

Education for European Production Engineers

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AGENDA

■ Background

Production Engineering

- Production engineering is that specialty of
- The skills needed by production engineers
- The future of Production Engineering will involve processes, materials, products, industries, and applications of technology that will open new markets and provide new challenges for manufacturing.

Key Factors

- Demographic structure
- University graduates
- Employment structure
- Labour costs

University graduates in selected countries, 1999
Percentage share of university graduates in the population

Country	20-24 years old	25-64 years old
USA	25	15
UK	20	12
France	18	10
Germany	15	8
Italy	12	7
Spain	10	6
Japan	8	5
China	5	3
India	3	2
South Africa	2	1
South Korea	1	1
Sweden	1	1
Denmark	1	1
Norway	1	1
Finland	1	1
Australia	1	1
Canada	1	1
Belgium	1	1
Netherlands	1	1
Portugal	1	1
Greece	1	1
Poland	1	1
Czechia	1	1
Slovakia	1	1
Slovenia	1	1
Hungary	1	1
Croatia	1	1
Serbia	1	1
Bulgaria	1	1
Romania	1	1
Latvia	1	1
Lithuania	1	1
Estonia	1	1

The Threats

- China is a Formidable Competitor
- Low-cost of manufacturing
- Chinese domestic market lures European and U.S. businesses
- Domino Effect: Suppliers follow customers

The Weakness

There is great concern that Europe no longer has the reservoir of expertise in manufacturing to take full advantage of these exciting opportunities and to meet the challenge posed by foreign competitors.

■ Education in Production Engineering (PE)

The Knowledge – Cross-disciplinarity

- The Production engineer must understand production, production control, design, facilities planning, plant layout, methods engineering, quality control, work standards, systems engineering, statistical process control, processing, and manufacturing engineering management— in other words, the whole spectrum of manufacturing concerns.

Production Engineer Skills

- Production engineering is that specialty of professional engineering able to understand, apply, and control engineering procedures in manufacturing processes.
- A production engineer needs the ability to plan manufacturing practices; to research and develop tools, processes, machines, and equipment; and integrate the facilities and systems for producing quality products with optimal expenditure.

Need for a Rewarding System

- After working in manufacturing, highly qualified engineers often transfer into non-engineering or non-manufacturing classifications that offer salary increases or other rewards.
- Manufacturers must recognize the loss they suffer when an experienced manufacturing engineer leaves the production function because there is no salary or promotion incentive to stay in that classification.

The Curricula Disagreement

- There appears to be no general agreement on what the course content should be, or how it can be applied to a given industry. Examples stressing manufacturing applications should be introduced into the curricula.
- There is also considerable uncertainty about what a manufacturing engineer is in terms of education and training, as well as the nature of manufacturing and engineering and the skills and ideas involved.

AGENDA

EPRODE - European Education in PE

The EPRODE Goals

- Define and understand the needs of the manufacturing industry for training and education in manufacturing strategy on a global basis
- To enhance the interaction among educators in PE form many European countries.
- To establish a unitary, transparent European education and accreditation system in Production Engineering.
- Enhance the prestige of manufacturing as a profession and as an intellectual challenge.

EPRODE Key Targets

- Increase the commitment of European engineering schools to production engineering
- Increase the interaction between industry and universities in production engineering education and research
- Increase mobility among students, teachers, production engineers.

The EPRODE Educational System

- A European Network - the EPRODE Organisational Structure,
- Procedures and practices for assurance and maintenance of academic standard - the Quality Assurance Manual
- An educational plan – EPRODE Curriculum
- A complete course package, the EPRODE Course Programme including examination tests and

EPRODE Curricula

EPRODE CURRICULA

Module I, 15 ECTS Materials Engineering	Module II, 15 ECTS Machining Technology	Module III, 15 ECTS Integrated Product and Process Design	Module IV, 15 ECTS Quality Engineering
Module V, 15 ECTS Information Technology and CNC	Module VI, 15 ECTS Manufacturing Systems	Module VII, 15 ECTS Forming Technology Sheet Metal Forming	Module VIII, 15 ECTS Joining Technology Welding
Module IX, 15 ECTS Production Management	Module X, 15 ECTS Joining Technology Mechanical & Chemical	Module XI, 15 ECTS Manufacturing Technology	Module XII, 15 ECTS Forming Technology Bulk Forming

Excerpt from Curricula

MODULE 3 15ECTS		
Subject	Course Name	Credits ECTS
EPR301	Engineering Statistics	2
EPR302	Experimental Design	3
EPR303	Quality assurance and Control	3
EPR304	Process and Capability Analysis	2
EPR305	Technical English	2
EPR306	Project work/Industrial case	3

Labels: Basic Subjects, Competence Subjects, Language, Practical activity

Quality Assurance and Monitoring

- Body of knowledge
- Homogenous PE knowledge among practitioners
- A highly qualified faculty staff.

