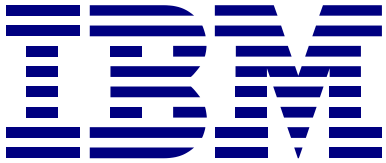


Technology, Innovation and Social Responsability

Christophe Rossel

EPS President

IBM Zurich Research Laboratory

CERN, 11 November 2015

Outline

- **The European Physical Society Perspective**
  - **EPS Roles, Policies & Activities**
  - **the Culture of Scientific Research**

- **The IBM Perspective**
  - **The Cognitive Era**
  - **The Internet of Things**
  - **The Future will be worn**

EPS founded in 1968 in Geneva

"… as a further demonstration of the determination of scientists to collaborate as close as possible in order to make their positive contribution to the strength of European cultural unity"
Gilberto Bernardini

…..**but also Science for Peace!**

Initial signatories: 62 individual members, 20 national societies

http://tinyurl.com/EPShistory

EPS 2015

Umbrella Organisation and Learned Society

- **42 Member Societies**
  representing over
  130’000 physicists in EU
- **> 3500 Individual Members**
- **> 40 Associate Members**
  (CERN, DESY, IOPP, ESA
  PSI, IBM, …)
- **22 Collaborating Societies**
- **Headquarter: Mulhouse (F)**

Key roles of EPS

- **Enhance cooperation with National Societies & Collaborating Societies**

- **Define priorities in areas of common interest such as funding of fundamental research, science & innovation programs, education and equal opportunity, outreach and promotion of talented students, physics students networks, links between industry and academia, large scale infrastructures, physics for development and north-south cooperation, etc..**

- **Decide on strategic initiatives and get involved in EU policies (research, energy, environment, health, ethics, etc.) and better represent physicists in Brussels (local office opened)**

EPS Policies

- **Through its broad membership base EPS represents the views of the physics community in Europe.**
- **EPS provides information to policy makers and general public to understand issues from the point of view of physics on**

  - **Science and Research**
  - **Education**
  - **Energy and Environment**
  - **Physics and Society**
  - **Physics and Economy**
  - **European cooperation**
  - **International cooperation**

Activities

❑ Scientific excellence

- Conferences
- Publications
- Prizes, Grants

❑ Community Services

- Networks
- Representation
- Information
- Integration
- Equal opportunity

❑ Physics Education

- Specification for Bachelors, Masters and Doctoral Studies
- European Science Education Academy (ICTP, UNESCO, CEI, EPS)

❑ EU Projects

- Horizons on Physics Education (HOPE)
- Inspiring Science Education (INSPIRING)
- CREATIONS, MUSE, LIGHT2015

Activities

❑ Publication

- EPN (Europhysics News
- EJP (European J. of Phys.)
- EPL (Europhysics Letters)
- e-EPS

❑ Outreach

- International Year of Light 2015
- Historic Sites (26 in 15 countries)
  (ex. CERN 600 MeV Synchrocyclotron)

United Nations
Educational, Scientific and
Cultural Organization

International
Year of Light
2015

EPS Statements & reports

2012: On the Use of Bibliometric Indices in Assessment
2013: Opportunities in Horizon 2020
2013: Managing the Transition to Open Access
2013: Impact of Physics on EU Economy

2015: On the Importance of Funding Basic Natural Science
2015: European Energy Policy and Global Reduction of CO_2 emissions
2015-16: Importance of Nuclear Science in the Preservation of Cultural Heritage

Physics and EU Economies

www.eps.org/physicsandeconomy

- EPS report 2013, over years 2007-2010, in 27 EU countries + CH & NO established by Center for Economics and Business Research (Cebr)

- **Physics-based industries** are defined as those sectors of the European economy where the use of physics – in terms of technologies and expertise – is critical to their existence

- Electrical, civil, & mechanical engineering
- Energy& environment
- Information technology & communications
- Design & manufacturing
- Transportation
- Medicine & related life-science fields
- Technologies used in space

Debate on Research Culture

As viewed by learned Societies like EPS

- The culture of scientific research must support and encourage ***high quality, rigorous, original, ethical and valuable*** science
- Research ***assessment by funding bodies*** and promotion panels affects what science is carried out and by whom
- ***Dissemination*** of science (outreach) and critical responses can influence how scientists work and behave
- Research scientists must ***take responsibility and encourage good practices***
- Scientific discoveries must ***benefit society*** on top of curiosity satisfaction and ***nurture technological applications and innovation***
- Regular assessments ***of societal and/or economical impact*** of research are needed

