

**Royal Academy of Sciences  
Collège Belgique**

**Brussels, 25 November 2014**

**Man - Technology  
interface in Europe**

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**European Commission, DG RTD\***

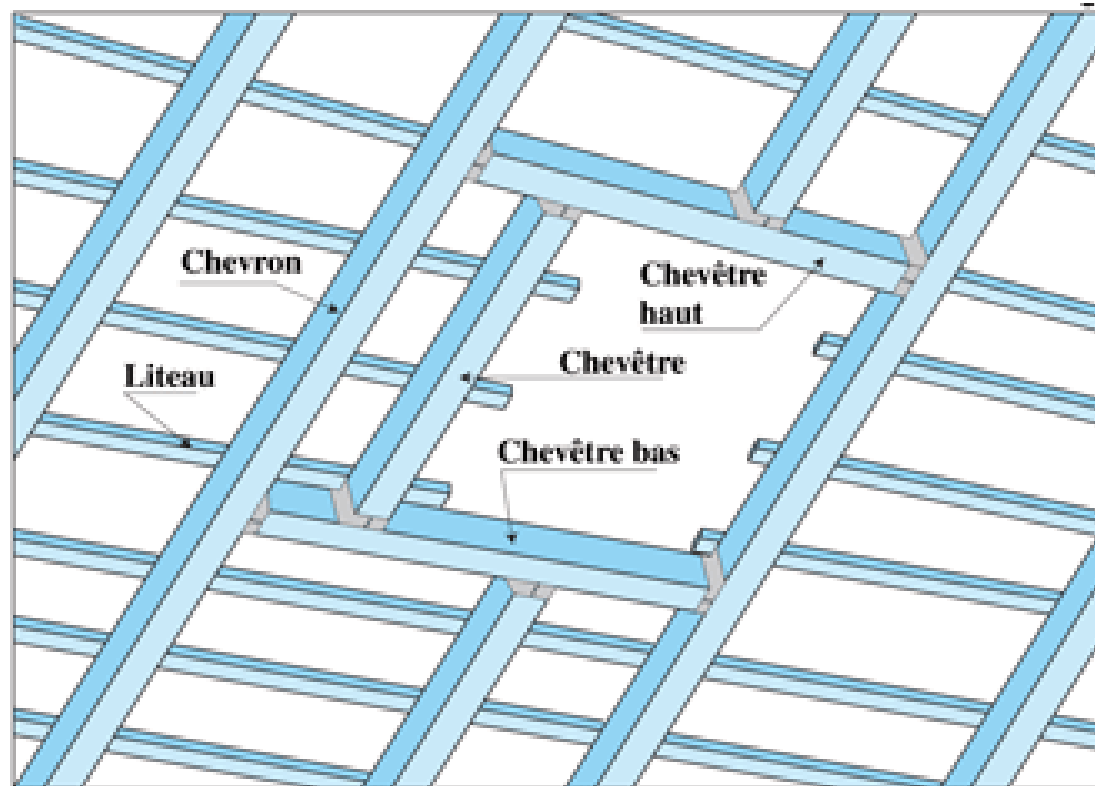
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**\* Personally speaking**

# ***L'enchevêtrement entre l'homme et la technologie en Europe***

## ***Mens et Manus***

***Complicé et confus mais aussi entrelacé, imbriqué, mêlé***



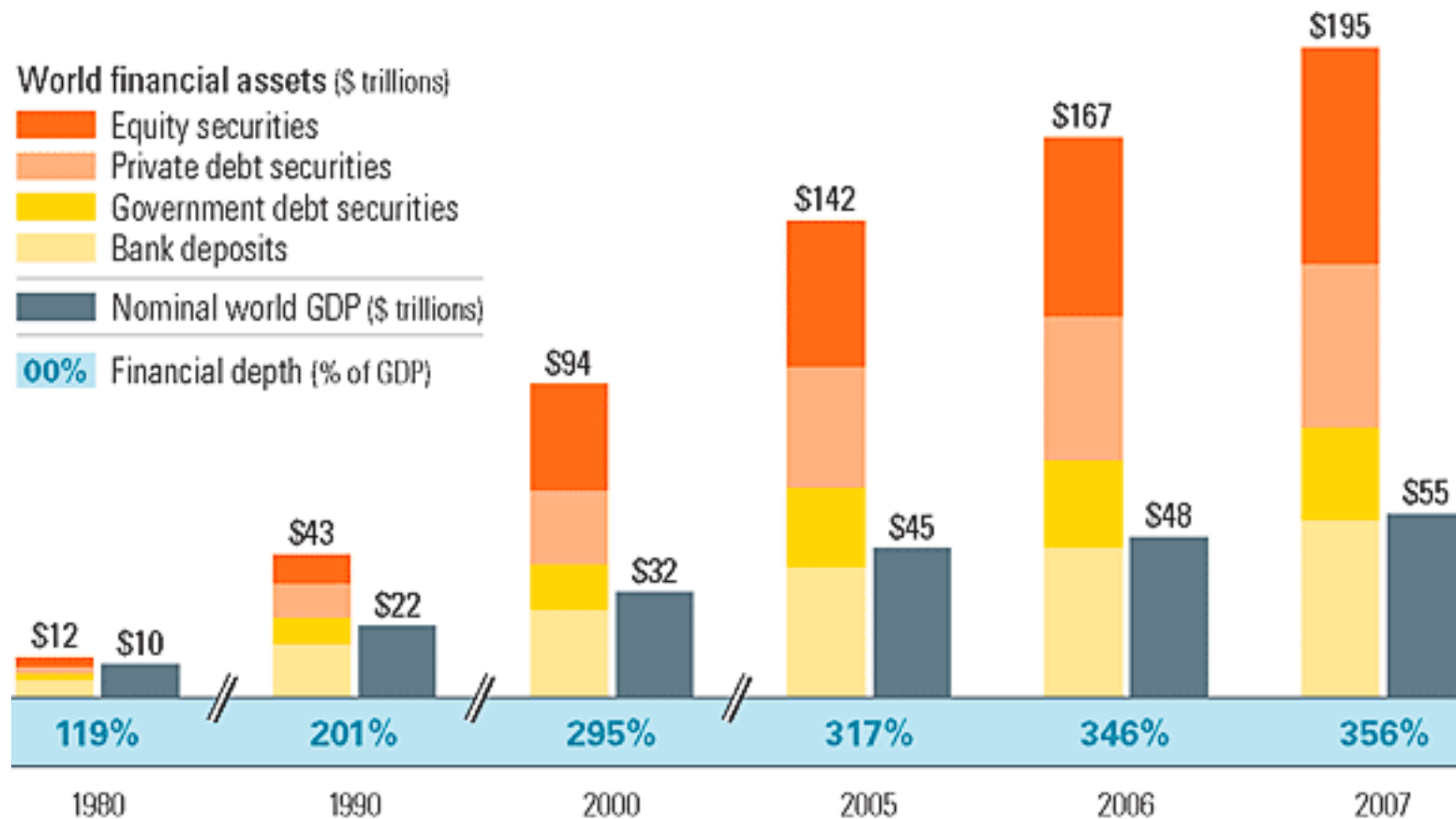
# Technology

- ***Techne*: art, skill, craft (*Homer*) - manual, impure (*Plato*)**
- **Electronic, mechanics, software, gadgets,...**
- **Alexandrine verse, Mozart fugue,...**
  
