The need to develop world class engineering schools

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Challenges faced by Universities in the 21st Century

→ Current situation:
  - Disruptive technologies
  - Need to re-educate the work force → life-long learning
  - Rising of tuition fees*

→ Future: “within 15 years more than half of the universities will be bankrupt”

* US students debt: 1.2 trillion US$
Challenges faced by Universities in the 21st century

Evolving context

→ Internationalization of higher education
→ Competition for top (and paying…) students
→ Impact of University rankings (THE, QS, ARWE etc.)
→ Development of powerful e-learning tools
→ Generalization of Quality Assurance
→ Issue of financial sustainability

Source: EUA Trends Report 2015
Challenges facing Universities in the 21st Century

World class Universities

→ Have a strong engineering school at the heart of converging disciplines

→ Allow to show the impact of the research & education effort

  - Economic development (i.e. Silicon Valley, Route 128)

  - “Pull effect” on the overall academic system
Three main missions of a University

Education
Learn to learn; use of online learning tools

Research
Advanced, fundamental & applied

Technology Transfer
to industry & society
How to build a world class research university?

Key ingredients

→ Recruit the best students and faculty
→ Go online
→ Develop high quality infrastructure and facilities
→ Provide an innovative environment
→ Have a budget > 1 billion €
→ Be jealous of your autonomy
→ Empower Leadership
The digital revolution

A challenge for education and research

→ **Education**
  
e-learning tools: MOOC, Extension Schools etc.

→ **Research**
  
Development of **Open Access**
  
**Collaborative research** ie crowd-based AI
  
**Simulation-based research**
Attract (and retain) the best students

→ Offer scholarships
→ Guaranty a good student/faculty ratio
→ Promote mobility
→ Create an attractive and lively campus
→ Develop the branding and corporate culture of the University
Higher Education is changing!

From transmission ...

... to accumulation and construction of knowledge
Adapt our education to the digital revolution

Location

Format

Age

18-25 year old

8-88 year old?
Adapt our education to the digital revolution

How to train professionals?

-Reputation of the university

“Uberification” of Universities?

- Recognition without certificate? Kaggle points
- Companies like Google fight for getting the best Kagglers
Go online...

Total: 2'262'611 students registered on EPFL MOOCs
MOOCs – the EPFL experience

→ 81 MOOCs EPFL on line; 33 in production

→ September 2012 – December 2016:
  2'056'471 participants from 186 countries

→ 66% are not students (continuing education), of which 90% are employees

→ 34% of the EPFL MOOCs are taken in French
  66% of the EPFL MOOCs are taken in English

→ > 100’000 users have succeeded and received a certificate
Continuous education

Concept of the Extension school

→ Develop new forms of life long learning
  (blend of online/residential experience)

→ COS (Certification of Open Studies), with no prerequisites

→ Establish a “Nanodegree” offer using on-line tools

→ Development of vouchers for industry
Education 2.0

→ Reduce the number of ex-cathedra lectures
→ Flip the class and use of the MOOCs
→ Problem solving approach
→ Foster team work and projects

Distance practical work for students
Develop an attractive campus

- Student housing
- Swiss Tech Convention Center
- Under One Roof
- EPFL Innovation Park
- Les Estudiantines & Starling Hotel
- Mechanical Engineering
- Extension sports center
- UNIL
- EPFL Innovation Park
- Under One Roof
Campus: need for socialization
School projects to promote transdisciplinarity
Attract (and retain) the best Faculty

→ Recruit on a **world wide** level
→ Develop a **tenure track** system
→ Competitive **funding**
  (start-up costs + running budget)
→ Modern **infrastructure**
→ Competitive **salaries**
“Elite revolutionary science should (...) be a place that welcomes brilliant, impulsive, inspired, antisocial oddballs – so long as they are also dedicated truth-seekers”

