

Engineering Education within the Building of the European Higher Education Area

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OUTLINE

Concepts and models of Today, concerning Engineering Education

- ① **Life Today – Changes in Society – The Young Generation, the ‘Millenials’**
- ② **TRUST, cooperation and mobility in the EHEA - European Higher Education Area**
 - ② **The concept of a three-layer Qualifications Frameworks for engineering education**
- ③ **Directions for Engineering Education**
 - ③ **‘Education/Learning without boundaries and without walls’ - tools in the information age, in the era of communications**

LIFE TODAY - GLOBALISATION
A MIX OF CHALLENGES, THREATS AND OPPORTUNITIES (I)

- ☞ **Major political changes in the World, the Fall of the Berlin Wall, on 9 November 1989**
- ☞ **Disruptive Advances in Science and Technology, by the end of the XX Century**
 - **The Computer and Communications era - dramatic changes of the concepts of time and space**
 - **Advances in Life Sciences - The increase of Expectation of Life**
- ☞ **Expectation of Life vs. Social sustainability – work longer years**
- ☞ **The decrease of knowledge half-time – Study longer years**
- ☞ **For all these reasons – Lifelong Learning , a requirement for development**

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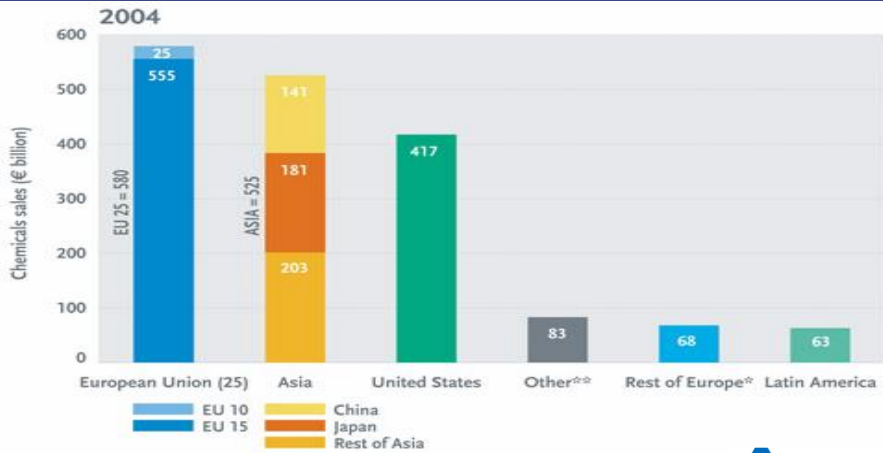
LIFE TODAY - GLOBALISATION
A MIX OF CHALLENGES, THREATS AND OPPORTUNITIES (II)

- ☞ **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**
- ☞ **Very significant changes in the concept of individual career management, mainly for Young People**
- ☞ **Very significant changes in the concepts of education**
- ☞ **An evolution that we have to understand and support, mainly by adapting the STRUCTURE AND THE SUBSTANCE OF THE OFFER OF EDUCATION**

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



World chemicals sales in 2004 is estimated at € 1736 billion
The EU accounts for 33% of the total



Source: Cefic

Definition: Rest of Europe* = Switzerland, Norway, and other Central & Eastern Europe (excluding the new EU 10 countries)

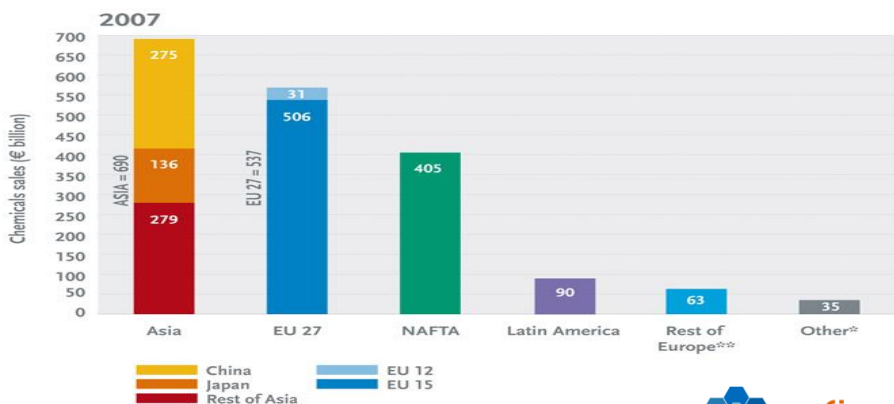
Other** including Canada, Mexico, Africa & Oceania

