Future of Computing: „In 1971 the fastest car was capable of 280 km/h and the tallest building — The New York Twins had 415 m. Intel launched first commercial microprocessor, the 4004 containing 2,300 transistors. A modern Intel Skylake processor contains 1.75 billion transistors. If cars and building would „improve at that rate, the car could make run at 0.1 speed of light and buildings would reach half the way to the Moon. Today 3 billion people carry smart-phones, more than those having access to adequate sanitation. Improvement in computer hard-work came to an end. The future of computing improvement is in three other areas: i) software (e. g. AlphaGo program playing the ancient game of Go defeated the world champion (there are more possible board positions in the game of Go than there are particles in the universe [it is estimated that the total number of particles in the observable universe is 1080]. To prevail AlphaGo relies on „deeplearning" technology modeled on the way the human brain works, ii) cloud, the network of data centers and iii) new computing architecture — specialized chips optimized for particular jobs.
[9] Ulam, Stanislaw (May 1958). „Tribute to John von Neumann". 64, #3, part 2. Bulletin of the American Mathematical Society. The concept of singularity is traced back to J. von Neumann in 1950 s.
[10] R. Kurzweil, The Singularity is Near: When Humans Transcend Biology (2006), Penguin Books The concept of singularity is traced back to J. von Neumann in 1950 s.
[11] Diamandis, P. H., Kotler, S., Abundance: The Future Is Better Than You Think, Free Press, 2012.
[12] Gartner, Press Release, Stamford, Conn., March 31, 2014, see also http: //www. gartner. com/newsroom/id/2696317, accessed on May 30, 2016.

[13] D-Wave, Quantum Computing: How D-Wave Systems Work. D-Wave Systems, Inc., 2016, see also http: //www. dwavesys. com/quantum-computing, accessed on May 30, 2016.
[14] Ying Chen, … Hui Zhen Sheng et al, Cell Research 13 (2003), 251–263
[15] D. Gibson et al, Science Express, (May 20, 2010)
[16] T. Toth, this Proceedings
[17] A. Likhotal, this Proceedings
[18] Robinson, K., Creative Schools: The Grassroots Revolution That's Transforming Education, Viking, 2015.
[19] E. Hoedl, this Proceedings
[20] A. Zucconi, this Proceedings
[21] A. Zidanšek and I. Šlaus, SEE SDEWES conference, Piran, June 2016
[22] Adair J. G., Vohra N., The explosion of knowledge, references, and citations. Psychology's unique response to a crisis. *Am Psychol.* 2003 Jan; 58(1): 15–23.
[23] Marin Katusa, Colder War. Wiley Casey Research (2015)
[24] Knoema; Forcibly displaced people worldwide (May 23, 2016): it is estimated that over 30 million persons are displaced, twice as many than less than ten years ago!
[25] Climate Change, Synthesis Report 2014, IPCC, Geneva, Switzerland
[26] R. K. Pachauri, this Proceedings
[27] Rees, W. E. (October 1992). „Ecological footprints and appropriated carrying capacity: what urban economics leaves out". Environment and Urbanisation *(2): 121.* doi*:* 10.1177/095624789200400212*;* Rees, W. E. and M. Wackernagel (1994) Ecological footprints and appropriated carrying capacity: Measuring the natural capital requirements of the human economy, in Jansson, A. et al. Investing in Natural Capital: The Ecological Economics Approach to Sustainability. Washington D. C.: Island Press; *Wackernagel, M. (1994).* Ecological Footprint and Appropriated Carrying Capacity: A Tool for Planning Toward Sustainability *(PDF) (PhD thesis). Vancouver, Canada: School of Community and Regional Planning. The University of British Columbia.* OCLC 41839429.

