

**Instituto Superior Técnico**

**Report of the Portuguese  
Engineering Education System**

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## 1. First Degree

### 1.1 Short Description of the National Higher Education System

#### Historical Perspective

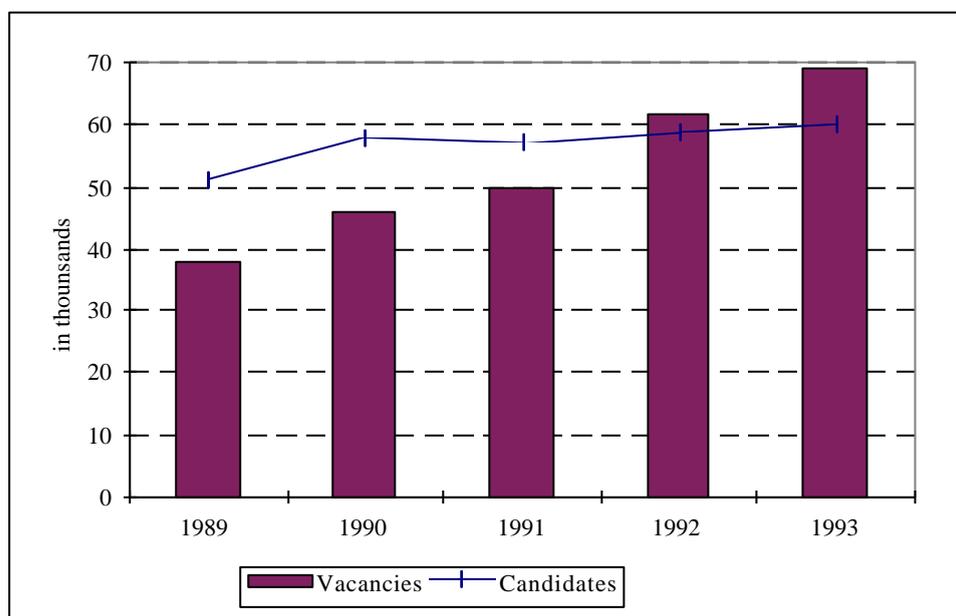
Until the seventies, higher education in Portugal was centred in 4 universities, all of them public. From that time on, higher education was expanded and diversified with the creation of new universities and the development of vocational higher education with the creation of many politechnic institutions.

During the eighties, the development of the system of higher education continued in a fast pace, together with the consolidation of the new institutions, increasing internationalization of universities (in terms of teaching and R&D) and the development of the private sector (mainly in the social sciences).

In 1977 the government had adopted a system of *numerus clausus*, by which indicated every year to each institution the number of vacancies for each course. Despite these restrictions, the number of vacancies grew at an average rate of 19% between 1986 and 1993 (30% in the private sector) which allowed Portugal to close the gap between candidates and vacancies.

Figure 1

#### Evolution of the Supply and Demand of Higher Education



Since 1992, the number of vacancies is a little higher than the number of candidates, reflecting an excess supply of higher education in absolute terms. In spite of this situation, in 1993, only 53.3% of the candidates were placed in the course of his/her first choice<sup>1</sup>. This implies that there is no

<sup>1</sup> Ministério da Educação (Portuguese Ministry of Education)

adequate adaptation of supply of higher education to the demand of the candidates. Overall, there is an excess of courses in the area of Law and Social Sciences (due to the large growth of the Private Universities) and a lack of supply in Engineering and Natural Sciences. This represents a structural deficiency of the system.

In terms of expenditure, the higher education system represented 1.4% of the GDP in 1993, (in a total of 104 billion portuguese escudos which is equivalent to 535 million ECU).

The average yearly cost per student in 1991 (current and investment expenses) was about 522 000 escudos (2680 ECU). It is estimated that the expenses with the higher education system will grow, in real terms, between 2.8 and 4.5% until the year 2005<sup>2</sup>.

The financing of the higher education system comes mainly from the state budget for the public universities and from tuition fees paid by students for the private universities. In recent years, public universities started to collect tuition fees from the students. Nevertheless, these fees represent no more than 10 to 15% of the real cost to the Universities of each student.

Presently, Universities are being encouraged to generate their own resources from services to the Community, but these funds still represent a very small amount compared to the expenditures of the institutions.

### The Engineering Education System in Portugal

The EES in Portugal represents around 25% of the higher public education system, in terms of vacancies and number of students enrolled. If private universities are taken into account, the weight of Engineering Courses will drop to less than 15%, due to the enormous growth of courses in social sciences supplied by private sector.

Figure 2

#### The Weight of the Public EES in the Public Higher Education System in 1993/94

		Higher Education (I)	Engineering Higher Education (II)	II/I x 100
University	Number of 5 Years Courses	371	98	26,4%
	Number of Vacancies	18 261	4 975	27,2%
	Number of Students	99 745 (92/93)	31 122	26,1% (92/93)
Politechnics	Number of <i>Bacharelato</i> Courses	276	54	19,6%
	Number of Vacancies	11 505	3 155	27,2%

<sup>2</sup> Prospectiva do Ensino Superior em Portugal -1995 - Instituto da Prospectiva

	Number of Students	38 040	approx. 12 000	31,6%
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Source: Portuguese Ministry of Education

The great majority of the Engineering institutions are of a public nature, funded by the government. Only 10% of the vacancies are offered by private institutions, representing 5% of the students enrolled.

