THE ATTRACTIVENESS OF BEING AN ENGINEER

João Fernandes
Rui Mendes
Marta Pile

Darmstadt, 23rd and 24th of September 2010
0. National Overview

Demographics
Higher Education
State of the Art
Demographic trend: decreasing young population


Source: INE, 2009
Demographic trend: decreasing young population
By gender


Source: INE, 2009
HE Admission in the S&T area – Total Education: Share of Science and Engineering – vacancies (%)

Source: GPEARI/MCTES, 2009
Trends in Graduation: S&T area – Total Education

Source: GPEARI/MCTES, 2009
<table>
<thead>
<tr>
<th>Research</th>
<th>Subject</th>
<th>Date (year)</th>
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<tbody>
<tr>
<td>The engineers in Portugal</td>
<td>The situation of engineers in Portugal between 1972-1991 focus: engineers survey</td>
<td>1999</td>
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<tr>
<td>Mª Lurdes Rodrigues</td>
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<td>Enginnering and Technology in service of the development of Portugal</td>
<td>The prospective and strategy of the sector in Portugal 2000-2020 focus: sector analysis</td>
<td>2000</td>
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<td>L. Valadares Tavares</td>
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<td>Sexual segregation in the ICT sector</td>
<td>The analysis of the gender relations in the work context focus: gender analysis</td>
<td>2006</td>
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<tr>
<td>Sara Falcão Casaca</td>
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<tr>
<td>IST Graduates Survey</td>
<td>General Survey focus: Academic &amp; professional status/evolution</td>
<td>2009</td>
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<tr>
<td>Perceptions about the Engineer</td>
<td>General Survey Focus: engineer social representations</td>
<td>2010 (i.d.)</td>
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1. Defining an Engineer

Formal concept of engineer
Engineering Formal Education: how hard?
How do we look at engineers?
Formal concept of Engineer

- The profession of engineer is governed by the Portuguese Professional Association of Engineers
- Graduates need to register in this Association to use the title of Engineer
- Only the graduates with a Master in engineering (2nd cycle) can apply

**ENGINEERING PRACTICE IS:**

Using the knowledge of laws of nature, to design, to analyse, to promote, to manage or to control an achievement of something:

...economically profitable
...technically predictable
...of social interest

*Definition by Portuguese Order of Engineers*
FOR THE DEVELOPMENT OF THE POTENTIAL OF ENGINEERING PROFESSIONAL IS ESSENTIAL THE ACQUISITION OF NON TECHNICAL EXPERTISES.

Structured by Portuguese Order of Engineers
**Engineering Formal Education: how hard?**

**Engineering vs Other Areas**

- **Most mentioned aspects:**
  - Quality (+)
  - Demanding (+)
  - Excessive Theory (+/-)
  - Differs according to HEI (+/-)

- **Other interesting aspects:**
  - Entrepreneurship skills (+/-)
  - Decreasing quality (-)
  - Solving problems (+)

**Source:** Engineering Perceptions Inquiry 2010, IST; Websurvey: 233 Answers
How do we look at engineers?

**Engineers**

1\textsuperscript{st} Dynamic  
2\textsuperscript{nd} Creative  
3\textsuperscript{rd} Affirmative  
4\textsuperscript{th} Entrepreneur  
5\textsuperscript{th} Assertive  
6\textsuperscript{th} Curious  
7\textsuperscript{th} Efficient  
8\textsuperscript{th} Uncomplicated

**Other Professions**

1\textsuperscript{st} Affirmative  
2\textsuperscript{nd} Dynamic  
3\textsuperscript{rd} Active  
4\textsuperscript{th} Arrogant  
5\textsuperscript{th} Confident

*Source: Engineering Perceptions Inquiry 2010, IST*
2. Engineer and Society

Contribution to development

Engineering profession - how hard?
## Engineer Contribution:

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Number</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>VERY IMPORTANT</td>
<td>170</td>
<td>74.2%</td>
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<tr>
<td>IMPORTANT</td>
<td>58</td>
<td>25.3%</td>
</tr>
<tr>
<td>LESS IMPORTANT</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>NOT IMPORTANT</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

- **“Scientific and Technological development of the country”**
- **“Public Works”: sciences in action**
- **“Process and Market Innovation”**
- **“Economic growth and development”**
- **“Life quality improvement”**

Source: Engineering Perceptions Inquiry 2010, IST
Engineering Profession: how hard?