- **Technophile and Technophobe**
- **Innovation and Precaution**

# ***World and EU challenges***

# World financial assets

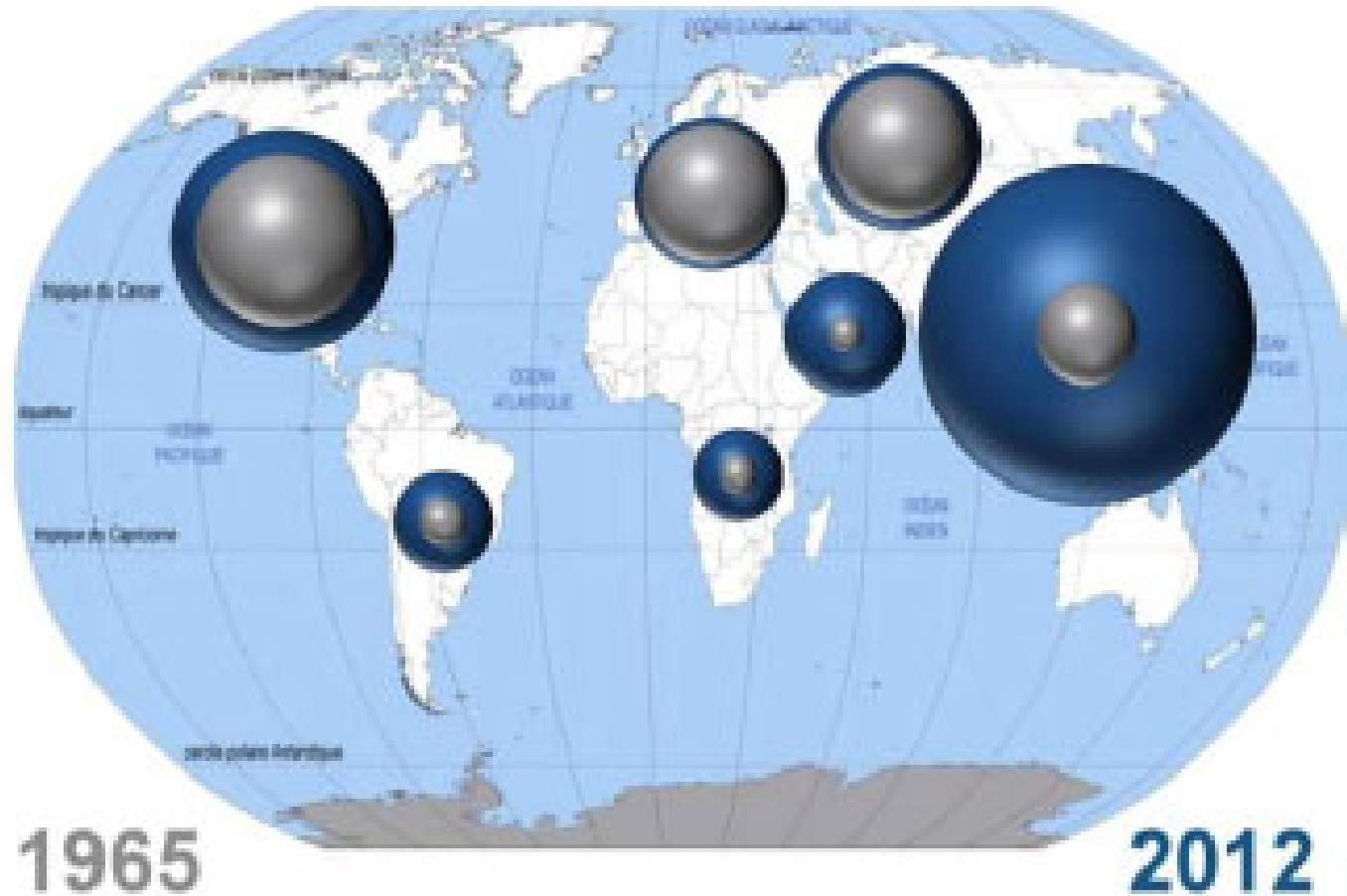
*More than three times higher than GDP*



Note: Asset and GDP figures have been rounded for simplicity. Financial depth percentages were calculated using nonrounded figures. Source: McKinsey Global Institute