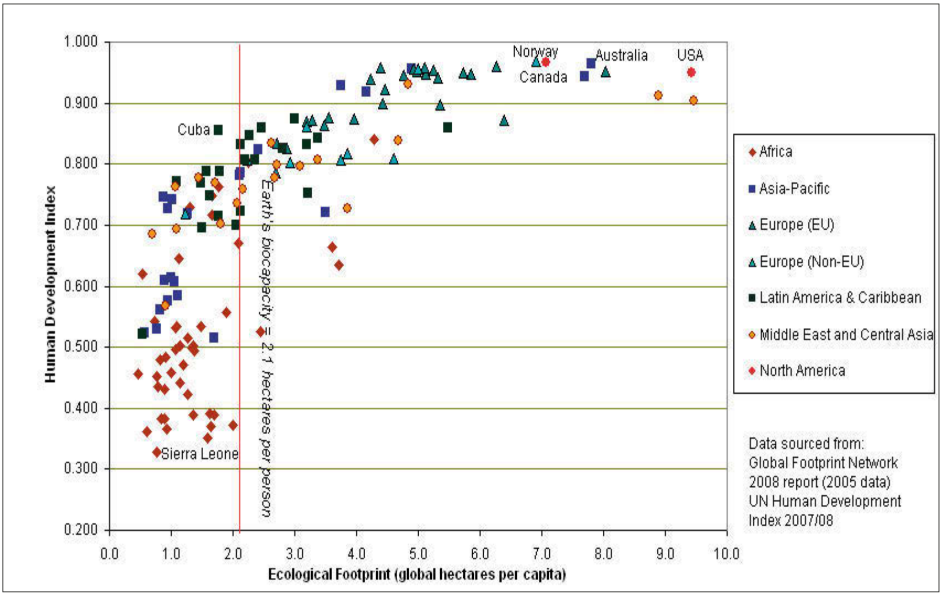


Fig. Human Welfare and Ecological Footprints Compared

[28] Farmer to Pope Francis
[29] Pope Francis, Laudato si, Encyclical letter, May 24, 2015 and officially published on June 18, 2015
[30] M. Sanchez Sorondo, this Proceedings
[31] WHO, Th. Pogge, Metaphilosophy 36 (2005) 182; Th. Pogge, Poverty, Human Rights and the Global Order, Framing the Post-2015 Agenda (2012); Th. Pogge, Global Justice Program, Yale University, www.yale.edu/macmillan/globaljustice/index.html
[32] Pope Francis: Evangelii Gaudium, Nov 24, 2013
[33] Walk Free Foundation, www.walkfree.org
[34] G. Kuo Petravić, Inequality in our capitalist society, American Center for International Policy Studies — amcips. org, 2015 (to be published; OXFAM, *https://www..org/…/…/Davos—62-people-own-same-half-…;www.dw.com/en/--wealth-of……/a-18985985*
[35] OECD, Tous concernés: Pourquoi moins d'inéqualités profite à tout, 2015
[36] The Economist, January 2, 2016, „Be serious"
[37] The Economist, June 4, 2016, „Basically flawed"
[38] R. Wilkinson and K. Pickett, Spirit Level (2009), Bloomsbury Press
[39] L. Gascon, this Proceedings
[40] G. Jacobs, this Proceedings
[41] M. Veskovic, this Proceedings
[42] O. Giarini, G. Jacobs, B. Lietaer and I. Šlaus, Cadmus 1 (2010) 9–27
[43] Schumacher Center for a New Economics, David Boyle, The Birth of the New Economics, April 20, 2016
[44] UNDP, Human Development report (2010) The Real Wealth of Nations
[45] Sir Partha Dasgupta et al, Inclusive Wealth Report (2014), UNU-IHDP, UNEP
[46] UN GA, Transforming Our World, The UN Agenda 2030 for Sustainable Development, unanimously accepted on September 25, 2015
[47] Paris Agreement on Climate Change negotiated by representatives of 195 countries, opened for signature on April 22, 2016, signed by 177 and 15 ratified it. Agreement will enter into force when 55 countries representing at least 55% of GDG emission have formally joined it. The process is expected to be completed by 2020. About ten countries account to about 50% of GHG emission.
[48] J. Engelbrecht, this Proceedings
[49] U. Segerstrale, this Proceedings
[50] Z. Lagumdzija, this Proceedings
[51] I. Šlaus, H. Gurgulino de Souza, W. Nagan and G. Jacobs, Our Common Enemies and Our Best Friends, Cadmus, Vol 2, Issue 3 (Oct 2014) iii-iv
[52] R. Axelrod and W. D. Hamilton, The Evolution of Cooperation, Science 211 (March 27, 1981) 1390–96, see also: R. L. Trivers, The Evolution of Reciprocal Altruism, Quaterly Review of Biology 46 (1971)35–57, J. M. Smith and G. R. Price, Nature 246 (1973) 15–18; Lee A. Dugatkin, The Altruism Equation, Seven Scientists Search for the Origin of Goodness, Princeton University Press (2006); see also U. Segerstrale, Nature's Oracle, Life and Work of W. D. Hamilton, Oxford University Press (2013)