Conclusions

Production Engineering

- **Production engineering is that specialty of professional engineering able to understand, apply, and control engineering procedures in manufacturing processes.**

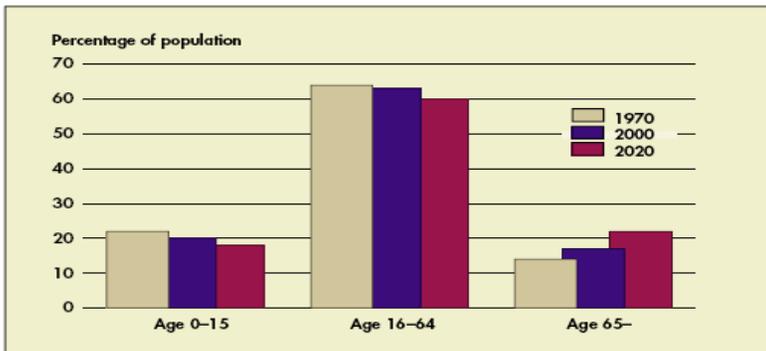
- **The skills needed by production engineers should be defined based on the factory of the future, not on the traditional academic degrees.**

- **The future of Production Engineering will involve processes, materials, products, industries, and applications of technology that will open new markets and provide new challenges for manufacturing.**