Bruce G. Charlton
Science megatrends

« Info-nano-bio-cogno » convergence, leading to a deluge of data

+ the AI potential to extract meaning of big data

The pace of technological developments has never been so fast
How technology is transforming the world

→ Big data and IA (info)
→ Robotics and advanced manufacturing (nano)
→ Gene editing (bio)
→ Cognitive sciences (cogno)

An extraordinary opportunity for engineering schools
Simulation-based research

Human Brain Project

Ambition
Build a simulation-based research facility capable of constructing unifying software models of the brain

Current achievement
Published the first detailed reconstruction of the somato-sensory cortex of juvenile rats (8 million connections and 37 million synapses)
Development of neuro-inspired Artificial Intelligence

→ Design chips based on our understanding of how the brain computes

→ Smarter chips for the next generation of robots

Modelling the neocortex (Blue Brain Project)

Neuromorphic Chip (Human Brain Project)
Brain machine interfaces

Connected artificial hand (Prof. Micera)

Sensing skin (Prof. Lacour)

Cognoceuticals (Prof. Blanke)
Digitization of the Venice archives

→ 80 km of archives about 1000 years of Venice history

→ Classic digitization: 450 books/day → 20 years

→ Develop new technologies (tomographic approach) → 2 years

Ambition: transform archives into an information system with a user friendly interface
Venice Time Machine  
Exploring New Frontiers

X-Ray Digitization

Place the book
Scan the entire volume

Computer extraction of pages
Venice Time Machine

3D imaging of sealed venetian testaments with x-ray sources

Saponario Cataruccia ux. Martin (13 August 1351)
Venice Time Machine
Venice Time Machine

Challenge: read, compute, interpret and visualize the data
Montreux Jazz Festival Archiving project

- Research on indexing, access and post-production of digital archives
- Prototypes of navigation in the archives
Collaboration Twist - EPFL

Samples of the Montreux Jazz Festival Archives stored on DNA

Deep Purple
Smoke on the Water

Miles Davis
Tutu

00 01 11 10
AGTC

Claude Nobs Foundation
Innovation culture

A question of emotion

Rolex Learning Center@epfl.ch
Development of innovative ecosystems

University active engagement for innovation

Science park on campus
Tech transfer office
Entrepreneurship programs
Access to coaches
Seed funding (ie angels, state etc)
Accelerators
Innovation culture
Innovative environment

Interactions

Being next door

EPFL Innovation Park
Development of EPFL start-up

245 start-ups established
EPFL Innovation Park

→ 55’000 m² of labs and space offices
→ More than 120 start-ups
→ 23 large companies
→ Creation of 2’000 high added value jobs
VC financing of start-up @ EPFL Innovation Park

Mio CHF

0  50  100  150  200  250  300  350  400

Leadership & management

« Empowerment of the leadership »

→ Promote professional leaders (presidents, vice-chancellors, deans, etc.)

→ Acquire sufficient autonomy vis-à-vis of the political power

→ Promote organizational flexibility

→ Develop a corporate culture
Leadership

« An academic Institution is not like an orchestra with a president as conductor. MIT is more like a jam session among a lot of talented musicians who listen to each other and get into the flow. The president, provost, deans and other administrators strive to hire the right « musicians », draw the themes from the evolving music, and keep the beat going. »

« An academic Institution evolves 50% by planning and 50% by serendipity. »

Charles Vest, past president MIT
EPFL 2017 rankings

QS Ranking: 12
Times Higher Education: 38
Shanghai Ranking: 76
CWTS Leiden: 17 *
Nature Index: 22
US News & World Report: 36

EPFL: 2015, 2016 & 2017 best young University worldwide

THE under 50: 1st
Conclusion

« Things take longer to happen than you think they will and then they happen faster than you thought they could »

Ruedi Dornbusch, MIT
Thank you for your attention
"To meet oncoming global challenges, we will need to better link discovery, innovation and entrepreneurship »

Phil Scharp, Nobel laureate, 1993