IBM Perspectives

Cloud Analytics & Big Data Mobile Social Security

= “CAMSS”

- **The Cognitive Era**
- **The Internet of Things (IOT)/ of Everything (IOE)**
- **The Future will be worn**

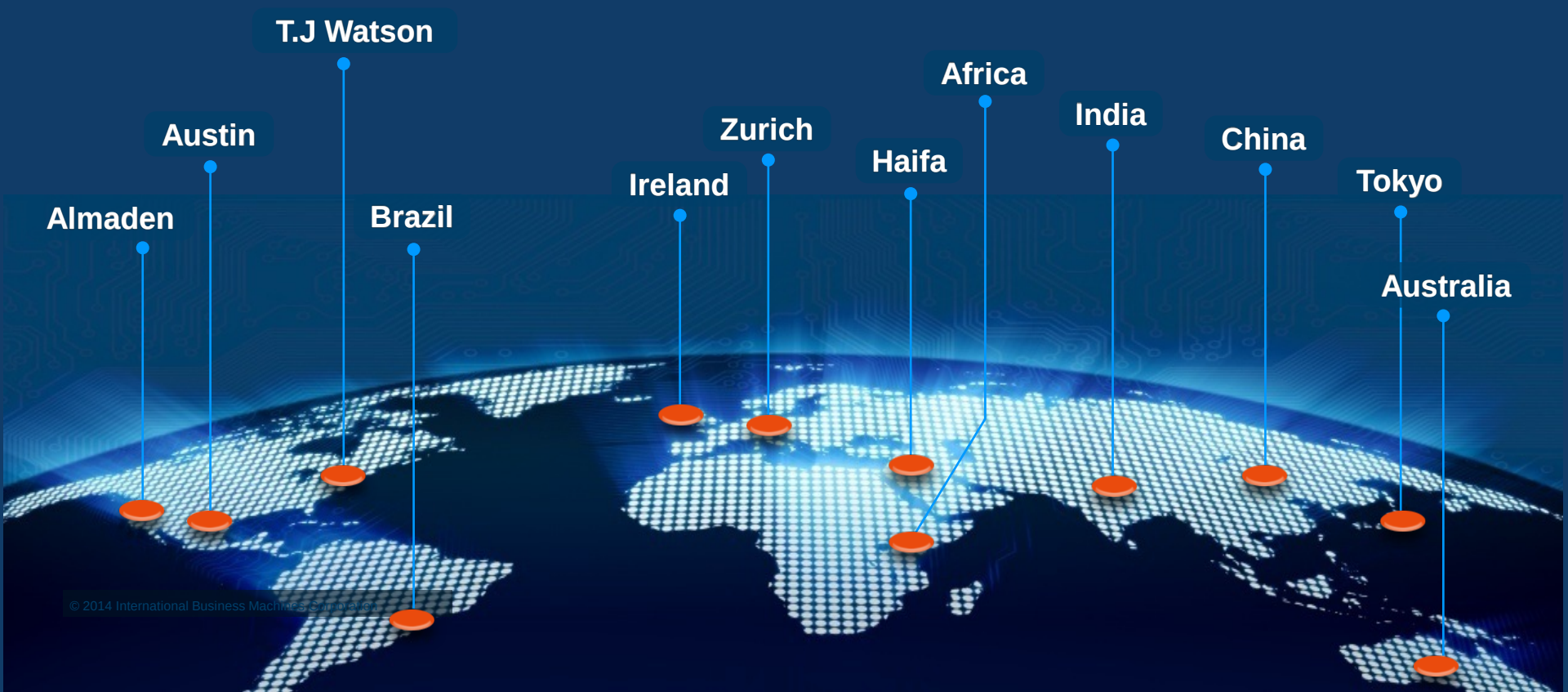


IBM Research: *The World is Our Lab*

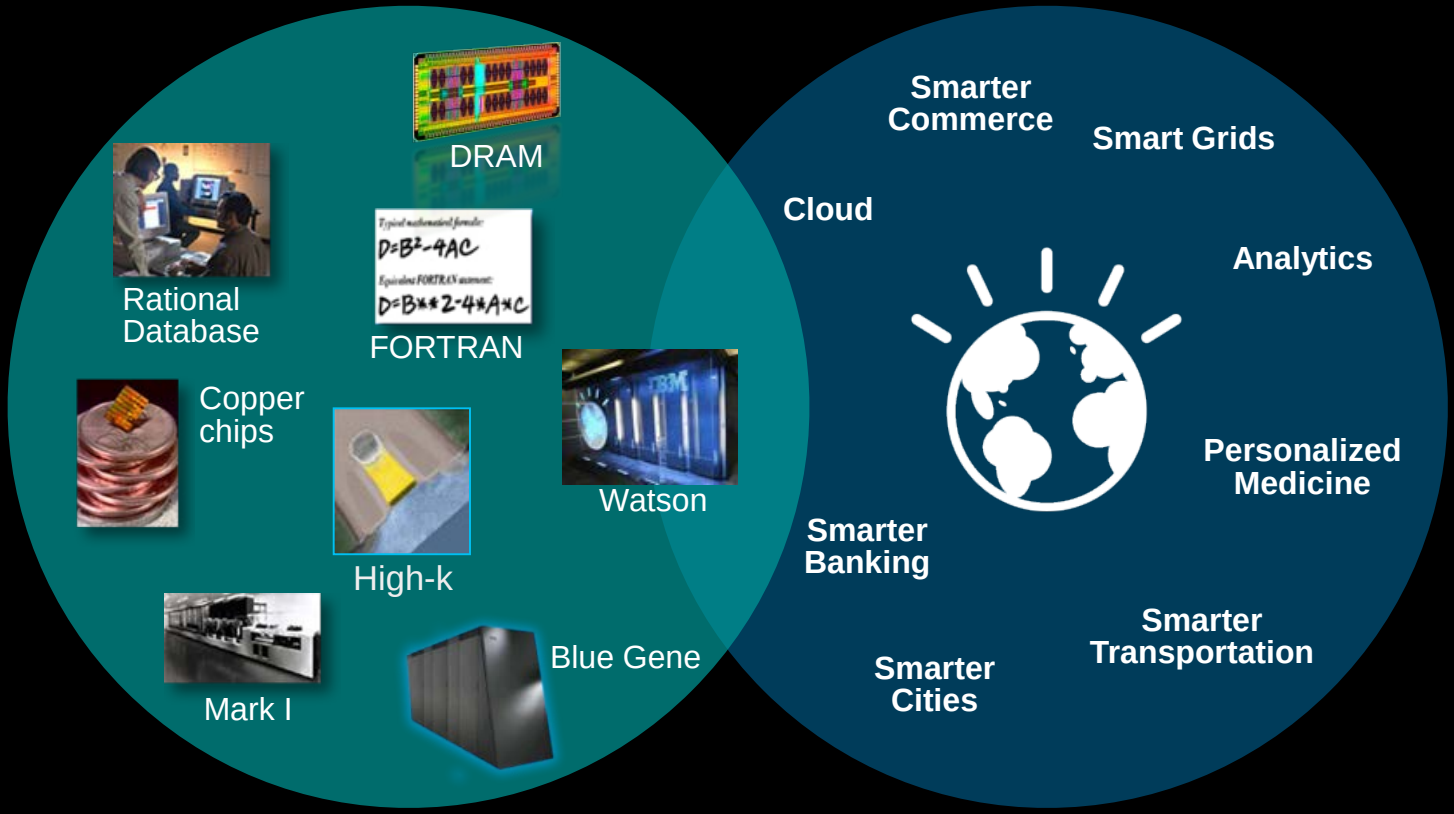
World's largest information technology research organization

More than 3,000 scientists and engineers

IBM spent $6.2B on R&D in 2013



IBM Research: A Culture of Innovation



Five Nobel Laureates

Nine Medals of Technology

Five National Medals of Science

Six Turing Awards

The Cognitive Era

How humans and machines are forging a new age of understanding

*Cognitive computing refers to systems that **understand**, **learn** at scale, **reason** with purpose, and **interact** with humans naturally*

- **Tabulating Era** (mechanical systems) ,1900s -1940s
- **Programming Era** (digital computers), 1950s-present
- **Cognitive Era** (computing with augmented intelligence, 2010 -), the most important transformation in computing's evolution ….from deterministic to probabilistic systems

