Looking at the Future of Industrial Engineering and Management in Europe: The Role of the European Academy for Industrial Management

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http://www.europe-aim.eu/
1. Context Analysis: The European Challenges
2. A Preliminary Survey on IE Competence in EU
3. Improving IE Competence
4. The Role of the European Academy for Industrial Management
5. Conclusions
Industrial Challenges

Key-Enabling Technologies:
- Materials & Manufacturing
- ICT-based Services

Image of Manufacturing
Holistic approach in R&D and industry transformation
Sustainability Issues
Innovation and Project Financing
Teaching Factory
University / Industry Education

Societal Challenges

Healthy Aging Society
- Workforce Aging
- Health-care Systems

Sustainable Urban Development
- Future Energy networks
- Urban and Industrial Symbiosis
- Global Security

with impacts on
Grand Challenges of the EU 2020 Strategy:

- Economic Growth and Jobs' Creation
- Energy and Climate Change
- "Well-being' and Social Welfare
A KETs-based product is (*): 

(a) an enabling product for the development of goods and services enhancing their overall commercial and social value; 
(b) induced by constituent parts that are based on nanotechnology, micro / nano electronics, industrial biotechnology, advanced materials and/or photonics; 
(c) produced by (but not limited to) advanced manufacturing technologies.

(*) European Commission, June, 2012
• Nanotechnology: 160,000 workers (+ 25% from 2000)

• Micro / nano – electronics: 700,000 additional jobs during the last decade in Europe (more service-oriented and highly skilled jobs)

• SMEs are a key driver of innovation: in the photonics sector 5,000 European companies are SMEs; in Germany, about 80% of the nanotechnology companies are small or medium sized.

Job Creation by KETs in EU
## Global Market Potentials of KETs

<table>
<thead>
<tr>
<th>KET</th>
<th>Current market size (bn USD)</th>
<th>Expected size (2012 / 15 - bn USD)</th>
<th>Expected Annual growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanotechnology</td>
<td>12</td>
<td>27</td>
<td>16</td>
</tr>
<tr>
<td>Micro and nanoelectronics</td>
<td>250</td>
<td>300</td>
<td>13</td>
</tr>
<tr>
<td>Industrial Biotechnology</td>
<td>90</td>
<td>125</td>
<td>6</td>
</tr>
<tr>
<td>Photonics</td>
<td>230</td>
<td>480</td>
<td>8</td>
</tr>
<tr>
<td>Advanced Materials</td>
<td>100</td>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>Adv. Manufacturing Systems</td>
<td>150</td>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>832</strong></td>
<td><strong>1282</strong></td>
<td></td>
</tr>
</tbody>
</table>

(from HLG KET Working Document, 2011)

Knowledge Generation is in EU but ...

Knowledge Exploitation is outside EU!
Industrial Challenges

Causes limiting KETs Exploitation

i. Lacking of a common EU industrial policy

ii. High Investments

iii. Shortage of skill and competences

Integration of the Value Chain

Public-Private Partnerships Coord. of Public Resources

University – Industry (dual) Education

Industrial Engineering could contribute in overcoming all limits!
Industrial Challenges

- Image of Manufacturing
- Holistic approach in R&D and industry transformation
- Sustainability Issues
- Innovation and Project Fin.
- Teaching Factory
- University / Industry Education

(*) Survey on 23 National Technological Platforms of ManuFuture
Societal Challenges

Ethic Commitments and Opportunity of Growth

*Healthyly Aging Society*
- Workforce Aging
- Health-care Systems

*Sustainable Urban Development*
- Future Energy Networks
- Urban and Industrial Symbiosis
- Global Security

*Industrial Engineering could play a central role to tackle Societal Challenges!*
Societal Challenges

Population Aging in the EU

<table>
<thead>
<tr>
<th></th>
<th>Nowadays</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MLE [years]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>75.7</td>
<td>84.5</td>
</tr>
<tr>
<td>Female</td>
<td>82.1</td>
<td>89.0</td>
</tr>
<tr>
<td><strong>ODR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>25.40%</td>
<td>53.50%</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MLE: Mean Life Expectancy

ODR: Old age Dependency Ratio

ODR = \( \frac{\text{people} \geq 65 \text{ years}}{\text{people} 15\div 64 \text{ years}} \)

- IE for Health-care Systems:
  - Analyzing Hospital Processes
  - Drug Logistics
  - De-Hospitalization Process
  - Remote Control and Diagnosis of Patients by IoTs
  - Long care assistance for aged and disabled people
  - ...