Figure 3  
**The Engineering Educational System in Portugal  
in 1993/94**

	5 Years Courses			Bacharelato Courses		
	Public	Private	Total	Public	Private	Total
Number of Different Programmes	48	16	52	36	12	41
Total Number of Courses	98	21	119	54	12	66
Number of students	31 122	1707	32 829	Aprox. 12 000	571	Aprox. 13 000
Number of institutions	18	8	26	15	5	20

Source: Portuguese Ministry of Education

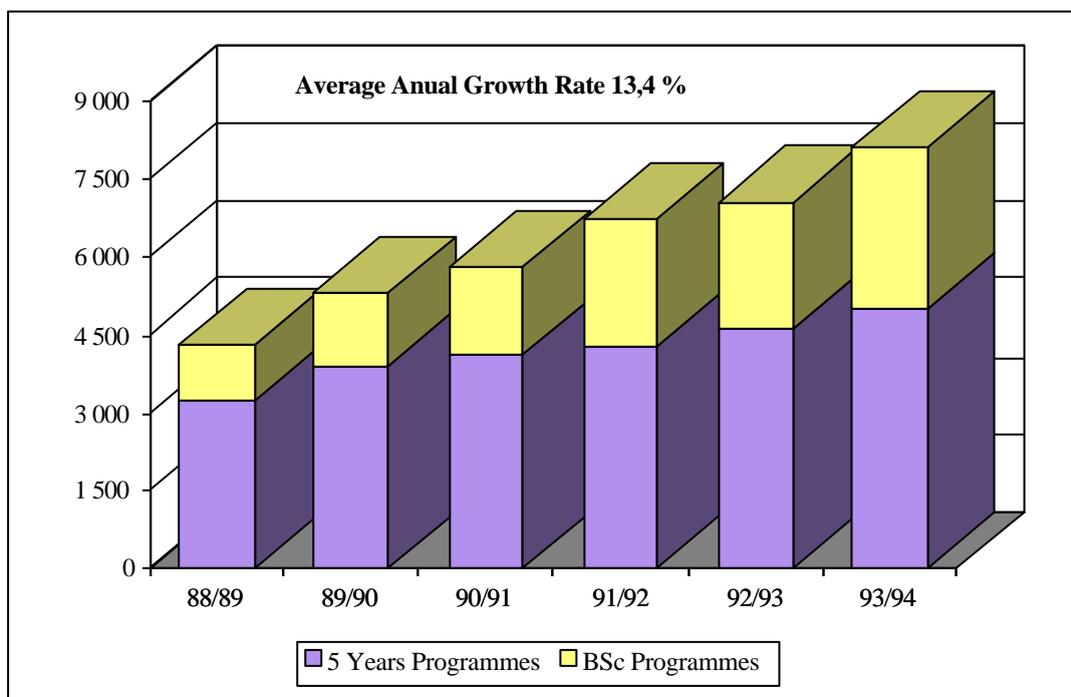
The EES can be divided in two different types of institutions - the Universities, offering a degree of *Licenciatura* after a five years course, and the Polytechnic Institutes offering a degree of Bacharelato (Bsc) after a three years course (with a possible extension of two more years to obtain a degree equivalent to the *Licenciatura*). While the university education is geared to the creation of competencies in the engineering sciences (Mathematics, Physics, Chemistry, Materials, followed by a focus in one Engineering area and then a specialisation), the polytechnic education is geared to the development of technical skills in an engineering area to be applied in specific situations.

The *licenciado* degree has academic and legal recognition (allowing the progression to a postgraduation programme or a doctoral programme) and also a very good professional recognition.

Half of the engineering courses are recognised by the *Ordem dos Engenheiros* (the National Association of Engineers, which officially certify the professional engineers). On the other hand, the *Bacharelato* (Bsc) degree does not allow an academic progression to postgraduation and is not recognised by the the *Ordem dos Engenheiros* (those who finish the *bacharelato* are considered Technical Engineers and not Engineers).

The number of vacancies in the EES has increased sharply in the nineties, especially in terms of the *bacharelato* degree. This resulted from the the recognition that there was a serious lack of supply of engineering professionals with more focused technical skills of imediate application, which corresponds to polytechnic education. It is expected that the number of vacancies will continue to grow in the next five years in the EES, although at a much lower rate than in the previous years and with an emphasis in the polytechnic education. For the Engineering Universities, the next decade will be more oriented to consolidation and quality than to quantitative growth.

Figure 4  
**Vacancies in the Public Engineering Education System**  
**88/89 to 93/94**



Source: Portuguese Ministry of Education

A serious restriction to the long term growth of the EES is the low growth of the demand of higher education in Engineering Areas. Between 1985 and 1989 the number of candidates in Economics

and Management increased fivefold (490.6%) while the candidates for Engineering Courses only increased by 30% in that period. This demand stagnation not only affects the growth of the system but also its quality. In average terms, the quality of the first year engineering students has been decreasing and their interest and capacity in Mathematic related subjects is weak.

## **1.2 University Education**

**In the scholar year of 1993/1994, the Public and Private Universities offered 52 different specialisations in Engineering Courses, in a total of 119 Courses, for 32 000 students in 26 different higher education institutions.**

### **1.2.1 Conditions of Admission**

A student who applies to the public higher education system is required to have successfully completed the secondary school (12th year of study) or to have an equivalent qualification. Besides, he/she is required to submit to an examination (which is made simultaneously at national level), specific for the course followed in the Secondary school (there are four options available). Finally, he/she has to pass specific examinations depending on the Courses he/she wishes to apply. Each examination focus on a specific subject (Maths, Physics, Chemistry, etc.).