Engineering Vs Other Areas

- Professor
- Doctor
- Psychologist
- Economist
- Lawyer
- Manager

Source: Engineering Perceptions Inquiry 2010, IST
3. Job Market & Reputation

What do IST Engineers do in Portugal?
What perceptions do we have about what engineers do ...
What reputation do engineers have in Portugal?
How is engineering linked to society domains?
Perceptions about income (engineering vs others)
Engineer importance to employers (engineering vs others)
Labour market access: unemployment statistics
Labour market access: perceptions
What do engineers do in Portugal: “The IST overview”

IST Graduates Functions

- Quality
- Project
- Production
- Planning
- Other
- Maintenance
- Computers
- R&D
- Management
- Teaching

Main Activity Areas:
- Consulting, Scientific & Technical activities (35%)
- Information & Communication (15%)
- Construction (11%)
- Education (11%)

Source: IST Graduates Survey 2009; (IST Engineers; N=802, Response Rate: 34%);
What do engineers do: Perceptions on skills

Main skills associated with engineers:

1º Versatility/Flexibility (26%)
2º Analytical Capacity
3º Accuracy
4º Entrepreneurship
5º Project Management (7%)
6º Leadership
7º Computer Skills
8º Focus
9º Team Management
10º Negotiation/Line of Argument (1%)

Skills not associated with engineers: Finance & Oral communication

Source: Engineering Perceptions Inquiry 2010, IST
What do engineers do:
Perception on skills (a comparative view)

Source: Science Perceptions Inquiry 2010, IST

The doctor
The engineer
The manager
The most prestigious professions in Portugal:

1st Doctor
2nd Engineer
3rd Manager
4th Lawyer
5th Teacher
6th Magistrate
7th Politician
8th Architect
9th Researcher

Source: Engineering Perceptions Inquiry 2010, IST
How is engineering linked to society domains?

Engineering primary association to society domains:
- Public Works & Transports (98%)
- Industry & Technology (96%)
- Environment & Territory (96%)
- Agriculture & Fishing (83%)

Engineering was also associated with:
- Defense & Military (30%)
- Politics (13%)
- Sports (8%)
- Education (1%)
- Finances (0.5%)
- Health (0.5%)
- Economy (0.5%)

Engineering wasn’t associated with:
- Justice

Source: Engineering Perceptions Inquiry 2010, IST
Perceptions about income: a comparative view

Engineering Vs Other Areas

Source: Engineering Perceptions Inquiry 2010, IST
Engineer importance to employers: a comparative view

**Engineering Vs Other Areas**

![Bar chart showing the importance of engineers compared to other professions.](source)

Source: Engineering Perceptions Inquiry 2010, IST
Weight of unemployees registered in the Job Centers in the last 10 years / Graduates in the last 10 years

3 most represented study areas (in number of entries), by descending order:

- “Management Sciences” (7,306 entries). Management, in some educational establishments should be pointed out.
- “Social and Behavior sciences” (5,162 entries). Psychology, Economics and Sociology, in some educational establishments should be pointed out.
- “Engineering and related areas” (3,437 entries). Mechanical Engineering and Chemical Engineering, in some educational establishments should be pointed out.

Source: GPEARI/MCTES,
Job Search for the Higher Education graduates, 2009
Job market access: perceptions

“Do engineers have easy Job market access?”

- Yes: 77%
- No: 23%

Main reasons: “Yes”
- Versatility of the engineer
- Need for engineers
- Large amount of job ads
- Most engineer acquaintances are employed

Main reasons: “No”
- Saturated job market
- Current global crisis

Interesting mixed perception: “Engineering has high job rates because engineers accept low financial income”

Source: Engineering Perceptions Inquiry 2010, IST
4. Media Coverage

Media coverage: job offers profile in engineering
Shadow engineers: ideas? Help us!!!!
Job offers profile in engineering

Job offers posted between 7th and 14th of September:

- Not for engineers: 29%
- Only for Engineers: 20%
- General request: 51%

What skills and traits do employers ask for?

- Specific technical skills
- Planning and organizing
- Leadership
- English speaking
- Goal-oriented
- Computer skills
- Responsibility
- Team work skills

65% of the engineering ads asked previous professional experience from candidates

Source: http://aeiou.expressoemprego.pt/
Job offers profile in engineering

**Requested Scientific Areas**

- Any engineering: 39%
- More than 1 Engineering: 26%
- Mecanical Engineering: 13%
- Civil Engineering: 22%

Source: http://aeiou.expressoemprego.pt/
### WHAT SKILLS AND TRAITS DO EMPLOYERS ASK FOR?

**ONLY FOR ENGINEERS**
- Specific technical skills
- Planning and organizing
- Leadership
- English speaking
- Goal-oriented
- Computer skills
- Responsibility
- Team work skills

**NOT FOR ENGINEERS**
- English speaking
- Computer skills
- Planning and organizing
- Specific technical skills
- Other foreign language
- Communication skills
- Team work skills
- Dynamism

54% of the NON engineering ads asked previous professional experience from candidates.

