Instituto Superior Técnico

ANNUAL REPORT AND ACCOUNTS

- 1994 -

VOLUME I

Preface

The Annual Report of the *Instituto Superior Técnico* for the calendar year 1994 presents its activities in the three areas in which it operates, namely Teaching, Research and Development, and Links with Society.

The first volume, divided into ten chapters, presents an overall view of the IST's activities carried out in 1994, together with the accounts related to those activities. Volume 2 presents reports on the activities of the Departments, Autonomous Sections and Research Centres of the IST. Lastly, Volume 3 presents a summary of the main decisions taken in 1994 by the Central Administrative Bodies, reports on the activities of the support units, offices and technical support services, in addition to summarised reports from collaborating institutions.

The Board of Directors acknowledges the support provided by the Planning and Studies Office in the preparation of this report. The content of volumes 2 and 3 is the responsibility of the various units and bodies involved.

CONTENTS - VOLUME I

1. MAIN INDICATORS

1.1. HUMAN RESOURCES

Number of Teachers (FTE)	Jan/94	866.8
	Jun/94	861.1
	Dec/94	842.6
Number of Non-teaching Employees		
Staff Members	Jan/94	385
	Jun/94	378
	Dec/94	387
Requisitioned and Seconded Personnel	Jan/94	6
	Jun/94	58
	Dec/94	58
Other Contracted Personnel (on ADIST Contracts)	Mar/94	46
	Jun/94	57
	Dec/94	91
Total Staff	Jan/94	442
	Jun/94	493
	Dec/94	536
IST Research Scholarship Students		
Number of Contracts initiated	1994	132
Number of Contracts concluded	1994	83
Total Number of Research Scholarship Students	Dec/94	132
Other Scholarship Students (JNICT)		

Number of Master's Students	Dec/94	63
Number of Doctorate Students	Dec/94	112

Ratio of Non-teaching Staff to Teachers (FTE)	Mar/94	44.1%
	Jun/94	43.2%
	Dec/94	45.6%
Ratio of Professors to Teachers (FTE)	Mar/94	52.1%
	Jun/94	53.6%
	Dec/94	56.7%

1.2. INFRASTRUTURE

Area of Classrooms and Amphitheatres	10,286m2
Area of Study Rooms and Libraries	3,045 m2
Area of Laboratories, Workshops and Computer Rooms	15,256 m2
Area of Students' Union (AEIST) Building and Document Section	4,498 m2
Area of AEIST Gymnasium, Swimming Pool and Sports Fields	3,108 m2
Area of Post-graduate Gymnasiums	317 m2
Area for Social Gatherings and Cafeterias	970 m2
Area of Museums	630 m2
Area of Offices	10,392 m2
Area of Secretariats and Meeting Rooms	2,916 m2
Total University Campus Area	84,338 m2

Ratio of Area of Classrooms, Study Rooms, Amphitheatres and Libraries per Undergraduate Student	1.74 m2
Ratio of Area of Classrooms, Study Rooms, Computer Rooms, Amphitheatres, Libraries, Laboratories and Offices per Undergraduate Student	3.75 m2
Ratio of Area of Offices, Secretariat and Meeting Rooms per FTE Teacher (Dec/94)	15.80 m2

Ratio of Area of Offices, Secretariat, Meeting Rooms, Libraries and Computer Room per FTE Teacher 22. 20 m2

1.3. FINANCIAL RESOURCES (millions of escudos)

Expenditure (excluding construction and repairs)	
Total Expenditure	9,449
Expenditure on Staff	5,433
Operating Expenditure	2,885
Tangible Fixed Assets (Gross Assets)	
Land	2,393
Buildings	10,567
Basic Equipment	4,337
Administrative and Other Equipment	196
Books	196
Other	201
TOTAL	17,890
Total Amortisations (excluding land)	1,132
Total Investments in 1994 (Construction/Repairs and Equipment)	852
Supply of Services and Development Grants	
State Budget	5,386
Structural Funds (PRODEP - training)	143
Own Income (JNICT)	254
Own Income (EC)	1,026
Own Income (Portuguese and other projects)	1,364
Secretariat (Fees)	402
TOTAL	8,575
Management Indicators	
Ratio of Staff Expenditure (State Budget) to Total (State Budget)	0.91
Ratio of Staff Expenditure to Total Expenditure	0.58
Ratio of Investments to Fixed Assets	0.05
Ratio of State Budget Funding to Total Income	0.58

Ratio of State Budget Funding to Total Profits and Supply of Services	0.63
Ratio of Structural Funds to Total Funding	0.02
Ratio of Funding from Community Projects to Total Funding	0.12
Ratio of Funding from JNICT to Total Funding	0.03

1.4. TEACHING ACTIVITIES

1.4.1. Undergraduate

Numerus Clausus	93/94	1,225
	94/95	1,195
Undergraduates	93/94	7,863
	94/95	7,635
Total Admissions	93/94	1,536
	94/95	1,407
First Year Students, first time enrolments	93/94	1,326
	94/95	1,307
Students admitted in their first option	93/94	80 %
	94/95	80 %
Students admitted in their first two options	93/94	92 %
	94/95	92 %
Number of Graduates		
(Requests for Graduation Certificates - *Cartas de Curso*)	1993	564
	1994	756
Undergraduate Courses offered	93/94	14
	94/95	14
Number of Disciplines offered	94/95	810

1.4.2. Post-Graduate

First time enrolments for Master's Degrees	93/94	206
	94/95	236
Total Number of Students for Master's Degrees	93/94	776
	94/95	897
Masters	1993	148
	1994	133
Master's Courses offered	93/94	16
	94/95	16
Doctorates started	1993	81
	1994	144
Doctorates awarded	1993	58
	1994	44
Aggregations	1993	10
	1994	8

1.4.3. INDICATORS

Ratio of Undergraduates to Teachers (FTE)	Dec/94	9.06
Ratio of Students (Undergraduates and first time enrolments for Master's Degree) to Teachers (FTE)	Dec/94	9.35
Ratio of Undergraduates to Professors (FTE)	Dec/94	15.98
Ratio of Students (Undergraduates and first time enrolments for Master's Degree) to Professors (FTE)	Dec/94	16.50
Ratio of Students (Undergraduate, Master's and Doctorate)		

to Teachers (FTE)	Dec/94	10.35
Ratio of Undergraduates to Non-teaching Staff	Dec/94	14.38

1.5. R&D ACTIVITIES

1.5.1. Publications

Books published and edited	14
Articles in Scientific Journals and Books	385
Conference Papers	602
Ratio of Articles to FTE Professors (Dec/94)	0.80
Ratio of Total Publications to FTE Professors (Dec/94)	2.09

1.5.2. Projects

Research Projects started in 1994	
Funded by JNICT	15
Funded by the European Union	53
Funded by Portuguese companies	14
Research Projects in progress	
Funded by JNICT	85
Funded by the European Union	139
Funded by Portuguese companies	35

2. PUBLICATION OF THE "ist" BOOK

As part of the activities to commemorate the fiftieth anniversary of the death of Duarte Pacheco, a book of photographs by Augusto Alves da Silva, with text by Professor Jorge Calado, was published in 1994. This initiative comes within the framework of the IST's overall strategy to support and promote cultural initiatives, linked to the *Técnico*, which have a large impact on Portuguese society.

(To be taken from English version in book)

" Uma fotografia, tal como uma palavra, pode ser o princípio dum projecto. Em 1993 0 Instituto Superior Técnico já não era o campus de Pardal Monteiro nem a pedagogia era a de Bensaúde. A população da Escola decuplicara, as cinco engenharias tradicionais (electrotécnica, mecanica, civil, química e minas) tinham-se fragmentado para pósmodernamente se recombinarem, a investigação científica passara a motor de desenvolvimento. Hoje assiste-se ao maior programa de expansão e reconstrução do Instituto desde a época de Duarte Pacheco e Pardal Monteiro. O tempo é de mudança e a hora de balanço. Homenagear Duarte Pacheco é também meditar no que somos, e investigar como convivemos uns com os outros e nos relacionamos com os edifícios e com o caos exterior. Daí a encomenda a Augusto Alves da Silva para fotografar a vida no Instituto regularmente durante quase ano e meio - de Fevereiro de I993 a Julho de I994, para ser preciso. Nunca em Portugal se desenvolveu um projecto fotográfico de tal escopo e duração. Sem constrangimentos censórios ou recomendações de qualquer espécie, Alves da Silva fotografou com total liberdade criativa as grandes construções e as pequenas obras; registou as aulas e os exames, o estudo nas bibliotecas e a investigação nos laboratórios bem como os lazeres nos espaços verdes e o desporto na Associação de Estudantes; observou a rotina dos registos e arquivos e também as impaciências da segurança; seguiu a carreira do estudante desde a humilhação das praxes ao caloiro até à alegria foguetória do finalista."

Quoted from the introduction by Prof. Jorge Calado to the book "ist"

"ist, by Augusto Alves da Silva, is the best book of photographs to be published in Portugal since Victor Palla and Costa Martins did "Lisboa, Cidade Triste e Alegre" ("Lisbon, City of Sadness and Joy") in 1959."

Alexandre Pomar, *Expresso*, 14 January 1995

"The new year has begun in the best possible way for (the art of) photography in Portugal. After eighteen months' work, the long-awaited book from Augusto Alves da Silva on the *Instituto Superior Técnico*, part of the activities to commemorate the fiftieth anniversary of the death of Duarte Pacheco, burst shiningly upon the public like a flawless pearl. The photographs are excellent, and the text by Jorge Calado on the Institute and its two great creators, Alfredo Bensaúde and Duarte Pacheco, as well as on the photographic work itself, would enlighten any reader with its presentation of facts, critical references, and opinions in an informal, yet elegant and sober style... The book is bilingual... don't miss it !"

António Cerveira Pinto, *O Independente*, 20 January 1995

"ist is the name of a successful project... If *ist* faithfully records the history of a building and a school (the "*Técnico*"), it is because the (photographic) discourse woven around it does not succumb to facile eulogy, or anachronistic romanticism... The images... allow us to glimpse, with absolute clarity, the web of images and relations (the routine, the dreams, the trials and tribulations, agreements and disagreements) to which a powerful institution like the *Técnico* is prone."

Margarida Medeiros, *O Público*, 20 May 1995

"a documentary which raises questions about the potential and styles of photographic representation..., opening up a vast range of possibilities of seeing more clearly."

Alexandre Pomar, *Expresso*, 20 May 1995

"a work which is a kind of overall portrait of the IST, built around photographs."

Isabel Carlos, *Expresso*, 27 Maio 1995

"ist, in which every situation and object seems to take on equal dignity through being photographed."

Carlos Vidal, *A Capital*, 1 June 1995

"over a period of a year and a half, he set out to capture the pulse of a complex with a life of its own : moments of leisure, laboratories and classrooms, offices, doors and staircases, green spaces, run-down corners and glimpses of construction work being carried out there, graffiti on the walls."

Leonor Nazaré, *Expresso, 17* June 1995

3. GENERAL FRAMEWORK OF ACTIVITIES AND STRATEGIC ORIENTATION

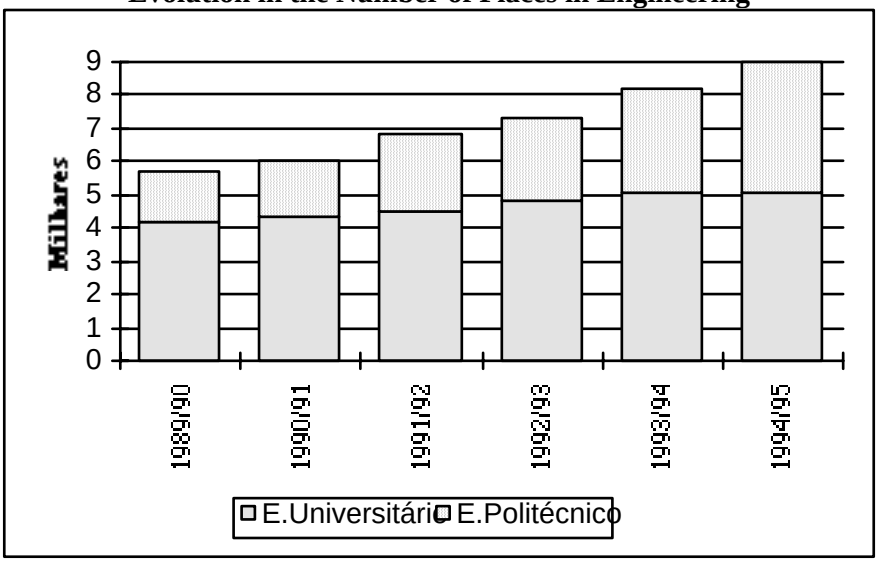
3.1 GENERAL FRAMEWORK OF ACTIVITIES

Portugal has caught up to its partners in the European Union and OECD in respect of the level of education of the population. Data from the OECD* show that in 1991 the percentage of the population between the ages of 25 and 64 with a university education was 5%. These indicators do not yet take into account the expansion of the system of higher education that has been seen as a result of the increase in supply that has occurred in Portugal. Between 1987 and 1993, the number of students matriculating from school increased at an average annual rate of 14.9%; during this period, the number of students in higher education doubled, around 250,000 students being enrolled in 1992. This increase was mainly due to the increase in the number of student places in private education, which has grown at an average annual rate of 29.5%.

Figure 1 shows the increase in the number of places in the engineering field in state universities and polytechnics. In 94/95, the total number of places in private and state higher education in the engineering field was 11,145, of which 2,150 were in private or co-operative higher education establishments.

Figure 1

Evolution in the Number of Places in Engineering



Thousands Universities Polytechnics

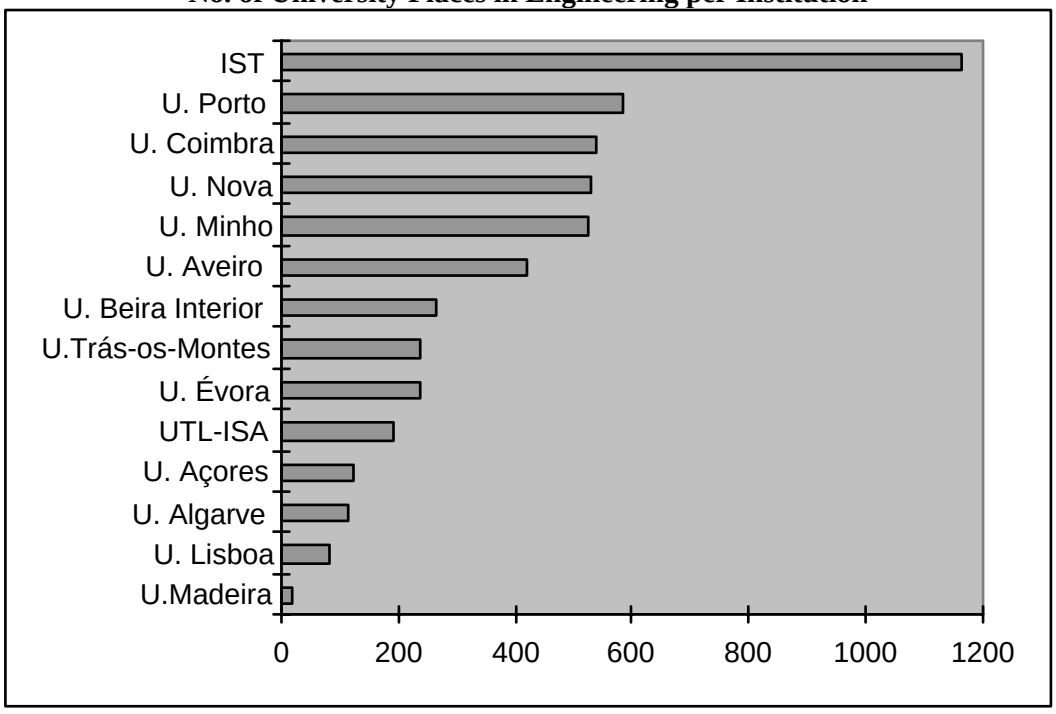
* *Education at a Glance*, OECD, 1995

As far as education in the engineering field is concerned, the number of places available in 93/94 represented around 12% of the total number of places in higher education, 7% in the university sector and 5% in the polytechnic sector. The increase in the number of engineering courses was mainly due to the expansion of polytechnic education since the number of university courses has increased at a considerably lower rate.

It should be noted, however, that the overall trend in higher education* towards a surfeit of supply does not apply to the engineering field. In 94/95, as has been the case in previous years, there were no unfilled places on the engineering courses offered by the five most important universities in this field (IST, FCT - UNL (Science and Technology Faculty of the New University of Lisbon), FCT - UC (Science and Technology Faculty of the University of Coimbra), FE - UP (Engineering Faculty of the University of Oporto) and the University of Aveiro). In other words, the number of applicants for these courses far exceeds the number of places available. Figure 2 shows the number of university places in engineering per institution, from which it can be seen that the IST offers 23.1% of the total number of places available nationally.

