...how people learn?

A system approach towards knowledge and learning

...which tertiary education institutions and campuses?

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Slow dancing @ Harvard’s Widener Library

...a Work of Art by David Michalek, April 2012
“I never teach my pupils. I only attempt to provide the conditions in which they can learn.”
Albert Einstein
Which governance strategy to help accelerating HE competitiveness and relevance?

Which roles for public policies and/or university strategy? How far are they different, complementary or competitive?

In general, how can universities foster new factors for development and growth at local and global scales? How far the governance model helps?
The international discussion on institutional building

“Notably there is clear evidence that success in improving quality within institutions is directly correlated with the degree of institutional autonomy. (...) At the same time, the role of leadership within universities is also critical.” EUA’s Trends IV, 2005

**strengthened autonomy:** to improve the responsiveness of HEIs to an expanded set of national and societal demands. This responsiveness can be improved through enhanced capacity for strategic thinking and taking advantage of emerging opportunities in a dynamic way.

**strengthened regulatory regimes:** so that a more autonomous HEI sector responds more effectively to the requirements of public interest. This may be seen as a contradictory trend of constraining institutional autonomy through more indirect mechanisms.

*the way to independent legal status (ILS)*...
Ao ingressar na era tecnológica, a ciência e a técnica passaram a constituir para nós, também, ingredientes fundamentais dos processos produtivos, e o seu domínio, um imperativo da autonomia nacional. Se fracassarmos neste desafio, justamente no momento em que nos tornamos independentes sob tantos títulos, nos veremos novamente subordinados. Já não dependeremos da importação de automóveis, geladeiras e televisores, mas da técnica que os produziu e os aperfeiçoa incessantemente.

Darcy Ribeiro
Revista Senhor, Janeiro 1962
The starting points:

- Institutional **autonomy and integrity** of modern universities are to be promoted in a context where building **human capital** is a priority.

- Research-based **alliances and partnerships** among universities worldwide, as well as between them and industry, gain significant relevance.

- **Built on the public opinion** through promoting science culture!
Background:

the university, even in mass higher-education systems, continues to fulfil **two basic functions** that depend on it being a relatively *stable* institution:

1. It remains the most important incubator of the next generation of **people**:
   - Researchers, and this do require effective “University-Science” relationships
   - the need to secure and explore “University-Industry” relationships: Among the most precious and valuable roles of the universities, is the supply and training of talented young people.

2. generating and promoting “**cultural norms**”, in both substantive and procedural terms

No other institution is so well equipped to undertake these tasks in modern societies!
If ability, and not the circumstances of family fortune, determines who shall receive higher education, then we shall be assured of **constantly improving** quality at every level of scientific activity.

Vannevar Bush to President Harry Truman

July 5, 1945
The process: which basics?

i) *scale of the system*, placed against the need for continued public support for the *advanced training of human resources through R&D*, and particularly, to attract research staff and personnel engaged in research and teaching activities;

ii) *diversification*, tied with the need to differentiate the role of public and private *funding* for science and higher education, while preserving the *integrity* of institutions and the freedom of thought;

iii) *time*, reflecting a basic truth namely, that evolution in the academic system is a *continuous process*. It requires both stability and the on-going engagement of *people and institutions*. 
A case study: Portugal – lessons learned

i) enlarging student graduation levels

ii) promoting system specialization

iii) fostering teaching staff qualification

iv) strengthening the research landscape

v) promoting internationalization

vi) securing funding conditions
Guiding the development of higher education systems and related public policies

1. Promoting autonomy: independent legal status
2. Fostering systems diversification and specialization, together with adequate funding levels

3. Attracting students and promoting a culture towards knowledge:
   • Fostering the substance of teaching and learning and its relation with research
   • Promoting research and teaching relationships: training and attracting a teaching body through “University-Science” relationships

4. Stimulating research and economic development and university-industry relationships
5. Promoting Internationalization
6. Developing assessment and evaluation practices: beyond quantitative methodologies
7. Optimizing organizational design

8. Look at the spatial dimension, integration and design
The research hypothesis - 1:

In *public policy terms*, by focusing governmental activity on strengthening *institutional autonomy*, we require *political actions to concentrate on the external dimension of knowledge institutions* and, thereby, *universities should strengthen their capacity to make the critical internal changes for building and modernising their systems of teaching and research within a path of *diversity* and *specialisation*, without compromising quality.*
The research hypothesis - 2:

Furthermore, by strengthening their institutional integrity together with enhancing their external links with society, universities are asked to carefully improve their relationships with economic, social and political actors, thereby creating “new” reinforced institutions that have gained societal trust.
PART A: a culture towards knowledge...but, how?