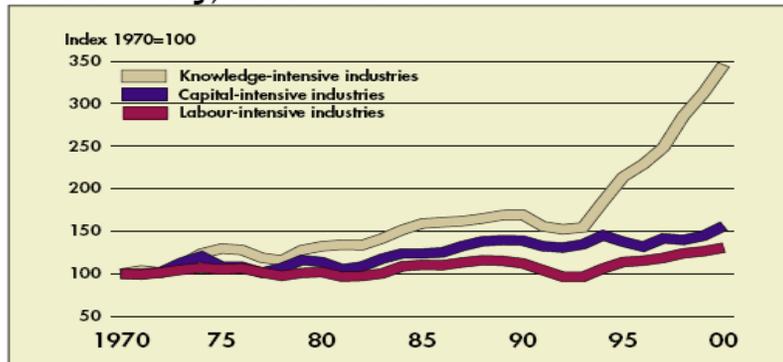
Key Factors

- Demographic structure
- Employment structure

Sweden's demographic structure, 1970–2020

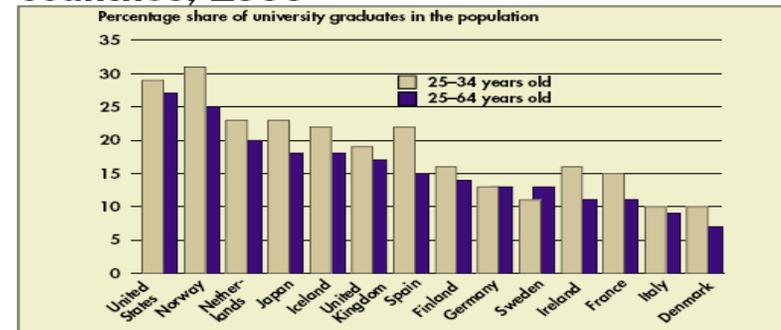


Changes in production in different sectors of industry, 1970–2000



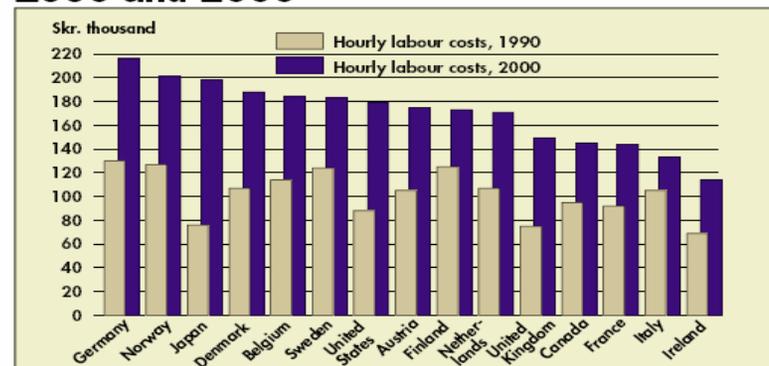
- University graduates
- Labour costs

University graduates in selected countries, 1999



A modern high skills economy places great demands on its labour force. In an international perspective, Sweden has a strikingly low proportion of university graduates.

Labour costs in selected countries, 1990 and 2000



- **2002 average labour cost in Sweden was SEK 198**
- **Germany SEK 250**
- **US SEK 215**
- **England SEK 165**
- **Ireland SEK 135**

40 hours/week working time

The Threats

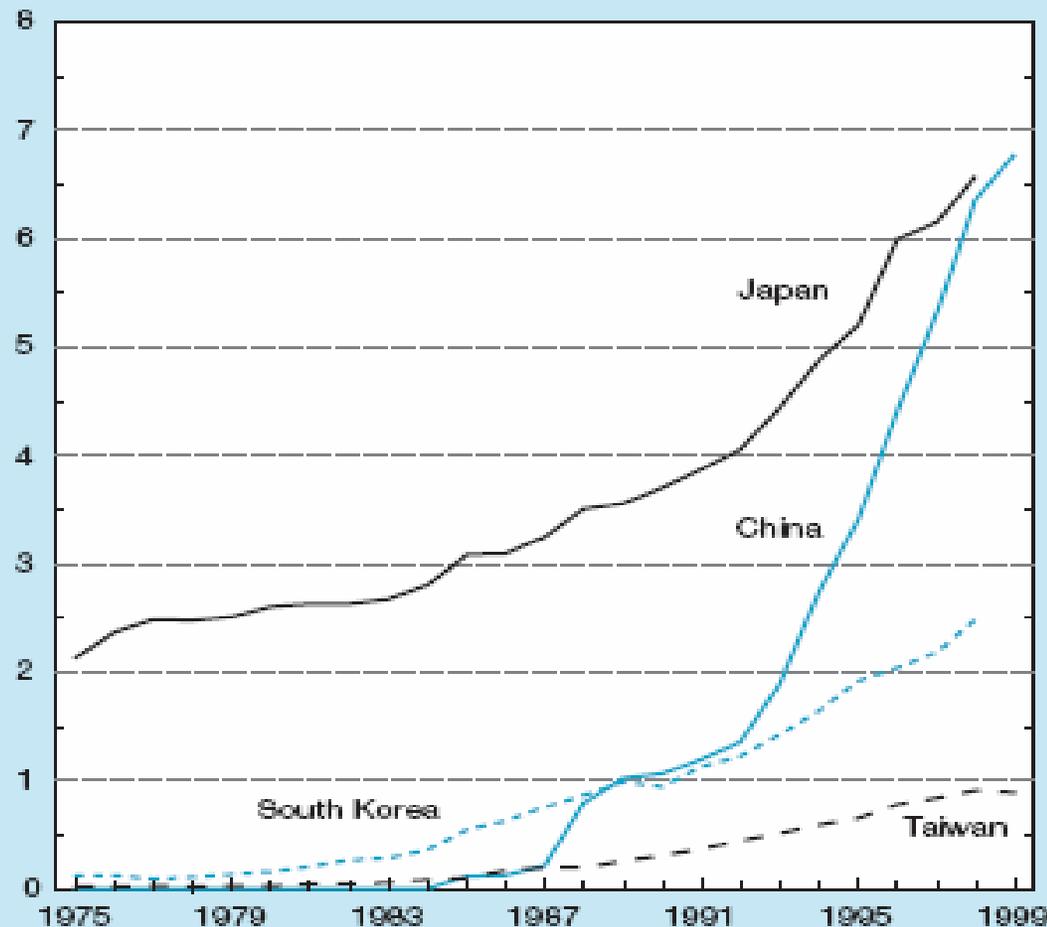
- “... Let me tell you this story: I just went to [a trade show] in Anaheim... 7 out of 10 people who stopped at the booth asked “Do you produce your molds overseas?”