Figure 2

No. of University Places in Engineering per Institution



* Proposed Guidelines for the Development of IST, Planning and Studies Office, 1994

The following tables show the position of the IST within the national context, in terms of the number of undergraduate and Master's degree courses taught respectively. They also show the particular characteristics which make the IST stand out from the overall picture of university education in Portugal, notably in respect of the diversity of technological areas covered. The position of the IST is also confirmed by the analysis of admissions shown in section 4.1.1.

Table 1
Undergraduate Courses Offered by the Main Engineering Schools in Portugal (1993/94)

	IST	FE UPorto	FCT UC	FCT UNL	U. Aveiro
Aerospace Engineering	•				
Environmental Engineering	•			•	•
Civil Engineering	•	•	•	•	
Naval Architecture and Marine Science	•				
Electrical and Computer Engineering	•	•	•	•	•
Technological Physics Engineering	•		•	•	•
Engineering and Industrial Management	•	•		•	•
Computer Science and Engineering	•	•	•	•	
Mechanical Engineering	•	•	•	•	
Materials Engineering	•	•	•	•	•
Mining Engineering	•	•	•		
Chemical Engineering	•	•	•	•	
Territorial Engineering	•				
Applied Mathematics and Computer Science	•		•	•	
Others			10 ii)	2 iii)	
Total Number of Undergraduate Courses	14	8	19	12	5 i)
Total Number of Students	7,863	4,004	6,997	3,291	2,488*

Source: Students enrolled in Higher Education, Dept. of Higher Education, Ministry of Education
i) Engineering or related courses only.
ii) Anthropology, Architecture, Biology, Biochemistry, Geographical Engineering, Geological Engineering, Geology, Chemistry, Industrial Chemistry, and Physics.
iii) Geographical Engineering and Applied Chemistry.

Table 2
Master's Courses offered by the Main Engineering Schools in Portugal (1993/94)

	IST	FE U. Oporto	FCT U. Coimbra	FCT New U.L.	U. Aveiro
Biotechnology (Biochemical Engineering)	•				
Construction	•				
Electrical and Computer Engineering	•	•			•
Naval Engineering	•				
Structural Engineering	•	•			
Materials Engineering	•	•		•	•
Mechanical Engineering	•	•	•		
Chemical Engineering (Processes & Industry)	•				
Chemical Engineering (Applied Chemistry)	•				
Physics	•				
Hydraulics and Water Resources	•				

Operational Research & Systems Engineering	•				
Applied Mathematics	•		•		
Mineralogy and Mining Planning	•	•			
Regional and Urban Planning [i)]	•				
Marine Environment Ecology, Management & Modelling	•			•	
Others			5 [ii)]	12 [iii)]	6 [iv)]
Total Number of Master's Courses	16	5	7	14	8
Number of Master's Students (First Year Enrolments)	238	108	150	126	72

Source: Students enrolled in Higher Education, Dept. of Higher Education, Ministry of Education
i) UTL (Technical University of Lisbon) Inter-Schools.
ii) Civil Engineering, Cellular Biology, Animal Ecology, Geosciences and Systems, and Information Technology.
iii) Education Sciences, Sanitary Engineering, Statistics, Geology of Engineering, Materials Management and Quality, Soil Mechanics, Food Technology, Industrial Engineering, Computer Science, Territorial Planning, Organic Chemistry, and Instrumentation.
iv) Supervision, Geochemistry, Physics and Chemistry Education, Paper Technology, Coastal Zone Sciences, and Education Sciences.

Within a European context, Table 3 shows the position that the IST occupies, in terms of numbers of graduates (equivalent to Portuguese *licenciatura*) and post-graduates, compared to some of the main European engineering schools, .

Table 3
Number of Students in some European Universities

	Total No. of Students		*Licenciatur* Equiv. *a* equivalent		Post-Grad. Equiv.	
	Number	% Sc&T	Number	% total	Number	% total
IST	8,717	100	7,635	87.4	1,082	12.4
Oxford, UK	14,271	40	10,407	73.0	3,864	27.0
Cambridge,UK	13,935	48	10,217	73.4	3,718	26.6
Imp. College, UK	7,049	95	4,740	67.3	2,309	32.7
UCL, UK	9,647	55	7,375	76.5	2,272	23.5
Warwick, UK	8,424	30	6,746	80.1	1,678	19.9
NTH, Norway	7,509	100	6,737	89.8	772	10.2
KTH, Sweden	8,800	100	7,500	85.3	1,300	14.7
Chalmers TH, Sweden	7,048	100	6,106	86.7	942	13.3
INPG, France	1,215	100	733	60.4	482	39.6

Source: Studies of Universities, Studies and Planning Office, IST

Note: %Sc&T - proportion of students in the field of science and technology.

Figure 3 shows those courses leading to the award of degrees equivalent to a *licenciatura*, in the areas of science and technology. The data show that the IST offers a wide range of first degree courses, which places it in a prominent position even in relation to other prestigious European universities, as a result of the quantity and diversity of disciplines. In large European universities, post-graduate education plays a significant rôle, due in part to their ability to attract students from a wider range of countries.

Figure 3

First Degree Courses or Equivalent Offered by the Main European Engineering Schools

Engineering Field	IST	UCL UK	DTH Den	UPC Sp	UPM Sp	INPG Fra	Fourier Fra	Tor Italy	NTH Nor	Delft Hol	Camb. UK	Oxf. UK	KTH Swe	CTH Swe
Aeronautics/Aerospace	■							■		■				
Environment	■		■		■			■			■	■		
Civil	■	■	■	■	■		■	■	■	■	■	■	■	■
Electrical/Electronics	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Physics	■	■			■	■	■		■	■		■	■	■
Industrial Management/Production	■					■	■	■	■		■	■	■	■
Computer Science	■	■		■	■	■	■	■		■	■		■	
Mechanical	■	■	■		■	■	■	■	■	■	■	■	■	■
Metallurgical/Materials	■	■	■		■			■	■	■	■		■	■
Mining	■	■								■				
Naval/Maritime Science	■			■					■	■				
Energy/Nuclear/Oil			■				■	■		■				
Chemistry	■	■	■			■	■	■	■	■			■	■
Territorial	■				■			■		■		■		
Mathematics	■	■			■				■	■				
Architecture		■		■	■			■	■	■		■	■	■
Natural Sciences and Physics					2							1		
Others				1	6	1				4		4	2	1
TOTAL	**14**	**10**	**7**	**7**	**19**	**8**	**7**	**13**	**9**	**13**	**6**	**7**	**11**	**9**

Source: Studies of Universities, Studies and Planning Office, IST.

3.2. STRATEGIC ORIENTATION

Following on from the strategic orientation pursued in 1993, in which emphasis was placed on strengthening the reputation and prestige of the *Técnico* by carrying out restructuring operations which would contribute to the sustained development of the institution, the IST's strategic orientation in 1994 has followed the same principle: to consolidate reforms which have an impact on the pursuit of its basic objectives of greater efficiency and effectiveness in carrying out the activities of the IST. In order to put this strategy into effect, the IST's actions have concentrated on two main areas:

- To improve the quality of teaching, mainly through new infrastructures coming into operation;

- To consolidate administrative reform.

With regard to the first point, the main contributing factor was the new buildings, construction of which was completed in 1993, becoming fully operational. In fact, this aspect is essential to the IST's aim of developing as an educational centre of excellence. The allocation of quality spaces for classrooms and other teaching activities was a priority in 1994, in parallel with the progressive elimination of classes in pre-fabricated buildings. In addition to the new conditions for teaching activities, spaces were also created for teachers (offices), research, and lastly, for leisure and recreational activities. In this way, the aim was to construct a university campus on a par with the best universities in the world, creating a healthy environment to fulfil the expectations and requirements of the IST's students, teachers and administrative staff.

The second point, consolidation of administrative reform, represents the continuation of efforts to modernise the organisational and financial structure. The work begun in 1993 continued with a view to a clearer definition of the allocation and use of resources, improvements in the quality and efficiency of services, and a reduction of unnecessary bureaucratic procedures. Administration, which traditionally has received little attention, being consigned to a minor role in university life, is taking on an increasingly important role insofar as university institutions are required to work to a combination of rules, behaviours and results in line with practices in business organisations. This new requirement, besides entailing structural reform of organisational and administrative procedures, has brought to the present administration of the IST a better allocation of resources and skills. In this way, it is intended to provide the central administration of the IST with the necessary capabilities and means to respond effectively and efficiently to the demanding challenges of the future.

4. ACTIVITIES

The presentation of the IST's activities in 1994 is structured according to the three areas of university activity: Undergraduate and Post-graduate Teaching, Research and Development, and lastly, Links with Society.

The presentation of graduate teaching is organised in two parts. The first, point 4.1, deals with aspects related to the general functioning of teaching at the IST, broken down into aspects related to admission to the IST (Section 4.1.1.) and a general description of undergraduate teaching (Section 4.1.2.), plus a detailed description of the 14 undergraduate courses. Section 4.1.3. shows the main results of the evaluation of undergraduate courses.

Point 4.2, the presentation of post-graduate teaching, is divided into three parts: Master's courses (Section 4.2.1), doctorates (Section 4.2.2), and other post-graduate activities (Section 4.2.3).

4.1. UNDERGRADUATE TEACHING

4.1.1. Admission to the IST

General Admission Procedure

The *Instituto Superior Técnico* offered a range of 14 undergraduate courses in the academic years 93/94 and 94/95, with 1,225 and 1,195 places available respectively.

Table 4 shows the evolution of *numeri clausi* in regard to undergraduate teaching at the IST, which confirms the policy of stabilising the IST's student numbers as set out in the Activity Plans for 1994 and 1995.

Table 4
Undergraduate Courses at the IST

Undergraduate Courses	***Numeri Clausi***			
	1991/92	**1992/93**	**1993/94**	**1994/95**
Civil Engineering	171	171	175	175
Electrical and Computer Engineering	240	240	240	240
Technological Physics Engineering	45	45	45	45
Industrial Engineering and Management	40	40	30	30
Computer Science and Engineering	200	200	200	200
Mechanical Engineering	175	175	175	175
Metallurgical and Materials Engineering	50	50	30	30
Mining Engineering	25	25	25	25
Naval Architecture and Marine Science	40	40	30	30
Chemical Engineering	116	116	120	120
Applied Mathematics and Computer Science	50	50	50	30
Territorial Engineering	40	40	40	30
Aerospace Engineering	--	30	35	35
Environmental Engineering	--	--	30	30
TOTAL	**1,192**	**1,222**	**1,225**	**1,195**

Table 5 shows the main indicators which give a general picture of admissions to the IST in 1993/94 and 1994/95*. The total number of applicants in 1994 increased by 3.1% compared to the previous year, the occupancy rate being maintained.

Table 5
Main Indicators of Admissions to the IST in 1993/94 and 1994/95

	93/94	94/95
Places	1225	1195
Occupancy Rate	100%	100%
Total Number of Applicants	8 305	10 919
% of General Quota Places	90.8%	90.8%
Average Application Mark	66.7%	63.5%
Average General Entrance Exam Mark	81.0%	59.2%
Specific Maths Exam Average	54.3 %	51.5%
Specific Physics Exam Average	50.7 %	54.0%
Specific Chemistry Exam Average	-	31.0%
11th Year Average	15.3	15.7
12th Year Average	16.1	16.0

Table 6
Distribution of Students Admitted per Admission Quota

Admission Quota					
General	Azores	Madeira	Macao	Emigrant	Military
1085	26	40	9	14	21
90.8%	2.2%	3.3%	0.8%	1.2%	1.8%

In 1994, the average application marks (*notas de seriação* - a combination of school exams, General Entrance exam, and specific exams) of students admitted was similar to that in 1993, although the average General Entrance examination (*prova de aferição*) marks were considerably lower. Figures 4 and 5 show the evolution of the distribution of placement options and in the distribution of students placed per application option in 1994.

Figure 4

Distribution of Placement Options

Unfilled
¤ 3rd
2nd
1st

* (Source: Description of Admissions to the IST in 1994/95, Studies and Planning Office)

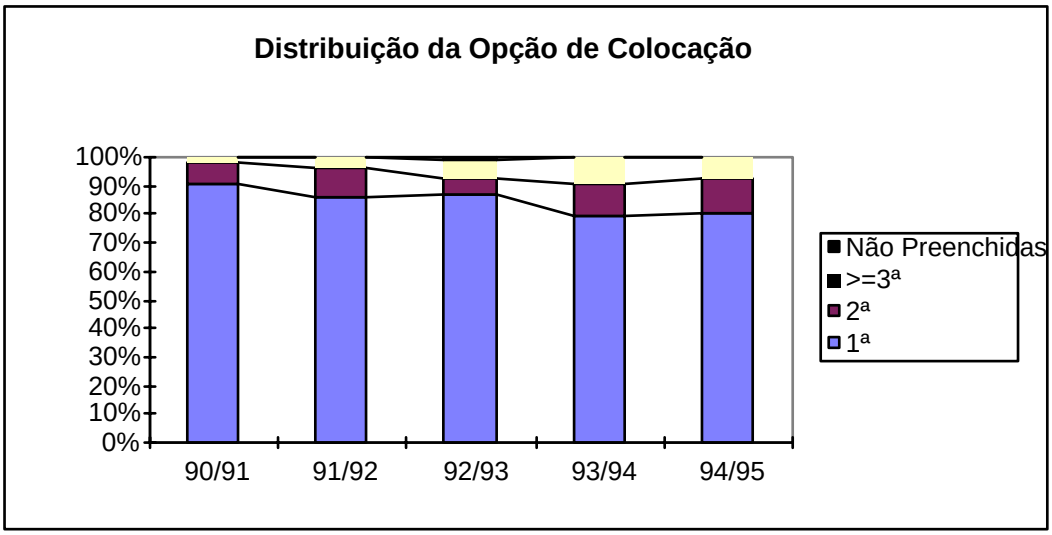
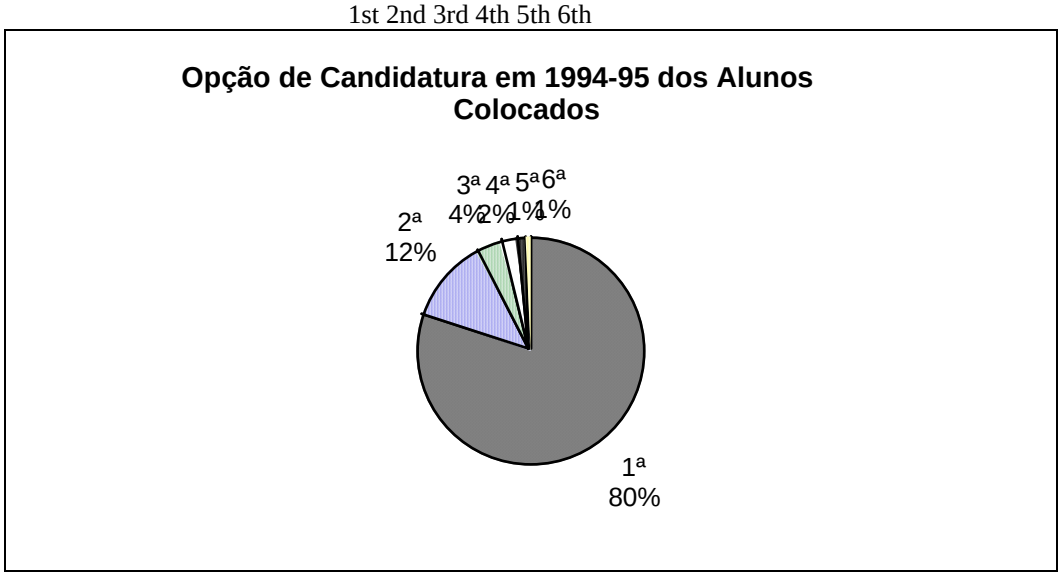


Figure 5

Application Options in 1994-1995 of Students Placed
1st 2nd 3rd 4th 5th 6th



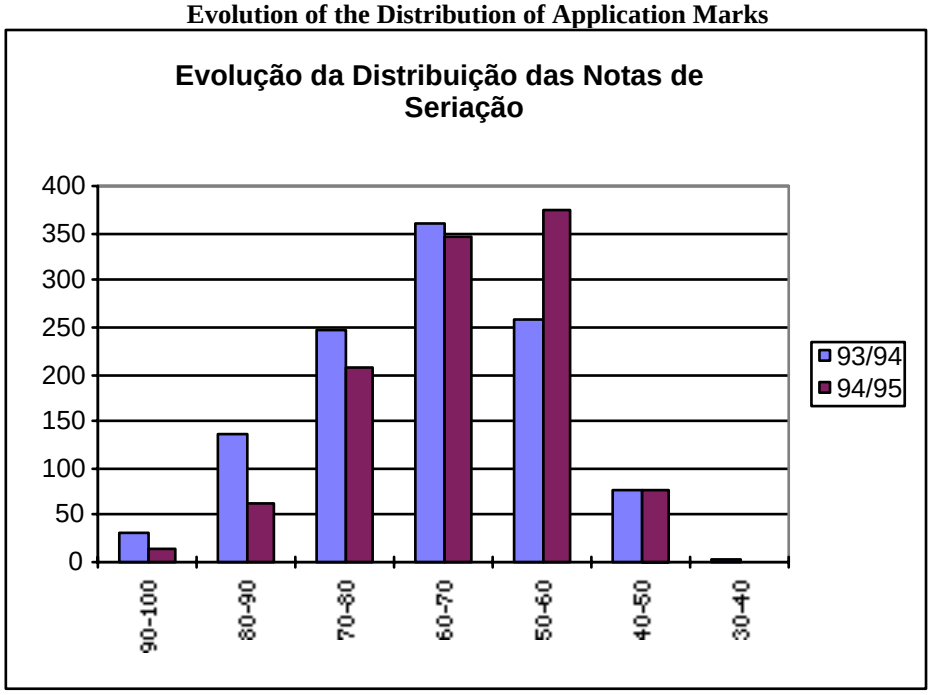
The distribution of placement options in 1994 shows a similar structure to that of 1993, with approximately 80% of students placed in their first option. This figure should be borne in mind when analysing admissions to higher education at the national level, as it confirms the special nature of the IST. In fact, in the 1993/94 figures, the national average of first option admissions was only 55%. Furthermore, analysis of admissions leads to the conclusion that for the vast

majority of undergraduate courses taught at the IST, applicants placed at the *Técnico* gain the highest marks in the various entrance examinations.