How higher education can be effectively oriented, transmitted and assimilated to allow societies to move towards a sustainable and entrepreneurial world?
The Painters’ Academy (1615), Pietro Francesco Alberti (1584-1638)
“the meaning of ‘knowing’ has shifted from being able to remember and repeat information to being able to find and use it.”

Nobel laureate Herbert Simon
the issue:...HOW people learn?
…HOW?
HOW, HOW, HOW?
Any knowledge is necessarily personal and social…

“indwelling” : ...learn by experiencing?

Polanyi (1966, 1969)

A new culture of learning? ... **Becoming**!

People learn how to embrace change, collaboratively, through *knowing, making and playing*

Thomas and Brown (2010, 2011)
endogenous growth:

...what do you know from the theories of economy growth?

- The **learning ability** is the critical aspect for economic growth, and is associated to the skill of assimilating and transforming the current knowledge.

- “Learning refers to building new competencies and establishing new skills and not just to get access to information”, Lundvall (1997).
LEARNING METHODS AND PROCESSES...

LEARNING PROCESSES

informal

learning-by-doing

- accumulation of experience
- more skills
- know-how

learning-by-living

- by-interacting

formal

learning-by-learning

acquisition of previously codified knowledge

learning-by-researching

exploration and discovery, trying to create new knowledge
from key concepts...to implementation?

- Interaction
- Constructionism
- Diversity
- Scope
- Integration
- Sustainability
- Ethics

Flexible implementation:
1. Collaborative learning
2. Design thinking, through project based learning
3. System thinking, through experiential learning

Together with abstraction, through research-driven learning of basic disciplines
Case Study: a glass chair

http://in3.dem.ist.utl.pt/glasschair/
Tito Silva: Yes to last question.
João Rocha: Avoiding slits is just because it's difficult to cut 12 mm thick glass.
Tito Silva: Slits with closed profiles are especially bad.
João Rocha: Even with good diamond tools.
Tito Silva: Yes it matches what I was going to draw in perspective.
Tito Silva: I can't give a definitive answer, yet.
João Rocha: Ok.

Is it necessary to have this corner rounded here?
What is the minimum width that you suggest here?
How about that for torsion?

Something like this,
COLLABORATIVE (& FLEXIBLE…) LEARNING

The same space

TRADITIONAL SCHOOL

same instant

different times

Different spaces

“OPEN UNIVERSITY”

FLEXIBLE LEARNING
Focus Areas:

1. HIGH-PERFORMANCE NETWORKS FOR TRUSTED HIGH-QUALITY SERVICES
2. SOFTWARE ENGINEERING FOR LARGE-SCALE DEPENDABLE SYSTEMS
3. CYBER-PHYSICAL SYSTEMS FOR AMBIENT INTELLIGENCE
4. HUMAN-CENTRIC COMPUTING
5. PUBLIC POLICIES AND ENTREPRENEURSHIP IN HIGH-GROWTH INDUSTRIES
6. APPLIED MATHEMATICS
MIT Portugal

Focus Areas:
- Bioengineering
- Sustainable Energy
- Engineering Design and Advanced Manufacturing
- Transportation

Innovative Academic Programs:

Targeted Application Areas:
- Stem Cell Engineering for Regenerative Medicine
- Sustainable Energy and Transportation Systems
- Advanced Engineering Design

Systems Thinking
Design Thinking

capabilities development

Design Development Capabilities

Knowledge Required for Design Process Development

Design Process Development

Knowledge about Production Problems and Conditions

Production Experience

Production Capabilities

Learning before Doing

New Process Technology

Learning by Doing

Capabilities Required for Production

...fostering industry-science relationships!
“design studios” are important to provide adequate forms of interaction of users with adequate research environments
DESIGN STUDIOS: Key Components towards design thinking

Learning ➔ A set of formal and informal processes and practices, strongly influenced by the environment, that lead to knowledge accumulation

Challenge ➔ How to promote learning that links diverse social actors with different degrees of development

Perspective ➔ Institutional diversity (Universities, R&D Centers, Firms)

Mechanisms ➔ Networks linking people in order to increase their ability to learn
Design thinking, through project based learning
Towards a “New University Pedagogy”? 