Montenegrin Academy of Sciences and Arts

World Academy of Art & Science

European Academy of Sciences and Arts

Global Round Table

ALLEA All European Academies

Technology + Society $\overset{?}{\rightarrow}$ Future

The International Conference
20th of May, 2016
in Podgorica

Provide Peaceful Prosperity

Participants from more than 30 countries recognise that:

- **We are facing previously unforeseen individual and societal challenges coming from science and technology.**
- **These challenges require new human value-based mechanisms to manage their benefits and minimise threats to ensure a dignified survivability of the human race.**
- **In building these mechanisms, we call for more involvement of civil society and especially the young generation in order to provide peaceful prosperity for all.**

The participants of the International Conference
Technology + Society $\overset{?}{\rightarrow}$ Future

Montenegrin Academy of Sciences and Arts

In cooperation with

World Academy of Art & Science

European Academy of Sciences and Arts

Global Round Table

ALLEA
ALL European Academies

International Conference

Technology + Society ?→ Future

Montenegrin Academy of Sciences and Arts
May 19–20, 2016, Podgorica, Montenegro


Academician Momir Đurović,


Academician Momir Đurović,
SUZA
Fürst

LIST OF PARTICIPANTS
in alphabetical order

Name	*Affiliation*	*E-mail*	*Country*
Arvanitis, Agni Vlavianos	President and Founder, Biopolitics International Organization; WAAS fellow	ava@biopolitics.gr	Greece
Avdagić, Amra	Academy of Sciences and Arts of Bosnia and Herzegovina	aavdagic@anubih.ba	Bosnia and Herzegovina
Badre, Abdeslam	Youth, Women, Migration & Policy Development in EU--MENA; Mohammed V University; NEF Ambassador for Morocco	abdeslambadre@yahoo.com; abdeslambadre@gmail.com	Morocco
Bahia, Saulo Casali	Professor and Federal Judge, Brazil, WAAS trustee	saulocasalibahia@uol.com.br	Brazil
Bajd, Tadej	President, Slovenian Academy of Sciences and Arts (SAZU)	bajd@robo.fe.uni-lj.si; spela.truden@sazu.si	Slovenia
Baltezarević, Vesna	John Naisbitt University, Faculty of Culture and Media; President of Alma Mater Europea of EASA	vesnabal@gmail.com	Serbia
Beqiraj, Gudar	Vice-president, Academy of Sciences of Albania	gudar.beqiraj@yahoo.com	Albania
Berg, Robert J.	Chair, The Alliance for Peace building; WAAS trustee	bobberg500@cs.com	USA
Bianchi, Gabriel	Director, Institute for Research in Social Communication, Slovak Academy of Sciences	gabriel.bianchi@savba.sk	Slovak Republic
Bushati, Angela Angelica	Frey University, Berlin	angela_angelica_bushati@hotmail.com	Germany/ Albania
Bushati, Salvatore	Scientific Secretary, Academy of Sciences of Albania	sbushati@yahoo.com	Albania
Caie, D. Graham	CBE, FRSE, FEA; European Federation of Academies of Sciences and Humanities (ALLEA)	graham.caie45@gmail.com	United Kingdom