Then he/she applies to a nation wide contest, choosing up to six courses in order of preference. The students will be ranked according to their global classification which is calculated based on the following information:

A: The classification of the 10th and 11th Grade

B: The classification of the 12th Grade

C: The classification of the Evaluation Exam

D: The classification of specific exams (each university chooses the exams which are relevant for each course - ex: for Chemical Engineering these might be Chemistry and Mathematics)

A simple formula is used to weight the different classifications in order to define each student's global ranking. Then, based on his/her preferences in terms of Universities/Courses chosen, the student will be placed in one of his six choices.

The Private Universities have diverse admission conditions. They can be as simple as having completed successfully the 12th Grade or, in very few cases, as complicated as demanding specific examinations or interviews.

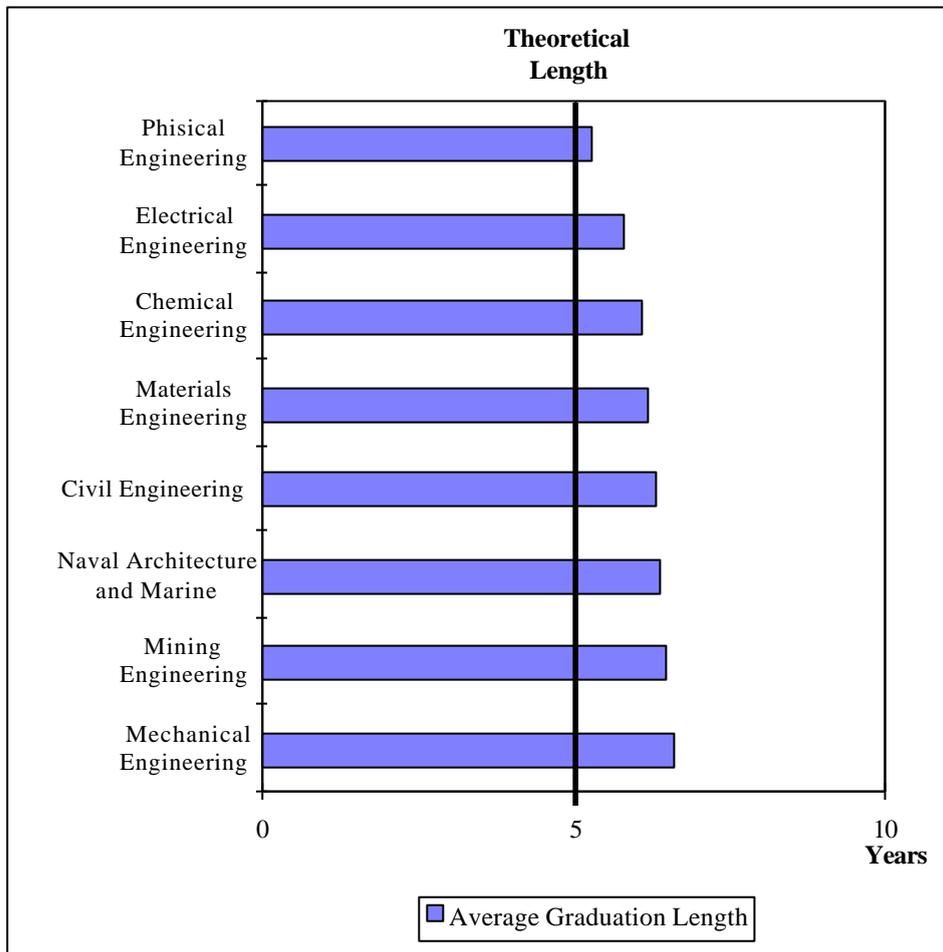
### **1.2.2 Duration of Studies and Success Rates**

All Engineering Curricula require a minimum of 5 years to be completed. Nevertheless, the average student takes between 6 to 7 years to complete the course. There are no statistics of success rate for

all the Engineering Education System. Nevertheless, we can present some data concerning the average graduation length at Instituto Superior Técnico, which is the largest Engineering Institute in Portugal, representing around 25% of the EES.

Figure 5

**Average Graduation Length at Instituto Superior Técnico-Lisbon  
from 1989 to 1991**



**1.2.3 Structure of the Curricula**

The curricula are structured in a credit system, with compulsory subjects, and a total minimum subjects required for graduation.

All the Engineering curricula at the Universities are organised in semesters, followed by examinations on all the subjects. The first 2 years ( 4 semesters) are the same, with minor differences, for all courses, and focus on basic sciences: Mathematics, Physics, Chemistry and an Introduction to Computer Sciences. The third year, is a combination of applied science to specific aspects of the course and more applied disciplines. The fourth and fifth years are specialised to the field which gives the title at graduation, and are not uniform, allowing the student to choose among several options according to his/her interests .This choice of options is made according to a sub-branch of a specialization within a more general branch. For example, at Instituto Superior Técnico, a Mechanical Engineer may choose a sub-branch of Manufacturing, Mechanical Design, Systems and Robotics or Applied Thermodynamics.

As a rule, all curricula have at least a compulsory semester of Economics and related subjects.

