The Role of Universities in the Emerging ICT World

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Politecnico di Torino  
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Chair: Martin Vetterli, Swiss National Science Foundation
Universities and the Digital Revolution

Karl Aberer
Vice-President for Information Systems

Symposium on Emerging Trends in Electronics, Montreux, 2014
The Digital Revolution – Big Data

**Trends**
- Big Data is pervading almost every field of science and engineering
- Innovation is happening at the boundary of disciplines
  - in particular at the boundary of IT and its applications
- Innovation in IT is driven by Big Data

<table>
<thead>
<tr>
<th>IT?</th>
<th>Big Data?</th>
<th>Interdisciplinary?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genome Editing</td>
<td>yes</td>
<td>pot.*</td>
</tr>
<tr>
<td>Agile Robots</td>
<td>yes</td>
<td>pot.**</td>
</tr>
<tr>
<td>Ultraprivate Smartphones</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Microscale 3-D Printing</td>
<td>yes</td>
<td>pot.***</td>
</tr>
<tr>
<td>Mobile Collaboration</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Smart Wind and Solar Power</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Oculus Rift</td>
<td>yes</td>
<td>pot.****</td>
</tr>
<tr>
<td>Neuromorphic Chips</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Brain Mapping</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Agricultural Drones</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

2014 breakthrough innovations,
MIT technology review – May-June 2014

* Genomic data is the basis
** Google bought the company
*** 3D model data
**** data visualization

Job Trends from Indeed.com

Job Postings mentioning Big Data
Similar for data scientist, social media, MongoDB
MOOCs at EPFL

28 courses delivered
750’000
Registered students in 2+ years

Digital Revolution
MOOCs
Impact of MOOCs at EPFL

- Global visibility
- Improving campus teaching
  - Learning data
- Outreach
  - Continuous education
  - Developing countries

MOOCs Studio
MOOCs for Africa

Digital Revolution

MOOCs

Data on number of registrations and courses by language and region.
Digital Humanities

Venice Time Machine

Venice – State Archive : 73 km library!

Montreux Jazz Archive
The Fifth Paradigm in Research

- **Fourth paradigm: data-driven science**
  - Simulation-based research (e.g. Human Brain Project)
  - Data-Driven research (e.g. Venice project)

- **Fifth paradigm: networked science**
  - Collaborative research (new ways to do science)
  - Crowd-sourced research (involving citizens)
Challenges

The digital revolution implies an educational challenge for Universities
• Rapidly increasing demand in Big Data Scientists and Digital Scientists
• Engineers and researchers have to become Big-Data savvy and open to other fields

Objectives
• Digital Science Research implies convergence among disciplines
• Education for future Digital Science needs of science, economy and society!
• Innovation in Digital Science to create new jobs and companies

• Promote Convergence of technological and humanistic thinking in novel ways
Mega-Trend: Dissolution of existing structures!

Change in organization
- Closed organization ➔ Open organization
- Hierarchical organization ➔ Networked organization
- Raises questions of boundaries, identity, attribution

Examples
- Education
  - Who are the students of a university? On campus only, all online?
  - Who grants degrees to students having courses from different universities/platforms?
  - Dissolving distinction between education and professional life
- Research
  - Who claims the result of collaborative research? Who played which role?
  - Where are the boundaries between disciplines after the bio-nano-info-cogno convergence?
  - How to share scientific data resources?
Adrienne Corboud Fumagalli

EPFL
Entourage d’Antoine Le Moiturier:
saint Denis, 1460/1470
Prof Silvestro Micera, Bionic arm
Restoring sensory and motor functions
after arm or hand amputation
The role of universities in the emerging ICT world

Prof. Georges Gielen
Vice-rector Science & Engineering
KU Leuven, Belgium
Evolution in mankind
Ubiquitous role of electronics

The smart world!!

How about 2050??
Waves of innovation

[Kondratieff – Schumpeter – Smihula]
which device(s) to use and study in 2020 – 2030 – 2040?

Note: Future options subject to change
Academic education

How to educate our youngsters for their future career?

• stimulate their interest to address societal problems by means of technological innovation

• growing complexity of systems
  o learn system thinking
    • teach principles of “engineering design”
  o interdisciplinary:
    • connect electronics / ICT to the biological

• which technology to use?
  o technologies continue to evolve and to emerge
  o need to learn basic principles
    • regardless of the SoA implementation device
Rapport ‘The engineer 2020’

A Vision of the Contexts for Engineering in 2020

Emergence of new fields, tools, and contexts
Examples: bio-tech, digital systems; computer systems/tools; sustainable technology; multidisciplinarity and interdisciplinarity, social, political & economic, diversity; global markets & contexts; interaction of engineering and public policy

Attributes of the Engineer of 2020

- Strong analytical skills
- Practical ingenuity
- Creativity
- Communication competencies (oral, written, and cultural)
- Business, management, and leadership skills
- High ethical standards and professionalism
- Agility, resilience, flexibility

http://www.nap.edu/download.php?record_id=10999
Role of ICT in education

• exponential growth in science and publications
• change teaching paradigm
  o from teaching everything to teaching basic principles
  o each student specializes in limited field(s)
  o use “database” on the internet for finding all information
• use ICT for:
  o preparation courses
  o individualized learning
    • focusing on each student’s weaknesses
  o support continuous learning after graduation
• large emphasis on hands-on design projects
  o learning engineering principles hands-on
The Learning Factory concept

- bring the real world into the classroom

[Penn State University]
Symposium on Emerging Trends in Electronics - Montreux
1st December 2014

The Role of Universities in the Emerging ICT World

Marco Gilli
Rector of Politecnico di Torino - Italy
The Evolution of the University Model

- Education oriented university
- Research oriented university
- Technology transfer/knowledge sharing
- Entrepreneurial oriented university
- 21st Century university
  all models combined
A New Strategic Role for Technical Universities

Significant contributions to attract strategic industrial investments and to address complex societal challenges, mainly a sustainable future for people living on our planet.