Name	*Affiliation*	*E-mail*	*Country*
Christophorou, Loucas G.	Academy of Athens; Foreign member of MASA; Vice-President of EASAC	christophorou@ Academyof athens.gr; kpanagiotak@ bioacademy.gr	Greece
de Souza, Heitor Gurgulino	President, World Academy of Art and Science (WAAS); Former Rector, United Nations University	hgurgulino@ aol.com	Brazil
Denis, Mathieu	Executive director, International Social Science Council (ISSC)	mathieu@world-socialscience.org	France
Duca, Gheorghe	President, Academy of Sciences of Moldova (ASM)	ggduca@gmail.com	Moldova
Duić, Neven	Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb; WAAS fellow	Neven.Duic@fsb.hr	Croatia
Đurović, Momir	President, Montenegrin Academy of Sciences and Arts (CANU)	momirdj@ac.me	Montenegro
Ećimović, Timi	Rector, WPF (World Philosophical Forum) University; Socratic Philosophical School and Aristotle Philosophical Academy, Izola — Isola; WAAS fellow	timi.ecimovic@ bocosoft.com	Slovenia
Engelbrecht, Jüri	Estonian Academy of Sciences; WAAS trustee	je@ioc.ee; je@cens.ioc.ee; engelbrechtjuri @gmail.com	Estonia
Etale, Anita	University of South Africa, Johannesburg	aetale@gmail.com	Republic of South Africa
Fayl, Gilbert	President, The Global Round Table (GRT)	gilbert.fayl@ global-roundtable.eu	Belgium
Frasheri, Neki	Academy of Sciences of Albania; Faculty of Information Technology, Polytechic University of Tirana	nfrasheri@fti.edu.al	Albania
Gascon, Lorenzo	Real Academia de Ciencias Economicas y Financieras, Barcelona (RACEF)	ll.gascon@ economistes.com; edu.gascon@ gmail.com	Spain
Gomes, Paulo Alcantara	former Rector of the Federal University of Rio de Janeiro, Former President of the Brazilian Institute for Support to Very Small and Small Business, Deputy Rector for Engineering, Innovation and Technology, Candido Mendes University, Rio de Janeiro; WAAS fellow	pagomes98@ gmail.com	Brazil

Name	*Affiliation*	*E-mail*	*Country*
Grga, Ivo	Secretary General, The Global Round Table Croatia / President, European Movement, Split	ivo.grga@inet.hr	Croatia
Grob, Gustav R.	Dean em. Fellow of the Energy Institute, London (former F.IP); Chairman, ISO committee for Technical Energy Systems Analyses; Founder and former President of ISO/TC197 Hydrogen Energy; President, International Clean Energy Consortium; Technical Board Member of Space Energy; President of CMDC and ISEO, Geneva; Accredited UN-ECOSOC Member	grob@icec.ch	United Kingdom/ Switzerland
Hentaller, Ulric Fayl v.	Director, The Global Round Table / Personal Adviser to the Chairman, Hares Group	ulric.fvh@global-roundtable.eu; office@global-roundtable.eu	Belgium
Hoedl, Erich	F. Rector of University of Wuppertal and Graz University of Technology; European Academy of Sciences and Arts (EASA)	erich.hoedl@aon.at	Austria
Ilieva, Jana	University of Tourism and Management, Skopje	ilieva80@gmail.com	Macedonia
Jacobs, Garry	Chief Executive Officer of WAAS	garryjacobs@gmail.com	India
Kocarev, Ljupčo	Macedonian Academy of Sciences and Arts (MANU)	lkocarev@ucsd.edu	Macedonia
Lagumdžija, Zlatko	F. Chairman, Council of Ministers and Minister of Foreign Affairs of Bosnia and Herzegovina; member Club de Madrid; member of WAAS; founder of Shared Societies and Values Sarajevo Foundation; School of Business and Economics and School of Electrical Engineering, University of Sarajevo	zlatko.lagumdzija@efsa.unsa.ba	Bosnia and Herzegovina
Lazar, Josef	The Czech Academy of Sciences (ASCR)	joe@isibrno.cz	Czech Republic
Likhotal, Alexander	President, Green Cross International; WAAS trustee	alexander.likhotal@gci.ch	Switzerland/ Russia