At the Polytechnics, the content of the basic sciences is reduced to the minimum required by the specialization to which the course is geared.

#### **1.2.4 System of Evaluation of the Students**

The evaluation system is based on written examinations, specific assignments (individual or in small groups), laboratory work, and professors' evaluation of individual performance.

Usually, the final year requires an extended individual project work, whose aim is to integrate the subjects learned during the course towards a specific objective.

#### **1.2.5 Quality Control and Quality Assessment**

There are some experiences in quality control developed by some higher education institutions, based on written inquiries to the students concerning the interest of the courses followed, the quality and competence of the teachers (in scientific and pedagogic terms) and the quality of the bibliography recommended. The results of these inquiries are then disseminated and used as internal feedback of the teachers.

Recently, a more sophisticated evaluation pilot project has started in the Portuguese Education System and has been applied to the EES. It was promoted by the Ministry of Education, the Rector's Council and the Universities Foundation, and has been implemented internally by some higher education institutions. It consists of a complete evaluation of each course in nation-wide scope (e.g.: all the courses of Civil Engineering) and focus on several aspects like success rates, performance in the labour market, quality of the academic staff, etc. Due to its recent start there is no global report to evaluate its first results. Partial results, however, as for example in Mechanical Engineering, Computer Science, Electricity, strongly suggest this approach to be a promising one.

#### **1.2.6 Background of Teaching Staff**

The academic career is quite strict in its formal requirements for promotion and a basic requirement for having tenure is to have a doctorate. In the Polytechnics, the equivalent requirement is a Master's degree.

The usual academic career starts as Auxiliary Assistant (must have at least a *licenciatura*), step which can only last two years if the equivalent of a Master's degree is not obtained in the meantime. With the equivalent to a Master's degree, one may become an Assistant Professor. He/she can only stay 8 years as Assistant Professor. The doctorate (PhD) is then required to become an Auxiliary Professor, bringing a 5 years contract and a permanent appointment afterwards if a 5 years probation period is successfully completed.

#### **1.2.7 Impact of the Community Programmes**

Community programs had a very strong and lasting effect on the whole EES, with the most noticeable effects on the institutions which already had achieved an international status. With a chronic lack of research funds, the opportunity to join EC research projects and partnerships was enthusiastically embraced with some outstanding results.

European Social Funds for training were, in the whole, a mixed blessing because of the negative side effects generated by bureaucracy and corruption.

On the whole, there is a clearly positive effect, but this must be assessed program by program, because the results are widely varying among programs and institutions.

### **1.2.8 Financing of the Institutions**

Almost every Engineering Programme is given at Public Universities, so the major source of financing comes from the yearly state budget. Since 1986, with the Portuguese membership of The European Community, there has been a great increase in investment expenses which is financed by European funds and organised in specific programmes to develop the Portuguese Educational System (PIDDAC, PRODEP). The European funds are also important to finance the R&D of the Engineering Universities (which represents more than 30% of all the Portuguese R&D). Tuition fees in the Public Institutions represent around 12% of the current expenses of the institutions.

### **1.2.9 Career Prospects**

In almost every Engineering Programme, the graduates are able to find a suitable job in less than 6 months. In some of the courses they find jobs even before they graduate. This is an indication of the lack of Engineers and technically trained people in the labour market. Nevertheless, the development of the Polytechnic Education brings some problems to the university graduates, because Polytechnic Graduates (Technical Engineers) have generally lower salaries and may be able to do some of the work formerly given to Engineers, because those jobs do not require scientific background and elaborated mental skills. These developments are positive because they tend to correct an unbalance between Engineers and Technical Engineers whose historical roots are mainly related to the relative social status of each profession.

### **1.2.10 Foreseeable Evolutions in a European Perspective**

With greater economic integration in Europe and a general evolution for value added products and services, the flexibility provided by a solid background of scientific and mental skills will always be an advantage. In a broad sense, the type of University training is required for the future development, while technically focused trained people are needed for a very wide range of present economic activities.

Portugal, in its present stage of economic and social development has more pressing needs for well trained technicians, than for ill formed engineers.

## **1.3 Polytechnic Education**

**In the school year of 1993/1994, the Public and Private Polytechnic Institutions offered 41 different specialisation in Engineering Bacharelatos, in a total of 66 Courses for 13 000 students in 20 different higher education institutions.**

### **1.3.1 Conditions of Admission**

The conditions for admission in polytechnic education are the same as for the university education. The only exception is that candidates that come from a vocational secondary school education (see Annex 1) have preferential access to 30% of the vacancies.

### **1.3.2 Duration of the Studies and Success Rates**

The Polytechnic Education gives, after three years of study, the degree of *Bacharelato*. In some of the Polytechnic institutions the students can take a specialisation that lasts two more years and receive a D.E.S.E. certificate (*Diploma de Estudos Superiores Especializados*). This certificate can be considered equivalent to a Licenciatura in certain conditions.

This course curricula is usually very intensive and the insuccess rate is higher than in the Universities. The average student takes about 5 years to obtain the *bacharelato* degree.

### **1.3.3 Structure of the Programmes**

The programmes are focused on the teaching of specific engineering skills.

Basic Engineering Sciences are only taught to the level required by the operative technical skills which are the object of the course. Curriculum is organized by semesters. To obtain the degree of *Bacharelato* a final assignment, taking approximately six months, is required.