# CO<sub>2</sub> emissions

***From 12 Bt/CO<sub>2</sub> in 1965 to 35 in 2012***



## Asia: from less than 2 Bt/CO<sub>2</sub> in 1965 to 16 in 2012

**Source: World Energy Council (CFE)**

# **NEETS and inequalities**

***Not in Employment, Education or Training***

**In EU: 14 M young people (15-29 years) are NEETS**

**Cost of NEETS: € 150 B**

**Inequalities: "*Le capital au XXI<sup>e</sup> siècle*" ( $r > g$ )**

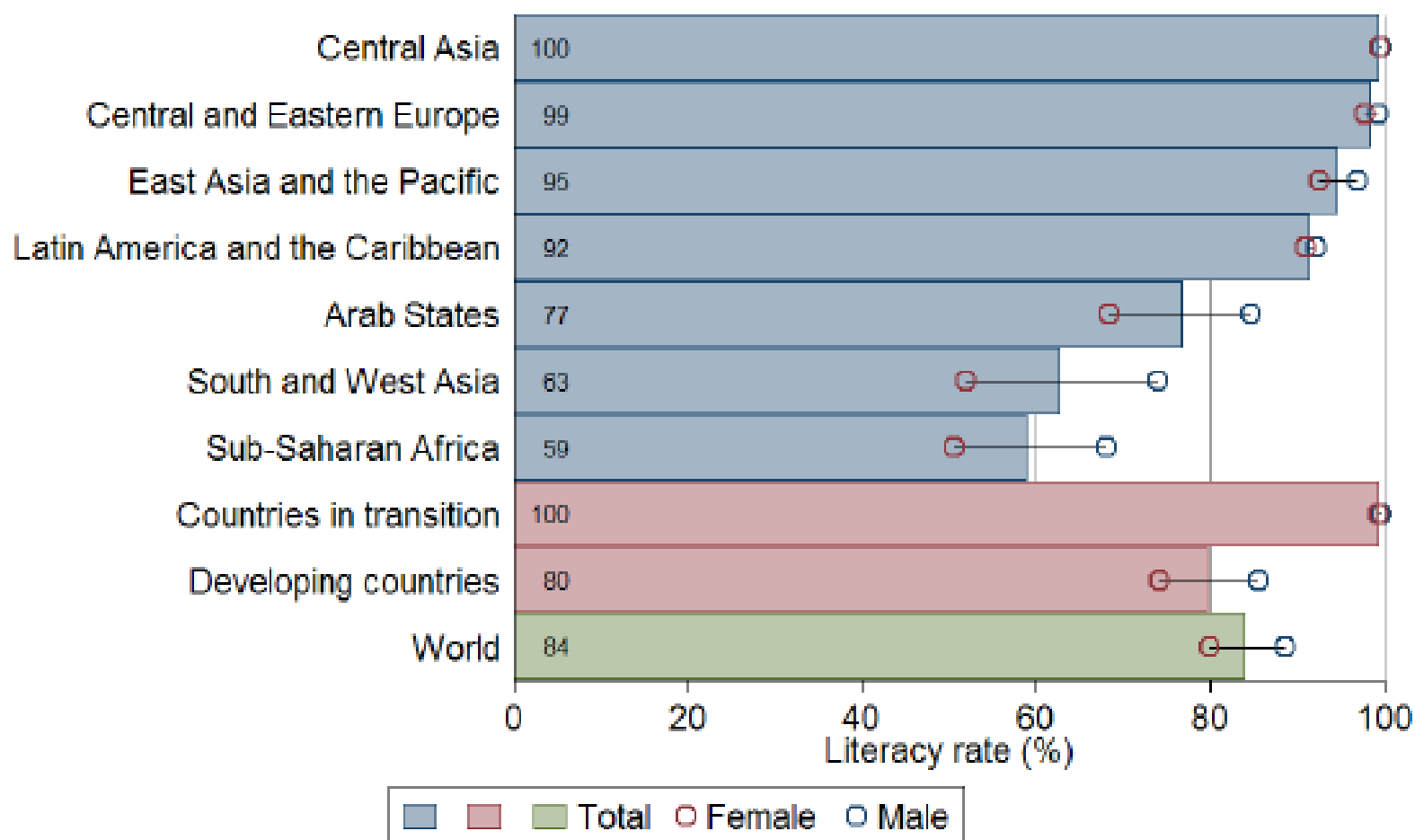
**Rentability of capital higher than growth rate**

**Revenues from labour lower than from capital**

**Increasing of inequalities and need to tax capital**

# Adult literacy rates

*From 55% illiterate in 1950 to less than 20% today*





# **Human life**

## **S&T and Socio-economic progresses**

- **Life expectancy has doubled in 150 years (and is increasing by six months every year) – ever expanding or starting of a plateau?**
- **In EU: Tuberculosis, cholera, scarlet fever, child birth, malaria, typhus?**

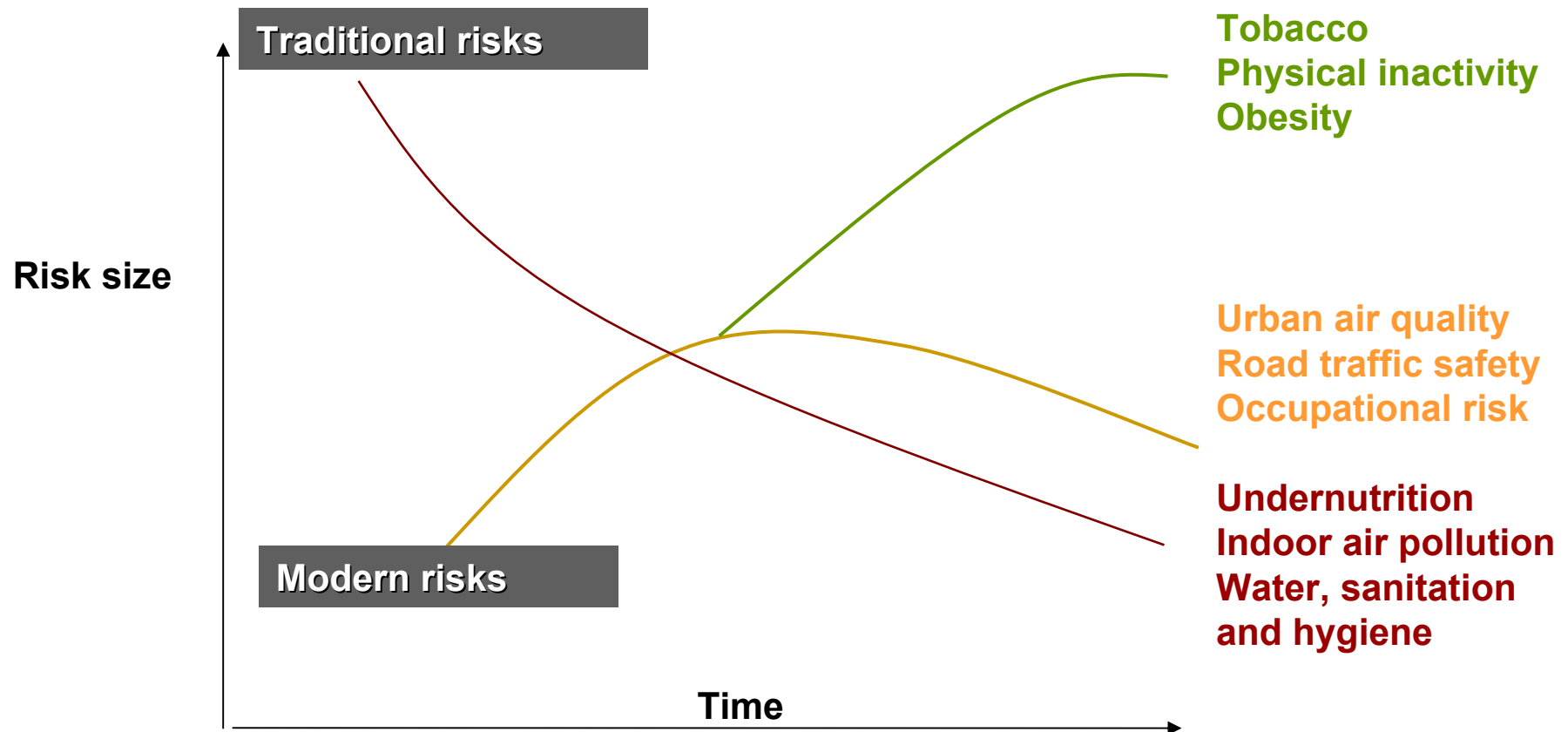
***Thanks to:***

- ***Science & technology (antibiotics, vaccines)***
- ***But also Socio-economic progress (clean water, beter housing)***

## Life expectancy (y)

	1955-1960	2005-2010
Japan	66.3	82.7
W. Europe	69.5	80.3
USA	69.7	78
China	45	72.7
India	40.9	64.2
<b>World</b>	<b>49.8</b>	<b>67.9</b>