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XIX ICIEOM, Valladolid 10-12
July 2013
Work Force Aging in the EU

IE new models for aged workers:
• WTM for Aged Workers
• Job Rotation Policy
• OR & Ergonomics

New Ergonomic Standards
(in the view of Workforce Aging)

The ‘2007’ vs. ‘2017’ distributions of workers’ age at the BMW plant in Dingolfing (G)
Societal Challenges

**Sustainable Urban Development**  
Future Energy Networks  
Urban and Industrial Symbiosis  
Global Security

World market of clean production technologies is expected to grow:

From 380 bn euro (2007 estimate) 765 bn euro (2020 estimate)  
(EU Commission, 2012)
Future Energy Networks

- Todays’ energy infrastructures are approaching their expected life.
- Over 60 % of energy demand is concentrated in Cities (*).
- Around 75 % of EU population lives in urban areas responsible for 80 % of energy consumptions and global warming gas emissions (**).

(**) Antonio Tajani, vice-President of the European Commission, Responsible for Industry and Entrepreneurship, 2012
Input Energy Carriers:
Fossil / Renewable Energy Sources

Energy District

Energy Hub

Energy Interconnector

Output Energy Carriers

Energy Storage System
(Electrical/Thermal/Chemical/Mechanical)
Urban and Industrial Symbiosis

Eco-town program in Japan:
- 26 eco-towns
- 61 new recycling projects
- 107 new recycling facilities
- 1.65 bn euros
Global Security

- Intentional and Unintentional Events
- Industrial Sites
- Gas / Oil Pipelines
- ...
- Urban Infrastructures: ports, airports, railway stations
- Cultural Heritage Assets: Museums, churches, archeological sites,...

High demand of technology-based security systems.
The Institute of Industrial Engineers (IIE) [http://www.iienet2.org/]:
“Industrial engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems.”

IESE project (Industrial Engineering Standards in Europe) [http://www.iestandards.eu/]:
“The branch of engineering that engages in the study of how to describe, evaluate, design, modify, control and improve the performance of complex systems, viewed over time and within their relative context.”
Industrial Engineering Educational Programme (IEEP)

ILO: International Labor Organization

**Mftg System Eng.:**
- Mass - Batch – Job production / FMSs / GT
- Lean Production
- Automation
- Maintenance
- ...

**IE Fundamentals:**
- Engineering Basics: (maths, physics, statistics & prob)
- IT Basics
- Work Measurement
- Processes
- Workplace Evaluation
- Logistics
- Organization Developments

**Operations Research:**
- Modeling Techniques
- Mathematical Programming
- Algorithms
- Statistics
- ...

**Mgmt System Eng.:**
- Quality Management
- Project Management
- Mgmt Information Systems
- Contract Management
- Health & Safety Management
- Business Ethics
- Cross Cultural Management

**Human Factors Eng.:**
- Ergonomics
- Human Interface Eng.
- Behavioural Science

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- Ergonomics
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Industrial Engineering Competence vs. Industrial and Societal Challenges

Industrial Challenges:

- **Technology and Innovation**
  - Knowledge Deployment
  - Product / Process / Services Development
  - Sustainable Manufacturing

- **Educational Activities**
  - Academic & Industry Programmes
  - Teaching Factory
  - European Multi-University Collaborative Framework
  - International Education

- **Competitive Management**
  - Project Financing & Management
  - Knowledge Management
  - Production Chain Integration
  - Public-Private Partnerships

Societal Challenges:

- **Healthily Aging Society**
  - Design and Management of healthcare Systems
  - Ergonomics and Safety in the View of Workforce Aging

- **Sustainable Urban Development**
  - Renewable Energies
  - Future Energy Networks
  - Energy Storage
  - Public Utilities
  - Waste Management Systems
  - Global Security

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Vision
A Multi-University System promoted by European Academic Institutions of the EHEA and Industry to bridge the gap between IE academic competence and industry needs with the common aim of preparing skilled and creative workforce providing effective answers to major grand challenges of the EU.