Name	*Affiliation*	*E-mail*	*Country*
Lior, Noam	School of Engineering and Applied Science, Mechanical engineering and Applied Mechanics, University of Pennsylvania, Philadelphia	lior@seas.upenn.edu	USA, Philadelphia
Machin, Amanda	Zeppelin University Friedrichshafen	Amanda.Machin@zu.de	Germany
McBean, Gordon	President, International Council for Science (ICSU); Co-Chair, Governing Council, Future Earth: Research for Global Sustainability; Institute for Catastrophic Loss Reduction; Professor, Western University, London, ON	gmcbean@uwo.ca	Canada
McGrath, F. Peter	Coordinator, The InterAcademy Partnership (IAP) including IAP for Science and IAP for Health	mcgrath@ictp.it; mcgrath@twas.org iap@twas.org	Italy
Medin Laštovička, Gordana	Faculty of Natural Sciences and Mathematics, University of Montenegro	gordana.medin@gmail.com	Montenegro
Mirjanić, Dragoljub	Academy of Sciences and Arts of the Republic of Srpska (ANURS)	medj.saradnja@anurs.org	Republic of Srpska, Bosnia and Herzegovina
Nagan, Winston P.	Visiting Professor Al-Farabi Kazakh National University of Kazakhstan; WAAS trustee	nagan@law.ufl.edu	USA, Philadelphia
Nešković, Nebojša	Vinča Institute of Nuclear Sciences, University of Belgrade; WAAS trustee	nnesko@vinca.rs nnesko@vin.bg.ac.rs	Serbia
Pachauri, Rajendra, K.	The Energy and Resources Institute (TERI), New Delhi; f. Chairman of the IPCC UN; Trustee of WAAS	pachauri@teri.res.in	India
Pereira, Carlos Alvarez	President, Fundacion INNAXIS; Full Member, Club of Rome; WAAS trustee	calvarez@innaxis.org	Spain
Popović, Saša	Head of Department of Finance, School of Economics, University of Montenegro, President of the Montenegrin Association of Economists (MAE); WAAS associate fellow	sasa@t-com.me; sasap@ac.me	Montenegro
Radovanović, Mirjana	Educons University, Novi Sad	mirjanagolusin@sbb.rs	Serbia
Rakić, Ljubiša	Serbian Academy of Sciences and Arts (SANU)	sasa.foreigndept@sanu.ac.rs	Serbia

Name	*Affiliation*	*E-mail*	*Country*
S.E. Sánchez Sorondo, Mons. Marcelo	Chancellor, Pontifical Academy of Sciences	marcelosanchez@acdscience.va; pas@pas.va	Vatican
Segerstrale, Ullica C.	Illinois University, Chicago; WAAS fellow	segerstrale@iit.edu	USA, Illinois
Slyusarenko, Oksana	Corresponding member of National Academy of Sciences of Ukraine (NASU)	kosenko2009@gmail.com; os5000@mail.ru	Ukraine
Stoilkovska, Aleksandra	University of Tourism and Management, Skopje	ilieva80@gmail.com	Macedonia
Stojanović, Radovan	Faculty of Electrical Engineering, University of Montenegro; Montenegrin Association for New Technologies (MANT)	stox@ac.me	Montenegro
Šlaus, Ivo	Honorary president, WAAS; Institute "Ruđer Bošković", Zagreb; Croatian Academy of Sciences and Arts	slaus@irb.hr; ivo.slaus@irb.hr	Croatia
Tóth, Tibor	Ambassador, Executive Secretary Emeritus (CTBTO); Founder and Chief Executive Officer, Glocal E-Cubator	ecubator2tb@gmail.com; totibi2tb@gmail.com	Hungary
Trifković, Miloš	President, Academy of Sciences of Bosnia and Herzegovina (ANUB&H)	mtrifkovic@anubih.ba; akademija@anubih.ba	Bosnia and Herzegovina
Unger, Felix	President, European Academy of Sciences and Arts (EASA)	felix.unger@euro-acad.eu; presidential.office@euro-acad.eu	Austria
Vesković, Miroslav	International, Interinstitutional and Stakeholder Relations Unit, Joint Research Center, European Commission; On leave of absence from University of Novi Sad	miroslav.veskovic@ec.europa.eu	Serbia
Vukotić, Veselin	Rector, University of Donja Gorica, CANU associate member	vukotic@t-com.me	Montenegro
Yurdusev, Ahmet Nuri	Vice-President, Turkish Academy of Sciences; Middle East Technical University, Ankara	any@metu.edu.tr; anyurdusev@tuba.gov.tr	Turkey
Zucconi, Alberto	President, Institute of Person Centered Approach (IACP); General Secretary of the World University Consortium (WUC); Treasurer of WAAS	azucconi@iacp.it; alberto.zucconi@iacpedu.org;	Italy