# The risk transition



# ***Society and Science***

***L'Art et la Science sont les plus hautes  
expressions de l'activité humaine***

**Giambattista Vico (1668-1744)**

# **Stronger interfaces**

## **Mutual respect**

### ➤ **Man - Nature**

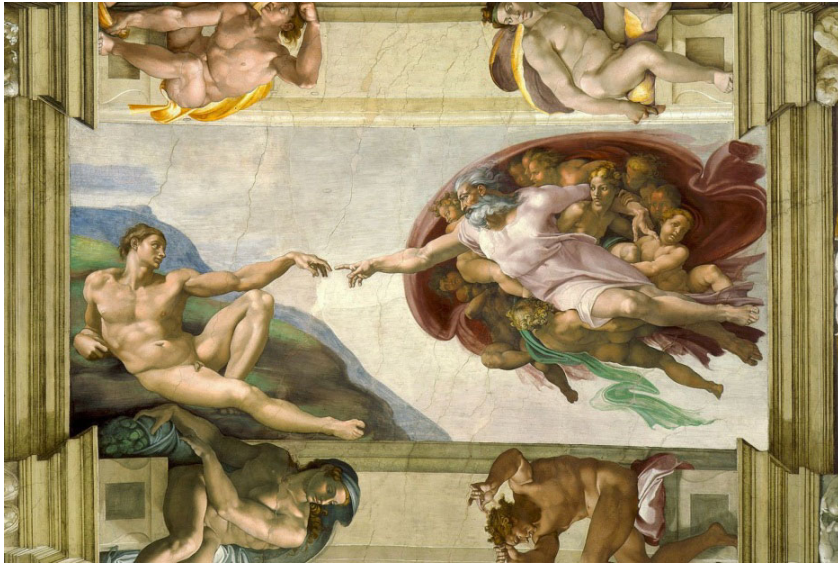
❑ *Respect – Exploitation*

### ➤ **Humanities - Engineering**

❑ *Design of a car - Efficiency of the combustion engine*

### ➤ **Social habits - Technological developments**

❑ *User friendliness – OS capacity of a smart phone*



**Source: Michelangelo**



**Source: dpaonthenet**

# Scientists engaged in societal debate

- **DNA**
- **GMO**
- **Nuclear**
- **Transport infrastructures**
- **Pesticides**
- **Antibiotics**
- **Geo-engineering**
  - ❑ Eg. fertilizing the oceans in order to induce growth of phytoplankton and uptake of carbon dioxide from the atmosphere
  - ❑ Eg. increasing the amount of reflective particles in the middle atmosphere, increasing the brightness of clouds, or making surfaces of the Earth brighter



# **Credibility of science**

- **Science is not always neutral and reliable**
- **Conflicting scientific perspectives on the same problem**
- **People / Social networks may distrust science or put it into question ("Open Science")**

***Questions of trust, independence  
and transparency***

# Science and Policy

	SCIENCE	POLICY
Logic	<i>Inference*</i>	<i>Advocacy**</i>
Medium	<i>Truth</i>	<i>Power</i>
Assessment	<i>Peer-review</i>	<i>Public opinion</i>
Conviction	<i>Non-normative</i>	<i>Ideology</i>
Time frame	<i>Long-term</i>	<i>Urgency</i>

\* Inference: Assumptions + Data = Conclusions

\*\* Advocacy: Conclusions (predetermined) = Data + Assumptions

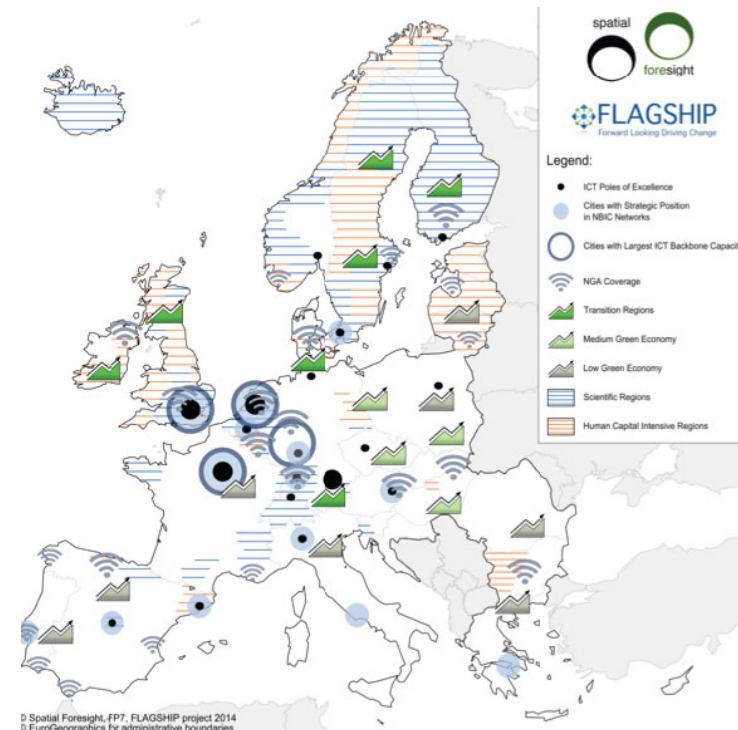
# Knowledge revolution

Large variety of tablets & smart phones with Internet access (< € 100) – The dream of Diderot and d'Alembert?

The end of a civilisation (and libraries) with concentration of knowledge in few places ?

New relationship between:

- Professor – Student
- Doctor – Patient
- Deputy – Citizen



Source: D. Rossetti, M. Serres and EC, RTD, FLAGSHIP

# Beyond S&T - Innovation



- Product innovation
- Process innovation
- Marketing innovation
- Organisational innovation
- ... And Social innovation



# **Innovation "ecosystem"**

- **Education and skills**
- **Research and Innovation**
- **State of law and IPR**
- **Entrepreneurship**
- **Imagination and creativity**
- **...**

# ***Human and Technology***

# **Transhumanism**

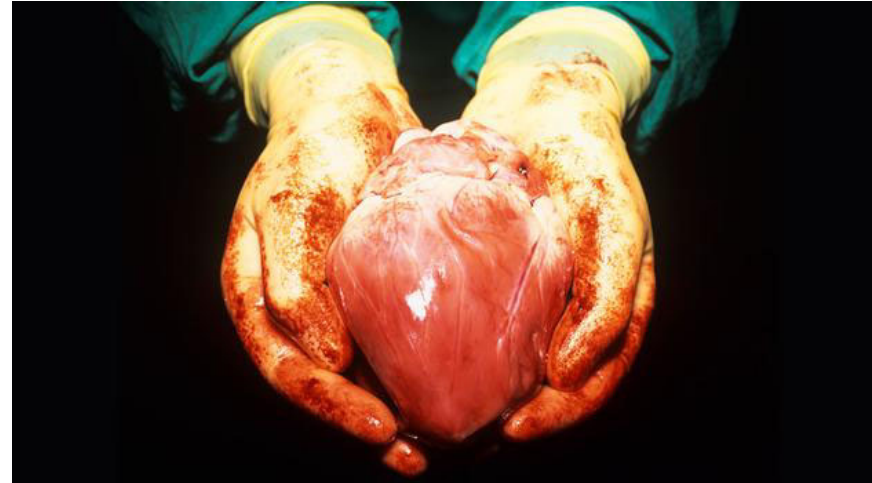
## **Human enhancement**

**Bionic implants in the human body (and in the brain?)**



Source: Telegraph

**Pig heart transplants into baboons (and men)?**



Source: BBC

# **BANG and NBIC**

- **BANG - Bits, Atoms, Neurones, Genes**
- **NBIC - Nanotechnology, Biotechnology, Informatics, Cognitive sciences - Convergence between the extremely small (nano or  $10^{-9}$ ), the bio, the thinking machines and the study of human brain**