Mission
• MS and PhD courses with specialty on different IE subjects
• Academic and Executive IE Curricula conceived by U & I
• Scientific Symposia and Executive Workshops
by
• Coupling Theoretical and Experiential Learning Approaches
• Sharing Educational Materials and Best Practice
• Privileging the Learning instead of the Teaching point of view
Origin and Evolution

1982: Technical Faculties of German Universities agreed on the need of updating IE competence.

1984: First nucleus of AIM consisted of 14 EU Universities: European Academy for Technical Plant Management (EHTB).

Nowadays: 47 Members from 31 Universities of 20 EU Countries.

http://www.europe-aim.eu/
Map of EU Countries (blue colored) represented in the European Academy for Industrial Management

http://www.europe-aim.eu/
Vision and Mission of AIM

Vision of AIM

AIM pursues to be the leading **European Academy developing and promoting education and research in the field of Industrial Engineering and Management (IE&M).**

As such, it endeavors to gather full professors in this field from all corners of the **European Higher Education Area (EHEA).**

IE&M education is promoted by classical and modern approaches including problem solving, case study as well as co-creative education. Active learning, instead of teaching, is the preferred point of view of AIM.

http://www.europe-aim.eu/
Mission of AIM

IE&M is concerned with the **design and management of sustainable manufacturing and service systems**. Service systems refer to both private and public sectors. Systems design integrates people, materials, information, equipment, and environmental resources into processes that generate value. IE&M also develops operational management methods to maximize process performance. Systems are investigated using both theoretical and experimental industrial engineering and operations research methods.

**AIM promotes networking both in scientific research and educational activities involving main IE&M schools in EHEA.** The Academy’s mission is aligned with the outstanding schools of engineering worldwide.

http://www.europe-aim.eu/
### IE Competence and Curricula should be more focused on:

- **Technology and Innovation**
  - Knowledge Deployment
  - Product / Process / Services Devel.
  - Sustainable Manufacturing

- **Competitive Management**
  - Project Financing & Management
  - Knowledge Management
  - Production Chain Integration
  - Public-Private Partnerships

- **Educational Activities**
  - Academic & Industry Programmes
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  - European Multi-University Collaborative Framework
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### Current Activities of The European Academy for Industrial Management (AIM)

- **Special Issue on** ‘Sustainable Manufacturing’ to be published in 4th number in 2013 of “Management and Production Engineering Review”
- 35th AIM Annual Conference on ‘Advances in Sustainable Production’, Split, 19-22 September 2013
- 36th AIM Annual Conference, S. Petersburg, September 2014

### Educational Projects

- WEB-based Project Management (*Project Leader: Polytechnics of Madrid*)
- Experiential Learning in Industrial Engineering and Management (*Project Leaders: Univ.s of Aalborg and Dortmund*)
- Kernel curriculum on 'Advanced Industrial Management'
  (*Project leader: University of Braunsweig*)
- MS and PhD students exchange
  (all AIM Universities involved)

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http://www.europe-aim.eu/
1. Industrial and Societal Challenges in the EU require IE Competence.

2. A Clear and Complete Picture of IE curricula in Europe is still missing.

3. IE Competence require to be updated with major focus on:
   I. Innovation Exploitation and Technology Management
   II. Societal Challenges of interest for IE (e.g. Workforce Aging and Sustainable Urban Development)

4. Education and Networking
   I. Dual University – Industry Programmes
   II. Teaching Factory and Experiential Learning
   III. European Multi-University Collaborative Network

5. The Role of the European Academy for Industrial Management
   I. Educational projects as well as scientific activities are promoted.
   II. Main focus on education of Industrial Engineers for Industry challenges; the Academy is being paid a growing attention also to societal challenges.
   III. Multi-University Academy projected in the EHEA.

http://www.europe-aim.eu/