In 1994/95, the specific mathematics examination was taken by all students, 53% obtaining a mark of more than 50%. Around a quarter obtained marks between 50 and 60%, 30% had marks higher than 60%, and 14% had marks higher than 70%. The specific physics examination was taken by 971 of the students placed, 60% obtaining a mark of more than 50%, 37% with marks higher than 60% and 18% with marks higher than 80%. The chemistry examination was taken by 85 of the students placed, only 5% obtaining a pass mark (more than 50%).

As regards the application examinations, the bar chart below quantifies the distribution of marks of students placed at the IST. In fact, while in the 40-50% range the number of students was similar to 1993/94, the proportion of students in the 50-60% range increased by 49% compared to the previous year; whereas there was a reduction of over 50% in the ranges 80-90% and 90-100%. Nevertheless, the data show that students placed at the IST perform well at secondary school, with a final average mark in their 12th year of 16/20.

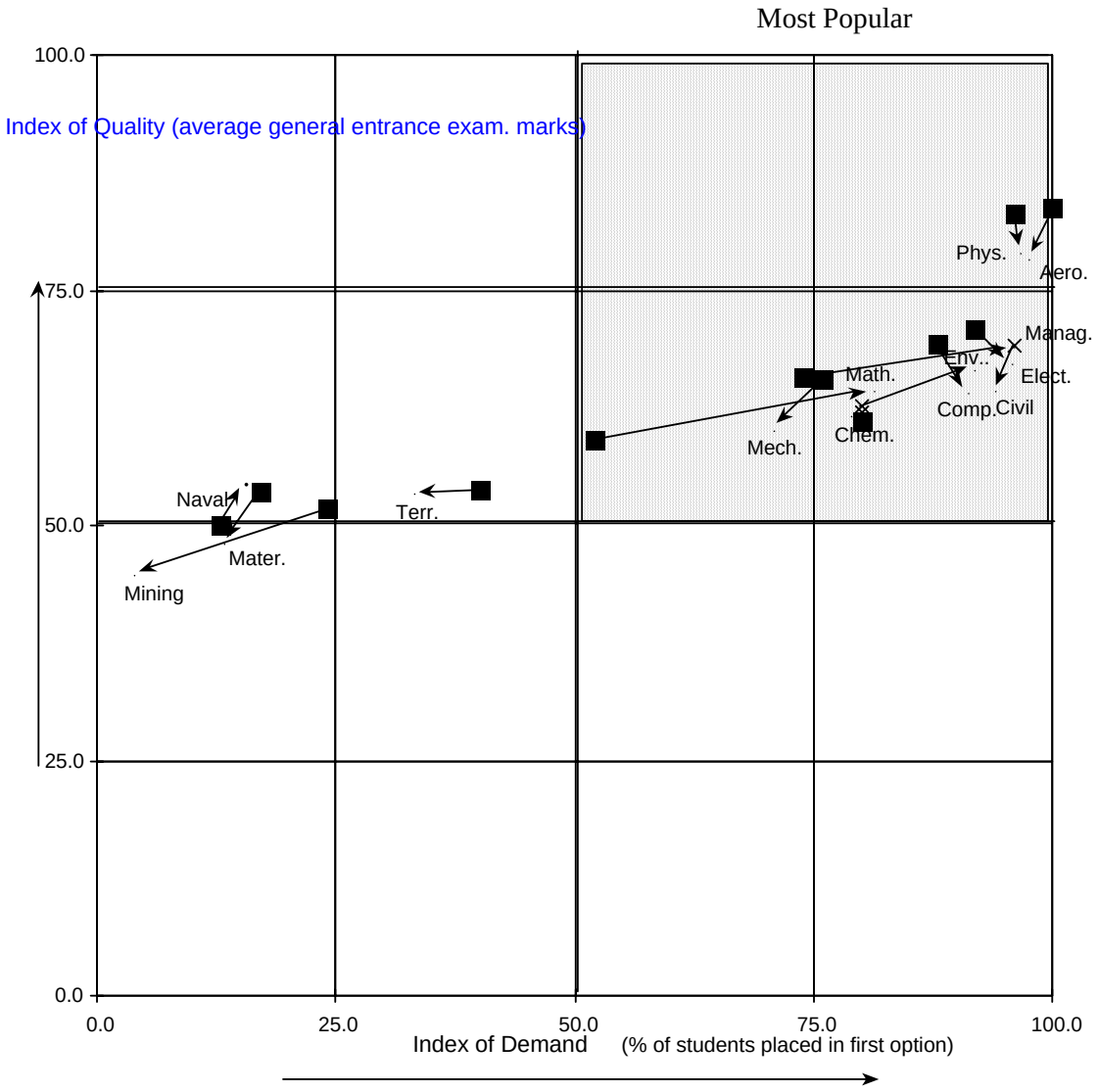
Figure 6
Evolution of the Distribution of Application Marks



In relation to the different areas of secondary education studied by students admitted to the IST, by far the greatest number (593 students) had followed Area B (technology), followed by Area A (natural sciences and health), with 369 students.

In terms of new students admitted to the IST, the grid in Figure 7 shows the position of the IST's various undergraduate courses, taking the percentage of students placed in their first option and their average application marks as indicators of demand and quality respectively. Analysis confirms the overall quality of students admitted, although the various undergraduate courses show different levels of demand. In fact, the 'movement' seen between the two years analysed shows a clear trend towards a demarcation between two very distinct areas: on the left are those undergraduate courses which are less in demand, and on the right those more in demand. It can be seen that the demand for undergraduate courses in Environmental Engineering, Engineering and Industrial Management, and Applied Mathematics and Computer Science has increased considerably, these courses crossing over into the quadrant of greatest appeal (shaded area on the grid). In this same quadrant, it should be noted, however, that there is one area which attracts the highest quality students, and this is for first degrees in Technological Physics Engineering and Aerospace Engineering.

Figure 7
Comparative Grid showing Appeal of IST Courses
(+ figure for 1993/94; **o** figure for 1994/95)



↑ Index of Quality (average General Entrance exam marks)

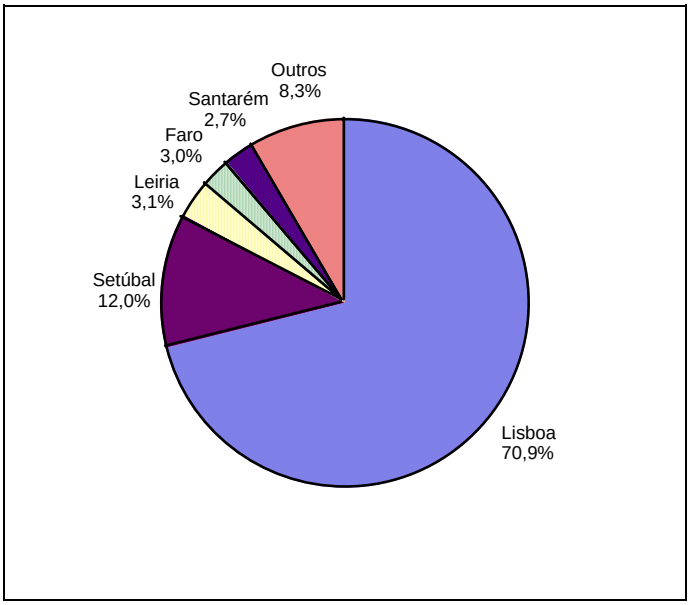
→ Index of Demand (% of students placed in first option)

Abbreviations of courses in grid:

Mining, Naval Arch., Mat., Terr., Mech., Chem., Math., Comp., Env., Civil, Elec., Manag., Physics, Aero.

It is of interest to note that the majority of students admitted to the IST are from the Greater Lisbon area, with around 71% from Lisbon and 12% from Setúbal. These figures should, however, be seen in terms of the national distribution of the school population, with Greater Lisbon representing around 25% of the population with access to higher education.

Figure 8
Home Districts of Students Admitted to the IST under the General Quota



Lisbon 70.9%
Setúbal 12.0%
Leiria 3.1%
Faro 3.0%
Santarém 2.7%
Others 8.3%

Exceptional Admission Procedure

Admission to the IST in 1994/95 under the exceptional procedure includes the categories described in Table 7. The places indicated for each category, with the exception of the special

procedures, have been decreed by the Co-ordinating Committee of the Scientific Board, the applicants being selected in accordance with the regulations in force.

Table 7

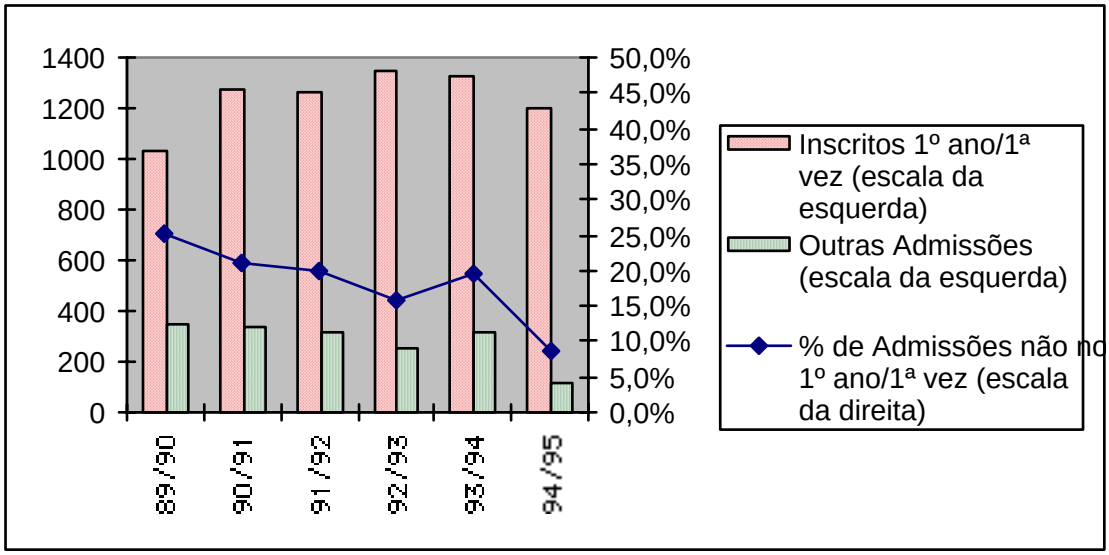
Number of Places, Applicants and Admissions under the Exceptional Procedure (1994/95)

	Places	Admissions	Applicants
Special Procedures	-	30	-
Transfers	28	32	74
Re-admissions	14	15	63
Ad-hoc	5	2	not known
Middle or Higher Courses with or without equivalents	24	19	226
Other Educational Systems	16	13	26

Based on the figures indicated in Table 7, Figure 9 shows total admissions to the IST, together with changes since 1989/90. The figures confirm the policy followed in 1994/95 of reducing admissions under the exceptional procedure, which was a result of evaluations already carried out.

Figure 9

Evolution of Admissions to the IST



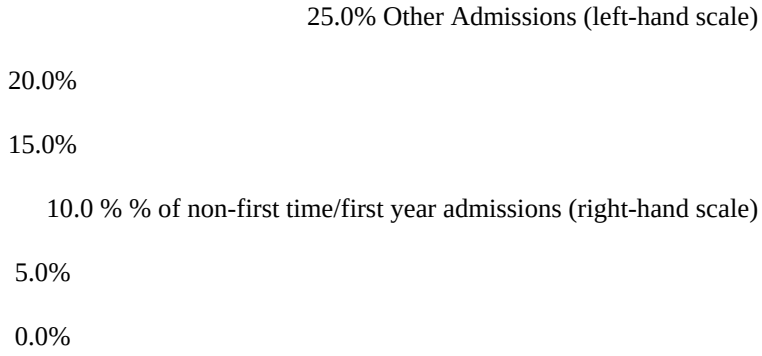
50.0%

45.0%

40.0% First Time/First Year Enrolments (left-hand scale)

35.0%

30.0%


25.0% Other Admissions (left-hand scale)
20.0%
15.0%
10.0 % % of non-first time/first year admissions (right-hand scale)
5.0%
0.0%

4.1.2. Overall Description of Teaching and Graduation

4.1.2.1. Overall Analysis

The *Técnico* has consolidated its exceptional position within the context of higher education in Portugal, in both the quality and the range of undergraduate and post-graduate courses offered. It should be noted that undergraduate courses offered by the IST in 1993/94 and 1994/95 represented around 25% of the national total in the field of engineering. Table 8 shows the number of disciplines in operation per department.

Table 8
Number of Disciplines in Operation in 1994/95

Departments	**No. of Disciplines**
Mathematics	70
Physics	72
Chemical Engineering	99
Naval Architecture and Marine Science (Autonomous Section)	26
Mechanical Engineering	129
Electrical and Computer Engineering	175
Civil Engineering	119
Economics and Management (Autonomous Section)	37
Mining Engineering	38
Materials Engineering	70
Total	**810**

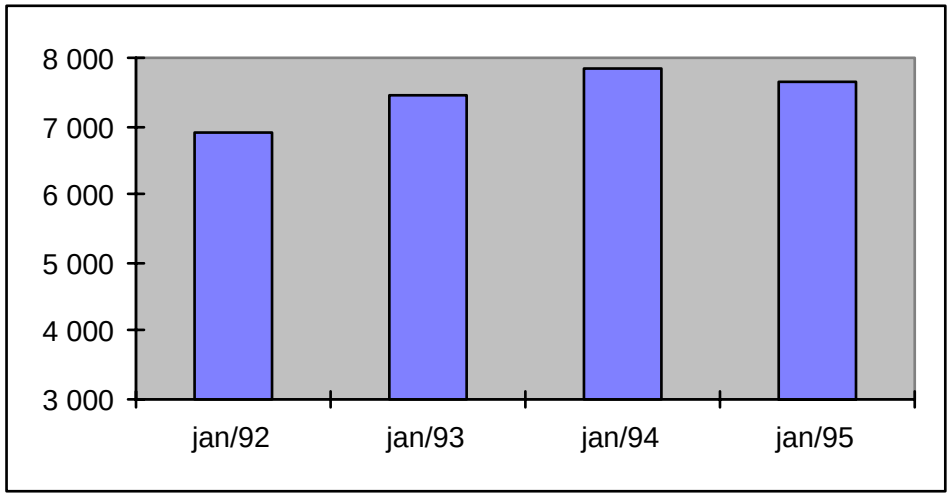
The number of students enrolled in 1993/94 was 7,863, with 7,635 enrolled in 1994/95, who, in December 1994, were distributed among the various departments and sections as shown in Table 9.

Table 9
Number of Students per Department in December 1994

Departments	**No. of Students**
Mathematics	1524
Physics	690
Chemical Engineering	856
Naval Architecture and Marine Science (Autonomous Section)	81
Mechanical Engineering	1194
Electrical and Computer Engineering	1604
Civil Engineering	1141
Economics and Management (Autonomous Section)	288
Mining Engineering	118

Materials Engineering	139
Total	**7635**

Figure 10
Evolution of Numbers of Undergraduate Students



These figures do not include students who were excluded, whose enrolment was affected by the following conditions.

- a pass mark was obtained in 1 or 0 disciplines in 1993/94; and
- an average of less than 2.99 disciplines were passed per year.
- And in addition, those students who, having enrolled for the first time in 1992/93 (and who in 1994/95 were going to enrol for the third time), did not obtain a pass mark in any discipline and their annual average was equal to zero.

