Civil Engineering and International Economy (EU 27)

- Annual investment: 1.211 billion euro
- 8.8 % of Gross National Product (down 15% since 2006)
- 45.1 % of the Gross Fixed Capital Formation (measure of the net new investment by enterprises, government and households in the domestic economy in fixed capital assets, during an accounting period)
- 3.0 million of enterprises (95% are SMEs with less than 20 employees)
- 14.1 million workers (6.5% of employment and 28.7% of industrial employment) (down 11% since 2006)
- 40 million workers (20% of employment) depend directly or indirectly from the building sector
- Biggest industrial employer in Europe

Civil Engineering and International Economy (EU 28)

- 20.6% Civil Engineering
- 32% Non-Residential
- 28% Rehabilitation & Maintenance
- 19.4% New Housebuilding
- 32.3% Asia/Oceania/Australia
- 25.4% North America
- 12.8% Middle-East
- 13.7% Central & South America
- 15.8% Africa
Civil Engineering and International Economy (EU 28)

EU 19 (Euro currency region) is the international block with largest production and export of building products (Portugal, Construction now in top 3 of country exports)

EU building companies are leading exporters, which won more than 50% of the large international contracts in the last triennium, with a business volume 10% larger than Japanese companies and 30% larger than US companies. Increasing international competition with companies Chinese, Turkish and many other countries.

The current challenges of the sector include aspects such as:
- Infrastructure network
- Sustainability (energy consumption reduction, emission reduction, residual reduction, lower visual and operating impact)
- Safety (for building workers and society in general)
- Increase in efficiency and productivity
20th Century – The century for construction

- Civil engineering and construction as a major agent for:
  - Comfort
  - Mobility
  - Health
  - Quality of Life

- Highly regulated, which lead to the public conviction of inefficiency, low technology and non-innovative: Wrong image of a sector responsible for numerous applications of innovative materials and advanced technologies

- But, high environmental costs:
  - 50% of the world consumption of raw materials
  - 40% of the world consumption of energy
  - 33% of the world emission of greenhouse effect gases

21st Century – Need for revolution: developed countries

- Market is saturated:
  - Contraction due to population reduction (and now economical crisis)
  - Excess of construction with respect to demand

- Image of the sector is negative:
  - Construction “lobby”
  - (Over) Usage of non-qualified workmanship
  - Lacks innovation and does not create value

- Sector needs a change
  - Think global. Be global
  - Innovate (be ahead from competition)
  - Concerns with sustainability
  - Conservation & Rehabilitation

- Are there lessons for developing countries?
Conservation & Rehabilitation

- Rehabilitation and conservation of the built environment is about 40% of the construction market in Europe, reaching 50%+ often

- Built heritage costs money! Maintenance costs are about 1 to 2% of the replacement cost. Operation costs are similar

- An estimate for the US government (Whitestone's Facility Cost Forecast System) provided an average value of 6%, with 35% of this value for operation, 46% for preventive maintenance, repair and replacement of parts, and 19% for recapitalization

- Modern societies believe that cultural heritage buildings are landmarks of culture and diversity. They should last forever, being the task of the current generation to deliver this heritage in good shape for the generations to come. This act of culture poses high demands to all involved because deterioration is intrinsic to life

Cultural Heritage

- “Memory, then, is bound to place, a special place, a homeland. It is also crucial to identity. In fact, one might almost say: no memory, no identity; no identity, no nation.” Anthony D. Smith, LSE, 1995.

- “we shape our buildings; thereafter they shape us”, W. Churchill, 1943. “I, naturally, should like to see it restored in all essentials to its old form, convenience and dignity”

- Europe has significant cultural diversity together with exceptional ancient architecture, built environment and artefact collections

- Tourism is 5% of the GDP and 10 million jobs. If sectors linked to tourism are considered, it accounts for 10% of the GDP and 12% of the employment. EU is the world's number one tourist destination (370 million, 40% of international tourists), with 7 European countries in top ten world touristic destinations. Estimates by WTO, indicate a significant increase in the coming years, particularly due cultural wealth. Built European heritage, namely monuments or historical centers, are main attractors (420 / 936 World Heritage Sites in the EU).

- Despite this richness, Europe failed in its duty to take sufficient care of historical physical artefacts – both indoors and outdoors
Research, Development and Innovation (I)

- Research – The search for new knowledge
- Development – The application of the knowledge in viable solutions
- Innovation – Exploitation of the novelty in services, products, processes and/or organization, with value for the company

Creativity exists in the universe of ideas, in which processes are cognitive

Invention exists in the universe of technologies, in which processes are technological

Innovation exists in the universe of the markets, in which processes are entrepreneurial
Research, Development and Innovation (II)

- R&D has no interest for companies if innovation does not occur
- With R&D companies must invest money to obtain knowledge
- With Innovation, companies transform knowledge in money

