

Notes and Comments about the Portuguese Chemical Industry

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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!**

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An invitation to visit the new Facilities of the Old FEUP



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2 relevant works (both in Portuguese)

- ☞ Valadares Tavares, L. (Ed.), *Engineering and Technology serving the Development of Portugal: Prospective and Strategy 2000-2020 (in Portuguese)*, Editorial Verbo, Lisboa/S. Paulo, November 2000.
- ☞ Ramôa Ribeiro, F. and C. Pedro Nunes (Co-ordinators and Eds.), *Chemical Industries in Portugal: Perspectives for the XXI Century*, Escolar Editora, June 2001
- ☞ Both publications include results from indicators supplied by 49 Companies of 21 industrial sectors, plus information from additional reports supplied by sectorial associations

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Scope - What Chemical Industry? - I Paradigms / Mindset in Chemical Engineering

① First paradigm - Key Words – Unit Operations

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

② Second paradigm - Transport Phenomena

- ② 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*.

Chemical Engineering - widening application areas(*)

- ☞ **1930... Inorganics, Petrochemistry..**
 - ☐ Heavy industry, nuclear
 - ☐ plastics, fine chemistry**Economy
Products**

- ☞ **...1960... 1980 Agrochemistry, Pharmaceutical, food...**
 - ☐ cosmetics
 - ☐ transports, software, systems**Safety
Environment**

- ☞ **...1980...Biotechnology, Biomedical Sciences, health...**
 - ☐ materials, specialties...
 - ☐ control, electronics and robotics...**Economy vs.
Sustainability
Risk management**

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

Table 1 – Portuguese Chemical Industries - Main Sectors and Products

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

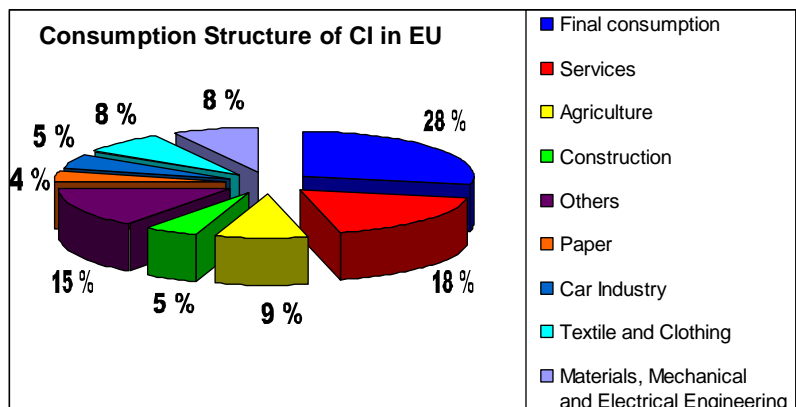
Statistics

- ☞ **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...**

The Strength of Chemical Industry
Figure 1 – Markets - Consumption structure in the EU



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Table 2 – World Production of CI in 1998**

Table 2 – World production of Chemical Industries in 1998*, **		
Universe	BILLION EURO	% Universe
WORLD	1 224	
EUROPE	392	32%
EU	367	30%
Portugal	3.8	0.3%
* Contribution of Chemical Industry for EU Economy - 2.4%		
**CEFIC (2000)		

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Table 3 – Structure of Companies and Employment in EU

Table 3 – Structure of Companies and Employment in EU*, **		
No. of Workers	% Companies	% Sales
0 - 9	68 %	3 %
10 - 49	20 %	6 %
50 - 249	8 %	19 %
> 250	4 %	72 %
* 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)		

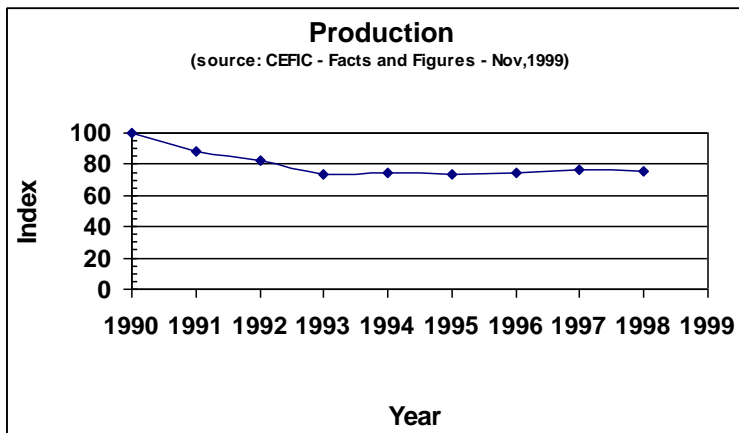
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Table 4 – Portuguese Chemical Industries - Educational Levels

Table 4 – Educational Levels in the Portuguese Chemical Industry *, **				
Code of Economical Activities	Number of Workers with:			
	Secondary School	Professional Degrees	B.Sc.	Licenciates
23	66	0	10	25
24	18 996	73	715	1653
25	18 205	23	228	479
Totals	37 273	96	953	2157
* Not included - Refining activity and Cellulose and Paper Sectors				
** Source - Ministry of Employment and Solidarity, 1997				