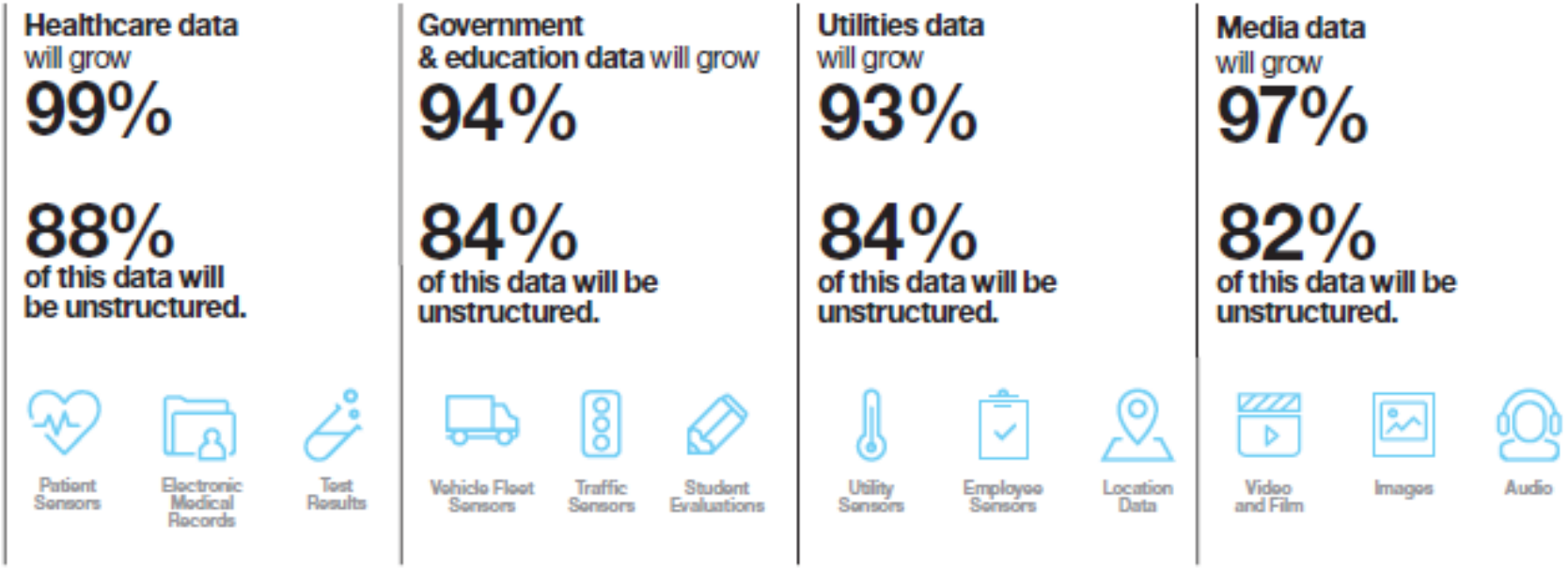
IBM Watson Analytics

delivers cloud-based guided analytics, data visualization and predictive analytics that make understanding data easier for practically everyone

The Cognitive Era

A new era in technology, a new era in business

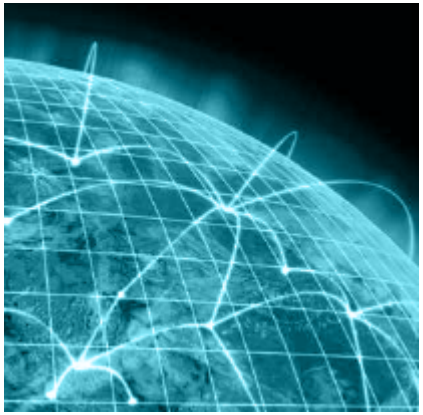
Data is transforming industries and professions.



Source: IBM Watson business unit

Internet of Things (IoT)