### **1.3.4 System of Evaluation of the Students**

The system of evaluation is based on two separate exams for each subject chosen. These exams are made during the semester. In the examinations season, after the semester, the student is allowed, if he wishes or if he failed in the exams, to repeat the first /second exam or to make a final exam.

### **1.3.5 Quality Control and Quality Assessment**

The quality control is made through inquires to the students about subjects like: the number of hours per week, the classes schedule, the number of subjects, the pedagogic methods used by the teachers. This inquires are developed by the pedagogic council of each institute.

### **1.3.6 Background of Teaching Staff**

The majority of the teaching staff have at least the Licenciatura degree in Engineering or an equivalent qualification. In the Polytechnic institutions the teaching staff can progress to the ranking of Professor with a Masters Degree (they do not need a doctorate degree as the university teachers need).

While research is a fundamental characteristic in the Universities, in the vast majority of Polytechnics research is not as important and is mainly connected with direct services to the community.

### **1.3.7 Impact of the Community Programmes**

Due to their stage of development, and to their very nature, the impact of community programs has been considerably less pronounced than in the Polytechnics than in the Universities.

### **1.3.8 Financing of the Institutions**

Similar to the financing of the University Institutions (See 1.2.8)

### **1.3.9 Career Prospects**

It's not very hard for a *Bacharelato* graduate to find a job, since the labour market has a lack of technically trained people. Usually, the companies hired Engineers for those types of jobs. Nowadays, with the increasing supply of Technical Engineers (*Bacharelatos*) the companies prefer to employ them in certain type of technical jobs, because they are less payed than the *licenciados* and the job does not require sophisticated mental skills.

### **1.3.10 Foreseeable Evolution in a European Perspective**

See 1.2.10

## **2. Postgraduate Education**

### **2.1. Types**

The postgraduate sector comprises two types of programs: Postgraduate Programmes (2.2.) and Master Programs (2.3.). If the postgraduate student's main aim is to get a job in industry, he/she should choose a Postgraduate Programme. On the other hand, if the postgraduate student wants to start an academic career or to do research in a specific field, the Master Program (2.3.) is the best option.

### **2.2. Postgraduate Programmes**

#### **2.2.1. Objectives**

The main objective of the Postgraduate Programmes is to complement the education of undergraduates holding a Licenciatura or a DESE, aiming at creating skills and delivering specialised professionals and researchers.

#### **2.2.2. Conditions of Admission**

The general condition is the completion of a University degree (Licenciatura) or a DESE from a polytechnic institute. For each program there are specific conditions of admission, such as having at least a classification of 14 (out of 20) in a Licenciatura or DESE in a compatible field to the Postgraduation Program.

### **2.2.3. Contents of the Programmes**

There are programmes in a significant variety of fields (especially in natural sciences and social sciences) in a total of 56 different courses, of which only five are in engineering areas.

### **2.2.4. Organisation of the Programmes**

The Postgraduate Diploma is awarded after the successful completion of a period of lectures, normally lasting one year. In some cases the Postgraduate Program corresponds to the first stage of a Master Program. In those cases, Master students having completed only the scholar part are awarded a Postgraduate Diploma.

### **2.2.5. Impact of the Community Programmes**

See 1.2.7.

### **2.2.6. Financing of the Institutions**

In Portugal, Postgraduate Programs are awarded by public institutions. Therefore, the indirect costs are supported by the institution, which is publicly financed. The direct costs are mainly supported by student tuition fees.

### **2.2.7. Professional Recognition**

The recognition of postgraduation degree varies from field to field and from school to school. As a supply side logic still exists in the creation and development of postgraduate programs<sup>3</sup>, they are not adapted to the labour market needs and their professional value is generally low.

## **2.3. Master Degree (*Mestrado*)**

### **2.3.1. Objectives**

The main objective of the master programmes is the adequate instruction of *Licenciados* in a specific scientific area, aiming at creating competencies and educating professionals and researchers for a professional or academic career.

### **2.3.2. Conditions of Admission**

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<sup>3</sup> Prospectiva do Ensino Superior em Portugal -1995 - Instituto da Prospectiva

The general condition is the completion of a University degree (*licenciatura*), usually in a compatible field. For each Master there are specific conditions of admission, such having a minimum classification of 14 in the *Licenciatura*..

### **2.3.3. Contents of the Programmes**

The existing Master programs cover almost all fields of knowledge. Concerning engineering programs, there are 93 programs available (out of a total of 528 in all fields), all of them provided by public institutions.

### **2.3.4. Organisation of the Programmes**

The master degree is awarded after the successful completion of a period of lectures, normally lasting for one year, and after the elaboration of a dissertation in a field related to the master subject. The subjects taught are usually organized in semesters.

### **2.3.5. Impact of the Community Programmes**

The great impact for the master students from the Community Programmes comes from the R&D Projects financed by the R&D Framework Programmes (sometimes the Researchers develop their thesis in the scope of an R&D project). Another very important source of finance are the Advanced Human Resources Development Programmes, financed by the European Union. These programmes give grants to Portuguese Master Students, both in Portugal and abroad.

### **2.3.6. Financing of the Institutions**

In Portugal, Engineering Master Courses are only provided by Public Universities. Consequently, the indirect costs are supported by the institutions which are financed by the government. On the other hand, the direct costs are mainly financed by tuition fees which are generally supported by scholarships.

