FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

FORUM ON EDUCATION

EFCE FORUM 2013 - EDUCATION
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OUTLINE

- **Educational goals and needs in a global world**
- **Structure of Education in Europe, post-Bologna**
- **The substance of chemical engineering education for the world**
- **Tools in the information age, in the era of communications**
- **A final thought – third paradigm of chemical engineering education, is it so?**

LIFE TODAY
A MIX OF CHALLENGES, THREATS AND OPPORTUNITIES

- **The computer and communications era - dramatic changes of the concepts of time and space - globalisation**
- **The global market economy - driving today's Societies**
  - **Sharp increase in standards and competition Worldwide**
  - **Volatility of jobs**
  - **Job market and opportunities - wider than ever**
- **The increase of Expectation of Life vs. Social sustainability – work longer years**
- **The decrease of knowledge half-time – back to School**
- **Significant change in the concepts of individual career management, mainly for Young People**

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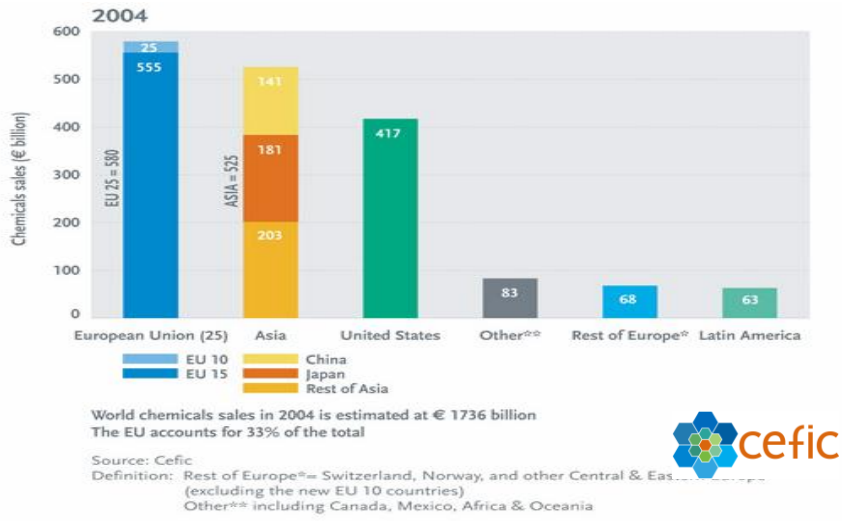
LIFE TODAY - PRODUCTION MOVES EAST
GEOGRAPHIC BREAKDOWN OF WORLD CHEMICALS SALES - 2004



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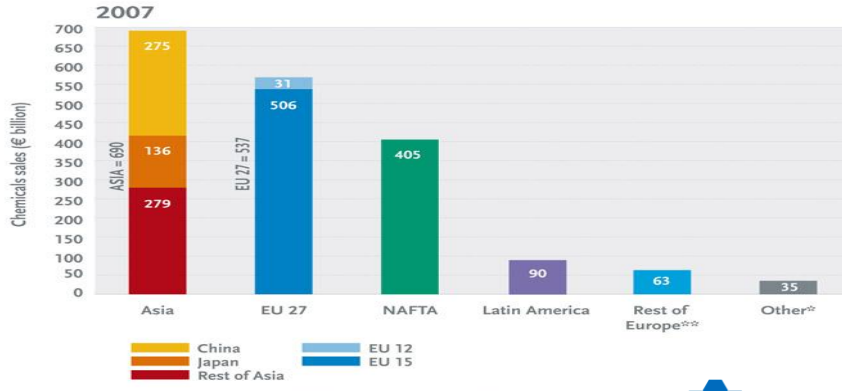
LIFE TODAY - PRODUCTION MOVES EAST
GEOGRAPHIC BREAKDOWN OF WORLD CHEMICALS SALES - 2007

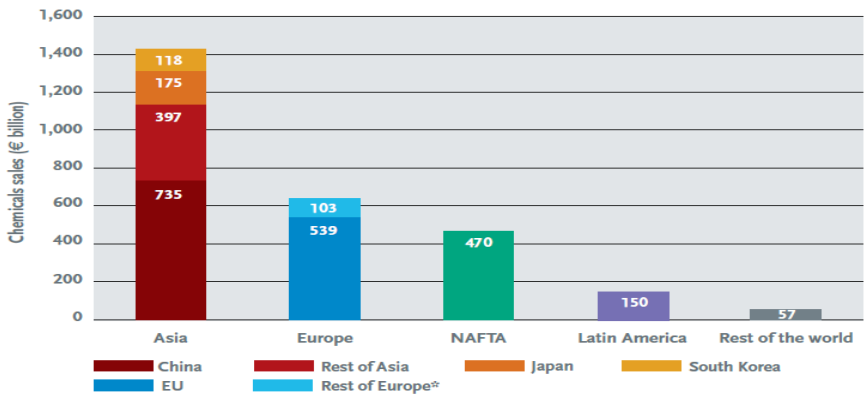
Chart 1.1: Geographic breakdown of world chemicals sales



World chemicals sales in 2007 are valued at € 1820 billion
The EU accounts for 29,5% of the total

Source: Cefic Chemdata International
Other* = Oceania and Africa
Rest of Europe** = Switzerland, Norway and other Central & Eastern Europe
(excluding the new EU 12 countries)

LIFE TODAY - PRODUCTION MOVES EAST
GEOGRAPHIC BREAKDOWN OF WORLD CHEMICALS SALES - 2011



World chemicals sales in 2011 are valued at €2744 billion. The European Union accounts for 19.6% of the total.

