Notes and Comments about the Portuguese Chemical Industry

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Porto, Portugal
October 11, 2001

Talk Outline

① Putting past, present and future in perspective...
② Today’s Society and Industry - questions and issues
③ European efforts and directions for CEE
④ Skills and competencies for the profession
⑤ About curricula for first degree courses
⑥ Some final notes on main topics
⑦ 3 key ideas elected for you to check them in 2020!
An invitation to visit the new Facilities of the Old FEUP

2 relevant works (both in Portuguese)


Both publications include results from indicators supplied by 49 Companies of 21 industrial sectors, plus information from additional reports supplied by sectorial associations.
First paradigm - Key Words – Unit Operations

1. Maturity, namely in the oil and petrochemical industries
2. Tackling continuous process scale-up to millions of tons of production

Second paradigm - Transport Phenomena

1. Understanding basic mechanisms and fundamental phenomena - The Era of Chemical Engineering Science
2. A Priori Design... A goal not yet achieved

Scope - II
New Identity(ies) - Chemical Industry in Lactus Sensus

A Tribute to the Second Paradigm of Chemical Engineering

Somewhere in the seventies… of last Century...

Concepts and methods of Chemical Engineering applied to a space of disciplines and knowledge wider than those of the old chemical engineering as understood in a Strictus Sensus.
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Chemical Engineering - widening application areas(*)

- 1930... Inorganics, Petrochemistry...
  - Heavy industry, nuclear
  - plastics, fine chemistry
- ...1960... 1980 Agrochemistry, Pharmaceutical, food...
  - cosmetics
  - transports, software, systems
- ...1980... Biotechnology, Biomedical Sciences, health...
  - materials, specialties...
  - control, electronics and robotics...

(*) Chemical Engineering seeks a new identity, Chemical Engineering, August 2000, p. 33-37

Table 1 – Portuguese Chemical Industries - Main Sectors and Products

<table>
<thead>
<tr>
<th>Inorganic Products</th>
<th>Artificial and synthetic fibers</th>
<th>Tensio-actives, soaps and detergents</th>
<th>Cellulose and paper industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic products</td>
<td>Elastomers and rubber products</td>
<td>Glues, adhesives and mastics</td>
<td>Environment industries</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>Pharmaceutical industry</td>
<td>Essential oils, perfumes and cosmetics</td>
<td>Food industry</td>
</tr>
<tr>
<td>Agrochemicals and protection agents</td>
<td>Resins</td>
<td>Non-edible oils and fats</td>
<td>Glass industry</td>
</tr>
<tr>
<td>Synthetic resins and plastics</td>
<td>Paints and varnishes</td>
<td>Oil refining</td>
<td>Ceramics industry</td>
</tr>
</tbody>
</table>

SFA, DEQ/ISR-FEUP, Porto, Portugal
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Statistics

- Fuzzy…The concept of Chemical Industry of Official Bodies is more that of Chemical Engineering in *Strictus Sensus*

- Economical Activity Coding
  - Code 23 -
  - Code 24 -
  - Code 25 -

- Then, we have to add Sectorial Statistics made available or supplied by Sectorial Associations...

Associative Organisation

- 12 Sectorial Associations for the Chemical Industries plus 2 for the Cellulose and for the paper sectors
  - E.g. APIFARMA - 125 Associates of the Pharmaceutical Industry

- APEQ - Portuguese Association of Chemical Companies,
  - The Portuguese Association represented in
    - CEFIC - European Chemical Industry Council

- Some Companies are members of transversal Associations:
  - CIP - Confederation of Portuguese Industry
  - AEP - Portuguese Entrepreneurial Association
  - AIP - Portuguese Industrial Association, etc...
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The Strength of Chemical Industry
Figure 1 – Markets - Consumption structure in the EU

Table 2 – World Production of CI in 1998**

<table>
<thead>
<tr>
<th>Universe</th>
<th>BILLION EURO</th>
<th>% Universe</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORLD</td>
<td>1 224</td>
<td></td>
</tr>
<tr>
<td>EUROPE</td>
<td>392</td>
<td>32%</td>
</tr>
<tr>
<td>EU</td>
<td>367</td>
<td>30%</td>
</tr>
<tr>
<td>Portugal</td>
<td>3.8</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