### **2.3.7. Professional Recognition**

In terms of academic recognition, the Master degree is very important for progression in the career. For that reason, the creation and attendance of master courses is often an internal system of the universities and has very little relation to the needs of the labour market. Given this supply side logic, the value of a Master Degree is not very high for the companies and professional experience is often preferred over what can be called an over-qualification.

## **3. Doctorate**

### **3.1 Types**

The engineering doctoral programmes in Portugal cannot be divided in different types because they all have the same kind of objectives and characteristics, defined by law. These will be described in the next sections.

## **3.2 Doctoral Programmes**

### **3.2.1 Conditions of Admission**

An applicant to a doctoral programme should have an academic degree of *Licenciatura* or some qualification considered equivalent. Usually, the applicant should have at least a classification of 14 in the *Licenciatura* (in a scale 0 to 20) to be able to apply for the doctoral programme. Besides these requirement the candidate needs a letter of recommendation from his scientific supervisor. If the candidate had a classification of 16 or higher in the *Licenciatura* he doesn't need the letter of recommendation.

### **3.2.2 Prerequisite or Simultaneous Doctoral Programme**

There is no formal course of doctorship. The doctorate is usually made under the supervision and responsibility of a professor and is up to him to recommend special courses or lectures.

The central piece of a doctorate is the Thesis, which is an extended and original research, aiming at developing the candidate's ability to conduct autonomous research.

The thesis is subject to a public examination by a jury nominated at the national level, with a minimum of 5 professors or researchers in the field, with no restriction for the participation of recognised international specialists.

### **3.2.3 Duration of the Programmes**

A doctoral programme in Engineering lasts usually four years, ending with the presentation of the doctoral thesis.

Between the years 1980-82 the average age of the completion of the Doctoral Programme in the Engineering Area was 32.9 years. Ten years later (between 1990-92) the average age had increased to 35.8 years.

### **3.2.4 Number of Students**

The number of doctorates completed in Portugal in the area of Engineering has increased steadily since the seventies. The degree, in itself, which have always been associated with the Classical Universities, was only introduced in 1957 in the Technical University of Lisbon, which still is the only Technical University in the Country.

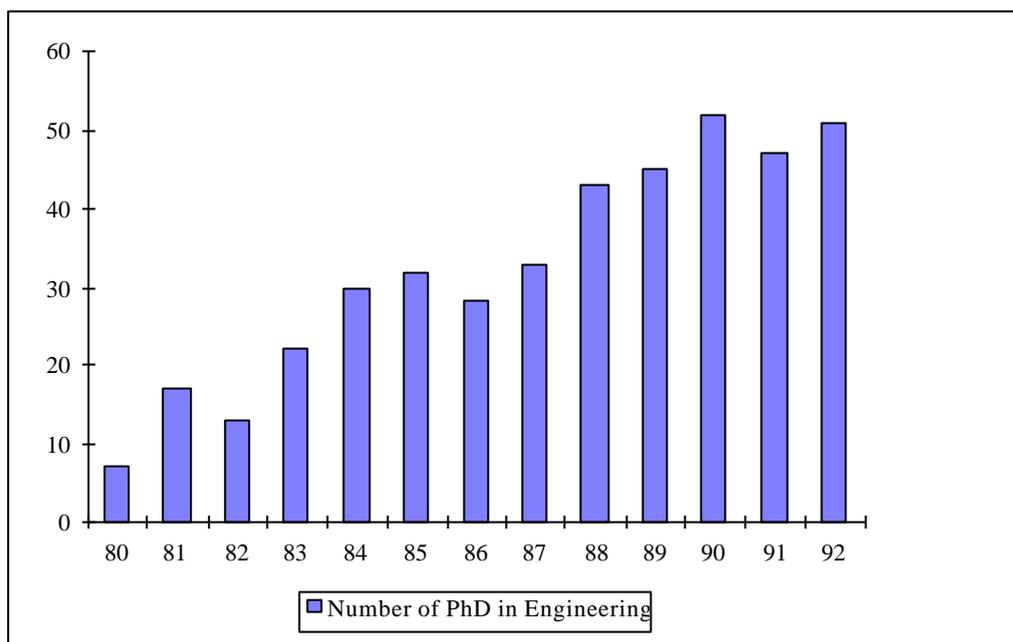
There is a complete database of all doctorates completed in Portugal for each Engineering Area between 1910 and 1992. This information can be found in Annex 3.

The Engineering Area is the one with the stronger dominance of male doctorates. From the 451 national doctorates in Engineering between 1970 e 1992, 342 were done by male students and 109 by female students. Only in the sub-area of Chemical Engineering the number of females doctorates was superior to the male doctorates.

The Doctorates of portuguese engineering students in foreign countries during that period were in the number of 391, of which 347 were made be male students and 44 by female students.

Figure 6

### Evolution of Engineering PhD Completed in Portugal



Source: Instituto da Prospectiva

### 3.2.5 Impact of the Community Programmes

The greater impact for the doctoral students from the Community Programmes comes from the R&D Projects financed by the R&D Framework Programmes (sometimes the Researchers develop their doctoral thesis in the scope of an R&D project). Another very important source of finance are the Advanced Human Resources Development Programmes, financed by the European Union. These programmes give grants to Portuguese Doctoral Students, both in Portugal and abroad.