# Internet of objects

**Internet of objects (connected or autonomous cars and robots) – Potential for an ageing population and disabled**



***90% of car accidents are due to human mistakes***

# 3D Printing

- Producing everything everywhere
- The coming back of local production and craft men?
- From Gutenberg to Zuckerberg and "downloading things"
- Cost: From € 200 to several millions



# Artificial intelligence

**Artificial intelligence and human intelligence (cf. systematic calculations)**



Source: Kasparov

# Robotic

- Robot comes from slavic "rabot", i.e. labour (*corvée*). It was launched by I. Asimov (1941) that provide different "laws" (cf. a robot may not injure a human being and it must obey the orders given to it by human beings)



# **Mobile technology**

- **Decreasing size of the equipment (nanotech, chips)**
- **Increasing size of the population (9 billion people by 2050)**
- **Personalized technologies**
- **More and more connection to the users (fast connectivity)**
- **Innovation and integration: PC, tablets, smart phones (battery life, thin, weight)**

# **Big data and human behaviours**

- **Big data: location data, transaction data, web data**
- **Predictability of our habits (cf. health, energy, transport)**
- **Connection sciences**
- **Legal questions related to data: Privacy and Ownership**
- **Security and Transparency**

***Le Prométhée définitivement déchaîné, auquel la science confère des forces jamais encore connues (...) réclame une éthique qui empêche le pouvoir de l'homme de devenir une malédiction pour lui***

**Hans Jonas (1903-1993)**

# ***Knowledge and Disciplines***



# ***New production of knowledge***

- **Mode 1 : Academic monopoly of knowledge production**  
***Discipline based***
- **Mode 2 : Co-production of knowledge**  
***Problem-orientated and trans-disciplinary***

**Impact: - Positive societal and/or economic difference**  
**- More likely if research coproduced**

**But: Academic promotion linked to top journals controlled by disciplines – Potential changes with Open Access?**

# **Civil and military knowledge**

## **Dual use of technologies**

- **Nuclear**
- **Bacteriology**
- **Space**
- **Energy**
- **Materials**
- **Internet**
- **GPS**

# Consciousness, nature and evolution

- ***Consciousness and tolerance*** with Rabelais: "*Science sans conscience n'est que ruine de l'âme*" and Voltaire : "*Eveiller les consciences*"
- ***Environment***: Alexander von Humboldt – interaction of the forces of the nature - influences on geographical environment on vegetal and animal life
- ***Evolution***: Charles Darwin and Alfred Russel Wallace – Struggle for life

# **Discipline(s)**

## **An evolving concept**

- **What is the best discipline to address NBIC?**
- **Is *Psychology* a medical or a social science?**
- **Where is the border between chemistry and physics?**
- **Are *European Studies* a new faculty?**
- **Is *Architecture* an art or a science?**
- **Is *Geography* an hard or a soft science?**

# More than one discipline

- **Multi - disciplinary:** Each discipline attempts to explain the same phenomena from its own viewpoint - *Independent stories*
- **Inter-disciplinary:** Looks at same phenomena from different viewpoints but tries to link the explanations – *Connected stories*
- **Trans - disciplinary:** draws together theories and approaches to form a shared conceptual and analytical framework – a new discipline - *Integrated story*

# The example of economics

- **Adam Smith - Economist and Philosopher**  
*Theory of Moral Sentiments*
- **John Nash - Economist and Mathematician**  
*Real Algebraic Manifolds*
- **Armartya Sen – Economist and Philosopher**  
*The Idea of Justice*
- **Daniel Kahneman – Economist and Psychologist**  
*Thinking Fast and Slow*

# Disciplinary narrowness

- **19<sup>th</sup> century and advent of "scientists"**
- **Work more and more technical**
- **Peril of overspecialization**

Source: G. Gutting

## **Eg. Physical sciences:**

**Atomic, molecular, chemical physics**  
**Condensed matter physics**  
**Particles and fields physics**  
**Nuclear physics**  
**Fluids and plasma physics**  
**Optics**  
**Acoustics**  
**Astronomy**