Instrumented – interconnected – intelligent

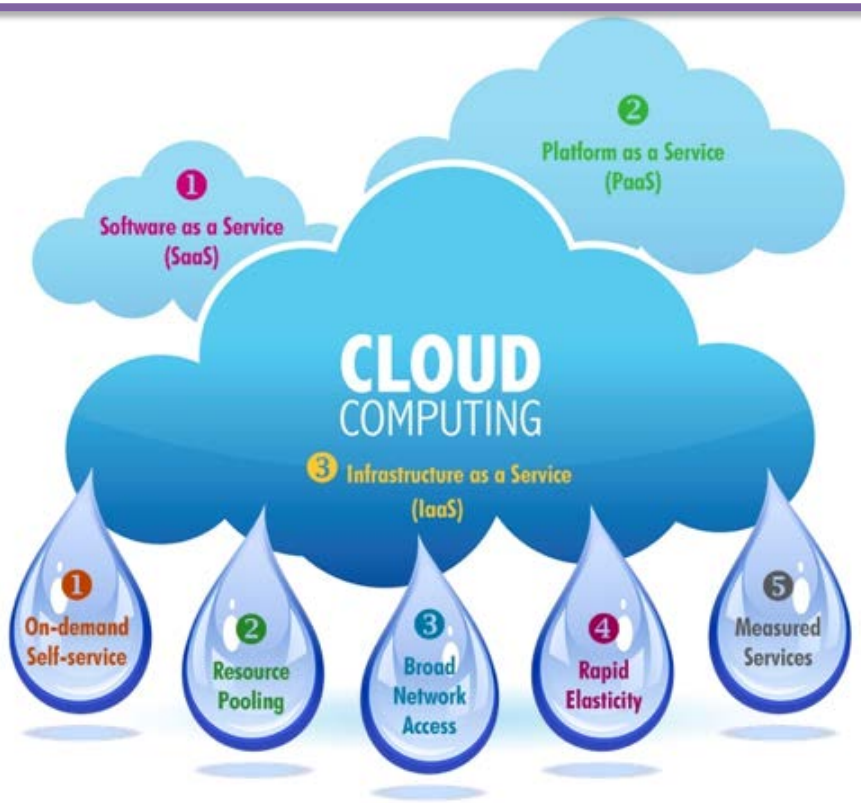


Huge market for semiconductors and IT companies

- **to reach $22.9 billion by 2020, the wireless IoT sensor market alone will be worth $12 billion by 2020**

Paradigm shift coming in powering wearable devices

- **Low-power design and proper energy management at the system level are a prerequisite**
- **IoT devices must integrate multiple blocks onto a single substrate (SoC) either with 2D or better 3D co-integration of functions**
- **Must be cost effective, rugged & durable, scalable to varying environments and communities**



The Cloud and IoT (IoE) promise to deliver convenience like never before

→ COT or COE

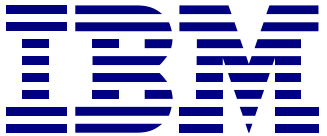
The Future will be... worn

Wearable technology is **exploding** thanks to smaller and better interacting systems

- Global sales of wearables to hit $30 billion by 2018.
- **Today's market** : ***Fitness & Wellness (+30% /y) , Healthcare & Medical, Infotainment, Industrial & Military***
- Many innovations to emerge to overcome technological inhibitors
- **Key inhibitors**: ***Power, Network Bandwidth, Pricing & Aesthetics, User Interaction, Accessibility (voice, visual interfaces), Security & Privacy***




Conclusions



- Thanks to the Cloud and IoT, the future IT technology will become more instrumented, interconnected and intelligent
- The market of wearable technology will explode
- New cognitive computing tools will be needed to treat the ocean of unstructured data

But……

What impact will this have on our life,
on the development of a fair and peaceful society
respectful of its environment and of the planet resources ?

Thank you !

Key technologies for industries

1. ***Information and communication technologies (ICT)***

   - cloud computing, Internet of Things, **big data analytics** will enable people, objects, services and systems to interact seamlessly

   - increasing **urbanisation** and **intelligent energy management**

   - transition to **networked, intelligent systems**, requiring increased monitoring of **critical infrastructures** for protection again cyber attacks

   - **Digital manufacturing (industry 4.0)** will complete penetration of industry, products and services with software, and interconnection of all devices

   - transformation from curative to **preventive, participatory medicine**, as **real-time monitoring**, **long-term data acquisition**

2. ***Additive manufacturing ("3D printing")***

   - development of new materials by new processing technologies

   - **smart materials** used as sensors; **biomaterials**, with biological function without damaging their environment; and **nanoparticles**, with very different characteristics to macroscopic bodies of the same material.

Key technologies for industries

3. Advanced sensors and actuators

- for monitoring and controlling future electricity and transport networks
- for user-friendly, low-impact and self-powered sensor systems for constant monitoring of patients in medical technology
- for the development of neural and sensory implants.

4. Robotics

- **mechanically flexible machines** to be used in assembly in replacement of conventional rigid robot
- **simple robot systems** as consumer goods for personalized assistance to people with disabilities or reduced autonomy, in physiotherapy
- **micro-robots** in replacement of today's surgical robots