Source: Cefic Chemdata International
* Rest of Europe – Switzerland, Norway and other Central & Eastern Europe
(excluding the new EU-12 countries)

Unless specified, chemicals industry excludes pharmaceuticals
Unless specified, EU refers to EU-27

LIFE TODAY
ESSENTIAL INSTRUMENTS AND POLICIES FOR THE FUTURE

- **A global World living in and with a new paradigm of coexistence**
  - ✓ **COOPETITION = COOPERATION + COMPETITION**
- **That requires**
  - **New management and transnational cooperation policies**
  - **A new cultural paradigm of Education - Lifelong Learning**
  - **Mobility of students and professionals**
- **Which in turn requires**
  - **Policies and Instruments for recognition of academic and professional qualifications**
  - **POLITICAL WILL**

EDUCATIONAL NEEDS IN A GLOBAL WORLD

- **Universities should widen the students' "scope of thinking"... to the dimension of the Earth... and beyond...**
- **The need to understand other cultures and backgrounds**
- **Namely in large global companies, the need to think global – 24/7 – when Asia goes to sleep we start our work, when we go to sleep America start their work**
- **The need to promote mobility and cooperation, by promoting TRUST**
  - **Develop comparable qualifications frameworks**
  - **Apply quality assurance procedures that are recognised and accepted by all stakeholders**

NEW PROGRAMMES IN CHEMICAL ENGINEERING EDUCATION

- **Revisit and modernize the programme**
  - **Bring in new topics – raise the awareness of new topics**
  - **Incorporate new Knowledge, Competences and Skills**
- **Bring in new methods for learning – adapted to the available tools and to the cultural evolution of society**
- **Develop within the institution an International Dimension (not only European) and Culture of Quality through mobility and academic cooperation and interchange**
  - **Prepare programmes for cooperation – Joint Degrees**
- **Prepare programmes to attract new publics – Lifelong Learning**

NEW PROGRAMMES IN CHEMICAL ENGINEERING EDUCATION DESCRIPTORS AT PROGRAMME LEVEL

- **Recommendations of the WPE-EFCE**
  - ✓ **WPE-EFCE – Working Party on Education – European Federation of Chemical Engineering**
  - ✓ **Developed between 2003 and 2010 an exercise of identification of core learning outcomes and curriculum for chemical engineering – contents and methodologies**
  - ✓ **Adapted to the engineering sectoral qualifications Framework – EUR-ACE**
- **See EFCE Site and Bologna Recommendations (2010) at**

  http://www.efce.info/wpe.html

  http://www.efce.info/Bologna_Recommendation.html

NEW DIRECTIONS FOR CHEMICAL ENGINEERING EDUCATION I – ADDRESS PROBLEMS, ANSWER DEMANDS…

- **New concerns on energy and environment problems and generally on sustainability**
- **Sharp demand for 'performance products' - specialties, food, personal care products…**
- **Functionalized materials….**
- **…….**
- **Process and product development times came down sharply (3 to 5 fold) - risk management…**
- **Technological and scientific developments - new paradigms on Unit Operations open for discussion - micro-systems, process intensification…**
- **…….**

NEW DIRECTIONS FOR CHEMICAL ENGINEERING EDUCATION II– INCORPORATE NEW KNOWLEDGE, COMPETENCES AND SKILLS

- **Programmes are of course directed to raise scientific and technical knowledge – fundamentals should never be put aside**