When I said, “No” they just walked away, automatically assuming I couldn’t compete. They wouldn’t hear any of the spiel, nothing....I’m a third generation molder. That’s humiliating! Just because I make my molds here (potential) customers won’t buy from me.” *Company Interview*

- **China is a Formidable Competitor**
- **Low-cost of manufacturing**
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Doctoral S&E degrees earned in selected Asian countries and economies: 1975-99

Number of degrees (thousands)



A recent survey conducted by the European Commission has estimated that over 400,000 European born researchers are now working in the US. Of the thousands who depart for the US each year, more than 70% are destined never to bring the education they receive there back home.

- European universities are at the crossroad of a dual deficit: the **EU spends only 1.1 % of GDP** (US: 2.3%) on higher education and **only 1.9 % of GDP** (US: 2.7 %) on research.

The Weakness and.. the Problem

There is great concern that Europe no longer has the reservoir of expertise in manufacturing to take full advantage of these exciting opportunities and to meet the challenge posed by foreign competitors.

Today's growing rate at which new technologies are being introduced into manufacturing has created a large demand for production engineers competent in the new technologies.

- Gearing the educational system more to the industrial need and facilitate closer cooperation between academic institutions and industry.

Increased importance of managerial and teamwork skills – industry is in need of people who are able to work in teams, have a broad knowledge of modern and advanced manufacturing practices and are capable of managing projects and other people.

How can education contribute to the revitalization of European manufacturing industry?

The Body of Knowledge – Cross-disciplinarity

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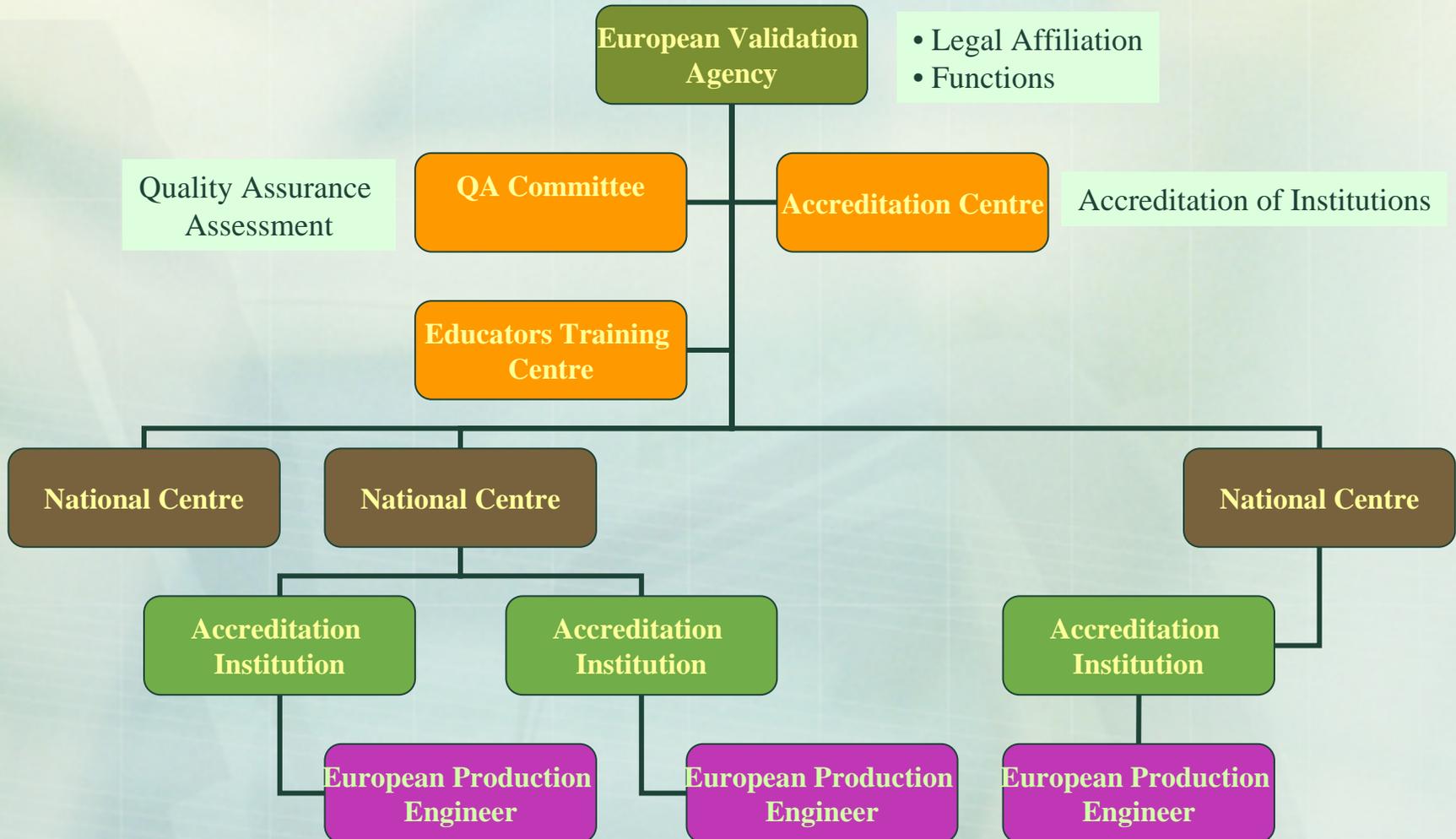
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EPRODE Organisational Structure