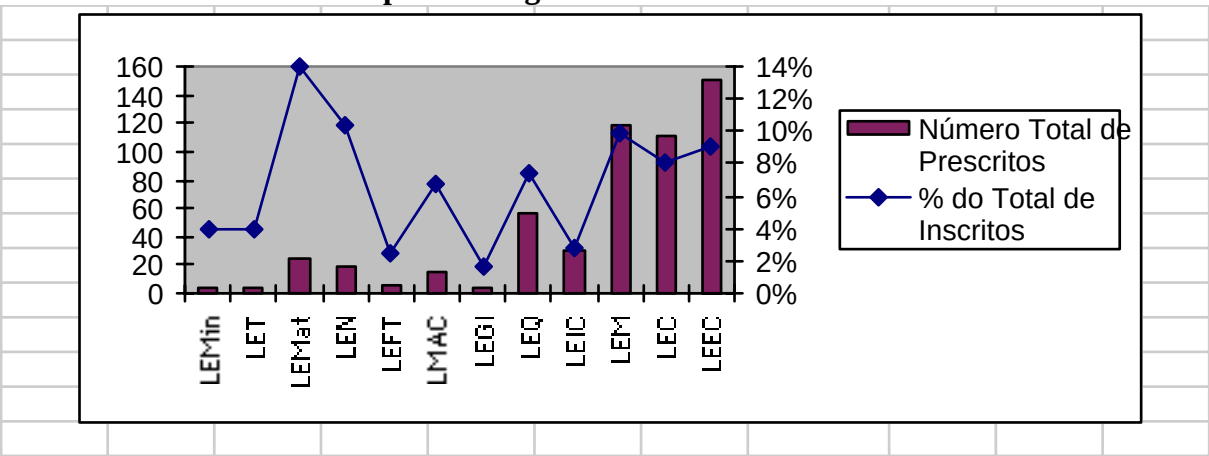
However, in 1994/95, a temporary exclusion procedure was adopted based on the following conditions:

- a pass mark in 2 disciplines was obtained in 1993/94; or
- an average of between 2.99 and 3.49 disciplines were passed per year.
- In addition, those students who, having enrolled for the first time in 1992/93 (and who in 1994/95 were going to enrol for the third time), met at least one of the above conditions.

As a result of this procedure, 546 students were excluded in 1994, distributed as shown in Figure 11. The enrolment procedure was also changed in 1994 in order to give students joint responsibility for their academic life in respect of optimising their timetable.

Figure 11

No. of Exclusions in 1994 and Percentage of Total Enrolments in 94/95 per Undergraduate Course



Total Number of Exclusions
% of Total Enrolments

Abbreviations of courses:

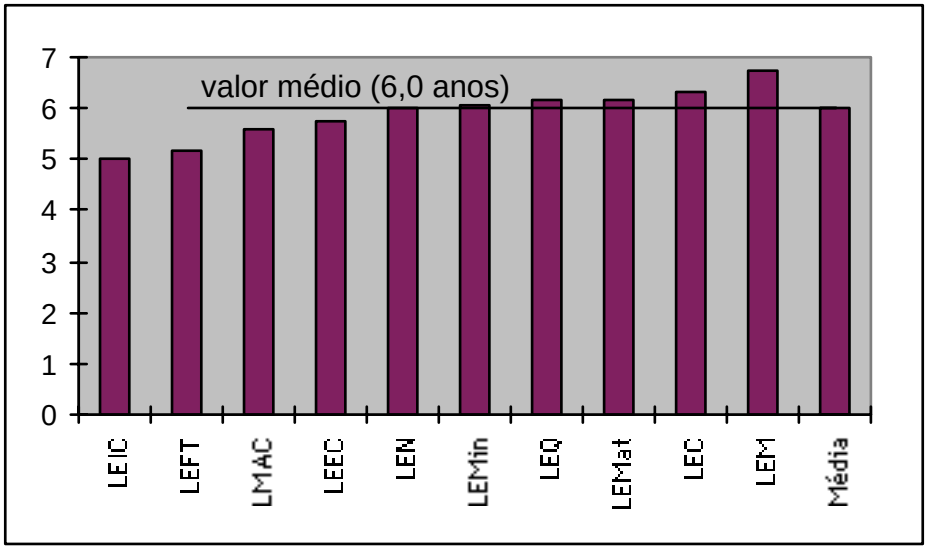
Min.Eng., Terr.Eng., Mat.Eng., Naval Arch., Tech.Phy.Eng., App.Math.&Comp., Ind.Eng.&Man., Chem.Eng., Comp.Sc.&Eng., Mech.Eng., Civil.Eng., Elec.&Comp.Eng.

The average period spent at the IST for students who graduated in the years 91/92, 92/93 and 93/94 was 6.0 years (Figure 12). It should be noted that the undergraduate course in Computer Science and Engineering produced its first graduates in 93/94 and has therefore not been included in calculating the above average.

Figure 12

Average Period at the IST for Students Completing Undergraduate Courses

average figure (6.0 years)



Abbreviations of courses as per Figure 11 PLUS "Average" at bottom of last column.

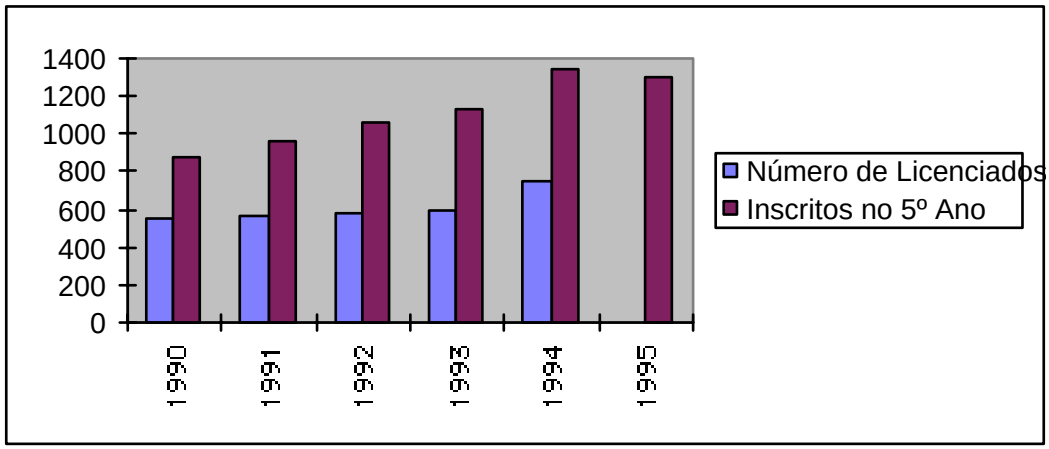
As far as graduation is concerned, the number of first degrees awarded by the IST (measured by the number of requests for degree certificates, or *cartas de curso*) has been increasing since 89/90, and increased from 564 in 92/93 to 756 in 93/94. This increase is mainly due to the graduation of the first students in Computer Science and Engineering, together with the increase in students admitted to the IST that has occurred since 1989/90.

Figure 13

Number of Graduates and Students Enrolled in the 5th Year

Number of Graduates

Enrolled in 5th Year



Figures 14 and 15 illustrate graphically the movement of students in the academic years 1993/94 and 1994/95, showing numbers of IST students entering and leaving.

Figure 14

Movement of Students in 1993/94

First-time Admissions Education Process at the IST Left and Re-admitted

Students in 1992/93 = **7,440**

Abandoned or Interrupted Studies = **631**

Graduated = **564**

Continued in
1993/94
= **6,245**

Others = **319**

Students Enrolled

Re-admissions = **74**

in 1993/94 =
7,863

N. Clausus
= **1,225**

Figure 15

Movement of Students in 1994/95

First-time Admissions

Education Process at the IST

Left and Re-admitted

Students in 1993/94 = **7,863**

Graduated = **756**

Excluded = **546**

Abandoned or Interrupted Studies = **333**

Continued in 1994/95 = **6,228**

Others = **112**

Students Enrolled in 1994/95 = **7,635**

Re-admissions = **100**

N. Clausus = **1,195**

4.1.2.2. Detailed Analysis by Degree

The 14 undergraduate courses available at the IST are described below.

• **Civil Engineering.** The main aim of this course is to train engineers who will work on the design, planning and operation of systems which, through exploiting natural resources, will allow their appropriate use by mankind, with particular emphasis on improvements in the quality of life of the population. Students on this course can receive training in five specialist areas: Municipal and Environmental Engineering, Structures and Construction, Geotechnics, Hydraulics and Water Resources, and Territorial Planning and Transportation

In Civil Engineering, the percentage of students placed in their first option in 1993/94 and 1994/95 was over 90%, in spite of a reduction of 5.2% in 1994/95 compared to 1993/94. The total number of enrolments also decreased 8.5% in 1994/95. 111 students were excluded in 1994.

• **Electrical and Computer Engineering.** The primary aim of this course is to train professionals who will be capable of working on the analysis, specification, planning, industrialisation, commercialisation and utilisation of products and services which depend on electricity, electronics or information technology. The course is therefore divided into four branches: Energy and Systems, Telecommunications and Electronics, Control and Robotics, and Electronic and Computer Systems.

In Electrical and Computer Engineering, the percentage of students placed in their first option increased by 4.34% compared to the previous year. A reduction of 8.2% has been seen in the total number of enrolments between the years 1993/94 and 1994/95, due, among other factors, to 150 students being excluded in 1994 and to an increase in the number of students graduating.

• **Technological Physics Engineering.** The main aim of this course is to train professionals who are qualified in physics and capable of keeping abreast of scientific and technological innovation, and participating in its development. Thus, the first three years of this course are spent in the study of the basic subject matter of physics, mathematics and technology. In the last four terms, students devote themselves to a specialist area, while at the same time carrying out an end-of-course project.

The course has shown a 6.7% increase in the total number of enrolments in 1994/95 compared to 1993/94. With regard to the quality of students admitted, it should be noted that for this course 96% of students were placed in their first option in 1993/94 and 1994/95. 6 students were excluded in 1994.

• **Industrial Engineering and Management.** The main aim of this course is to train technical staff who have a command of current technology and a solid training in economics, management and social science, which will allow them to take on the role of agents for change. This course covers three specialist areas, namely: General Management, Production Management and Project Management.

Offered for the first time in 1990/92, the first students in this field will only graduate in 1994/95. It should be noted that, for the academic year 1994/95, 93% of applicants were placed in their first option. 4 students were excluded in 1994.

• **Computer Science and Engineering.** The main areas in which graduates of this course will work are the production, operation and maintenance of systems and applications software, whether for the management of services or for industrial production. The course is divided into 4 branches, namely: Computational Systems, Programming and Information Systems, Industrial Computer Science, and Artificial Intelligence.

The first engineers on this course graduated in 1993/94, a total of 88. With regard to the proportion of students placed in their first option, this has been maintained at 88%, the total number of enrolments having increased by 6.28% between 1993/94 and 1994/95. 31 students were excluded in 1994.

• **Mechanical Engineering.** The main areas in which mechanical engineers work are in the analysis, design, manufacture, automation, and the related organisation and management of productivity, of all types of technical equipment, machines, components and structures used in industry. The course is divided into 3 branches, namely: Applied Thermodynamics, Production, and Automation and Robotics.

There was a reduction of 4.92% in the total number of enrolments for this course in 1994/95 compared to 1993/94, and a 7.88% reduction in the percentage of students placed in their first option. 119 students were excluded in 1994.

• **Materials Engineering.** The aim of this course is to train professionals with a thorough knowledge of the materials used in engineering. Although it is not divided into branches, this course provides options in various scientific areas: Structure and Properties of Materials, Surfaces and Interfaces, Materials Technology, Product Development, Graphical and Computational Methods, Economics and Management, and Environmental Technology.

In 1993/94, the number of enrolments for this course was 210, with a reduction of 8.52% in 1994/95. As far as admissions in 1994/95 are concerned, 13% were placed in their first option, and 31% in their second option. 25 students were excluded in 1994.

• **Mining Engineering.** The aim of this course is to train professionals in the areas of exploration, exploitation and use of the earth's mineral resources. The course offers two specialist branches: Applied Geology and Mining Planning.

This course showed an increase of 4.12% in the number of enrolments in 1994/95 compared to 1993/94. As far as admissions were concerned, 24% of applicants were placed in their first option in 1993/94, this figure being reduced by 83.3% in 1994/95. It should be noted however that 40% of students admitted in 1994/95 were placed in their second option. 4 students were excluded in 1994.

• **Naval Architecture and Marine Science.** The main aim of this course is to train engineers who are capable of supporting all activities connected with the exploitation of the seas, including the planning, construction and operational management of ships and systems designed for maritime exploitation in all its forms. The course provides for the following specific study areas: Naval Architecture, Statics and Dynamics of Ships, Naval Structures, Hydrodynamics, Resistance and Propulsion, Maritime Machinery and Systems, Maritime Transport, Ship Design, and Shipyard Organisation.

This course showed a reduction of 7.5% in the total number of enrolments for 1994/95 compared to 1993/94, with the number of first-time admissions to the first year being maintained. With regard to students admitted in 1994/95, 17% were placed in their first option, and 40% in their second option. 19 students were excluded in 1994.

• **Chemical Engineering.** The main aim of this course is to train engineers capable of studying the establishment of industrial plants designed to produce goods by means of chemical reactions. This course is divided into three branches: Applied Chemistry, Processes and Industry, and Biotechnology.

This course showed a reduction of 9.15% in the total number of enrolments, the number of admissions having also decreased by 7.51% 57 students were excluded in 1994.

• **Applied Mathematics and Computer Science.** The main aim of this course is to train specialists for industry, services, and polytechnic and university teaching. The course offers students the choice of a specialist area at the end of the second year, to be chosen from the following: Computational Science, Numerical Analysis, Mathematical Analysis, and Probability and Statistics.

This course showed a reduction of 5.53% in the total number of enrolments in 1994/95 compared to 1993/94. The proportion of students placed in their first option in 1994/95 increased by 53.8% compared to 1993/94. 16 students were excluded in 1994.

• **Territorial Engineering.** The main aim of this course is to train professionals who will work in the area of classification, planning, transformation, and management of Portuguese territory.

The number of enrolments increased by 16.5% from 93/94 to 94/95. As far as exclusions are concerned, 4 students were excluded in 1994. There have been no graduates so far from this course.

• **Aerospace Engineering.** The main objective of this course is to train engineers to work with aeronautical and space vehicles.

In 1993/94, 100% of students admitted to this course were placed in their first option, this figure decreasing by 4% in 1994/95. As this course was created only three years ago, no students have graduated yet.

• **Environmental Engineering.** The main aim of this course is to train engineers with the technical capability to analyse and find solutions to environmental problems, as well as for the management of natural resources.

As far as admissions are concerned, 93% of students admitted in 94/95 were placed in their first option, which represents an increase of 16.25% compared to the previous year. As this course was created only two years ago, no students have graduated yet.

4.1.3. Evaluation of Degrees

The first stage of the Pilot Scheme for the Evaluation of the Quality of Education in Portugal was completed in 1994. At the IST, this first stage consisted of the evaluation of the degree courses in Physics Engineering and in Electrical and Computer Engineering for the academic year 92/92. Following on from the first phase, evaluation of the degree courses in Naval Architecture and Marine Science and Mechanical Engineering was also begun in 1994.

Self-Assessment for the Evaluation of the Electrical and Computer Engineering Course

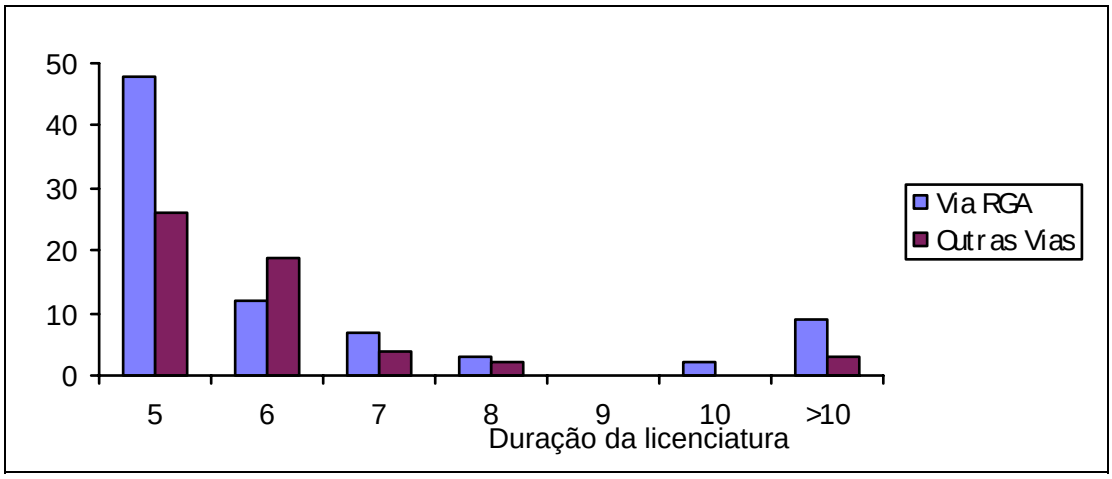
This evaluation was based on the gathering of opinions from those most directly involved in the educational process, by means of surveys and interviews. The sample of those surveyed was made up of 62 teachers (30%), 12% of first year students and 210 final year students (24%), as well as 16 company employers.