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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

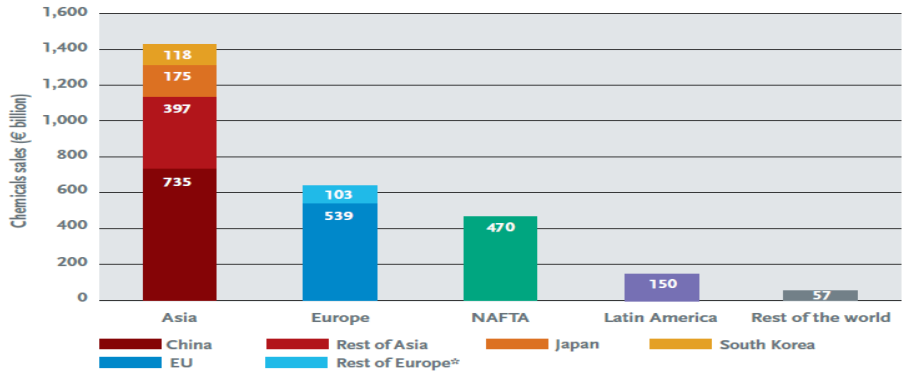
Rest of Europe** = Switzerland, Norway and other Central & Eastern Europe (excluding the new EU 12 countries)

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LIFE TODAY - PRODUCTION MOVES EAST

GEOGRAPHIC BREAKDOWN OF WORLD CHEMICALS SALES - 2011



World chemicals sales in 2011 are valued at €274.4 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



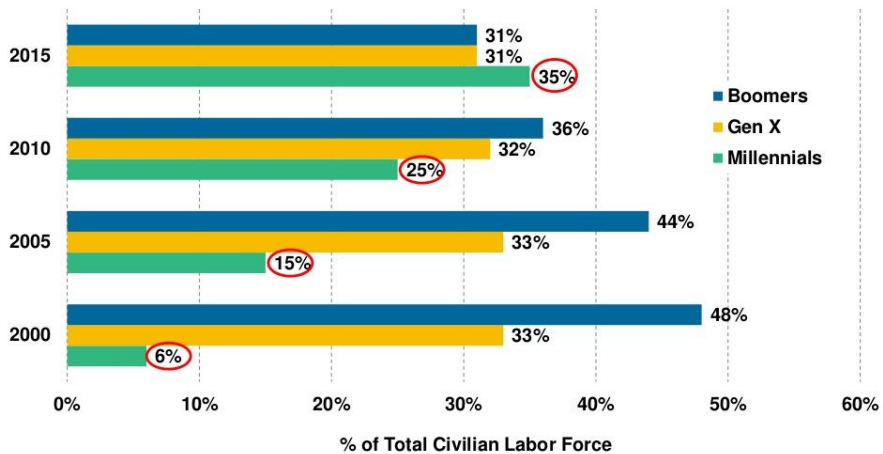
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LIFE TODAY - PEOPLE

THE MILLENNIAL GENERATION, MAJORITY IN 2015

Civilian Labor Force by Generation, USA, 2000 – 2015



Source - Mary Meeker (KPCB), *Internet Trends 2015*
 (Code conference: <http://goo.gl/gjWrtG>)

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LIFE TODAY - PEOPLE

EDUCATIONAL NEEDS FOR THE GENERATIONS OF THE FUTURE

- ☞ **Today, as in the past, the issue is to train and widen the scope of thinking of young people**
- ☞ **BUT, just some major differences from the past and a major difference for the future are that ‘millennials’:**
 - **will live longer**
 - **will work longer**
 - **will have to study longer**
 - **more and more will have to work away from the original home**
 - **indeed will have to think global, just to the dimension of Earth (... or even beyond...)...**