CONTENTS

OPENING OF THE CONFERENCE

Momir Đurović
CAN WE LIVE WITH TECHNOLOGY ADVANCE? 7

Heitor Gurgulino de Souza
OPENING REMARKS 11

Graham D. Caie
WELCOME FROM ALLEA 15

Felix Unger
WELCOME REMARKS 17

Gilbert Fayl
OPENING WORDS 19

Gordon A. McBean
OPENING COMMENTS 21

Peter McGrath
WELCOME ADDRESS 23

Milo Đukanović
LETTER TO MR MOMIR ĐUROVIĆ 25

Key-note lecture

Loucas G. Christophorou
SCIENCE-BASED TECHNOLOGY AND SOCIETY 27

Gordon McBean
SCIENCE AND TECHNOLOGY FOR
A SUSTAINABLE FUTURE EARTH 39

Miroslav Vesković
REINVENTING TOGETHER SOCIETY, ECONOMY AND SCIENCE 51

Tadej Bajd
SCIENCE AND TECHNOLOGY ISSUES THROUGH THE DEVELOPMENT OF ROBOTICS 65

Alexander Likhotal
SCIENCE AND PROGRESS 77

Alberto Zucconi
WHAT KIND OF EDUCATION IS NEEDED TO NAVIGATE THE FOURTH INDUSTRIAL REVOLUTION? 83

Agni Vlavianos Arvanitis
BIOPOLICY — BUILDING A VISION OF HOPE AND TECHNOLOGY AS THE TOOLS FOR FUTURE SOCIETY 95

Jüri Engelbrecht
COMPLEX SOCIETY AND VALUES 103

Miloš Trifković
CAN MORAL BEHAVIOR OF PUBLIC ENTERPRISES IN BOSNIA AND HERZEGOVINA BE IMPROVED BY LEGISLATED MODEL CODES OF ETHICS? 115

Josef Lazar
TECHNOLOGY AND KNOWLEDGE TRANSFER IN POST-TRANSFORMATION ECONOMIES 145

Mathieu Denis
SCIENCE AND TECHNOLOGY, AND THE WORK OF THE INTERNATIONAL SOCIAL SCIENCE COUNCIL 151

Ljubiša Rakić
TECHNOLOGY — SOCIETY RELATION, CHALLENGE FOR FUTURE EXISTENCE 153

Winston P. Nagan
Megan E. Weeren
TECHNOLOGY, SCIENTIFIC CONSCIOUSNESS AND VALUES 165

Noam Lior
Mirjana Radovanović
SUSTAINABILITY AND ITS MEASUREMENT 183

Vesna Baltezarevic
Radoslav Baltezarevic
THE INTERNET AND VIRTUAL „REALITY" 193

Ullica Segerstrale
COOPERATION AS A SOCIAL TECHNOLOGY 201

Peter F. McGrath
SYNTHETIC BIOLOGY: OPPORTUNITIES AND GOVERNANCE 213

Oksana Slyusarenko
THE CURRENT STATE OF POLITICAL REPRESENTATION
OF WOMEN AND BASIC METHODS OF THEIR
INVOLVEMENT IN THE POLITICAL PROCESS 225

A. Nuri Yurdusev
TECHNOLOGY-DRIVEN CHANGE IN INTERNATIONAL
RELATIONS: QUANTITATIVE OR QUALITATIVE? 231

Zlatko Lagumdžija
SHARED SOCIETY AND VALUES — GOALS AND TOOLS
OF SUSTAINABLE DEVELOPMENT 239

Erich Hoedl
HOW TO GOVERN TECHNOLOGICAL
ADVANCES BY EDUCATION? 249

Veselin Vukotić
SENSE OF FUTURE OR LEARNING FROM LIFE 259

Lorenzo Gascón
SHAPING THE WORLD AT AN ALMOST
UNCONTROLLABLE SPEED 265

Saulo José Casali Bahia
MULTICULTURALISM (TECHNOLOGY, VALUES AND SOCIETY) 269

Neven Duić
SMART ENERGY SYSTEMS — DECOUPLING
FROM RESOURCE BASED ENERGY 279

Timi Ecimovic
HOMO SAPIENS UNIVERSAL UPBRINGING, EDUCATION
AND LIFE-LONG LEARNING TOWARD THE SUSTAINABLE
FUTURE OF HUMANKIND 289