* Contribution of Chemical Industry for EU Economy - 2.4%
**CEFIC (2000)
### Table 3 – Structure of Companies and Employment in EU**

<table>
<thead>
<tr>
<th>No. of Workers</th>
<th>% Companies</th>
<th>% Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 9</td>
<td>68 %</td>
<td>3 %</td>
</tr>
<tr>
<td>10 - 49</td>
<td>20 %</td>
<td>6 %</td>
</tr>
<tr>
<td>50 - 249</td>
<td>8 %</td>
<td>19 %</td>
</tr>
<tr>
<td>&gt; 250</td>
<td>4 %</td>
<td>72 %</td>
</tr>
</tbody>
</table>

* Total no. of Companies in EU ~ 36 000
* Total number of Companies in Portugal ~1400
* Total no. of Workers in EU ~ 1.7 million
* Total no. of Workers in Portugal ~ 45 000
* Ratio Workers CI / Industry in EU - 7 %

**CEFIC (2000)

### Table 4 – Educational Levels in the Portuguese Chemical Industry *, **

<table>
<thead>
<tr>
<th>Code of Economical Activities</th>
<th>Secondary School</th>
<th>Professional Degrees</th>
<th>B.Sc.</th>
<th>Licenciates</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>66</td>
<td>0</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>24</td>
<td>18 996</td>
<td>73</td>
<td>715</td>
<td>1653</td>
</tr>
<tr>
<td>25</td>
<td>18 205</td>
<td>23</td>
<td>228</td>
<td>479</td>
</tr>
<tr>
<td>Totals</td>
<td>37 273</td>
<td>96</td>
<td>953</td>
<td>2157</td>
</tr>
</tbody>
</table>

* Not included - Refining activity and Cellulose and Paper Sectors
** Source - Ministry of Employment and Solidarity, 1997
More Figures...
Figure 5 – Portuguese Production Index

Production
(source: CEFIC - Facts and Figures - Nov, 1999)

Some Statistics
Figure 3 – Turnover (1990-1998)

Turnover
(source: CEFIC - Facts and Figures - Nov, 1999)
Some Statistics
Figure 2 – Employment in Portuguese CI

Employment (Index 100 ~ 50000)
(source: CEFIC - Facts and Figures - Nov, 1999)

The Strength of Chemical Industry
Figure 4 – Portuguese Import - Export

(source: CEFIC - Facts and Figures - Nov, 1999)
Trends
Up-to-now

- Portuguese CI is experiencing some recession, so the numbers say and so we feel...for some reasons -
  - Fragile mono-production small companies
    - Unable to fight evolution: new energy and environmental restrictions
  - Lack of tradition in R&D&I - very low activity level
    - ~ 1400 companies, ~ 2000 licenciates
    - ~ 60 companies report research infra-structures
    - ~ 35 M.Sc., ~ 30 Ph.D
  - Low interaction Industry-University

Table 5 – Functional Structure of Companies*

<table>
<thead>
<tr>
<th>Strategic perspective</th>
<th>Functional contents</th>
<th>Position in the structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decides future directions</td>
<td>Company strategy</td>
<td>Director/General Director</td>
</tr>
<tr>
<td>Links sectors of the global business</td>
<td>Business management</td>
<td>Departmental Director</td>
</tr>
<tr>
<td>Anticipates and manages required changes</td>
<td>Innovation, R&amp;D, liaison to process</td>
<td>I&amp;D or production group leader</td>
</tr>
<tr>
<td>Develops and makes improvements. Optimise activities</td>
<td>Adapts, improves process</td>
<td>Senior engineer or process director</td>
</tr>
<tr>
<td>Designs, performs commissioning and operates</td>
<td>Does.</td>
<td>Junior engineer</td>
</tr>
</tbody>
</table>

Life Today…what matters for the discussion - I

- Economy and market forces - driving force of Today’s Societies
- The computer and communications era - dramatic changes of the concepts of time and space - Globalisation
- Sharp increase in standards and competition - Worldwide and within the European Space
- Job market and opportunities - wider than ever
- Significant change in the concepts of Individual Career Management

Life Today…what matters for the discussion - II

- Process and product development times came down sharply (3 to 5 fold) - risk management...
- New concerns on environment problems and generally on sustainability
- New paradigms on Unit Operations open for discussion - micro-systems, process intensification...
- Sharp demand for ‘performance products’ - specialties, food, personal care products...
- Management has acquired a new relevance - Risk management
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Trends for the Future
I - Macro-strategic variables

- Technological innovation
- Qualification of Human resources
- Logistics - promotion of integrated production, minimising transport
- Employment policies - legislation to face expansion and contraction periods
- Environment protection and sustainability
  - Promotion of technical culture and PR actions
  - Legislation - labour; promotion and licencing of industrial activities
  - Industrial property
  - Sector internationalisation - stable decision centers

Trends for the Future
II - Factual reasons to believe...