Main Causes of Failure 

- Reductionist mode of knowledge 
- Absence of “sustainability” norms 

University Intervention 

- Transdisciplinarity 
- Constructionism 
- Learning-by-living 

Incompetence in reflexive practice 

Learning in Action
Sample Example: Oberlin College

Adam Joseph Lewis Center for Environmental Studies

Mission Statement:
• become a producer of energy
• treat wastewater for reuse;
• use no materials known to be carcinogenic, mutagenic, or endocrine disrupters;
• use products and materials grown or manufactured sustainably.
The “Green Islands” test bed

System Dynamics

- urban typology
  - Rank size
  - Geography
  - Development
  - Material intensity
  - Energy intensity
  - Historical profile
  - Cultural elements

Material Flow Analysis

- inputs (passive)
  - water
  - air
  - solar rad.
- active
  - municipal extraction
  - environmental dispersion (air + water)
- indicators
  - Net Primary Production
  - CO2 emissions
  - Mat/energy intensity (MIP5)
  - Human Development Index
  - Resilience + risk reduction
  - Environmental responsibility
  - Global resource burden
Renewables Integration

Hourly dynamics of supply and demand in energy systems planning tools

Grid management for large renewable penetration

Fig. 1. Electricity demand variation in São Miguel

Fig. 2. Integrated modeling framework

Fig. 3. Electricity production scenario using TIMES

Fig. 4. Electricity production scenario using the developed framework

Fig. 1. Short circuit simulation with the loss of large wind power generation

Fig. 2. Voltages drops after short circuit simulation

Fig. 3. Short circuit simulation without the loss of wind power generation

Fig. 4. Voltages drops after short circuit simulation

Fig. Portuguese installed Wind Power

Fault Ride Through capability:

Simulation results:
Electric Vehicles

Economic and environmental impact of EV in Electric Systems

Impact of V2G in grid operation
Buildings Retrofit

Multi-objective optimization of retrofit strategies

Energy Efficient Retrofit in Lisbon

- Typology Approach (Point III.)

- Results
  (Point II. and IV.)
  Not just energy savings (40%) but also the improvement of coupled comfort, air quality and health dynamics.
Buildings Design

Decentralized Energy Production for sustainable built environment

Design of Carbon Neutral Buildings
Energy as a Service - DSM

Locally automated control of residential energy use

Demand response in residential sector

Daniel Livengood

Joana Abreu
The local context embeds a set of social and technical challenges that stimulates systems thinking and promotes new learning practices...
Summary: The opportunity for university education…

to find a balance between striving for more social and economic relevance, while keeping the fundamental ability of being a place for new technical discoveries and free intellectual inquiry
PART B: Look at the spatial dimension, integration and design
...but, how?

How far the growth in higher education worldwide and the prospects for the rapid evolution of research-based activities in many emerging economies and societies is calling for the need to better understand and frame potential evolving scenarios for spatially integrating universities, science parks and related “knowledge infrastructures and facilities” in growing urban areas worldwide?
University campuses ("campi") have existed for more than 2000 years, including the very initial "Buddhist learning centers" in India and at least since the 11th century in Islamic societies (namely with the creation of the Universities of Bagad and Nishapur in 1060 and, therefore, earlier than the creation of European universities in the 12th century.)
“Buddhist learning centers” in India in Taxila, 6th Century BC, in Nalanda, 3rd Century BC and Ajanta, 2nd Century BC

Students and Teachers: cave in Ajanta, 2nd Century BC
NALANDĀ: DISTRICT PATNA, EXCAVATED REMAINS
Laurentius de Volto, Bologna 1390
Creating Spaces for Exchange
I.I.T. DELHI CAMPUS PLAN
Chowdhury and Gultar Singh, Architect
U.P.A.U. CAMPUS PLAN
Original P.W.D. plan — 1963 (there have been major revisions since)

1 ACADEMIC BUILDINGS
2 STUDENT HOSTELS
3 RECREATION — PLAYFIELDS
4 STAFF RESIDENCES
5 COMMUNITY CENTER
- approximate 1/2 mile diameter (10 minute walking distance)
- circulation routes
- lines of expansion
- specialized academic (mainly lecture rooms)
- general academic (mainly lecture rooms)
- restaurant bases
- core facilities (library, auditorium, theatre, etc.)
- social centres (student Union, etc.)
- residential
Oscar Newmeyer’s work in the early 70’s to accomplish the design of the University of Constantine, in Argel, which has involved the preparation of a program following that of the University of Brasilia in the 60’s
Projetar um auditório de leveza estrutural, visando contrastá-la com a forma mais robusta e imponente do bloco de classe.