The results obtained show a good academic performance by students who complete their degree courses, as well as the fact that all the IST graduates have been placed in the job market. Other conclusions include the following points:

• The average time spent by students on this course at the IST is 5.8 years, but the distribution of years spent varies depending on the type of admission. In fact, Figure 16 shows that students admitted via the general admission procedure (RGA) spend on average less time than students admitted via other means.

Figure 16

Duration of Degree Course for Graduates in 1992/93



Duration of Degree Course

Via RGA

Via Other Means

• The best students in the country, specialising in this field, choose the IST's Electrical and Computer Engineering course;

• Graduates state they are generally satisfied with the education obtained;

• Employers state they are satisfied with the level of education of graduates;

• There is convergence between the aims of the course and the strategy of the school, as a driving force for the transformation of society;

• A considerable number of students on this course are involved in R&D projects, which has been extremely beneficial to the students.

Self-Assessment for the Evaluation of the Technological Physics Engineering Course

The evaluation of this course was based on surveys and interviews. The sample includes surveys of 17 teachers (24%), 32% of final year students, and 16 company employers.

The results obtained show an excellent level of education in the students admitted (all in their first option in the year under analysis), and excellent performance by students on this course at the IST, a high number of students going on to post-graduate studies.

Figure 17 shows, for the year 1992/93, the marks obtained by students admitted (general quota) to this course.

Figure 17

Marks	Overall Entrance Mark	Specific Examination (Mathematics)	General Entrance Examination *
>90%	**24**	**9**	**6**
81-90%	**17**	**12**	**23**
71-80%	**0**	**12**	**10**
61-70%	**0**	**8**	**6**

* Includes students from the special quota.

Graduates state they are generally satisfied with the course, although employers say that the objectives of this course have yet to be clearly defined. The main results obtained by the work group include the following points* :

• 88% of final year students have a positive opinion of the course and 82% feel that their expectations were fulfilled;

• Teachers feel that attendance at classes was good, especially with regard to theoretical and laboratory classes;

• The amount of time devoted to assessing knowledge is excessive;

• The pass rate is very good, frequently reaching 100%, especially from the third year onwards. For the first two years, the actual rate (students examined) is almost 90% and for the total (students enrolled) almost 80%;

• The classifications obtained by graduates are very good (an average of 16.2/20);

• 84% of students completed the course in 5 years.

* (Source: Self-Assessment for Evaluation of Technological Physics Engineering Course, Department of Physics Work Group)

4.2 POST-GRAUDATE EDUCATION

There were 16 Master's degree courses in operation at the IST in 1993/94 and 1994/95, together with the possibility of doctorates in 15 separate scientific fields. Within this context, 133 Master's degrees, 44 doctorates, and 8 Aggregations were awarded in 1994.

4.2.1. Master's Degree Courses

Table 11 sets out the number of first-time enrolments and the total number of enrolments for each Master's for the academic years 93/94 and 94/95, and shows an average increase of 15.7% in the number of Master's students. The number of degrees awarded is shown in Table 12.

Table 11
Number of Students Enrolled on Master's Courses

	93/94		94/95	
	1st time Enrol.	Total (Dec 93)	1st time Enrol.	Total (Dec 94)
Biotechnology (Biochemical Engineering)	12	36	10	37
Ecology, Management & Modelling of Marine Resources	**	**	**	**
Construction	20	49	23	67
Electrical and Computer Engineering	120	274	84	304
Structural Engineering	11	29	11	40
Materials Engineering	1	1	5	5
Mechanical Engineering	46	109	40	126
Chemical Engineering (Processes and Industry)	11	39	0	34
Chemical Engineering (Applied Chemistry)	0	6	0	2
Physics	10	24	6	27
Hydraulics and Water Resources	10	27	12	37
Operational Research and Systems Engineering	26	45	25	64
Applied Mathematics	20	59	12	64
Mineralogy and Mining Planning	20	47	9	51
Regional and Urban Planning	**	**	**	**
Transportation	10	32	14	40
Total	**317**	**777**	**251**	**898**

** UTL (Technical University of Lisbon) Inter-School Master's Degree

Table 12

Master's Degrees Awarded by the IST from 1991 to 1994

	1991	1992	1993	1994
Biotechnology (Biochemical Engineering)	9	9	9	9
Construction	2	11	9	5
Electrical and Computer Engineering	36	23	51	54
Structural Engineering	7	3	10	0
Materials Engineering	0	3	3	1
Mechanical Engineering	16	9	17	23
Chemical Engineering (Processes and Industry)	0	0	3	5
Chemical Engineering (Applied Chemistry)	0	1	8	4
Physics	1	1	10	3
Hydraulics and Water Resources	4	6	9	2
Operational Research and Systems Engineering	3	10	3	6
Applied Mathematics	8	5	4	7
Mineralogy and Mining Planning	2	5	7	5
Transportation	6	4	5	6
Total	**94**	**100**	**148**	**133**

The 16 Master's courses in operation at the IST in 1994 are briefly described in the following paragraphs:

• **Biotechnology (Biochemical Engineering)**. The aim of the current Master's course is to train specialists for research and development in the various biotechnological fields. Of the 36 students enrolled in 1993/94, 9 Master's degrees were awarded.

• **Electrical and Computer Engineering**. This Master's course aims to train personnel with a high level of technical competence in the field of Electrical and Computer Engineering, and provide them with the ability to adapt to a technological reality which is subject to rapid change. This is the largest Master's course at the *Técnico,* producing 54 new graduates in 1994.

• **Mechanical Engineering**. The main aim of the Master's course in Mechanical Engineering is to train specialists in the fields of Energy, Computer-Assisted Production, and Systems. There were 109 enrolments in 1993/94, and 40 first-time enrolments in 1994/95; this course produced 23 new Masters in 1994.

• **Physics**. This Master's course is based on three fundamental aims: to complete scientific training in the field of Physics and Technological Physics Engineering; to concentrate on the teaching of experimental techniques and advanced technologies; and to introduce students to the practice of scientific research. There were 6 new enrolments in 1994/95, 2 in the Elementary

Particle Physics, Astrophysics and Nuclear Physics option, and 4 in Physics and Plasma Engineering.

• **Hydraulics and Water Resources.** The aim of this Master's course is to provide solid training in the planning, design and management of water systems, while at the same time establishing real contact with research. There were 27 students in 1993/94, 12 first time enrolments in 1994/95, and 2 students received their Master's degree in 1994.

• **Operational Research and Systems Engineering**. This Master's course aims to provide solid training in the field of operational research and follows a consolidated curriculum suited to the needs of Portuguese organisations. There were 45 students in 1993/94 and 6 students received their Master's degree in 1994.

• **Applied Mathematics**. This Master's course aims to provide a solid training in the fundamentals and applications of Mathematics. Of the 59 students enrolled in 1993/94, 7 received their Master's degrees in 1994.

• **Mineralogy and Mining Planning**. This Master's course aims to provide a solid training in Mining Engineering and related sciences, particularly in the areas of mining planning and mineralogy. There were 47 students in 1993/94, and 5 received their Master's degree in 1994.

• **Construction**. The main aim of this Master's course is to provide specialist and in-depth training in the field of building construction, particularly Structure and Behaviour of Materials, Building Construction, Economics, and Construction Quality. 23 students enrolled in 1994/95 and 5 received their Master's degrees.

• **Transportation**. The main aim of this Master's course is to train specialists in the areas of design, planning and operation of transport systems. 14 students enrolled for this course in the academic year 1994/95, and 6 students received their Master's degree.

• **Materials Engineering.** The aim of this Master's course is to extend knowledge in the areas of Materials Science and Technology, and to prepare students for research. There were 5 enrolments on this course in 1994/95, and 1 student graduated in 1994.

• **Chemical Engineering (Applied Chemistry)**. This Master's course aims to train technical personnel in the development of new products and in bringing new chemical processes to the pilot plant stage. In 1994, 4 students received their Master's degree in this field.

• **Chemical Engineering (Processes and Industry)**. This Master's course is designed to provide advanced professional training resulting in a greater capacity to innovate and deal with the problems which are increasingly confronting industries which use chemical technologies. 5 students received their Master's degree in 1994.

4.2.2. Doctorates

Table 13 and Figure 18 show the doctorates awarded by the IST in the last four years, with an indication of the number of PhDs with links to the IST, divided into the 15 areas of doctorates available.

Table 13

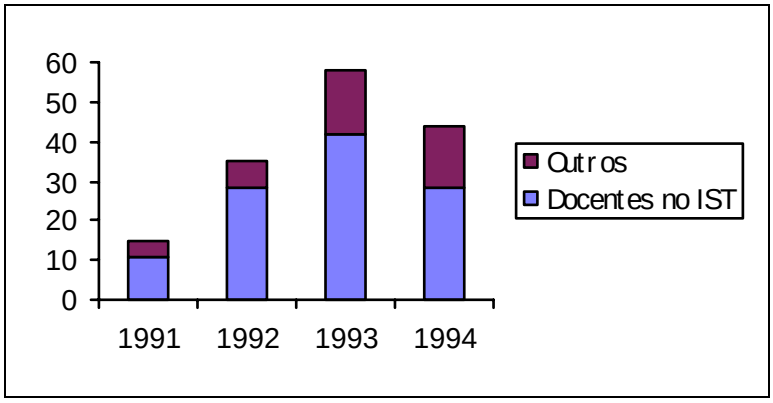
Doctorates Awarded by the IST from 1991 to 1994

	1991		**1992**		**1993**		**1994**	
	IST(1)	Others	IST(1)	Others	IST(1)	Others	IST(1)	Others
Biotechnology	0	0	0	0	0	1	0	1
Civil Eng.	0	1	6	2	6	3	2	4
Elec. and Computer Eng.	5	0	11	0	6	0	8	3
Physics	0	0	1	0	4	3	1	2
Physics Eng.	2	0	1	0	0	0	0	0
Industrial Eng. and Management	0	0	0	0	0	0	0	1
Computer Science and Eng.	0	0	0	0	1	0	0	0
Mechanical Eng.	0	0	1	2	3	2	7	0
Metallurgical and Materials Eng	0	0	0	0	1	0	3	0
Mining Eng.	0	0	1	0	2	0	1	0
Naval Arch. and Marine Eng.	0	0	0	0	0	0	0	0
Chemical Eng.	4	2	4	2	11	2	6	3
Systems Eng.	0	0	0	0	1	0	0	0
Mathematics	0	1	2	1	2	0	0	0
Chemistry	0	0	1	0	5	5	0	2
Sub-Total	**11**	**4**	**28**	**7**	**42**	**16**	**28**	**16**
Total	**15**		**35**		**58**		**44**	

(1) teachers with links to the IST

Figure 18

Evolution in Doctorates from the IST from 1991 to 1994



Others

Teachers at the IST

The fluctuating nature of the annual variation in the number of doctorates awarded in the past few years is typical of post-graduate education, with the number of new doctorates per year being approximately 10% of the number of professors at the IST.

4.2.3. Other Post-Graduate Activities: Aggregations

Table 14 shows Aggregations awarded in the last four years, which represent approximately 8% per year of the number of associate professors in office.

Table 14

Aggregations from 1991 to 1994

	91	**92**	**93**	**94**
Civil Engineering	2	1	0	3
Mining Engineering	1	0	0	2
Mathematics	0	1	0	1
Electrical and Computer Engineering	2	9	3	1
Chemistry	0	1	2	0
Chemical Engineering	0	1	2	0
Physics	0	1	1	0
Naval Architecture and Marine Engineering	1	0	0	0
Industrial Engineering and Management	1	0	0	0
Computer Science	1	0	0	0
Mechanical Engineering	2	1	2	1
Total	**10**	**15**	**10**	**8**

4.3. RESEARCH AND DEVELOPMENT

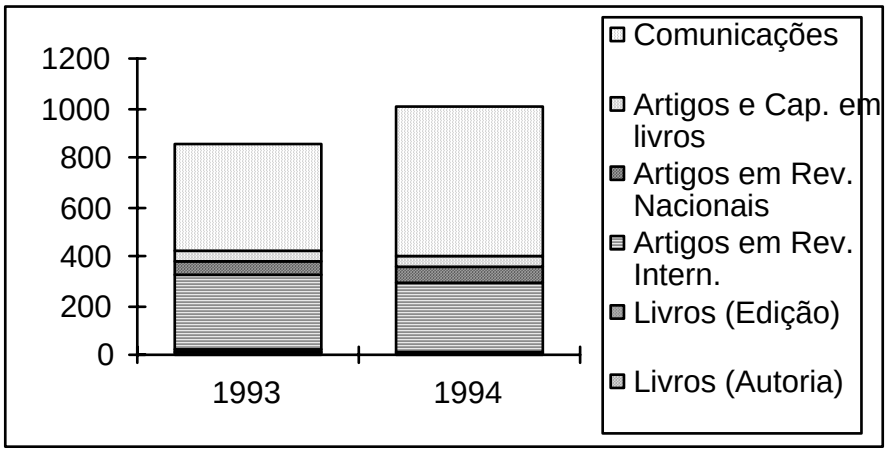
The approach used to report on research and development activities is based on an analysis and description of results obtained in 1994, and on a description of the main research areas of the IST.

As far as R&D results are concerned, Table 15 and Figures 19 and 20 show the number of publications per scientific area in accordance with the departmental divisions of the IST.

Table 15
Publications Resulting from R&D at the IST in 1994

Areas	Books (Author-ship)	Books (Editor-ship)	Papers in International Journals	Papers in Portuguese Journals	Articles and Chapters in Books	Conference Papers
Civil Eng.	1	1	21	16	11	120
Elec.and Comp. Eng	1	1	32	10	4	190
Mech. Eng.	1	2	32	5	10	95
Mat. Eng.			13			9
Min. Eng.		1	3	9	2	32
Naval Arch. & Mar.Eng		1		1	5	7
Chem. Eng.	1	2	125	10	8	95
Econ. & Management						3
Physics			35	10		36
Mathematics		2	27	1	3	19
TOTAL	**4**	**10**	**288**	**62**	**43**	**606**

Figure 19
Total Publications in 1993 and 1994



Conference Papers

Articles and Chapters in Books

Papers in Portuguese Journals

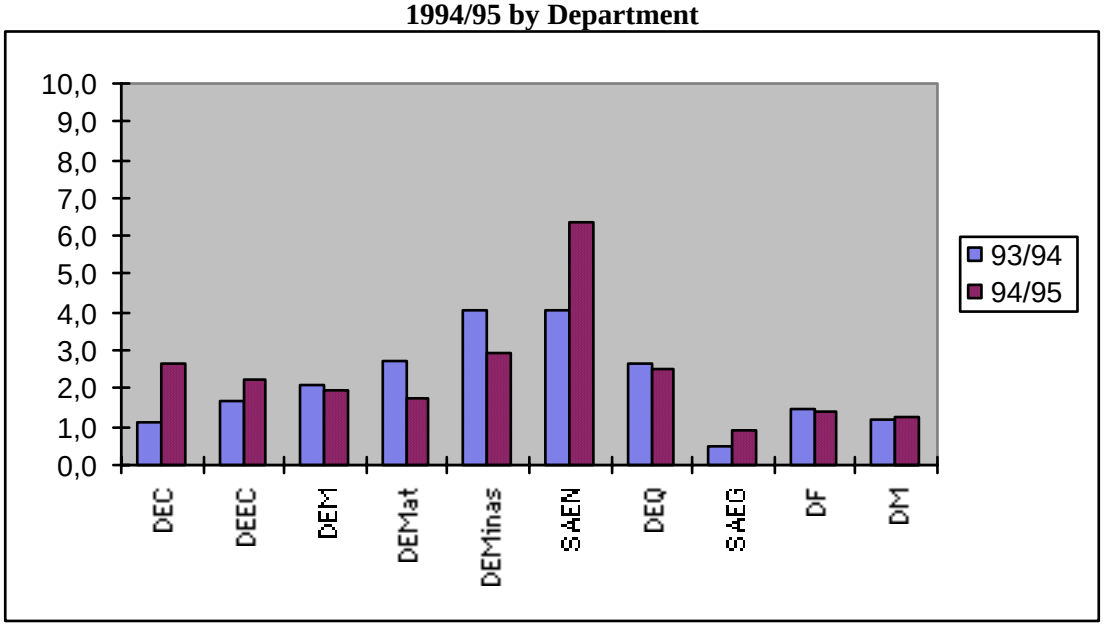
Papers in International Journals

Books (Editorship)

Books (Authorship)

Figure 20

Ratio of Total Number of Publications per Professor (FTE) in 1993/94 and 1994/95 by Department



R&D activities carried out at the IST are fully described in the reports from the respective departments, centres and research groups in operation; this report deals only with those projects funded from sources outside the IST. A list of centres and research groups, together with a list of projects carried out in 1994, can be found in the appendices. Table 16 quantifies these projects in terms of type of funding, and shows totals of 139, 85 and 35 projects funded respectively by the European Union, JNICT (National Scientific and Technical Research Board), and Portuguese industries and companies. A list of universities and companies who are collaborating with the IST groups on these projects can also be found in the appendices.