Societal challenges: Energy, Water, Food, Population, Climate Changes, Health care

Human capital

Higher education
## The Role of Universities in the Emerging ICT World

### Research and Technology Transfer
- To promote a collaborative and interdisciplinary approach
- To foster the creation of inter-department Labs/Centers, possibly in partnership with industry, where IT technology and methodologies are developed in multidisciplinary fields, like energy, transports, health care and others;

### Collaboration with Industry
- Strategic partnership agreement with Executive Board Meeting
- Common research infrastructures and joint laboratories with industries in the campus
- Joint research projects (European National Regional level)
- Extensive PhD programs and joint master programs
- Job opportunities for talented students and researchers

### Education
- A Bachelor/First level degree in IT subjects with a fundamental background in mathematics and basic sciences
- Some Masters of Science/ Second level degrees, focused on IT application to interdisciplinary subjects, possibly co-designed by Academy and Industry
- In particular the potentiality of MOOCs for regular and continuing education should be exploited
To develop an **entrepreneurial approach** for both research and teaching, by promoting **incubators**, with a section devoted to interdisciplinary IT businesses, and **proper policies** for exploiting the most significant outcomes in IT research and applications.

**WHY PROMOTING INCUBATORS**

To support the creation of knowledge-based start-ups with high-growth potential

**To provide consultancy services**

along the process from Idea to Company

**To manage a high-profile marketplace**

and network linking entrepreneurs, professionals, managers and investors

**To Offer high-quality logistics services** to host start-ups and foster motivation and collaboration.
Steve Kang

KAIST
Role of Universities in the Emerging ICT World: University Social Responsibility (USR)

Sung-Mo “Steve” Kang
President
KAIST (Korea Advanced Institute of Science and Technology)
The Role of Universities in the Emerging ICT World

**HES with ICT** (Healthcare, Education, Safety)
Dr. M (Technologies Bridging the Gap between Hospitals & IT Industry)  
- Mar. 2014 ~ Feb. 2015 (1.8M US$ / 1 year)  
- 28 faculty from College of Information Science and Technology of KAIST and MDs from Sun Medical Center
Bio-Synergy Research Center  
Sep. 1. 2012 ~ Aug. 31. 2022(10yrs)  
150M US$ Project

- To develop fusion source technology of IT and BT that can be utilized in investigating system-level MCMT (Multi-Component, Multi-Target) activation principles of natural materials empirically proven by traditional knowledge including the Dongeuibogam (1596~1610).
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**Education 3.0 (KAIST Open Online Course, KOOC)**

**Interactive Class**
- No Lecturing
- Problem-Based, Collaborative, Active
- Team Learning + TA Support

**Online Self-Learning**
- Lecture Video
- Lecture Slides
- Textbook
- Quiz & HW
- Virtual Lab
- Q&A, Information Sharing, Social Network Services

**MOOC or e-Learning**

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*Forbes*

KAIST Doesn’t Wait For Change In Korea, Pioneers 'Education 3.0'

As South Korea struggles to escape the doldrums of centuries of a Confucian emphasis on rote learning while retaining the positives from that Confucian legacy, at least a couple institutions in the country aren’t waiting for permission to move forward.

KAIST, the Korean Advanced Institute of Science and Technology, a top public research university located 250 km south of Seoul in the city of Daejeon, is doing not only to spark innovation in research and the creation of new products, services, and companies, but also in how it educates.
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KIDS (KI for Disaster Studies)

- Fusion research in the disaster sciences, with the goal reducing the hazard.
- About 70 faculty members, researchers and graduate students with specialties extending from natural science, engineering, and informatics, to social sciences.

Source: https://www.linkedin.com/today/post/article/20141021184519-39418-how-big-is-big-data

Prediction, Detection & Containment

IoT (Internet of Things)

Social Computing Platform

Big Data Technology
Donatella Sciuto

Politecnico di Milano
The role of universities in the emerging ICT world

Donatella Sciuto
The challenge

1. The way we shape the future of our universities research and education will also shape the future of society

2. The trouble with our times is that the future is not what it used to be (Paul Valery)

3. In today’s complex rapidly changing world the only certainty is that we are facing uncertainty
The evolving mission of university

- Technology, creativity and culture
- Provide opportunities of developing skills and competences complementary to the specific course curriculum
  - Transdisciplinarity
  - Entrepreneurship
  - Intercultural knowledge
  - Soft skills
  - Social responsibility
Action lines

• ICT technologies provide new ways of teaching
• Students are digital native

BUT

Big ships turn slowly

• Increase the use of ICT based tools for blended learning
• Experiment with MOOCs to bridge the gaps
• Increase the opportunities to work on social challenges in interdisciplinary teams
MOOCs to bridge the gaps

- MOOCs for teachers: How to design blended learning courses
- MOOCs for all: Bet on math, Code for all
Concluding remarks

• Universities need to continue imagine the future of education to empower students to make meaningful and lasting contributions to society

• ICT plays a role as key enabling technology today in education, research, service and entrepreneurship

We cannot predict the future but we can help in shaping it
Il Politecnico di Milano dà il via a una serie di iniziative per incentivare lo spirito imprenditoriale.
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