Source: OECD

# **Trans-disciplinarity applied to my life**

***The enchanting of Words and the power of Numbers***

***L'amour de la lettre et la force du chiffre***



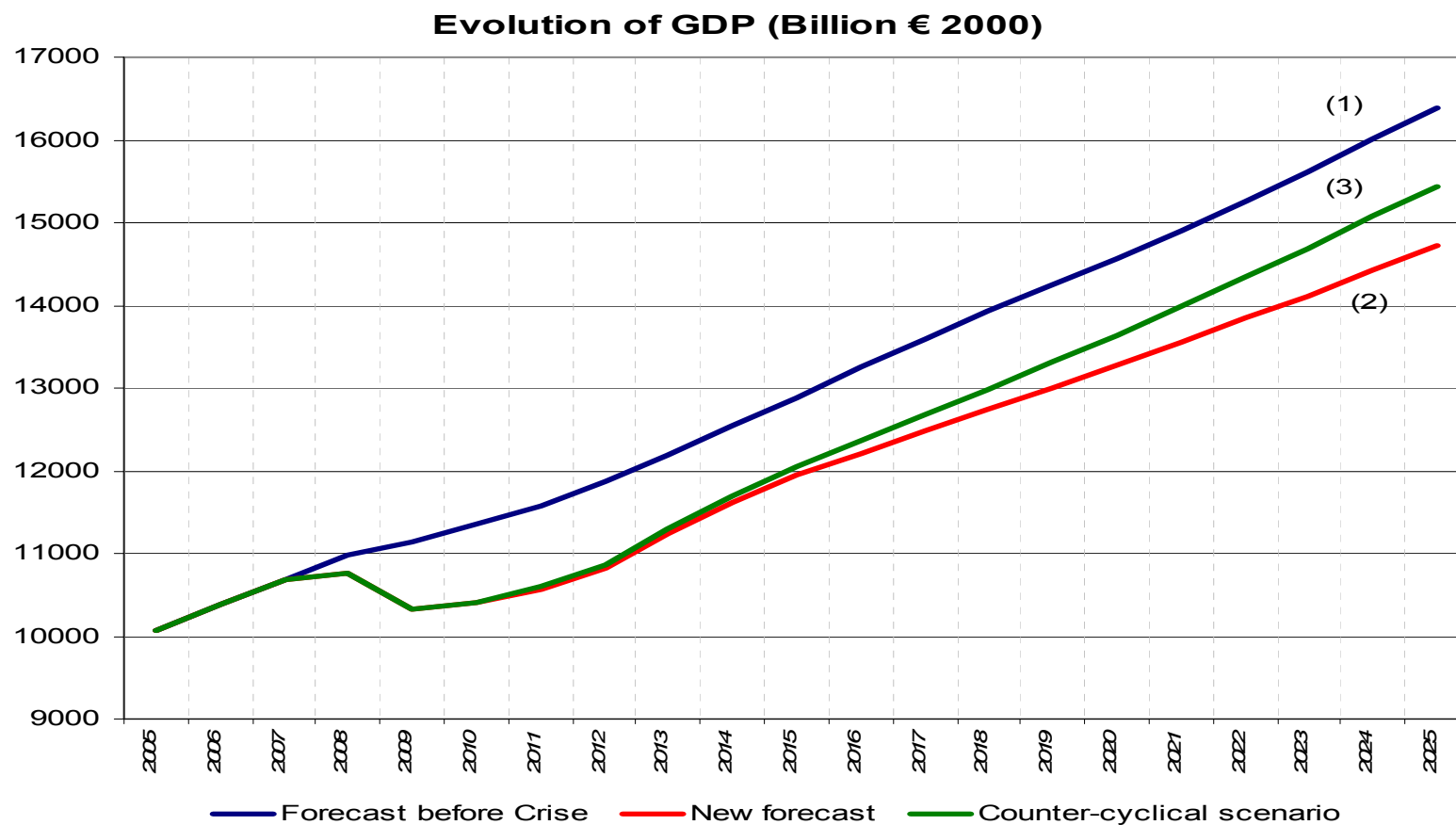
# S&T, new and old generations



- ***Creating a learning society: A new approach to growth, development, and social progress (Joseph Stiglitz)***

# ***S&T and socio-economic development***

# Role of research and innovation on GDP ("3% GDP target")



Source: EC, DG RTD, DEMETER, P. Zagamé

# Value of science and new skills

- The value of "science" or "research" remains limited to purely measurable values (patents, publications, GDP)
- Science has to be valued considering the desire to understand better life, the earth and humans
- *As technology races ahead, low-skill workers will reallocate to tasks that are non-susceptible to computerization, i.e tasks requiring creative and social intelligence (Carl B. Frey and Michael Osborne)*

***"Creative destruction is the essential fact about capitalism"***

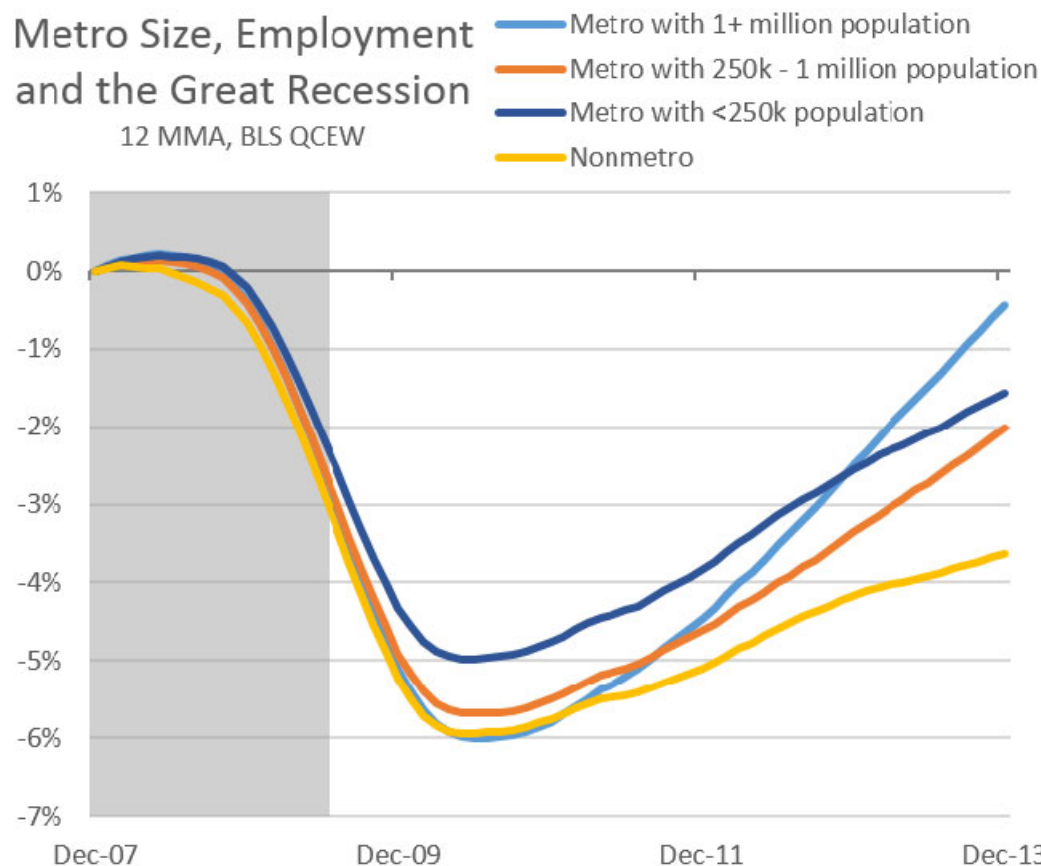
**The introduction of new goods (...), new methods of production (...), the opening of new markets (...), the conquest of new sources of supply (...) and the carrying out of a new organization of any industry**

**Joseph Schumpeter (1883-1950)**

# Technology and economics

Metro Size, Employment  
and the Great Recession

12 MMA, BLS QCEW



- Agglomeration effects
- Knowledge spillovers
- Clustering

*Similar firms from the same industry can benefit from locating together (A. Marshall, 1890)*