Garry Jacobs
TECHNOLOGY, EMPLOYMENT & HUMAN WELFARE 297

Gheorghe Duca
SCIENCE FOR SUSTAINABLE DEVELOPMENT OF SOCIETY 307

Carlos Alvarez-Pereira
A NEW CONCEPTUAL FRAMEWORK TO PREVENT
TECHNOLITARIAN FUTURES 321

Nebojša Nešković
IMPORTANCE OF BASIC RESEARCH FOR TECHNOLOGY ADVANCES... 333

Saša Popović
FINANCIAL INNOVATION AND TECH-NO-LOGICAL PROGRESS.........343

Dragoljub Mirjanić
THE INFLUENCE OF RENEWABLE ENERGY SOURCES
AND CLEAN TECHNOLOGIES TO THE CLIMATE CHANGES
IN THE UNDEVELOPED COUNTRIES. OVERWIEV
OF REPUBLIC OF SRPSKA AND B&H 353

Anita Etale
Sabelo D. Mhlanga
ETHICAL ISSUES IN NANOTECHNOLOGY RESEARCH:
PERCEPTIONS OF RESEARCHERS AT THE
UNIVERSITY OF SOUTH AFRICA.. 369

Rajendra K. Pachauri
CLIMATE CHANGE AND ITS TECHNOLOGICAL IMPLICATIONS......... 379

Tibor Tóth
GLOBAL REGIMES OF WEAPONS AND TECHNOLOGIES
OF MASS DESTRUCTION (WTMD): IS SCHRÖDINGER’S CAT
DEAD OR ALIVE? WILL WIGNER’S FRIEND SPEAK OUT?........................ 391

Ulric Fayl v. Hentaller
Gilbert Fayl
Ivo Grga
SCIENCE + SOCIETY = POLICY-ADVICE..407

Paulo Alcantara Gomes
TECHNOLOGICAL ADVANCES TO IMPROVE
SOCIAL CHANGES IN BRAZIL.. 417

Gabriel Bianchi
WHAT TO DO WITH THE SPIRIT-SOUL GAP WHEN FACING
TECHNOLOGY INNOVATIONS: ANOTHER CASE FOR
A LIMINALITY HOTSPOT? (A SCIENCE ESSAY) 431

Alexander Ruser
Amanda Machin
TECHNOLOGY CAN SAVE US, CAN’T IT? THE EMERGENCE
OF THE ‘TECHNO-FIX’ NARRATIVE IN CLIMATE POLITICS.................. 437

Angela Bushati
Salvatore Bushati
ENCOURAGE THE CREATIVITY STARTING AT THE EARLY
CHILDHOOD: THE MOST EFFECTIVE INVESTMENTS FOR
QUALITY YOUNG RESEARCHERS IN THE FUTURE..................................449

Marcelo Sánchez Sorondo
THE MESSAGE OF ‘*LAUDATO SI’, MI SIGNORE*’ —
‘PRAISE BE TO YOU, MY LORD’ 461

Abdeslam Badre
LEVERAGING SCIENCE DIPLOMACY FOR SOCIETAL
DEVELOPMENT ACROSS NATIONS 467

Radovan Stojanović
SCIENCE AND TECHNOLOGY TRANSFER FROM
RICH TO POOR — THE HELP OR A BUBBLE 473

Neki Frasheri
Gudar Beqiraj
THE TRAGEDY OF INNOVATION — REFLECTIONS
ON INNOVATION AND DISRUPTION IMPACTS 479

Ivo Šlaus
CONCLUDING REMARKS 487

DECLARATION: PROVIDE PEACEFUL PROSPERITY 495

LIST OF PARTICIPANTS 501

MONTENEGRIN ACADEMY OF SCIENCES AND ARTS

PROCEEDINGS

International Conference

TECHNOLOGY + SOCIETY $\xrightarrow{?}$ FUTURE

Prepress
Bojan R. Popović
Medeon — Podgorica

Printed by
Pro File — Podgorica
2016.

Каталогизација у публикацији
Национална библиотека Црне Горе, Цетиње

ISBN 978-86-7215-384-2
COBISS.CG-ID 31080464

9 788672 153842