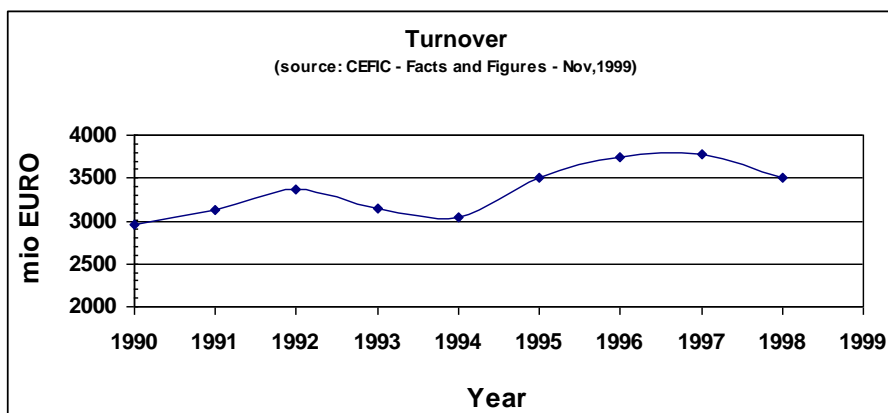
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More Figures...
Figure 5 – Portuguese Production Index



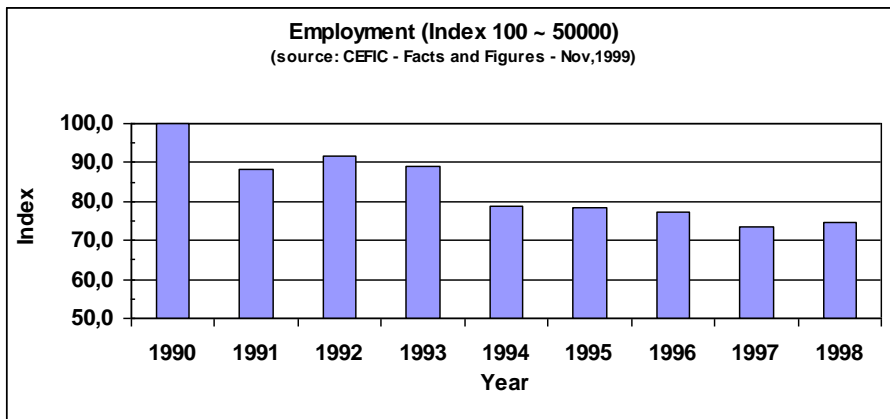
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Some Statistics
Figure 3 – Turnover (1990-1998)



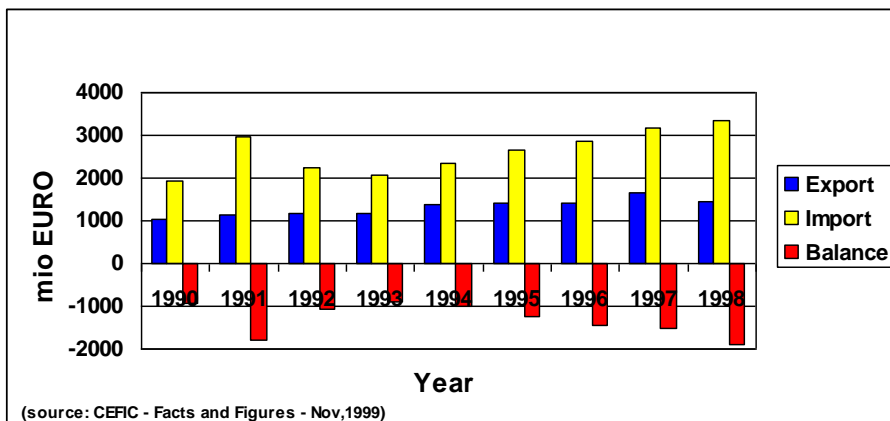
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Some Statistics
Figure 2 – Employment in Portuguese CI



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



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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**

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Table 5 – Functional Structure of Companies*

Table 5 – Functional structure of a Company, on the form of levels of internal contributions*		
Strategic perspective	Functional contents	Position in the structure
Decides future directions	Company strategy	Director/General Director
Links sectors of the global business	Business management	Departmental Director
Anticipates and manages required changes	<i>Innovation, R&D, liaison to process</i>	I&D or production group leader
Develops and makes improvements. Optimise activities	Adapts, improves process	Senior engineer or process director
Designs, performs commissioning and operates	Does.	Junior engineer
*Adapted from Gillett, J.E. (2001), <i>Chemical Engineering Education in the Next Century</i> , Chem. Eng. Tech. 24(6) 561-570.		

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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**

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**

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**

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**

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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.

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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

Job related skills	Competencies (How tasks are done)	Technical knowledge
Teamwork	Holistic thinking	Chemical engineering, batch processing, particle technology, SHE...
Communication	Influencing	Organic chemistry, biotechnology, microbiology...
Leadership	Self-management, people management	Systems engineering, production engineering, process control..
	Achievement of objectives	

* Adapted from Gillett, J.E. (2001), *Chemical Engineering Education in the Next Century*, Chem. Eng. Tech. 24(6) 561-570.

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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

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**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 !