Projetar un auditoire d'une légèreté structurelle extrême afin de créer un contraste avec les formes plus robustes et imposantes du bloc des classes.
Levels of Analysis:

**Building design**: Inside the realm of learning and scientific work production.

**Campi design**: work, live and interact in university campi and SP;

**Urban design**: the city- knowledge infrastructures interaction;

Towards “Knowledge Urbanism”?
Education Environments: OCDE
Distributed Learning Environment

Virtual

- e.g. Intranet
- e.g. video conferences
- e.g. Internet sites
  - Social media /
  - Facebook / twitter/
  - wikipedia

Physical

- e.g. Academic offices; Research labs; home; office
- e.g. Classrooms Auditoria; external / internal
- e.g. interface with the City

PRIVATE

PRIVILEGED (invited)

PUBLIC CITY

Source: After DEGW Working beyond Walls, 2008
What should we focus on?

Physical

OR

Virtual or On-line

or Both?
## Matching learning to technology and space

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<tr>
<th>Learning mode</th>
<th>Technology</th>
<th>Space type</th>
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<td>Work-based learning</td>
<td>ePortfolios</td>
<td>Collaborative spaces with high-end technology</td>
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<tr>
<td>Work-integrated learning</td>
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<td>Field-trips – real and virtual</td>
<td>Virtual field-trips</td>
<td>Collaborative spaces with high-end technology</td>
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<td>Lectures</td>
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<td>Assessment</td>
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</tbody>
</table>

*Source: Prof Shirley Alexander, University of Technology Sydney*
Reusing Existing Space
Reusing Existing Space
Reusing Existing Space
Reusing Existing Space
Large collaborative learning spaces
Large collaborative learning spaces
Creating Stimulating Environments for Learning
In between spaces

- Lab
- Admin
- Studio
- Cafe
- Lecture
- Seminar
Spaces in between

Faculty of Education, University of Cambridge. Architect: BDP

- Openness
- Transparency
- Overlooking
- Passive and active engagement

CELE Compendium 2011 Entry
The Saltire Centre – Glasgow
Caledonian University. Architect: BDP
Spaces in between

The Saltire Centre – Glasgow Caledonian University. Architect: BDP

School of Art & Art History University of Iowa: Steven Holl Architects

CELE Compendium 2011

© David Barbour

CELE Compendium 2011 Award

© Christian Richters
Spaces between buildings: University of Melbourne
The potential of external space
Flexibility
Just enough

Agility
Speed of response
Rearranging furniture quickly

Variability
Range of sizes

Spatial Opportunity
Provide a mix of space types and sizes
University facilities represent 20% of operating costs.

Source: TEFMA 2009

Space Costs Money
IT University, Copenhagen Architect: Henning Larsen

Macquarie Bank, Sydney, Australia. Clive Wilkinson
The City as the Learning Environment
Paris Rive Gauche

130 Hectares industrial land

Economic Development Agency

SEMPA set up in 1997

Université Denis Diderot
University buildings mixed with residential, commercial, research, welfare
Universities as a focus for regeneration
... after

Library: Université Denis Diderot
Creating a Sustainable Knowledge City
Ciudad Juarez

300 hectare site

Moving the University away from the conflict zone
Proposed Layout  UACJ

Student population: To rise from 20,000 to 40,000 by 2020
Ciudad Juarez

300 hectare site
Moving the University away from the conflict zone
Urban development will grow around the campus.

Educational hub with other universities present.
Ulsan National Institute of Science and Technology
Ulsan, South Korea

155,066.58m² of accommodation – 5,000 students
"Ilha do Fundão", UFRJ, the tec park, and the city of Rio de Janeiro...
City4k: the case of Rio de Janeiro...
Two trends: inner city *versus* outer city *campi*
Accompanying the expansion of higher education systems (HE) worldwide, beginning in the 1950’s and 60’s in the western societies and recently pronounced in many developing regions, knowledge infrastructures, including UNIVERSITY CAMPI and SCIENCE PARKS, tend to be established outside the city core in urban edges, facilitating new urban expansions.

How to ensure that these "knowledge-intensive edges” can mobilize and structure the "social construction" of cities, as well as to enable socially active and sustainable learning environments?
Thus it makes sense revisiting knowledge infrastructures concepts, at a global scale, and build a new narrative towards “KNOWLEDGE URBANISM” as an emerging issue?