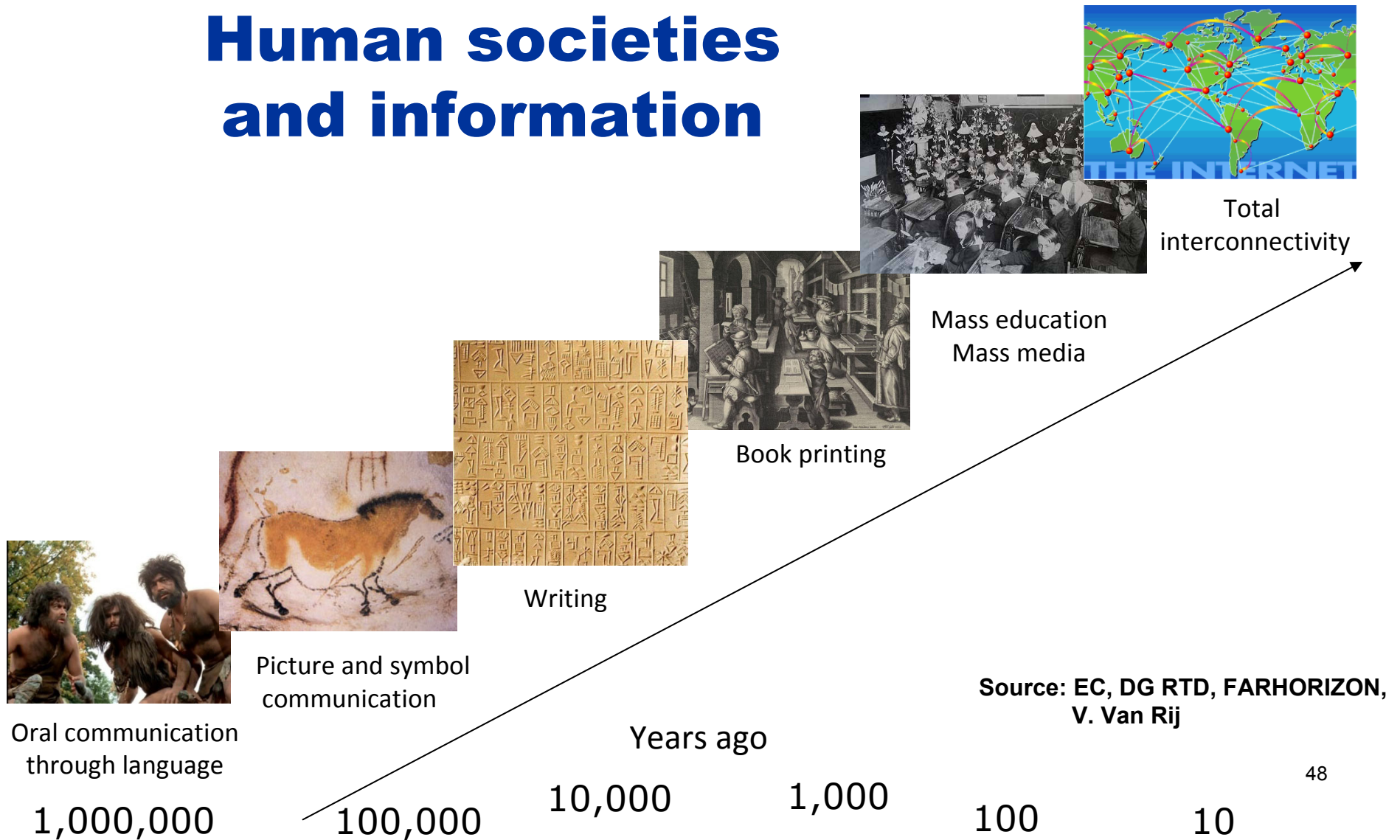
Source: J. Lehner, BRUEGEL

Oregon office of economic analysis

# Physical and human capital

- From traditional manufacturing to innovation & knowledge
- Agglomeration effects: more of the same (eg. high-educated workers and innovative employers)
- Self-reinforcing trend (more and more differences between winners and losers)
- Idem for R&D expenditures, venture capital investment and patent per capita (cf. Baden Wurttemberg vs. Andalousia)
- Economic success depends on the entire "ecosystem"
- From Detroit to Silicon Valley, from Charleroi to LLN, Bangalore, Shanghai