Table 16

Number of Projects in Progress in 1994 by Scientific/Technological Area and by Funding Source

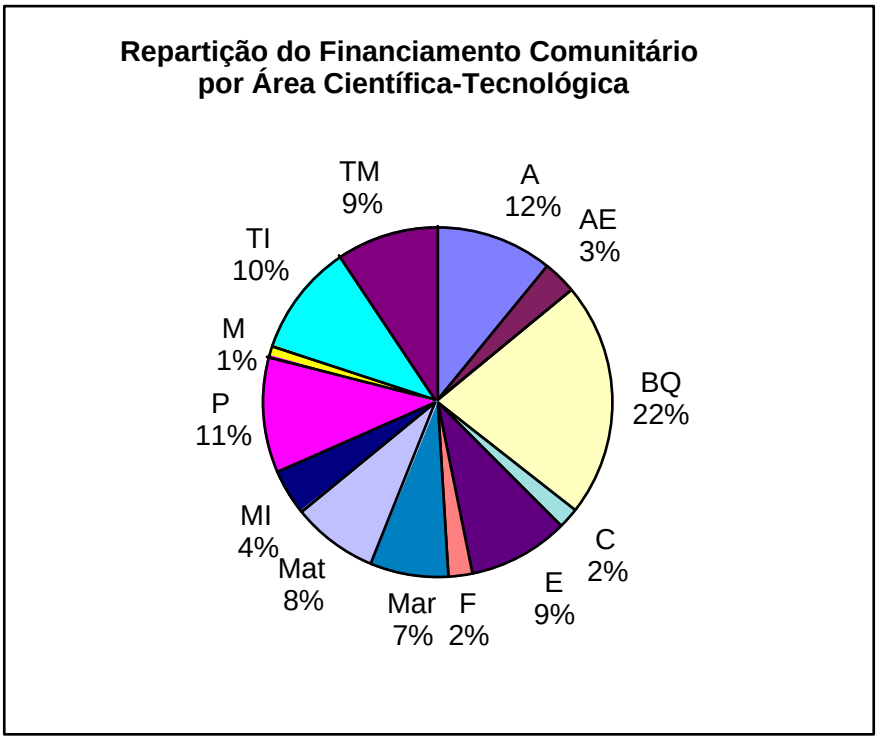
	EC	JNICT	Companies
Energy	**19**	**3**	**-**
Environment	**16**	**9**	**3**
Information Technology	**12**	**6**	**6**
Materials	**18**	**11**	**1**
Marine	**11**	**2**	**-**
Biotechnology	**21**	**23**	**1**
Production	**11**	**-**	**11**
Microelectronics	**4**	**1**	**-**
Telecommunications	**8**	**4**	**2**
Civil	**3**	**7**	**3**

Aeronautics	**5**	**-**	**3**
Physics	**10**	**8**	**5**
Mathematics	**1**	**5**	**-**

The above data can be presented in terms of the distribution of funding received, as shown in Figures 21 and 22 in respect of funding from Community R&D programmes and JNICT programmes respectively.

Figure 21

Distribution of Community Funding by Scientific/Technological Area



Key

A- Environment
AE- Aeronautics
BQ- Biotechnology and Chemistry
C- Civil
E- Energy
M- Mathematics
MAR- Marine
MAT- Materials
MI- Microelectronics
P- Production
F- Physics
TI- Information Technology
TM-Telecommunications

Projects under the scope of Community programmes in the area of Biotechnology and Chemistry represent 22% of Community funding, the percentages in respect of projects in the areas of Environment (12%), Production (11%), Information Technology (10%), Telecommunications (9%) and Energy (9%) also being significant.

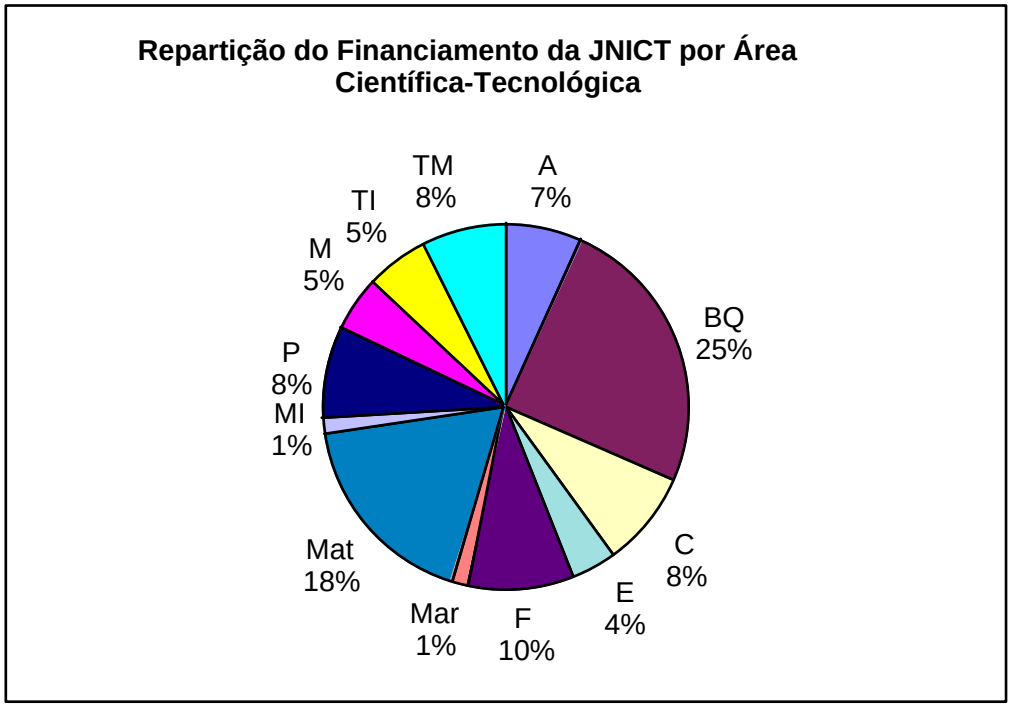
Particular mention should also be made of the projects carried out under the Partnership Contract agreed between the IST and the European Atomic Energy Community (EURATOM) in which the IST has participated via the Centre for Nuclear Fusion. Around 30 graduates, 6 Masters and 13 PhDs participate in this project, working in the following activities: ISTTOK tokamak; the study of transport properties in the ASDEX-Upgrade tokamak using micro-wave reflectometry; participation in JET (Joint European Torus); studies of non-inductive current generation; X-ray spectroscopy in the TCV tokamak; participation in ITER (International Thermo-Nuclear Experimental Reactor); and participation in the MAST and W7-X projects.

It should also be noted that 1994 was marked by the transition from the Third to the Fourth R&D Community Programme, the European Union Council of Ministers having approved in April a total of 12,300 MECUs for the Fourth Programme. As a consequence, a series of projects were concluded in 1994, and much effort was put into preparations for the Fourth European Framework Programme for Technological Research and Development, mainly in the preparation of proposals for applied research and technological development.

Projects supported by JNICT in the field of Biotechnology and Chemistry represent 25% of the total funding, the percentage related to projects in the Materials field (18%) also being significant.

Figure 22

Distribution of Funding from JNICT by Scientific/Technological Area



Key

A- Environment
BQ- Biotechnology and Chemistry
C- Civil
E- Energy
M- Mathematics
MAR- Marine
MAT- Materials
P- Production
F- Physics
TI- Information Technology
TM-Telecommunications

4.4. LINKS WITH SOCIETY

The provision of services and the development of other scientific and technological activities is important for modern universities, mainly because it brings them closer to society, and in particular, to the business and working world. While there has been a considerable increase in a wide range of activities connected to consultancy, the greatest proportion of services provided to the outside community have been in the area of vocational training. With this in mind, the approach used to report on the main actions carried out to forge links with society is based on the analysis of vocational training carried out at the IST in 1994, and on the analysis of the

IST's collaboration with R&D and Technology Transfer Institutions. A list of all the conferences, gatherings, and technical/scientific meetings held at the IST in 1994 can be found in the appendices.

4.4.1. Vocational Training at the IST

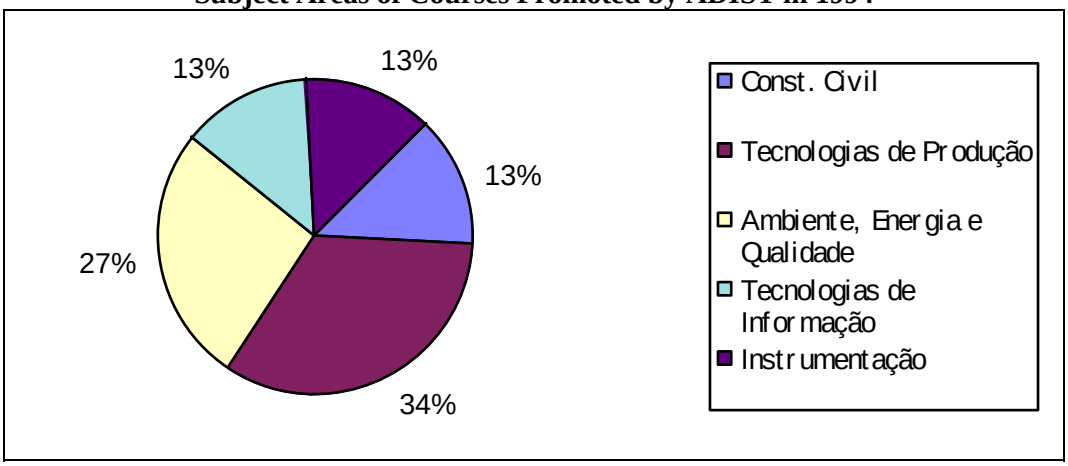
A significant proportion of the IST's resources were mobilised for these activities in 1994, as was the case in 1993. In fact, the training initiatives promoted and organised on the IST's campus, mainly through ADIST and ITEC, have had a considerable impact on the training of young technicians and researchers for Portuguese industry, as well as on the training of non-teaching personnel.

15 courses promoted by ADIST in 1993 under the scope of the European Social Fund were concluded during 1994. These courses were given to more than 340 trainees, 216 of whom were under the age of 25 and in search of their first job. The courses covered various technological areas, namely: Environment, Energy and Quality, Civil Construction, Information Technology, Production Technology and Instrumentation. In addition, ADIST promoted a new training programme in 1994, including around 39 courses in the following different fields: Environment, Energy and Quality (8 courses), Civil Construction (4), Biotechnology (2), Geology (2), Management (2), Information Technology (6), Chemistry (2), Production Technology and New Materials (11), and Instrumentation and Electronics (2). The range of course offered was determined by the IST's available capacity.

While on the subject of ADIST, reference should also be made of the activities of LEMAC (Computer-Assisted Mechanical Engineering Laboratory), as a Skill Centre under Programme 5 of PEDIP and RETEX. In fact, this body has taken on a leading role in providing services in various branches, particularly training. In addition, LEMAC carried out 9 consultancy studies and 4 research and development projects in 1994.

Figure 23

Subject Areas of Courses Promoted by ADIST in 1994



Civil Construction

Production Technology

Environment, Energy and Quality

Information Technology

Instrumentation

A programme of continuous training for university administrative staff was also prepared in 1994, which has been submitted by ADIST to the PROFAP programme; it includes computing, human resources, organisation, accounting, auditing and management, quality, secretariat and public relations, library and documentation, and languages.

With regard to initiatives promoted by ITEC and organised at the IST in 1994, there were 38 training courses in different fields under the Young Researchers for Industry programme. In addition, there were 10 training courses under Measure E of PEDIP, with emphasis on the training of technical managers and directors of companies.

Mention should also be made of the Technological Enhancement Programme for Senior Staff, under which two courses were organised, namely “Advanced Technology in Glass Production” and “Technology Transfer and Management”, the latter in collaboration with the University of Texas in Austin. As a result of this course, the signing of a co-operation agreement is expected between the IC2 Institute of the University of Texas, the IST and ITEC.

It is also important to mention the training actions promoted by FUNDETEC, which involved a significant number of teachers and researchers from the IST during 1994.

4.4.2. IST's Collaboration with R&D and Technology Transfer Institutions

The consolidation of closer links between the IST and society has come about through collaboration with autonomous R&D and technology transfer organisations. The stimulus provided by these organisations has enabled the IST to concentrate on strengthening its R&D activities, which are important in order to accomplish its mission of confirming its value and its link to the business community.

Figure 24 illustrates the way in which the IST relates to the interface organisations and, through them, to companies. In fact, one of the areas of action of universities is to exploit their technological potential and knowledge beyond that obtained through their teaching and research activities. This point is of particular relevance for the *Técnico*, given the quality of its teaching staff and the importance of the research it carries out. The additional value of IST's scientific potential comes through its links with society, and in particular with companies, being based on a strategy of transmitting added value through technology. The latest economic theories emphasise innovation as the best means by which to carry out the transfer and endogenisation of technology. The Link in the Chain of Innovation Model* constitutes the most advanced methodological instrument to explain technological innovation and was the inspiration behind the conceptual framework presented in Figure 24, which shows the position of the IST in relation to interface organisations and the latter's link in the central chain of innovation in companies.

In this context, a brief summary is given in this section of the activities carried out in 1994 by IST teachers in IDMEC (mechanical engineering), INESC (information technology), INTERG (energy), IT (telecommunications), ITEC (multidisciplinary), and ISR (robotics).

* Technology and Economics, OECD, 1992

Figure 24

Framework of R&D Activities

Source: "The Role of Universities in the Technological Innovation Process",
Studies and Planning Office, IST.

Technical/Scientific Knowledge

Scientific & Technological System

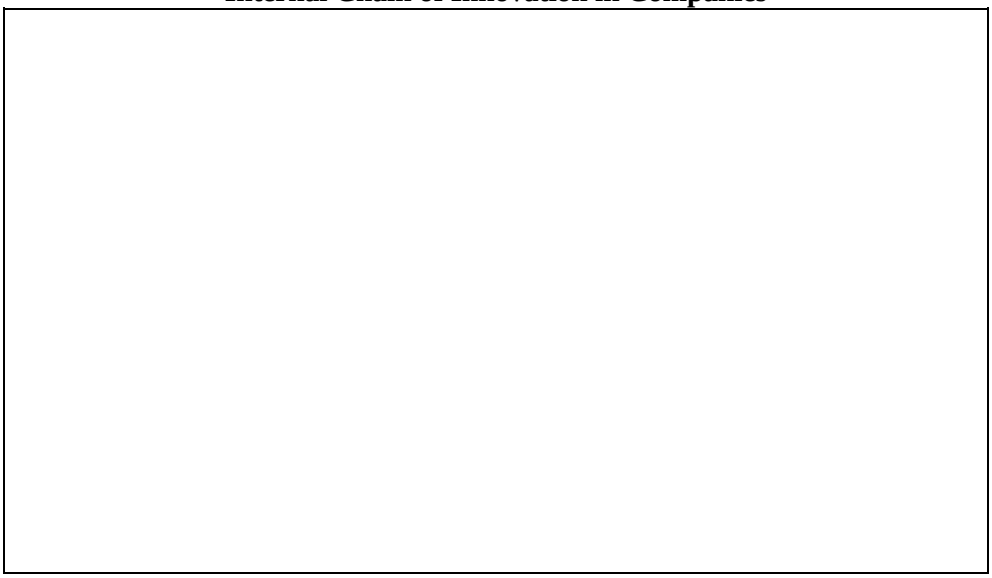
International Co-operation in R&D

I S T

R&D Activities

'Interface' Organisations

Internal Chain of Innovation in Companies



a) IDMEC (Mechanical Engineering Institute)

The aim of IDMEC is to carry out specific and specialised actions in the field of Mechanical Science and Technology, particularly through the promotion of R&D activities, the development of advanced training plans, the promotion of technology transfer, the evaluation of

new processes in companies, and the development of integrated management programmes in the fields of energy, logistics and technology.

This institute has two sites, one at the IST and another in the Engineering Faculty of the University of Oporto. The IST site is organised into four Research Centres, which are supported by a total of nine laboratories, related to the scientific fields covered in the activities of the IST site. In 1994, the number of projects in progress reached 64, of which 28 were international. With regard to publications, the activities of the IST site can be seen in 70 papers in journals and 132 articles and chapters published in books and treatises and at conferences.

b) INESC (National Institute for Systems and Computer Engineering)

The activities carried out by IST teachers at INESC fall within four main strategic areas: Telecommunications and New Services, Computers and Computer Science, Electronic Systems and Technology, and Integrated Industrial Systems for Management and Production.

The organisational structure of INESC in 1994 included around 58 Research Groups, of which 26 were headed by IST teachers. Of a total of around 296 university researchers collaborating with INESC in 1994, 114 had contractual links with the IST, while, of the 16 Technology Transfer Centres at INESC, 6 were run by IST teachers. The number of research and development projects in progress rose to 316, of which 141 were within groups and centres headed by IST teachers. In the same year, 176 Master's and Doctoral theses were in progress at INESC, of which 122 were being supervised by IST teachers.