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LIFE TODAY

CHANGING PARADIGMS

- ☞ **A global World living in and with a new paradigm of coexistence**
 - ✓ **COOPETITION = COOPERATION + COMPETITION**
- ☞ **THE NEED to understand other cultures and backgrounds**
- ☞ **THE NEED to think global, namely in large global companies, – 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**

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LIFE TODAY
ESSENTIAL INSTRUMENTS AND POLICIES FOR THE FUTURE

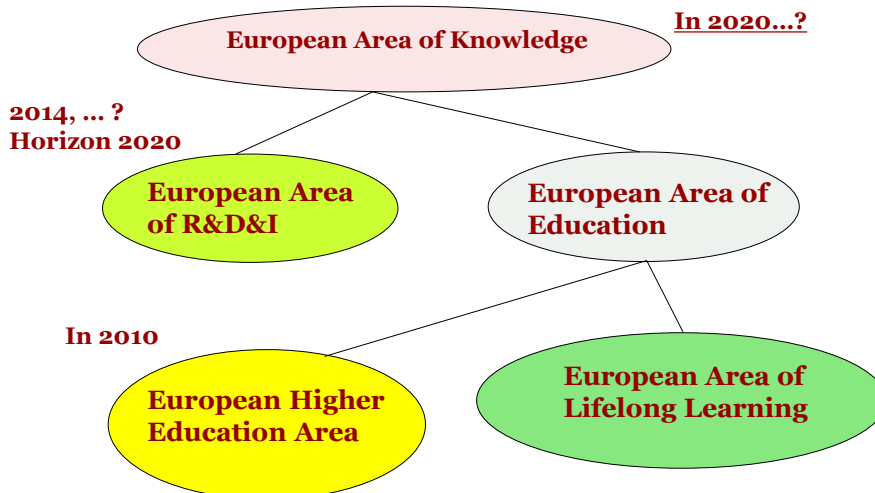
☞ **SO, WE NEED**

- **New management and transnational cooperation policies**
- **A new cultural paradigm of Education - Lifelong Learning**
- **To promote Mobility of students and professionals**

☞ **Which in turn requires**

- **Policies and Instruments for recognition of academic and professional qualifications**
- **POLITICAL VISION AND WILL**

AND, HOW DID EUROPE REACT TO THIS CHALLENGE?
THE EUROPEAN AREA OF... KNOWLEDGE...
LAUNCHED ON 11-12 MARCH 2010, IN BUDAPEST-VIENNA –
STILL UNDER CONSTRUCTION... TILL 2020...



FROM BOLOGNA (1999) TO YEREVAN (2015)... AND BEYOND CHARACTERIZING THE PROCESS TODAY

- ☞ **Policy areas**
 - **Including great concern with the challenge of ‘Education without Boundaries’.. . Which is already massively with us!!!**

- ☞ **The Structure - organization issues**

- ☞ **The Substance – academic issues**

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FROM BOLOGNA TO YEREVAN ... AND BEYOND THE STRUCTURE - ACTION LINES AND INSTRUMENTS FOR ACTION

- ✓ **Degree Structure –**
 - **Based on recognised QUALIFICATIONS FRAMEWORKS**

- ✓ **A System to measure work and OUTCOMES**
 - **The ECTS credit and accumulation system, reviewed in 2015**

- ✓ **A way of documenting qualifications**
 - **The DIPLOMA SUPPLEMENT**

- ✓ **A System to guarantee transparency, reviewed in 2015**
 - **Building accepted QUALITY ASSURANCE procedures**

- ✓ **A System for recognition of qualifications**
 - **OVERCOMING DIFFICULTIES posed by the diversity of ‘recognition cultures’**

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FROM BOLOGNA TO YEREVAN... AND BEYOND THE SUBSTANCE - THE LATECOMER IN THE BOLOGNA PROCESS...