- The market (and the Society) demand for CI products will always be high
  - Hence, the driving-force is there...
- Significant improvement in quality and dimension of Human Resources
  - Important number of young licenciates with technical knowledge and initiative
  - Availability of postgraduate young people for industry
  - Inequivocal capacity for R&D&I in Research Laboratories
- A reasonably clear picture for development is available
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Trends for the Future
II - Factual reasons to believe..., yes, but ...

- Appropriate policies are required

- Change of mindset, in a number of cases, at all levels...
  - at government level
  - at managerial level,
  - at university level

Trends for the Future
III - Priority technological areas

- Strengthening technology
  - Catalysis and Reaction Engineering
  - Separation Processes
  - Process Systems Engineering -
    - process integration and optimisation and
    - computer-aided process operations
  - Waste recovery technologies
  - Biochemical processes
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Trends for the Future
IV - Existing opportunities

➢ Development of main industrial platforms
  ➢ Optimising logistic structures
➢ Development of companies with ‘clean’ technologies
  ➢ residue recycling / recovering
➢ Preferential development of clusters
  ➢ Energy oil refining / plastics / fibers
  ➢ Forest / Cellulose paste / paper
  ➢ Specialties / fine chemicals / pharmaceutical industry
➢ International partnerships

Positive signals from the Industry - Sustainability and Holistic Thinking

➢ There is now a true and deep global concern, both in the scientific and the industrial society, for the environment and for the problems of overpopulation and industrialisation.

➢ This need for developing sustainable technology and for sustainability as an attitude has now become an active premise of work for chemical engineers.

➢ Sustainability can also be taught and learned indirectly through increasing knowledge on environmental problems, on biochemistry, on life cycle analysis and as well on economics, just to mention a few subjects.
Health Safety and Environment - Positive action from the Industry

- Responsible Care Action
  - ICCA - International Chamber of Chemical Associations
  - CEFIC - European Chemical Industry Council
  - APEQ - Portuguese Association of Chemical Companies
- Self-evaluation and volunteer reporting of relevant parameters and indices

Skills, Personal Career and Lifelong Learning - I

- Contractors and employers do not so much at present provide opportunity for specialist training, expecting that the young engineer they hire will have sufficient technical background.
- Companies value nowadays competencies and skills that are not limited to the technical areas.
- Indeed, Companies more easily provide opportunities for developing those other skills and competencies that are of the short-term benefit of their organisations.
## Table 6 – Skills and Competences valued by Industry

<table>
<thead>
<tr>
<th>Job related skills</th>
<th>Competencies (How tasks are done)</th>
<th>Technical knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>Holistic thinking</td>
<td>Chemical engineering, batch processing, particle technology, SHE...</td>
</tr>
<tr>
<td>Communication</td>
<td>Influencing</td>
<td>Organic chemistry, biotechnology, microbiology...</td>
</tr>
<tr>
<td>Leadership</td>
<td>Self-management, people management</td>
<td>Systems engineering, production engineering, process control..</td>
</tr>
</tbody>
</table>


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### Skills, Personal Career and Lifelong Learning - II

- Lifelong learning is the key for ensuring progress,
  - 1st degrees for sure do not cover all relevant technical topics,
  - It is the only way to avoid obsolescence.
- Formal courses, ‘hands-on’ and ‘on-the-job’ training, distance and interactive courses…obviously the Internet...
- Paradox - employers, promoting short-term jobs and forced mobility, are reluctant to educate staff - SOMETHING TO FIGHT AGAINST:
  - Legal incentives for positive action
In form of conclusions -
3 ideas to take with you and check them in 2020...

- Whole integrated approaches
- Skills and competencies
- Cultural interchanges

European co-operation through Core Quality Criteria within diversity

All that remains is to thank you for the attention you cared to pay to the talk!

The End!