Innovation as a strategy

Innovation plan

Innovation to survive — Innovation to compete

Innovation is Risk!
RDI (or R&I) in Civil Engineering

- Research is a component of a knowledge triangle (the other two being education and innovation) meant to boost growth and employment in the European Union (EU) in the context of a global economy.
- Horizon 2020, 2014-2020, is an opportunity for the EU to consolidate the European Research Area (ERA).
- European Commission funding for RDI in Civil Engineering has been very low (2 to 3% in FP4 and FP5, about 1% in FP6 and FP7)
- Previous signs of change:
  - Lisbon Agenda (1% – Public + 2% – Enterprises from GNP in RDI)
  - Creation of European Technology Platforms as a “forum involving the main public and private agents to respond to the most relevant technological challenges, directed to support the EU growth initiative”
    - A common long term vision between public and private partners
    - Creation of a dynamic and coherent strategy to reach this vision
    - Industrial leadership, including all other agents

ECTP

- The “European Construction Technology Platform” was launched in October 2004 (http://www.ectp.org/). National platforms have been created in many countries, with the Portuguese platform established in 11/02/2008 (www.ptpc.pt).
- The recent advances have been impressive with the document "Vision 2030“ and definition of Focus Areas:
  - Underground Construction
  - Cities and Buildings
  - Quality of Life
  - Materials
  - Networks
  - Cultural Heritage
  - Processes & ICT
- Involvement of the larger building companies in very large “Integrated Projects” from EC for new products and processes, typically in the range of 20 M€ / Project
Cultural Heritage and FP7

- Key action since 1974, with the first RDI project funded in 1986. Since then, some 120 projects have been supported involving more than 500 stakeholder organizations from all European countries.
- 1993, EU Treaty (Article 167) specifies that safeguarding moveable and immoveable cultural heritage of European significance must be treated as a priority for the EU and is the legal basis for protection initiatives including research on cultural heritage

- Many FP7 Projects, e.g.:
  - 3ENCULT: Energy Efficiency
  - CLIMATE FOR CULTURE / MEMORI / TEACH / WRECKPROTECT: Climate Change & Pollution
  - EU-CHIC: Identity Card
  - NIKER / PERPETUATE / FIRESENSE: Earthquake and Fire Protection for Immovable Heritage
  - HEROMAT / Nanoforart / NANOMATCH / PANNA / ROCARE: Multifunctional and Nano-Materials and Systems
  - IMAT / POPART / SYDDARTA: Conservation of Movable Heritage
  - MUSECORR / SMooHS: Monitoring

Horizon 2020 (2014-2020)

- Objectives: Excellent Science, Competitive Industries, Better Society

- Priority 1
  - EUROPEAN RESEARCH COUNCIL (ERC) / FUTURE AND EMERGING TECHNOLOGIES (FET) / MARIE SKŁODOWSKA-CURIE ACTIONS / RESEARCH INFRASTRUCTURES

- Priority 2
  - Information and Communication Technologies (ICT) / Advanced materials / Space / Nanotechnologies / Biotechnology / Advanced manufacturing and processing

- Priority 3
  - HEALTH, DEMOGRAPHIC CHANGE AND WELLBEING / BIOECONOMY / SECURE, CLEAN AND EFFICIENT ENERGY / SMART, GREEN AND INTEGRATED TRANSIT / CLIMATE ACTION, RESOURCE EFFICIENCY AND RAW MATERIALS / INCLUSIVE, INNOVATIVE AND REFLECTIVE SOCIETIES / SECURE SOCIETIES
Our Vision

- A top quality MSc in terms of education for research and practice
- Establish an enduring European partnership in the framework of conservation and strengthening of existing structures with cultural value
- Global partnership
- Unique international program, for a niche market

Involved partners

- University of Minho (Coordinating Institution), PT
- Czech Technical University in Prague, CZ
- Institute of Theoretical and Applied Mech., CZ
- Technical University of Catalonia, SP
- University of Padua, IT
The MSc Program: Some Numbers

- One MSc → Two locations for coursework
- Thesis locations: Portugal, Czech Republic, Spain & Italy
- Always two countries (and two legal certificates. We hope to deliver them before 6 months). One consortium certificate provided upon conclusion
- 35 students this year
- Alumni: 75% working in the field of SAHC
- Alumni: 31% in consulting offices, 20% as PhD students, 15% in higher education institutions, 13% in contractors, 9% in own practice, 6% in governmental bodies and 6% in other.
- Alumni: 50% of the students start working immediately after concluding the program; 26% find a job in the 3 months after concluding the program; 9% in the subsequent 6 months; 14% take more than 6 months
**Students Gender and Origin**

**Male %**

![Male Percentage Chart]

**European %**

![European Percentage Chart]

**Students Age**

![Students Age Chart]
Students Origin (59 countries)

Students Top Countries

Advanced Masters in Structural Analysis of Monuments and Historical Constructions
The Course Path

- No changes in mobility allowed
- You need to arrive to your 2nd location by the first week of April. Welcome week in 2nd institution starts on April (check your calendar)
- If you failed one exam from the coursework, a 2nd chance is given by the end of March
- If needed, you should be handling your Visa to the 2nd country very soon. Check locally or with the Secretariat. It will take time and will probably require a visit to the consulate

The MSc Program: What to expect

- You will have lecturers from all partners (½ of courses by local partner and ½ by international team). English is not yours (and ours) native language.
- MSc thesis subject to be sent to you in February. You can discuss with your possible supervisor and propose your own subject (the Management Board will try to find a supervisor and will make adjustments to the subject). We do not allow changes afterwards