- **Changes in slow progress...**
 - **New contents... closer to more immediate Societal concerns**
 - **New programme structures, linked to a concept of lifelong Learning**
 - **New Methods – change from**
 - ✓ **Teacher-Centred to Student-Centred methodologies**
 - ✓ **Teaching based on Teacher Inputs to Learning Centred in well defined objectives – Learning Outcomes**
 - ✓ **Digital repository support systems to Digital Collaborative and Cooperative Systems**
- **New tools for distance and cooperative learning**
- **The third wave – Pedagogical qualification of ‘Faculty’**

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QUALIFICATIONS FRAMEWORKS - A THREE LAYER VISION I – META FRAMEWORKS: QF-EHEA AND EQF-LL

- **High level descriptors – Meta Frameworks**
 - **Characterized at institutional level of governments and stakeholders**
 - **They represent the ‘legal crust’ and the basis for National Qualifications Frameworks**
- ① **The QF-EHEA – Framework for Qualifications of the European Higher Education Area**
 - **Launched in 2005, within the Bologna Process, with 3 main cycles**
- ② **The EQF-LL – European Qualifications Framework for Lifelong Learning**
 - **A vertical framework, with 8 levels, from basic secondary to higher education, approved at EU level on April 23, 2008**
 - **Establishes a link of compatibility with the Framework for Qualifications of the European Higher Education Area**

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QUALIFICATIONS FRAMEWORKS - A THREE LAYER VISION II –SECTORAL FRAMEWORKS (I)

- ☞ **Relevance of Sectoral and/or Curriculum Frameworks - taken from the Leuven/Louvain-la-Neuve Communiqué of Ministers, on 29 April 2009**

“... ”

Curricular reform will thus be an ongoing process leading to high quality, flexible and more individually tailored education paths.

Academics, in close cooperation with student and employer representatives, will continue to develop learning outcomes and international reference points for a growing number of subject areas

... ”

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QUALIFICATIONS FRAMEWORKS - A THREE LAYER VISION II –SECTORAL FRAMEWORKS (II)

- **Sectoral Frameworks develop sectoral descriptors**
- **By area and specialty**
 - **In close cooperation with higher education institutions and professional associations**
 - **In transnational cooperation**
 - **They represent Bologna in practice**
- ① **A few Sectoral Frameworks proposals for Engineering Education**
- ② **The EUR-ACE Framework and Accreditation System**
- **The European System for Qualification of Engineering Education programmes**

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EUR-ACE DEVELOPMENT AND IMPLEMENTATION

- ☞ EUR-ACE, a consortium of 14 European partners, Academic and Professional Associations and Academic Institutions, started with the support of 2 EU SOCRATES and TEMPUS projects
- ☞ The EUR-ACE project has led to the creation in 8 February 2006 of an European Association
 - ✓ **The ENAEE – European Network for Accreditation of Engineering Education – www.enaee.eu**
 - **Today with 17 full members and 5 associate members**
- ☞ The ENAEE is responsible for maintaining and awarding the EUR-ACE label

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QUALIFICATIONS FRAMEWORKS - A THREE LAYER VISION III – DESCRIPTORS AT BRANCH LEVEL

- ☞ **Sectoral Frameworks should be complemented by descriptors at branch level**
 - **Typically developed in Education Working parties and Academic Consortia, at European Level, or within regulatory bodies at national level**
 - **They are the basis for credibility of the whole system**
- ☞ **This concept is largely employed informally, but has not yet received formal recognition**
 - **CORE branch level descriptors are most relevant, BUT:**
 - ✓ **We still have to overcome concerns about the possibility of falling into a too prescriptive path that might damage ‘autonomy, diversity and innovation’....**

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DESCRIPTORS AT BRANCH/PROGRAMME LEVEL THE CASE STUDY OF CHEMICAL ENGINEERING (I)

- ☞ **The Recommendations of the WPE-EFCE – Working Party on Education – European Federation of Chemical Engineering (2005, 2010)**
- ☞ **The VDI-GVC Recommendation for Chemical and Processing Engineering (2008)**
- ☞ **The CHEMEPASS Project (2006-2009) – that aimed at identifying relevant general and specific Learning Outcomes for Chemical Engineering Programmes**

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DESCRIPTORS AT BRANCH/PROGRAMME LEVEL THE CASE STUDY OF CHEMICAL ENGINEERING (II)

RECOMMENDATIONS OF THE WPE-EFCE (II)