EPRODE CURRICULA

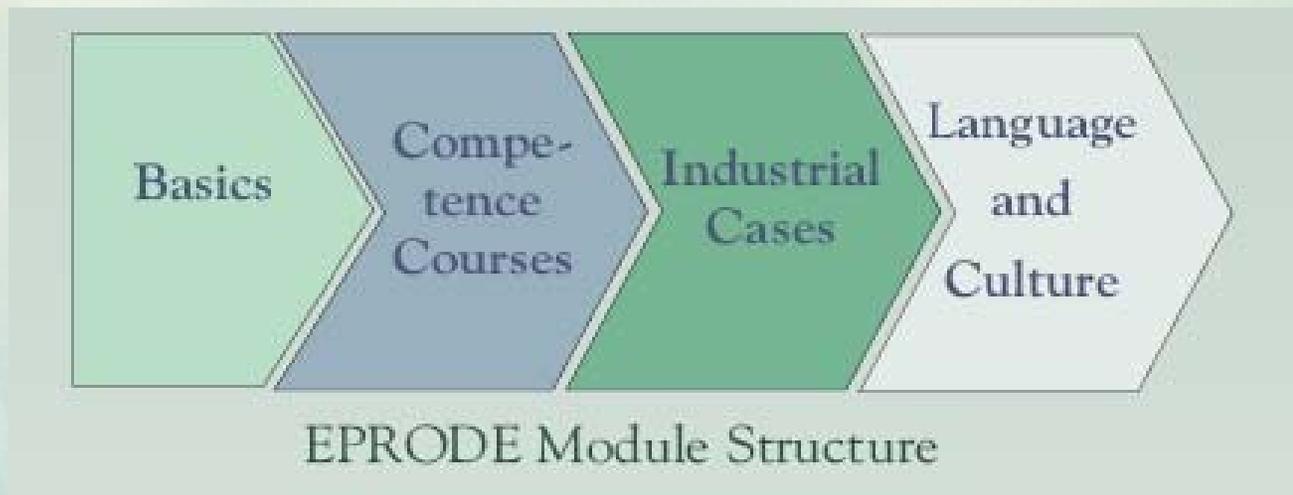
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Quality Assurance and Monitoring

- Body of knowledge
- Homogenous PE knowledge among practitioners
- A highly qualified faculty staff.



Conclusions

Production Engineering

- In the focus is the competitiveness of European PE companies
- The nature of work is changing as are the workforce skills in manufacturing industry
- Gearing the educational system more to the industrial need and facilitate closer cooperation between academic institutions and industry.
- There appears to be no general agreement on what the course content should be, or how it can be applied to a given industry.

EPRODE

- To establish a unitary, transparent European training and validation system in Production Engineering.
- Enhance the prestige of PE as a profession and as an intellectual challenge
- European Dimension
- Modular Curricula