# Human societies and information



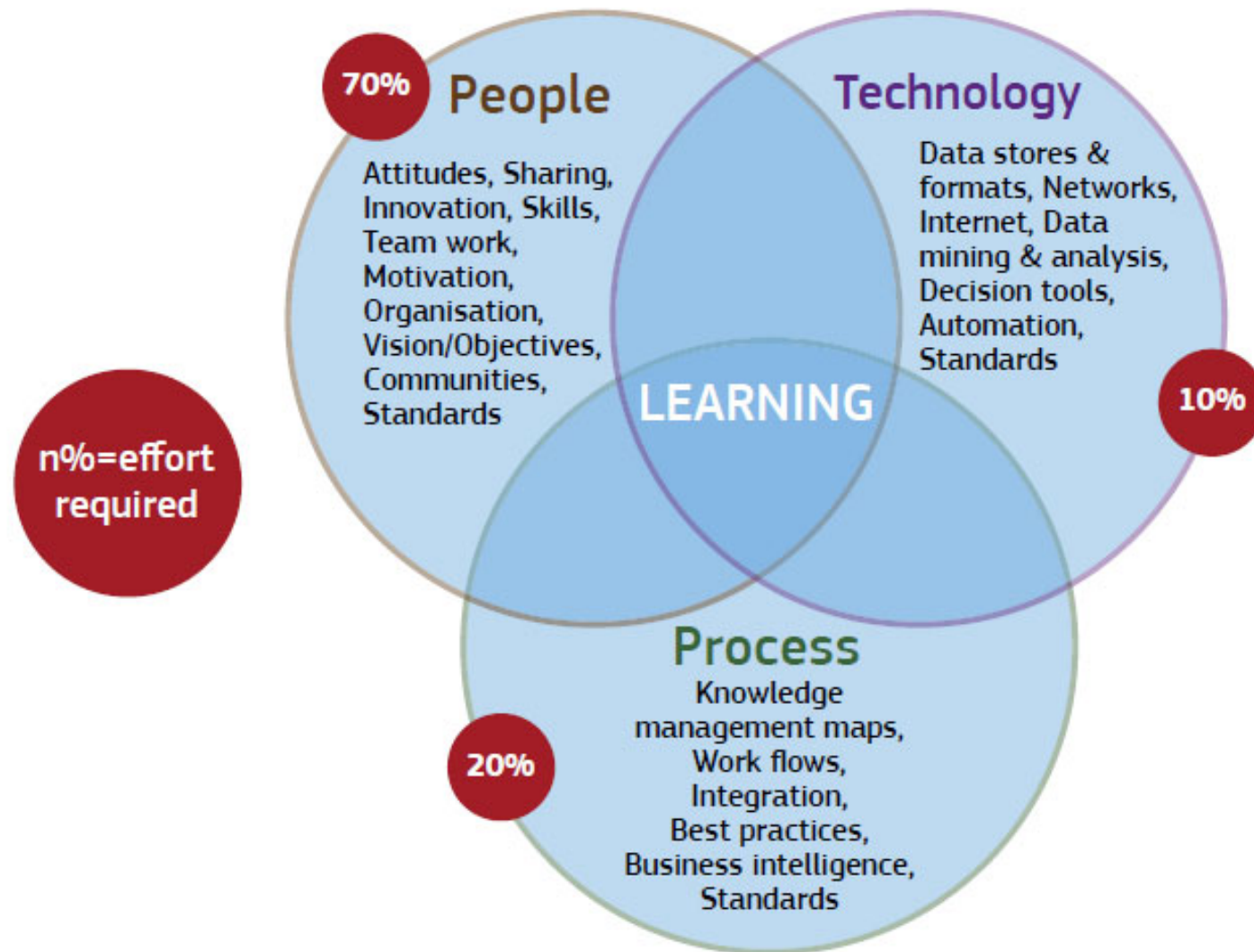


# Time use structure worldwide up to 2100



Source: EC, DG RTD, WETO-T  
B. Chateau and D. Rossetti

# Knowledge components



# **The future of Europe**

***EU as a "hub" of innovation?  
(no brain drain and no talent war)***

***Attracting both STEM\* and SSH\*\****

***Conclusions:***

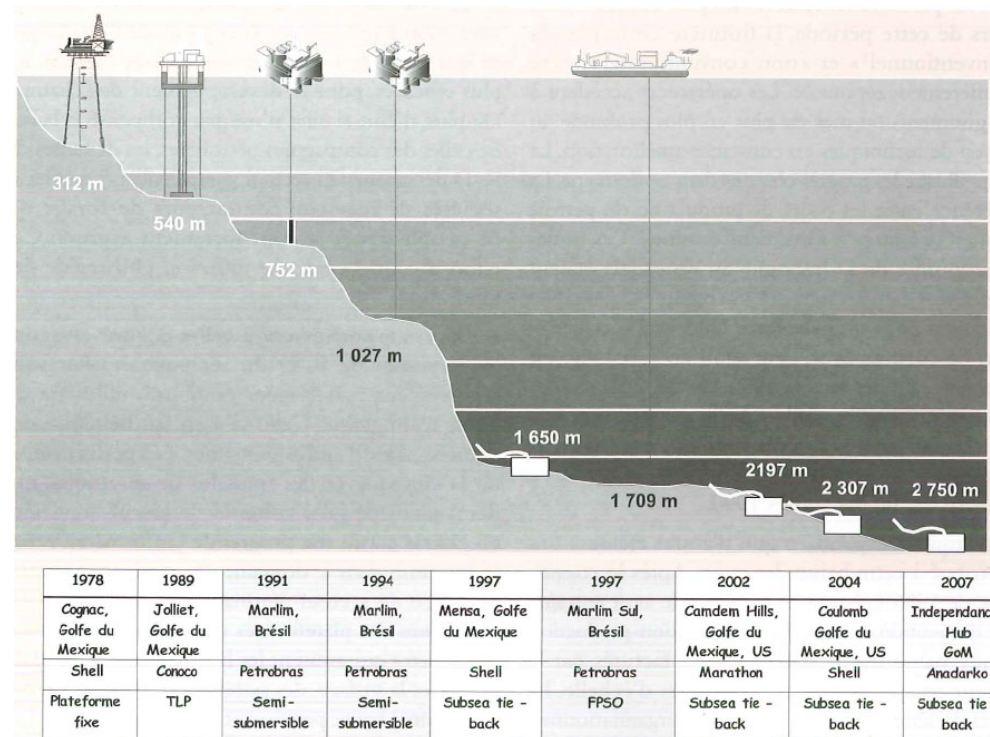
***The best & the worst***

***Difficulty to anticipate***

# Technological progresses and policy messages

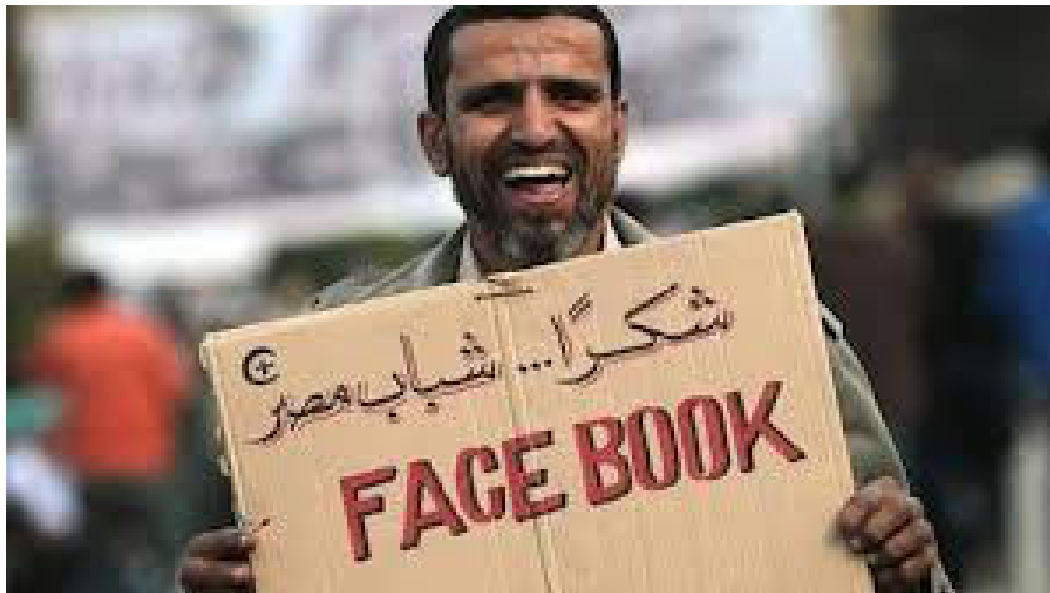
- Malthus "Essay on the principle of population"
- Meadows Report "The Limits to Growth"
- Association for the Study of Peak Oil and Gas

Source: D. Rossetti



Source: IFP

# **Social movements and the two sides of the same technology**



Source: BBC



Source: Public intelligence

# Individual vs. Co-creation

- ***NIMBY*** - Not in my backyard
- ***BANANA*** - Build absolutely nothing, anywhere, near anybody
- ***KEFA*** - Knowledge Everywhere For Anybody
- ***B-GOT*** – Beyond GDP, Beyond Oil, Beyond Tangibles
- The real and the virtual are blurred (*what I am and what I would like to be?*) – Shared economy
- ***Man as a shark or as a gardener of the planet?***

# Time

- **"Management" of time**
- **Day/night restructuring with ICT**
- **"Real-time" for communication, for science, for politics**
- ***Règne de l'immédiateté et dictature de l'instant* (A. Minc)**
- **Time for transmitting knowledge and know-how**
- **Decades for infrastructures and *nanotrading* in finance; discount rate; privilege to the present**
- **Very fast techno-economic changes and very slow changes in values, citizenship and identity**



# A forward- looking Europe

- EU as a "Hub of innovation" – Creative and social skills
- S&T connected to societal aspirations
- A precautionary innovation against an ethical evil
- Rationality vs. irrationality of actors
- *L'impensable n'est pas impossible* (Blaise Pascal)
- Technology to support ageing of population
- Theoretical knowledge reconciled with experience
- *B-GOT*: Beyond GDP, Oil, Intangibles

## Some European risks

- New technological addictions
- Simple copy of *American way of life*
- Selfies and *Egolaïtrie*
- *Indignados* without programme - No creative utopia
- Scientists in an ivory tower (*peer-review* rather than confronting with people)
- The dream of immortality (cf. Transhumanism)

***Si mélancolique paraisse la mort, je suis trop  
philosophe pour ne pas voir que le terrible serait si  
l'homme ne pouvait mourir jamais***

***Vient le temps de la préparation à l'idée de disparaître***

**Benedetto Croce (1866 – 1952)**

# The Power of Science

Economic research and European decision-making:  
The case of energy and environment policies

Domenico Rossetti di Valdalbero

P.I.E. PETER LANG