- ☞ **These recommendations cover**
 - **Learning outcomes**
 - ✓ **Adopting the EUR-ACE Framework Standards for Accreditation of Engineering Education**
 - **Achieving the learning outcomes**
 - ✓ **Core curriculum, leaving large room for diversity**
 - ✓ **Teaching and learning**
 - ✓ **Industrial experience**
 - ✓ **Review of the educational process**
 - ✓ **Student assessment**

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NEW DIRECTIONS FOR ENGINEERING EDUCATION GENERAL GUIDELINES ON HOW TO PROCEED (I)

- ☞ **Revisit and modernize the programme**
 - **Bring in new topics – raise the awareness of new topics**
 - **Incorporate new Knowledge, Skills and Competences**
- ☞ **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**

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NEW DIRECTIONS FOR ENGINEERING EDUCATION GENERAL GUIDELINES ON HOW TO PROCEED (II)

- ☞ **Make recognition of qualifications easy**
 - **Re-design curricula with reference to agreed recommendations or descriptors of learning outcomes at high level, sectoral level and branch level**
 - **Perform internal quality assurance exercises, following agreed guidelines**
 - **Submit the programme to recognized external quality assurance agencies**

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NEW DIRECTIONS FOR ENGINEERING EDUCATION INCORPORATE NEW KNOWLEDGE, COMPETENCES AND SKILLS

- ☞ **Programmes are of course directed to raise scientific and technical knowledge – fundamentals should represent the core**

BUT

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

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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 (or equivalent tools...) 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**

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

Exames SDIS 2012 ☆

File Edit View Insert Format Tools Table Help Last edit was made 18 minutes ago by Renato Rodrigues

Jose Manuel Martins Ferreira

Comments 3 other viewers

Normal text Arial 11

2 1 1 1 2 1 3 1 4 1 5 1 6 1 7 1 8 1 9 1 10 1 11 1 12 1 13 1 14 1 15 1 16 1 17 1 18 1 19

9. Considere o seguinte protocolo de autenticação, onde R_A e R_B são identificadores "once-in-a-lifetime" (nonce). Qual das seguintes afirmações é verdadeira?

- O protocolo é vulnerável a ataques por reflexão
- O protocolo é vulnerável a ataques por repetição de mensagens antigas
- O protocolo é baseado em chaves simétricas
 - <http://ass.cs.umass.edu/~shenoy/courses/677/lectures/Lec19.pdf>, slide 5
 - <http://userpages.umbc.edu/~dgorin/1451/security/dcomm/authentication.htm>, ap4.0
 - o gráfico apresenta K_{AB}
- O protocolo é vulnerável porque a primeira mensagem não é encriptada.

10. Nas propriedades ACID, qual das seguintes definições não é válida (AT12 - 04)

- Atomic: se uma transacção não conseguir executar todas as suas operações, algumas das suas operações serão visíveis desde que executadas na respectiva ordem
- Consistent: as transacções não alteram a integridade da estrutura de dados
- Isolated: se duas ou mais transacções estão a executar ao mesmo tempo, o resultado final é o mesmo que executar essas transacções sequencialmente
- Durable: Os efeitos de uma transacção em caso de sucesso (commit) são permanentes

Anonymous 21:29 13 Jun 2012
No pdf resumos na pasta da drop parece dizer que esta é a verdadeira: "Infelizmente, este protocolo já não existe por ser vulnerável a ataques por reflexão."

João Alves 21:35 13 Jun 2012
Na correção, by RMA, a solução é a c)

Anonymous 21:38 13 Jun 2012
weird...

Afonso Rosa 21:41 13 Jun 2012
é a c), porq' temos a certeza absoluta que está correcta, logo é porq' o protocolo não deve ser sempre vulneravel a ataques por reflexão

João Anes 21:56 13 Jun 2012
http://en.wikipedia.org/wiki/Reflection_attack
Se fores ver a solução (na wiki), percebes que isto que está na imagem é LITERALMENTE a solução para a resolução da