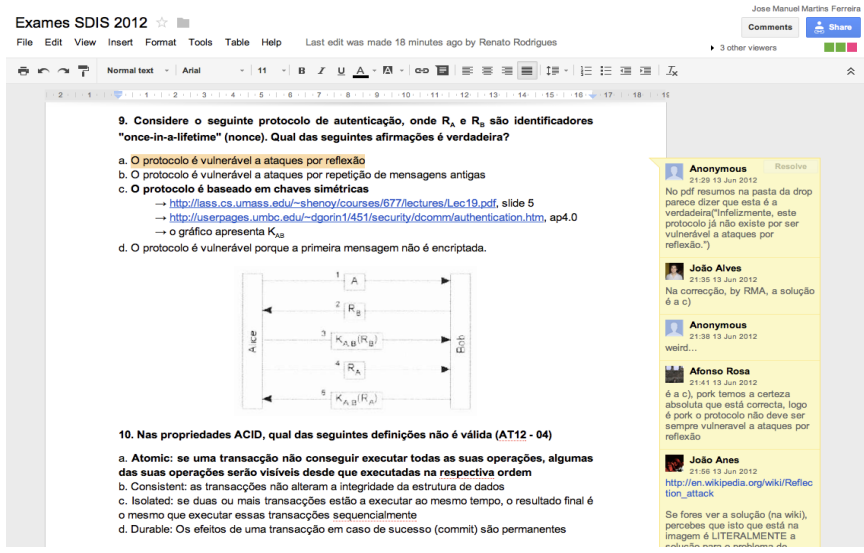
BUT

- **Must bring in the development of attitude, skills and competences valued by Industry and Society in general**
  - **Skills and competences for innovation and entrepreneurship**
  - **Job related skills**
    - ✓ **Teamwork, Communication, Leadership**
  - **Competencies (How tasks are done)**
    - ✓ **Holistic thinking, self-management, achievement of objectives..**

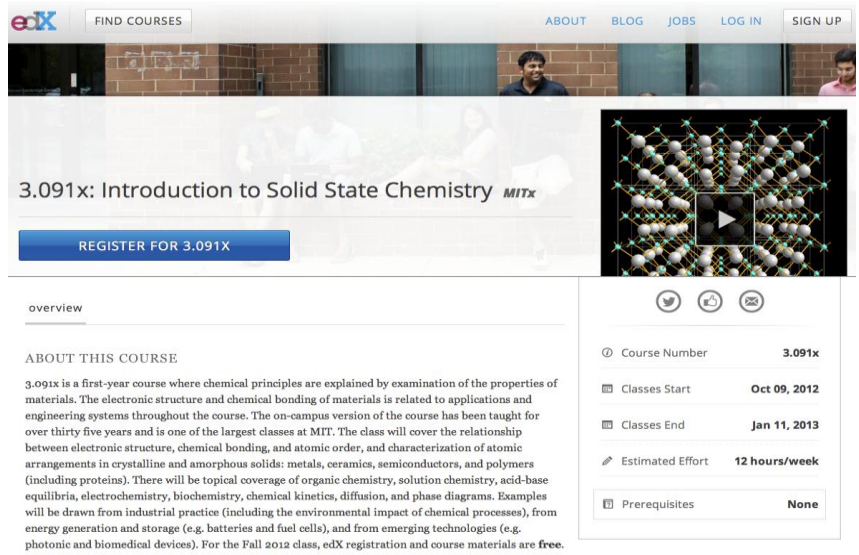
TOOLS IN THE INFORMATION AGE, IN THE ERA OF COMMUNICATIONS

- **The 'good old days of Moodle' ?**
  - **Moodle is indeed and essentially a digital repository system with some capacity for interchange**
- **Google Apps for education?**
  - **Google Apps are indeed tools for collaborative study and learning**
  - **A growing number of universities are going 'Google Apps'**
- **MOOCs – Massive Open Online Courses – Coursera, EdX…**
  - **Tools and means for learning through cooperative learning**
  - **They challenge the educational model… the concept /paradigm of 'constant time- variable learning'**
  - **Indeed platforms for education without boundaries – a political issue**

TECHNOLOGIES X TRANSFORMATIVE LEARNING: VIA TOOLS (E.G. GOOGLE APPS)



TECHNOLOGIES X TRANSFORMATIVE LEARNING: VIA CONTENTS (E.G. MOOCS)



AT THE END OF THE DAY... A PARADIGM SHIFT IN CHEMICAL ENGINEERING EDUCATION?

- **1st Paradigm(s)**
  - **In general terms - First quarter of the XX Century - Education close to industrial operations - Unit Operations**
- **2nd Paradigm(s)**
  - **In general terms – Third quarter of the XX Century – Education shift to Engineering Science**
- **3rd Paradigm ? ? ?**
  - **We are possibly at present on the process of developing a model and of conceptualizing the evolution for a new paradigm... which is not yet quite identified...**

INSPIRING WORDS ABOUT CHEMICAL ENGINEERING EDUCATION
WE SHOULD NOT FORGET THE SINE WAVE OF LIFE…

- **The words of A.B. Newman, President AIChE, 1938**

  'Theoretical descriptions should be limited to illustrate the engineering fundamentals, because a manager does not hire a young engineer just because he is able to describe how a product is produced'.

- **Words of Ralph Landau, Stanford University, 1997*:**

  'I believe chemical engineering's third paradigm, if there is one, is to return the discipline closer to the practices in industry'

* **Landau, R. (1997), "Education: Moving from Chemistry to Chemical Engineering and Beyond," Chemical Engineering Progress, AIChE, pp. 52-65**