### 3.2.6 Main Types of Financing of the Institutions

The costs of the doctoral programmes (which are not very high) are financed entirely by tuition fees paid by the students. The students usually cover that fees with the scholarships that they obtain for their doctoral work (see 3.2.5)

### 3.2.7 Professional Recognition

The completion of a Doctoral programme is the essential step for the advancement in the academic career. In terms of professional recognition, the doctorate is usually considered over-qualified for almost all jobs (his wage would have to be comparatively increased...). Professional experience is preferred to an over-academic qualification. The Doctorates generally have jobs related to consultancy and R&D and are, most of the time, connected to the University.

## **4. Continuing Education**

The postgraduate education offered by the portuguese higher education institutions is oriented for the academic career progression and not for the labour market needs. This explains the large number of Master Courses when compared to specialization courses (almost seven to one). In general terms, one may state that the creation of effective links between the University and Industry is yet to be achieved and that Portugal lacks a well defined orientation and programme for the continuing education of advanced human resources.

Due to the deficiencies of the higher education system, the market for continuing education has been explored and developed by a number of private and public institutions, independently from the higher Education system and supported by European funds. In the Engineering area however, this institutions are generally connected to the Higher Education Institution, using the resources and competences of the teaching staff.

Even in the courses offered by these institutions, the supply logic still presides at the development of the curricula and definition of subject areas. This is explained by the fact that the courses are generally financed by subsidies. If this subsidies ended it is doubtfull that the existing institutions would survive, which indicates the lack of maturity and deficient connection to the labour market of the continuing education in Portugal.

## **5. New Needs of Education and Training**

### **5.1 Noticeable Deficiencies and Gaps<sup>4</sup>**

#### **5.1.1 Evolution of the Study Subjects**

- A failure to establish postgraduate courses in areas of strategic importance for the country's economic and social development.

#### **5.1.2 Evolution of the Professions**

- A very high- ratio of Licenciatura courses offered compared to Polytechnic Education, at a timre when all labour demand data in Portugal point to the priority need to train technical students to upper-secondary education level or vocational courses and, at the higher level, to offer intense practical and vocationally-oriented training

#### **5.1.3 European Integration**

- Deficiencies in the link between research activities and education.

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<sup>4</sup> Grilo, E.M. (1993)- The Transformation of Higher Education in Portugal

- Insufficient preparation of the students for entry into higher education, especially in basic areas as Portuguese and Mathematics.

## **5.2 Prospective**

### **5.2.1 Evolution of the Study Subjects**

- Increasing distinction between the university and the polytechnic education in terms of course length and structure.

### **5.2.2 Evolution of the Professions**

- Decreasing importance of an academic degree when compared to professional experience and effective technical skills
- Increasing connection of the Universities to the labour market, through the association with interface institutions in the areas of continuing education and technology transfer.

### **5.2.3 European Integration**

- Increasing internationalisation of the Engineering higher education institutions.
- Increasing importance of the region for the development of the institutions activities (all except the largest engineering school have lost the national focus).
- Increasing flexibility and autonomy of the universities (which has a recent legal coverage) will reinforce the identity and capacity to change of the higher education institutions.

## **6. Measures to Implement to Satisfy these New Needs**

### **6.1 To Undertake in the Framework of Higher Education**

#### **6.1.1 At University Level**

- Development of new management models and information systems for the higher education institutions.
- Development of the strategic management of the institutions and improvement of the capacity to change and innovate.

#### **6.1.2 At the Level of National Public Authorities**

- Possible creation of a Ministry of Higher Education and Scientific Research. This ministry would promote the links between Higher Education and R&D and coordinate all the higher education system (which is now dependent of the Ministry of Education)
- Alteration of the legal framework concerning the academic career progression, introducing more efficiency and rationality in the system.
- Analysis and dissemination of all information concerning the admission to higher education (average of candidates, secondary school of origin, etc) and creation of a system to measure the performance of the universities. The objective is to develop the notion that the higher education institutions are competitors, fighting for the best students, R&D projects and teachers. This notion will create an incentive to quality and efficiency of the whole education system.
- Increase in the national mobility of the higher education students through better information and financial aid to the best students.

### **6.1.3 At Community Level**

- Development of a programme of international traineeships for last year students or new graduates.

## **6.2 To Undertake in the Framework of Continuing Education**

### **6.2.1 At University Level**

- Development of partnerships with companies, associations and education institutes to promote continuing education.