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TECHNOLOGIES & TRANSFORMATIVE LEARNING: VIA CONTENTS (E.G. MOOCs)

edX FIND COURSES ABOUT BLOG JOBS LOG IN SIGN UP

3.091x: Introduction to Solid State Chemistry MITx

REGISTER FOR 3.091X

overview

ABOUT THIS COURSE

3.091x is a first-year course where chemical principles are explained by examination of the properties of materials. The electronic structure and chemical bonding of materials is related to applications and engineering systems throughout the course. The on-campus version of the course has been taught for over thirty five years and is one of the largest classes at MIT. The class will cover the relationship between electronic structure, chemical bonding, and atomic order, and characterization of atomic arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers (including proteins). There will be topical coverage of organic chemistry, solution chemistry, acid-base equilibria, electrochemistry, biochemistry, chemical kinetics, diffusion, and phase diagrams. Examples will be drawn from industrial practice (including the environmental impact of chemical processes), from energy generation and storage (e.g. batteries and fuel cells), and from emerging technologies (e.g. photonic and biomedical devices). For the Fall 2012 class, edX registration and course materials are free.

Course Number 3.091x

Classes Start Oct 09, 2012

Classes End Jan 11, 2013

Estimated Effort 12 hours/week

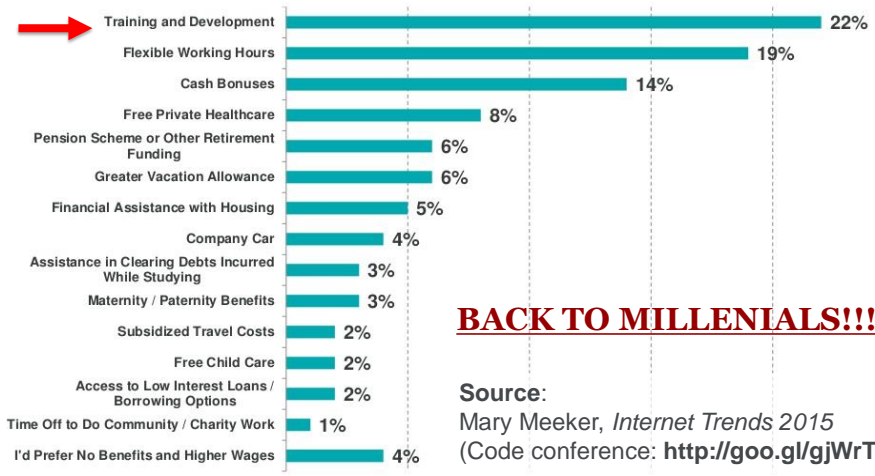
Prerequisites None

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Millennials' Most Valued Work Benefits =
 1) Training & Development 2) Flexible Hours 3) Cash Bonuses

Which Three Benefits Would You Most Value From an Employer?
 % Ranking Each 1st Place, Global



BACK TO MILLENIALS!!!

Source:
 Mary Meeker, *Internet Trends 2015*
 (Code conference: <http://goo.gl/gjWrTG>)

@KPCB Source: "Millennials at Work: Reshaping the Workplace," by PWC, 2011, Global. Survey of 4,364 graduates across 75 countries. All respondents were aged 31 or under and had graduated between 2008 and 2011. Millennials defined as those born between 1980 and 2000. In 2015, they are ages 15-35. 110

**Training & Development
 People >> Companies >> Technologies**

- Mobile, on-demand
- Scalable and collaborative
- Flexible, easy to use
- Cost effective
- Rich, multimedia experience
- Skill-based, practical and engaging



- Promote employee engagement
- Enable anyone, anywhere to create content
- Allow training to be tailored to organizations
- Enhance relevance of learning content

Source:
 Dennis Yang & Dan Chou, *Revolutionizing Corporate Workplace Training with MOOCs*, 2014
 (<http://goo.gl/Imql9a>)

TAKE HOME...

WHERE DO WE HEAD TO IN ENGINEERING EDUCATION?

- ☞ **1st Paradigm(s) - First quarter of the XX Century - Education close to industrial operations**
- ☞ **2nd Paradigm(s) - Third quarter of the XX Century – Education shift to Engineering Science - a priori design**
- ☞ **3rd Paradigm ???**
 - **We are at present on the process of developing a model and of conceptualizing the evolution for a new paradigm... which is not yet quite identified...**
 - **The challenge is to understand and anticipate the evolution of the World and the motivations of the young generations**

YET, it seems that Engineering Education is moving in the direction of returning closer to the practices of Industry proving that Life to a large extent evolves as a sine wave.....