The IST's collaboration with INESC is of a different formal nature from its role in the other institutions mentioned in this chapter, since it takes the form of shares in its capital. In December 1994, the total share subscribed by the IST was 26%, to which can be added those of the following partners: UTL (3%), UP (12%), UA (6%), UC (35%), PORTUGAL TELECOM (9%), TLP (12%), CPRM (8%), CTT (1%), with 20% of share units not subscribed.

c) INTERG (Institute for Energy)

The main aim of INTERG is to carry out specific and specialised actions in the field of Energy.

In 1994, there were 40 researchers at INTERG, of which 20 were PhDs, 18 being IST teachers. Its activities are related to internal projects, 12 projects being carried out in 1994. The projects

are carried out through close collaboration with Portuguese and foreign research centres, in parallel with contacts with companies. A further task of INTERG is the creation of synergies between the various engineering fields which contribute to this sector.

d) IT (Telecommunications Institute)

The main aim of IT is the promotion of research and development in the field of telecommunications, and it has sites in Lisbon (at the IST), Coimbra and Aveiro.

In 1994, out of a total of 55 researchers at IT's Lisbon site, 49 were IST teachers, 36 of whom are were PhDs. Apart from these, IT has around 50 collaborators, a significant proportion of whom are Master's and doctoral students from the IST; there are also dozens of undergraduates who work at IT as part of their final course work.

e) ITEC (Technological Institute for the European Community)

ITEC is designed to act as an interface institution between the academic and business worlds in three specific areas: Knowledge Transfer, Technology Transfer, and Business Valorisation. These aspects are dealt with by, respectively, the Technological Training Centre (Cenfortec), the Institute for New Technologies (INT), and the Centre for the Promotion of Innovation and Business (CPIN).

The training activities carried out by CENFORTEC in 1994 have already been described in the previous section. However, mention should also be made of the strategic planning of new actions within the framework of the Second Community Action Plan, particularly the following programmes: RH+ - Incentive Programme for the Development of Human Resources; PFE - Training Programme for Entrepreneurs; PFAID - Training Programme for Agents for Innovation and Development; and Technical Schools in Priority Areas.

In the case of INT, 1994 was characterised by the construction of its new premises on the INETI campus at Lumiar, where planning has begun for activities in the following technological areas: Automation and Robotics, Energy, Environment, New Production Technologies, Materials and related Laser Processing, and Industrial Management.

In the area of business valorisation, the process of making CPIN into an autonomous entity, an EC-BIC (European Community - Business Innovation Centre) was begun and should be

completed in 1995. During 1994, CPIN continued its initiatives for the incubation of technology-based companies, three companies having completed the relevant incubation period.

g) ISR (Systems and Robotics Institute)

ISR operates in the fields of Robotics, Automation and allied areas, and has sites in Lisbon (IST), Coimbra and Oporto. During 1994, R&D activities were carried out at ISR (Lisbon site) by 82 researchers, of whom 22 were PhDs, 35 were working on Master's or doctoral theses, and 25 were engaged on their final undergraduate work. During this period, special mention should be made of activities carried out in the fields of Autonomous Mobile Robotics (Terrestrial and Submarine), Computer Vision, Artificial Intelligence, and Dynamic Systems, mainly in the following projects: PO-Robot, MARIUS, SOUV, Medusa and MAESTRO led by the IST Site and funded by the NATO SfS programme, by the European Community (MAST Programme) and by Lisbon Municipal Council; as well as the BENTHIC LAB project (MAST programme) led by IFREMER (France).

R&D results for 1994 have been reported through the publication of 3 doctoral theses, 4 Master's theses, 5 articles in books, 16 papers in international journals, 48 international conference papers, 2 papers in Portuguese journals, and 15 papers at Portuguese conferences.

h) Others

The main aim of ICTM (Materials Science and Technology Institute) is to carry out specific and specialised actions in the field of Materials.

The main aim of ICTPOL (Polymer Science and Technology Institute) is to carry out specific and specialised actions in the field of Polymers.

4.4.3. IST's Participation in Other Companies

a) SITAF

SITAF operates in the field of teaching and training material and is intended to put to good use the high level of scientific and technical expertise of the IST's human resources so as to development innovatory projects with an advanced technological content.

One of the main objectives of SITAF in 1994 was the commercialisation of its own products and those for which it is a representative. At the same time, efforts were continued to develop and market two products developed by teachers and students from the IST, namely, the Modul-Comp System and TCMLab-Models software.

b) TAGUSPARK

From the outset, the IST has participated in TAGUSPARK, the company for the Promotion and Development of the Science and Technology Park for the Lisbon Area. The IST has an area of 15 hectares in the Oeiras Park.

In 1994, the discussion process was set in motion at the IST on the programme for the IST's installations at the Oeiras Park, with a proposal to PRODEP being prepared in respect of the infrastructures. The process will continue in 1995, with the architectural project being put out to public competition.

In December 1994, the share structure of the TAGUSPARK was as follows: IST (12.6%), CMO (16.0%), CGD (10%), BCP (10%), INESC (8.44%), PORTUGAL TELECOM (5.98%), BFE (5.5%), EDP (5.0%), SIBS (4.9%), UTL (4.2%), JNICT (3.5%), IAPMEI (3.5%), BPI (2.8%), BFB (2.8%), CMC (1.2%), FLAD (1%), AIP (1%), GESTIFER (0.9%) e ISQ (0.7%).

c) Others

Within the framework of the IST's participation in two other technology parks, namely LISPÓLIS (Association for the Lisbon Technological Centre), and PTM/A (Mutela/Almada Technological Park), it was involved in activities promoted by these parks, including in particular its own installations.

4.5. INTERNATIONAL CO-OPERATION

IST's activities carried out within the international context during the year 1994 are presented in relation to the European Union and to other regions, mainly Portuguese-speaking African countries.

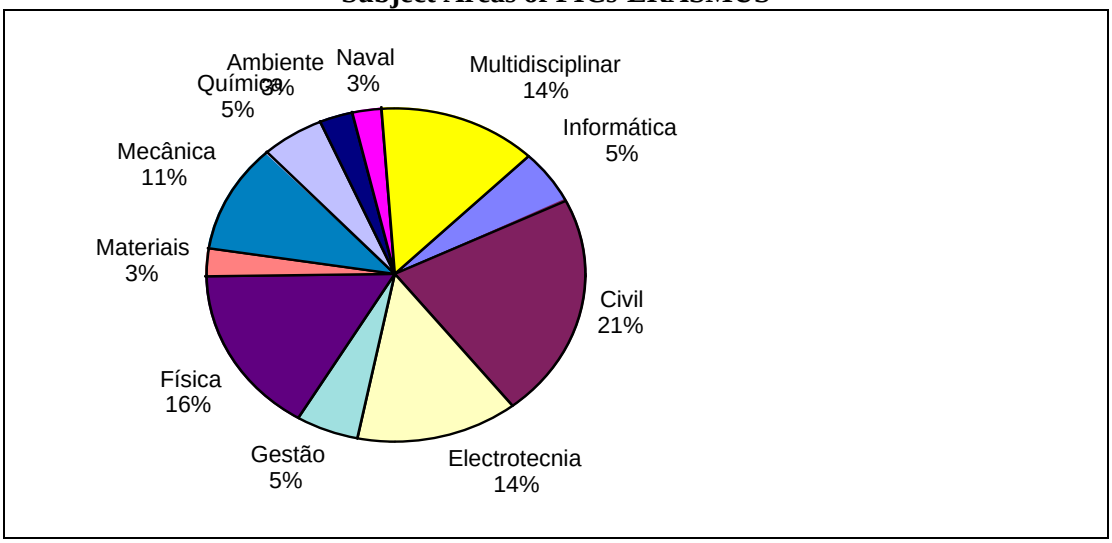
4.5.1. European Union

Co-operation between the IST and other European Union organisations has been given a considerable stimulus since Portugal's accession to the EC, particularly in relation to the mobility of students and teachers and the development of R&D proposals. These links will be analysed in the following paragraphs. Mention should also be made of the IST's participation in European networks of a strategic nature, such as CAESER, EuroPACE, and UNIMED.

Mobility of IST Students

IST students had innumerable opportunities in 1994 to participate in study and research periods abroad, as well as opportunities for placements in companies, and attendance on intensive courses. Under the ERASMUS programme, the IST participated in 37 Programmes for Inter-University Co-operation (PICs), 70 scholarships having been granted to the IST, of which only 50% were actually used. In addition, through the Department of Mechanical Engineering, the IST participated in the ECTS (European Credits Transfer System)-ERASMUS programme.

Figure 25
Subject Areas of PICs-ERASMUS

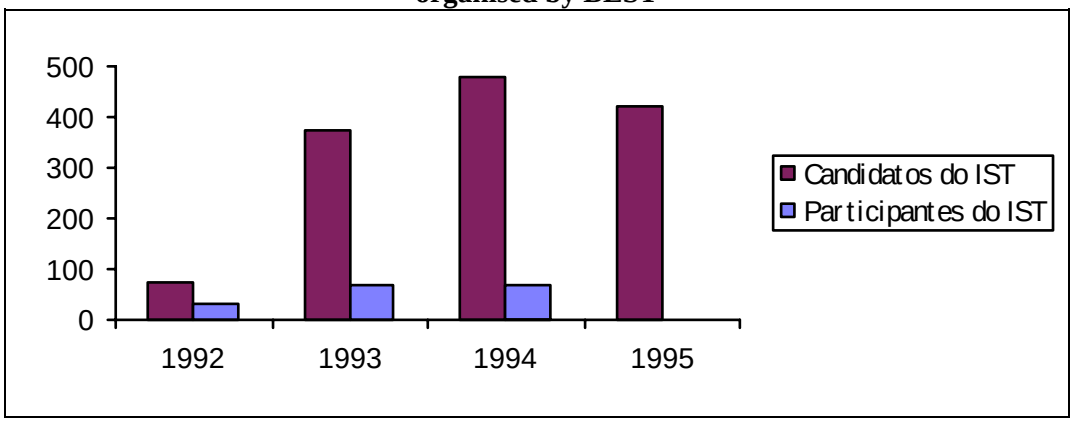


Clockwise: Multidisciplinary, Computer Science, Civil, Electrotechnical, Management, Physics, Materials, Mechanical, Chemical, Environment, Naval.

The IST also participated in the TIME (Top Industrial Managers for Europe) network, which brings together the most prestigious European universities, and under which one student from the IST attended the École Centrale in Paris in 1994.

With regard to intensive courses of an international nature, in 1994 72 students from the IST participated in the BEST (Board of European Students of Technology) Summer Course programme, attending one of the 32 European universities belonging to the network for periods of two or three weeks. The evolution in the number of applicants and participants from the IST on this type of course is shown in Figure 26, which illustrates the great demand for this type of activity, as well as the disparity in its supply. In addition, the BEST Local Group at the IST, in collaboration with the ISR (IST Site), organised a summer course for foreigners, which was held at the IST in August 1994, with the title "Land and Underwater Mobile Robotics".

Figure 26
Evolution in the Number of Applicants and Participants in Summer Courses organised by BEST



Applicants from IST
Participants from IST

With regard to placements in R&D institutes and companies, 30 placements were awarded to IST students during 1994 within the framework of IAESTE (International Association for the Exchange of Students for Technical Experience).

Mention should also be made of exchanges with students from other European universities, in particular with the Université Catholique de Louvain (Belgium), Chalmers TH (Sweden)

organised by BEST, with TU Eindhoven (Holland) organised by ESTIEM, and with the University of Munich (ERASMUS).

Research and Development

European co-operation in R&D activities, in particular the IST's participation in Community programmes, is described in Section 4.3. Representative lists of universities and companies who are participating in projects in conjunction with the IST can be found in the appendices.

4.5.2. Co-operation with Other Countries

In the context of co-operation with other regions of the world, reference should be made to co-operation with African countries whose official language is Portuguese, which has obvious comparative advantages for Portugal. In 1994, the IST was invited to participate in the International Forum on Higher Education in Small Island Nations, organised jointly by UNESCO and the Commission for the Establishment of Higher Education (CIES) in Cabo Verde. A project for the creation of a Higher Institute of Science and Technology (ISCT) was presented at this Forum, following which a delegation from CIES visited the IST in order to agree the preparation of a '*baccalaureate*' (advanced) course in Industrial Engineering, using the infrastructure of the Centre for Nautical Training. This course will constitute the 'embryo' of the ISCT.

In addition, mention should be made of, among others, contacts established with the Agostinho Neto University in Angola, and with the Eduardo Mondlane University in Mozambique. It should also be noted that the IST decided to join the Portugal-Africa Foundation, created in 1994 through an initiative of the *Banco de Fomento e Exterior* (External Development Bank).

In the case of Latin American and Middle Eastern countries, the European Commission launched the ALFA and MedCampus programmes in 1994, which afford comparative advantages for the Iberian countries. Thus, various IST teachers and groups prepared contributions to the ALFA programme in order to promote co-operation with Latin American countries.

4.6. SOCIAL AND CULTURAL ACTIVITIES

4.6.1. General Activities

In 1994, as was the case in 1993, the *Técnico* played an important role as a cultural agent, developing initiatives directed at opening up the School to society, through seminars, classical music concerts, the publishing of a book of photographs on the IST, and exhibitions of the plastic arts, among others.

Under the heading of "Technology and Society", a series of seminars was organised in 1994, with the aim of promoting discussion on the interactions between technology and society, starting with an event within the framework of the national programme for scientific dissemination "*Viva a Ciência*" (Long Live Science) organised by the Secretary of State for Science and Technology. Mention should also be made of the seminars "Teamwork and Group Dynamics" and "Competitiveness and Limits to Competition".

In the spirit of the initiative "Lisbon, European Cultural Capital", various activities of a cultural nature were held at the IST during 1994, in particular classical music concerts and other related activities, such as the publicising of collections of classical music under an agreement made with the Lisbon Metropolitan Orchestra.

Continuing the commemorations of the fiftieth anniversary of the death of Duarte Pacheco, a Commemorative Ceremony for Duarte Pacheco was held in the *Salão Nobre* at the IST. As part of these same commemorations, aeGIST organised a photographic competition on the work of Duarte Pacheco.

With the aim of bringing IST students into contact with employers, AEIST organised the 6th Jobshop in 1994. The initiative "20,000 Minutes of Art" was also successfully held at the *Técnico*, a pioneering action which took place at the IST from 27th October to 9th November, and brought together the works of 23 artists.

Special mention should also be made of the activities of the IST Choir and *TUNA* (university band), the latter giving around 50 performances and festivals in 1994. On the occasion of the IST's "2nd International Festival of University Bands", held at the *Coliseu dos Recreios* on 18th March, the *TUNA* recorded and prepared the launch of a double CD. The following performances are also worthy of mention:

- TAGIDES'94 Festival in Almada, where they were awarded prizes for the "3rd Best *Tuna"*, *"Melhor Pandeireta"* (Best Tambourine), and *"Tuna Publicozinho"* ("The Fans' Favourite Tuna");
- CELTA (Braga) in December '94, where it was considered to be the "*Tuna Mais Tuna"* (The Most Tuna Tuna);
- II FITUE (Évora) - Prize for the Best Tuna.

During 1994, there was also strong activity from the Theatre Group of AEIST, with particular mention of the staging of the play "Woyzeck".

With the aim of enhancing social life at the IST, improvements have been carried out and social support infrastructures created, such as CASIST (Social Support Centre of the IST). In addition, space has been reserved in the Post-Graduate Building for a refectory which will improve social conditions for all involved at the IST.

A Gala Ball was held in 1994, organised by aeGIST. The traditional Christmas Festivities also took place, which included a circus festival and presents for children. A considerable number of employees and their families joined in the festivities.

4.6.2. Technical Journal

The Technical Journal took on new vigour in 1994 following its re-launching in 1993, with four issues being published this year. The subjects covered included most aspects of engineering, with one issue being dedicated to Duarte Pacheco.

5. INTERNAL ORGANISATION AND ADMINISTRATIVE SERVICES

5.1. INTERNAL ORGANISATION

Figure 29 presents an organisation chart showing the organisational macro-structure of the IST in 1994, consisting of three types of units, namely academic and research, support, and administrative, and whose operations are co-ordinated by the Central Bodies (Figure 28). The academic and research units cover 8 departments with 29 sections, 2 autonomous sections and various research groups and centres, as listed in the appendices. The support units include the Computer Centre (which was officially designated a *Centro de Grande Dimensão - (*Large-scale Centre) by Despatch 111/MF/ME/93 dated 17th June), the Library and Workshops. The administrative units include 8 support offices and 3 services, namely academic, materials and human rescues, and technical support, as shown in Figure 29.