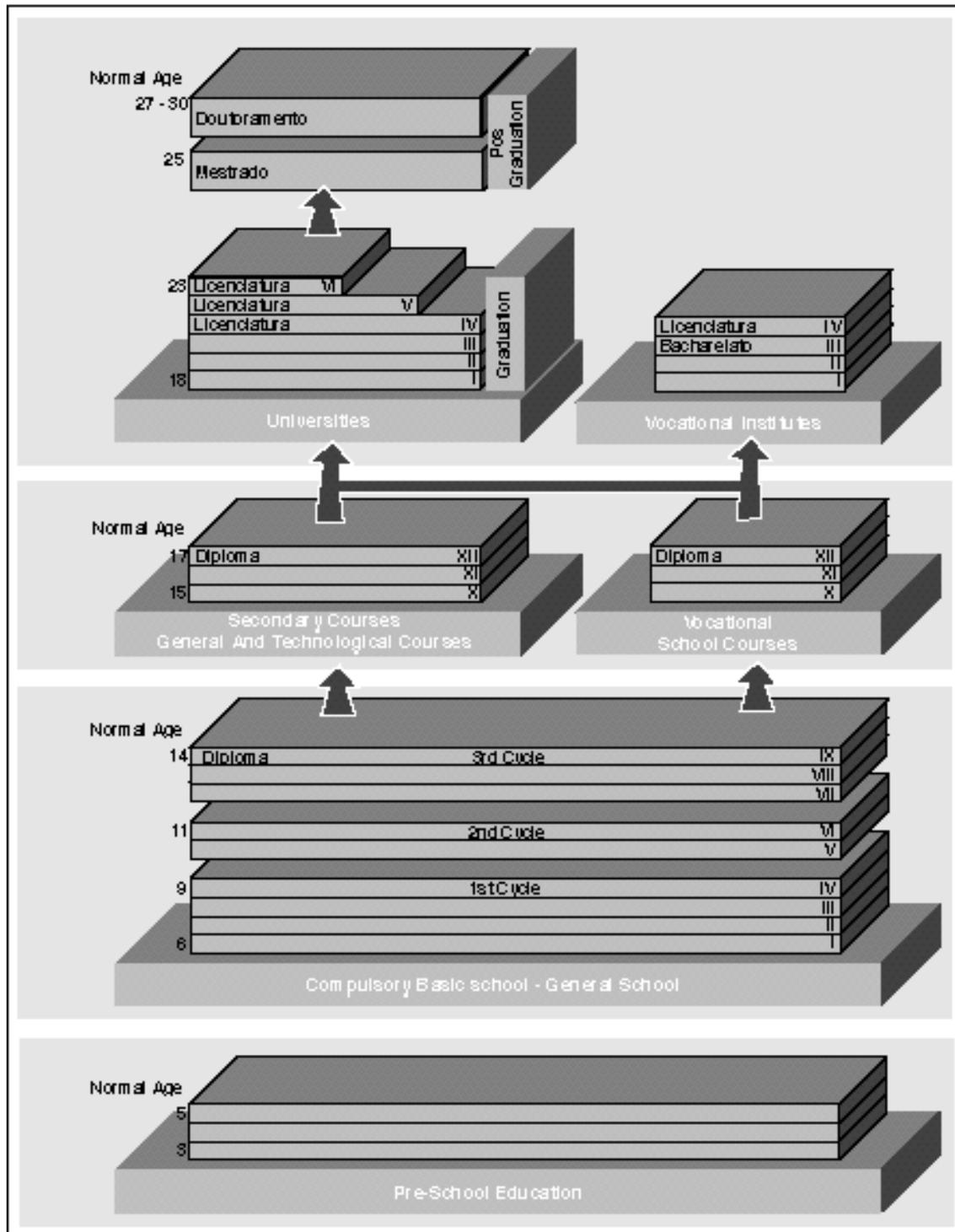
### **6.2.2 At the Level of National Public Authorities**

- Development of surveys, at national level, to identify the needs in terms of continuing education. Dissemination of the results.

### **6.2.3 At Community Level**

- Characterisation of the European situation in terms of continuing education.
- Development of programmes to support the University-Industry cooperation.

## Annex 1: The Education System in Portugal



**Annex 2: Evolution of PhD Completed in Portugal between 1910 and 1992 in Each Engineering Area**

PhD Areas	40-50	50-60	60-70	70-80	80-90	80	81	82	83	84	85	86	87	88	89	90	91	92	Total
Mining Engineering		2	4	1	14	1	1	1		4	1	1	1	1	3	3		1	25
Materials Engineering		1	1	1	6			1	1			1	1	1	1	4	1		14
Chemical Engineering		1	3	9	63	3	8	1	8	5	8	6	11	4	9	8	11	7	102
Mechanical Engineering			3	3	28	1	1			1	7	4	2	6	6	8	7	6	55
Civil Engineering	4		7	9	44		4	2	3	5	5	7	6	7	5	6	3	12	85
Electrical Engineering	3	4	5	2	75	1	2	6	7	9	8	4	10	17	11	15	12	16	132
Electronic Engineering		2			1						1						1		4
Transportation Engineering				1	0														1
Other		1		4	39	1	1	2	3	6	2	5	2	7	10	8	12	9	73
<b>Total</b>	<b>7</b>	<b>11</b>	<b>23</b>	<b>30</b>	<b>270</b>	<b>7</b>	<b>17</b>	<b>13</b>	<b>22</b>	<b>30</b>	<b>32</b>	<b>28</b>	<b>33</b>	<b>43</b>	<b>45</b>	<b>52</b>	<b>47</b>	<b>51</b>	<b>491</b>

Source: Instituto da Prospectiva

## **Bibliography**

- Instituto da Prospectiva, 1995 - *Prospectiva do Ensino Superior em Portugal* (Portuguese Higher Education Prospective)
  
- Grilo E. M., 1993 - *The Transformation of Higher Education in Portugal* - in: Higher Education in Europe, Edited by Claudius Gellert, JKP
  
- Miranda M. T. L., Caseiro T., 1994 - *Panorama do Ensino de Engenharia em Portugal e do Desempenho do IST* (Overview of the Engineering Higher Education in Portugal and the Performance of Instituto Superior Técnico), SAEG and GEP - Instituto Superior Técnico
  
- Ministry of Education: Department of Higher Education - Statistics
  
- Conceição P., Durão D., Heitor M., 1994 - *Posicionar o Instituto Superior Técnico para o Início do Século XXI* (Positioning IST for the beginning of the XXI Century), Instituto Superior Técnico