Job offers profile in engineering: IST most requested areas (2009)

Most requested engineering and scientific IST areas:
- Electric and computer engineering
- Information systems and computer engineering
- Mechanical Engineering
- Mathematics
- Communication networks engineering
- Industrial engineering and management
- Environmental engineering

Source: Job Banking IST, 2009
Shadow engineers: ideas? Help us!!!
5. Engineers Outside Engineering

Engineer profession attractiveness
Engineer profession attractiveness in other sectors

35% of the prime ministers were engineers
30% of the overall ministers were engineers
Engineer profession attractiveness in other sectors

**MINISTERS SCIENTIFIC AREAS**
- 25 - Chemical Engineering
- 24 - Civil Engineering
- 22 - Engineering (unspecified)
- 15 - Mechanical Engineering
- 9 - Electrical Engineering

**MINISTERIAL PORTFOLIO**
- 7 - Education
- 5 - Industry and Technology
- 5 - Public Works, Transports and Communications
- 4 - Industry and Energy
- 4 - Housing and Public Works
- 4 - Trade and Tourism
- 4 - Internal Administration
- 4 - Transports and Communications
Engineer profession attractiveness in other sectors

Top Portuguese companies CEO’s academic background:

<table>
<thead>
<tr>
<th></th>
<th>PSI 20</th>
<th>Exame Magazine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(20 Main Portuguese Companies listed on the Stock Market)</td>
<td>(20 Best companies)</td>
</tr>
<tr>
<td>Engineering</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Law</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Economics</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Management</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Without Higher Education</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Undetermined</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>
Gender Differences
Context (HEI).1
Results of the 1st Inquiry on Social Perceptions.2
Gender Differences
Higher Education evolution

Total registered HE students – 2000-2009 – By Gender

Source: GPEARI/MCTES, 2009
Gender Differences: Engineering, Transforming Industry and Construction

Registered Engineering, Transforming Industry and Construction HE students – 2000-2009 – By Gender

Source: GPEAR/MCTES, 2009
Gender Differences: IST Registered Students – 2009, By Course and Gender

Integrated Master IST students 2009 – By gender

Source: Global characterization of the IST School Population, NEP 2009
Gender Differences: IST Registered Students – 2009, By Course and Gender

Source: Global characterization of the IST School Population, NEP 2009
Gender Differences: Engineer contribution to Portugal’s development

Engineer contribution—By gender

Source: Engineering Perceptions Inquiry 2010, IST
Gender Differences: Easy Engineer access to job market?

Source: Engineering Perceptions Inquiry 2010, IST
Final comments

Perceptions

Factors that influence perceptions
Analysis Model (potential influence factors)

Players:
- H.E. Applicants
- H.E. Students
- Graduates
- Companies
- Governmental Agencies
- Professional Associations & Orders
- Labour Unions & Confederations
- Families
- H.E.I.
- Secondary Schools
- H.E. Context
- Mobility Environment
- Socio-Cultural Factors
- Demographic Factor
- Age Pyramid

Environment:
- National Economy Competitiveness
- Entrepreneur Qualification
- Engineers Unemployment Rate
- H.E. Applicants
- H.E. Students
- Graduates
- Companies
- Governmental Agencies
- Professional Associations & Orders
- Labour Unions & Confederations
- Families
- H.E.I.
- Secondary Schools
- H.E. Context
- Mobility Environment
- Socio-Cultural Factors
- Demographic Factor
- Age Pyramid

Impact:
- Technological Innovation
- Sector Concentration of R&D
- Value Chain
Main Factors that influence the attractiveness of engineering in Portuguese context

• Positively:
  – High media projection/coverage
  – Important social role of the engineer: relevant political and economic positions
  – Family background/context: parents graduates in S&T motivated children to pursue their studies and careers in the same area
  – HEI’s and Government S&T initiatives (like Mathematic Routes – UTL)
  – % GDP related to Science, R&D and H.E.(high increase in the last decade)
  – Increase in researchers and scientific publications in Portugal as compared to the EU average
  – Relative increase in the number of graduates in S&T
Main Factors that influence the attractiveness of engineering in Portuguese context

• Negatively:
  – Mathematics; Physics: linked “negatively” with the prospective students (weak results in the PISA scores)
  – High rates of academic failure/drop-out in secondary and higher education
  – Weak linkage to the study object (eg: civil engineering, along the course has small contact with the real work) and low synergies between industry and university (projects during academic course and integrated seminars)
  – Pre-bologna period did not emphasize the soft skills; the learning outcomes aren’t centered on students
  – Demographic trend;