- 6 Regular Units:
  - SA 1: History of Construction and of Conservation / SA 2: Structural Analysis Techniques
  - SA 3: Seismic Behavior and Structural Dynamics / SA 4: Inspection and Diagnosis
  - SA 5: Repairing and Strengthening Techniques / SA 6: Restoration and Conservation of Mat.
  - SA 7: Integrated Project (Examples on the webpage)
  - SA 8: Thesis (Examples on the webpage)

- Modular structure. It is (very) intensive (and stressing) and it is much about group work, presentations, hands-on and project led education!
The 2nd Institution

- If you have questions, do not be afraid to ask to the Secretariat or to me.
- You should complete the thesis in 4 months and defend publicly the work in front of a committee by end July.
- Expected date for delivery of the thesis (in pdf and paper) is early July.
- The thesis will be graded as a normal course unit, taking into account your dissertation work and the public defense.
- A template is available for the text (flexible) and cover (compulsory).
- You will have to follow a “state exam” (for the CZ degree).

- Time is very limited. Plan ahead.
- Define a schedule with your supervisor asap.
- Meet your supervisor regularly.
- Try to close up things.
- **Publication ethics:** No publishing without contacting your supervisor.

Writing your dissertation (I)

- Title page using the cover template.
- Abstract giving a short overview of the work in your project.
- Table of contents giving page numbers for all major section headings.
- Introductory Chapter:
  - Motivation for the work: why this work has been done, what is the problem that is being solved; what your work does that is new or is better than what other people have done in the same field;
  - Description of the work: what it is meant to achieve, how it is meant to function, perhaps even a functional specification.
- Main Body:
  - Literature Review / State-of-the-Art
  - E.g. Materials and Methods, Theory, Results and Discussion: The work you have done.
Writing your dissertation (II)

- Conclusions and Further work: very brief
  - What are the conclusions that you have obtained
  - What is necessary to do next and possible directions to better solve the problem
- References: a list of books and other publications that are explicitly referred to in the text
- Appendices: Supplementary material should be included in appendices - these are optional, but might contain:
  - Code listing of code you have written.
  - User manuals
  - Technical documentation
  - Raw experimental data
  - Similar or repetitive graphs / tables

Writing your dissertation (III)

- Number all pages. Add a header or footer with author’s name and title dissertation (possibly chapters)
- Always use automatic numbering of Tables, Figures, Equations and Headings
- Always use automatic cross-reference of the above
- All Tables and Figures are to be cited in text (“to be read”)

- Prepare reference list in accordance with the CMS or APA styles (next slide).
- Option 1: Cite references in the text by author and date (Smith, 1983) and place references in the end of the dissertation sorted by author’s family name.
- Option 2: Cite references in the text by number [1] and place references in the end of the dissertation sequentially. Use automatic numbering and automatic cross-reference.
Writing your dissertation (IV)

- Examples CMS:

- Examples APA:

Writing your dissertation (V)

- Dissertation size: Aim at 20,000 words (80 pages ± 20)
  - The reason for this is to stop the presentation of unstructured and verbose dissertations which are generally repetitive. If you can present all your work clearly in 5,000 words or less then that is fine. However, think carefully about the examiners who have never met you and might not know the application area you are describing. Poor dissertations are generally notable for what is omitted rather than what has been included.

- Copying - quoting or plagiarism:
  - Absolutely not allowable is copying of text or other material from any source at all and passing it off as your own work. This is called plagiarism and will result in you being awarded zero marks, and may result in expulsion from the University.
  - A very small amount of text might be included, but you must indicate it very clearly, with the reference, and you must delimit it with quotation marks.
  - By copyright it is illegal to duplicate substantial amounts of text (with or without indication), code, images, etc. unless you have explicit permission of the copyright owner.
  - Staff can usually easily detect copied work and there are automatic tools for that (even in Blackboard). Plagiarism is ILLEGAL, as it preaches copyright, and is CHEATING, as it breaches University regulations.
References

- Eco, U., Como se hace una tesis / How to create a thesis, Gedisa Editorial, 2001
- Philips, E.M., Pugh, D. S. How to get a PhD. A handbook for students and their supervisors, Open University Press, 2005
- Davis, G., Parker, C.A., Writing the doctoral dissertation, Barron’s, 1997

The Integration Week

- Objective #1 is integration 😊
- Objective #2 is soft skills (Soft Skills & Emotional Intelligence / EQ vs. Hard Skills & IQ)
  Wikipedia: A sociological term relating to a person's EQ, the cluster of personality traits, social graces, communication, language, personal habits, friendliness, and optimism that characterize relationships with other people. Soft skills complement hard skills (part of a person's IQ), which are the occupational requirements of a job and many other activities. Soft skills are personal attributes that enhance an individual's interactions, job performance and career prospects. Unlike hard skills, which are about a person's skill set and ability to perform a certain type of task or activity, soft skills relate to a person's ability to interact effectively with coworkers and customers and are broadly applicable both in and outside the workplace.