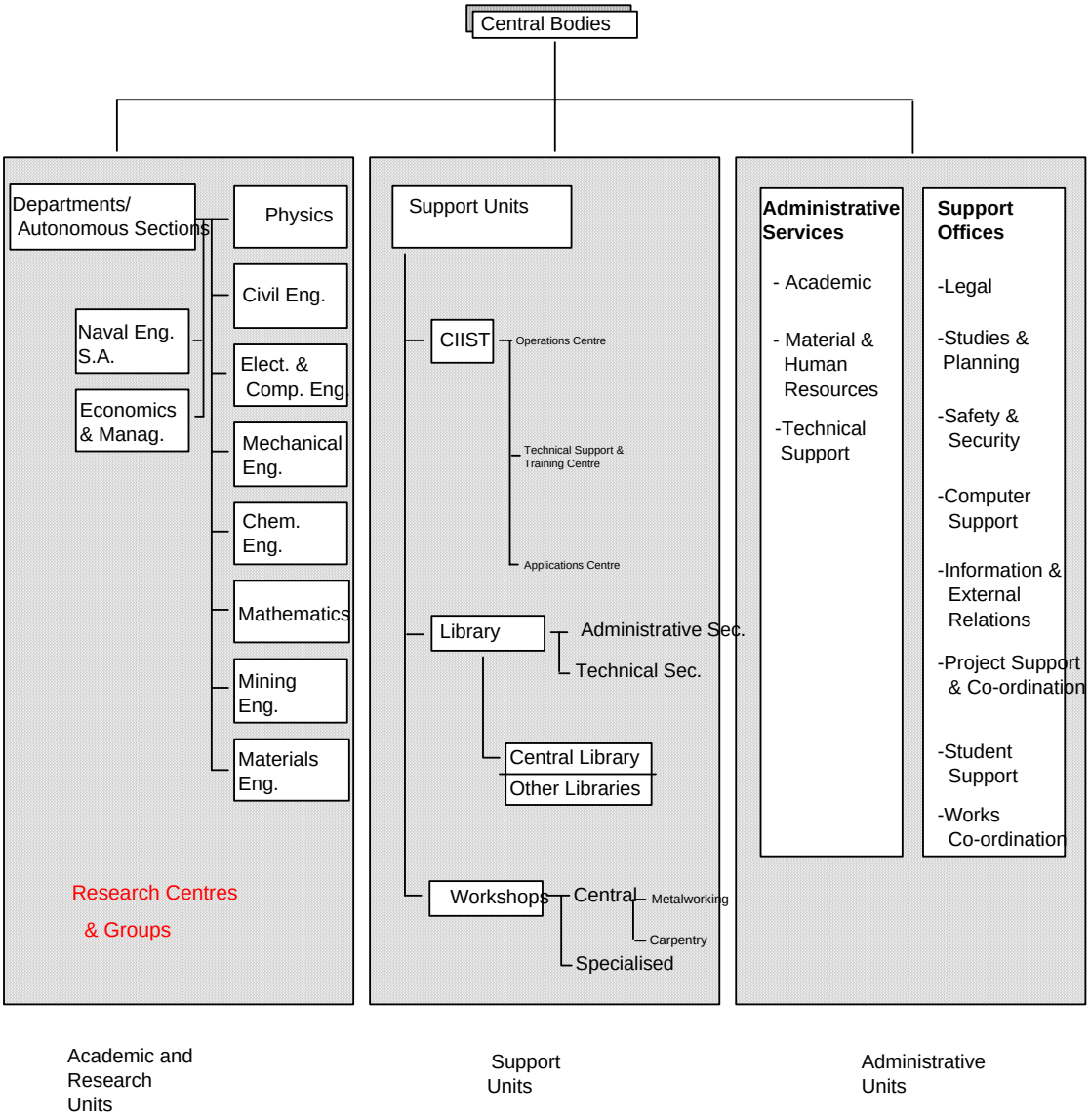


Figure 27
Organisational Macro-Structure

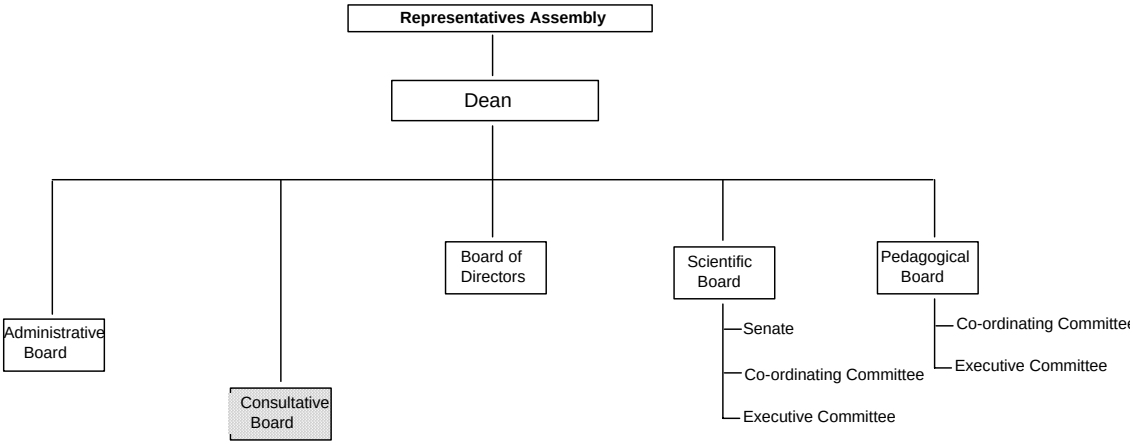


Figure 28

Organogram of Central Bodies

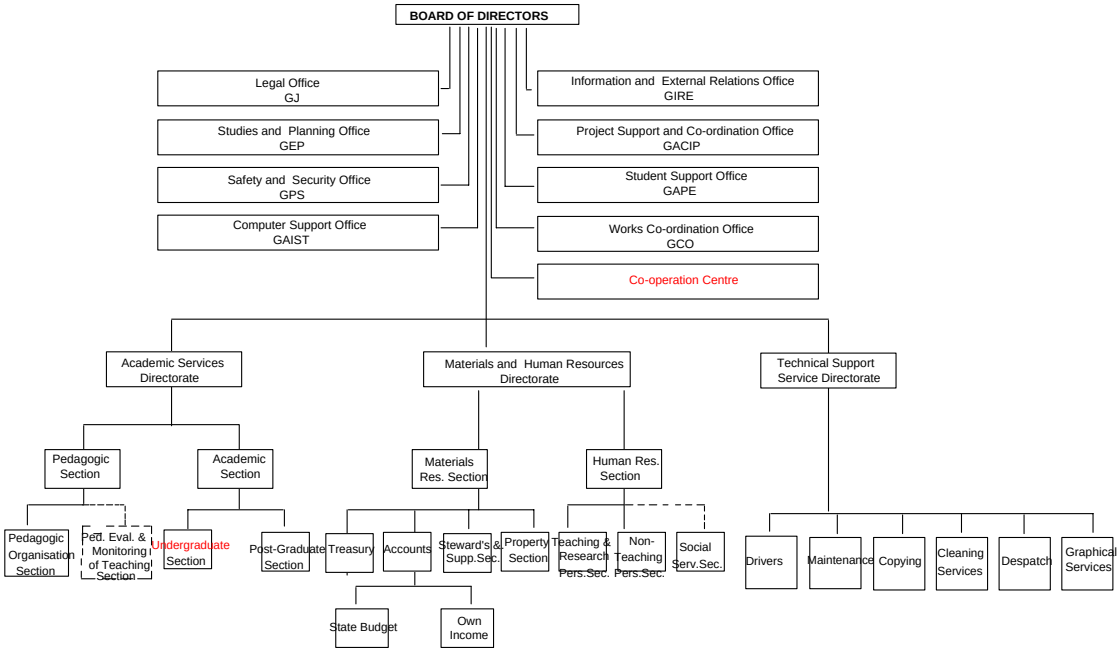


Figure 29

Organogram of IST Administrative Units

5.2. MATERIAL AND HUMAN RESOURCES SERVICES, AND ADMINSTRATIVE MODERNISATION

The modernisation of the IST's administrative services begun in 1993 was continued in 1994 with the aim of producing improvements in effectiveness and a reduction in costs, in accordance with the strategy developed concentrating on:

- cost control by centre of responsibility and by activity;

- optimisation and efficiency of resource use, in accordance with the size and nature of the *Técnico*.

The principle of property management having been implemented in 1993, the first steps were taken during 1994 to adopt analytical accounting principles, incorporating aspects of costing by activity. The ultimate objective of this process is to allow for a better description of university activity, which is obviously strongly knowledge-intensive.

In fact, what truly represents the extent of a university's activity is the level of knowledge and skills to be found in that institution, together with the way it which it manages to create, organise, transmit and use such knowledge to best advantage, thus contributing to the development of society. Therefore, the indicators generally accepted for evaluation in the business world become reductive if applied to the evaluation of the performance and potential of university institutions. In particular, the accounting indicators normally presented in the accounts of institutions do not show a significant proportion of the so-called "intangible assets" of those institutions. In the context of efforts to modernise the administration, it is important to show and, if possible, translate into accounting terms, the intangible resources and assets of the IST so that the accounts faithfully reflect the true potential, prestige and capabilities of the IST.

In the framework of the current modernisation process, a proposal was prepared and submitted in 1994 for a plan of training and upgrading for non-teaching staff, with the aim of increasing both their efficiency and their motivation and dedication. The training plan developed covers four main areas of general training (Computing, Safety and Security, Public Relations, and Languages), and three areas of specific training (Accounting, Library, and Filing), plus Human Resources Management.

The main actions carried out in 1994 following on from the work begun in 1993 are described below:

• The operation of a new and **sole treasury** was put into effect so as to permit proper control of financial operations.

• The operations of the **Accounts Section,** through its two centres, were improved through the recording of expenditure and income by cost centre and by activity, thus enabling the use of concepts from analytical accounting, incorporating aspects of costing by activity.

• The **Property Section** came into operation, whose function is the acquisition of current assets and (moveable and fixed) capital, as well as to maintain an up-to-date property inventory.

• The **Supplies Section and Steward's Office** also came into operation, following the implementation of a rigorous purchasing procedure for consumable goods, entailing the call for public tenders and subsequent agreement of supply contracts for consumable goods, following consultation with the State Central Purchasing Body.

• The offices of the **personnel** sections, namely the Section for Teaching and Research Staff and the Section for Non-Teaching Staff, were refurbished; the IST research scholarship contracting service was put into operation.

• A **traffic control** system was also put into effect for the IST's private car parks, based on multiple-use magnetic-strip cards.

5.3. ACADEMIC SERVICES

Following on from previous measures aimed at re-organising Academic Services, the separation of the graduate and post-graduate secretariats was completed. A plan was prepared in 1994 which envisages the automation of enrolments in particular, as well as entry of other data.

With regard to the Pedagogic Organisation Section (SOP), there was a re-organisation of the service, with new responsibilities in the areas of teaching equipment, the quality of teaching spaces, and the allocation and maintenance of the audio-visual systems installed in some classrooms.

There was further support from GEP (Studies and Planning Office) in the development of Pedagogic Evaluation activities, which may in the future form the basis for a Pedagogic Evaluation and Monitoring of Teaching Section, as provided for in the IST's statutes. These activities arose as a result of the School's interest in the evaluation of higher education and various actions related to the Evaluation of Universities were monitored, planned and carried out. In the context of this process, special mention should be made of the IST's participation in organising meetings/seminars and in preparing and carrying out surveys. In 1994, the unit operating within GEP assisted the self-assessment teams in respect of the Electrical and Computer Engineering and Technological Physics Engineering undergraduate courses, and began support work for the corresponding teams for the self-assessment of undergraduate courses in Mechanical Engineering and Naval Architecture and Marine Science.

5.4. SUPPORT UNITS, OFFICES, AND TECHNICAL SUPPORT SERVICES

5.4.1. Support Units

• IST Library (BIST)

1994 was marked by the installation of an Integrated Library Management System (LIBERTAS), acquired by the IST. Apart from providing easy access to information for users, the installation of this system means that there will be greater co-operation and collaboration between the 17 libraries (consisting of 24 Library Centres) that make up the IST Library (for more details, see the BIST Report, Volume 2).

During the course of the year, apart from the installation of central equipment in CIIST and of the structured network, network equipment and peripherals in the various libraries, specific training courses were run in the use of the system, at various levels, covering staff from all the

libraries. Work on setting up a database for the IST Library was also begun, by importing records from the SLS Database, with 23,434 records at the end of December 1994.

The training courses for BIST staff will continue during 1995, and the IST Library catalogue should be available to users as from October, with a remote control reservation and borrowing facility. This catalogue will also be available from any part of the IST campus with access to the network, as well as from outside.

In December 1994, BIST included 120,687 monographs and 1,572 periodicals, as listed in the following table. These figures do not include library stocks acquired with own income and in the possession of IST teachers.

Table 17

Library Stocks (Dec 94)

	Central Library	Civ.Eng Dept	Elect. & Comp. Eng. Dept.	Mech. Eng. Dept.	Chem. Eng. Dept.	Phys. Dept.	Math. Dept.	Min. Eng. Dept.	Mat. Eng. Dept.	Econ. & Man. Auto. Sect.	Comp Sc. & Eng. Dept	Research Centres
Library Stocks												
No. of Monographs	28,456	16,998	813	13,854	2,313	1,727	14,676	1,541	814	388	1,107	38,000
No. of Titles of Periodicals												
Total	173	88+220*	107	124+244*	61	74	139	31	10	11	0	290
Current	73	88+220*	123	81+68	73	86	140	31	12	11	0	278

* Includes Research Centre titles

• CIIST (Computer Centre)

The most important changes in 1994 in the operation of the Computer Centre include better guidance for users, and the following actions should be noted:

- students saw their space substantially increased, with easier access to central computers, PCs, IP services and the Internet. This initiative affected 7,615 students who use this service. The greatest change was seen in the Electrical and Computer Engineering undergraduate course, where usage increased to an extraordinary degree, reaching 26% of the total. This undergraduate course, together with that in Computer Engineering, currently use more that 30% of the total resources of CIIST.

- access to the UNIX machine was considered a right of students, who returned to using CIIST's services on a large scale.

- teachers saw their disc space increased to the limit they had requested.

- calculating capacity was increased tenfold during 1994..

- access to Internet services, via the National Scientific Calculation Network, was made available to teachers, master's and doctorate students, and fifth-year undergraduates.

- a staff redeployment programme was prepared and successfully incorporated within the new perspective of providing services to departments and students.

- staff were adapted to the needs of users, receiving specific training and participating in seminars and courses.

• Central Workshops

In 1994, the Central Workshops carried out a considerable amount of work, including 379 carpentry jobs and 292 metalworking jobs.

During 1994, support from the *CIENCIA* Programme to establish a network of workshops at the IST was re-analysed. The overall aim is to create a workshop infrastructure to support the

scientific community in general, and the existing IST research groups in particular, strengthening the workshop capacity already installed at the IST. Based on this support, new Specialist Workshops will be installed in 1995 for Precision Mechanics, Specialist Welding, Electronics, Glass, and Civil Construction, and the existing capacity of the General Workshops will be increased, particularly in the Metalworking Section.

5.4.2. Offices

• **Safety and Security Office (GPS)**. A permanent Central Security office was created in 1994 and a central alarm monitoring system was acquired to centralise the alarms distributed around the campus. The aim of this is to strengthen the intervention capability of this office, i.e. protection against fire, intruders and theft, hygiene, health and safety at work.

• **Information and External Relations Office (GIRE).** With the acquisition in 1994 of new premises, GIRE enjoyed improved conditions to carry out its activities in the various areas which make up its mission, namely attending to the general public, producing publications, promoting the IST, and supporting the IST's participation in Community programmes.

• **Studies and Planning Office (GEP)**. Besides the preparation of the 1993 Report and the 1995 Plan, various other actions were carried out within the IST's three areas of operation. In the Studies and Planning area, a proposal for strategic guidelines for the IST, prepared in collaboration with a multinational firm of consultants, was completed and circulated. In the pedagogic area, support was continued in the evaluation of undergraduate courses, and in the financial area, for the first time, the IST's accounts were prepared in accordance with the regulations set out in the Official Accounting Plan.

• **Student Support Office (GAPE)**. In 1994, GAPE organised the welcoming of new students enrolled at the IST for the academic year 1994/95, and was responsible for the publication of the Students' Guide. Three new study rooms were created, with GAPE responsible for the co-ordination of supervisors for these rooms.

• **Legal Office (GJ).** Within the framework of providing routine legal advice, mention should be made of the systematic monitoring by this office of personnel matters, particularly in relation to the preparation of examinations and contracts for teaching and non-teaching staff.

• **Computer Support Office (GAIST).** GAIST carried out monitoring of the IST's micro-computer equipment and assisted in the preparation of computer-assisted audio-visual presentations.

• **Support Office for the Co-ordination of Projects (GACIP).** This office continued work in its two main areas of operation, namely Project Control and Management and Training.

• **Co-ordination Office for Construction and Repairs (GCO).** In 1994, GCO co-ordinated all aspects related to the completion of new buildings, as well as renovation, maintenance and conservation work.

5.4.3. Technical Support Services

• **Copying**. The capacity, speed and quality of copying services were increased by the more efficient use of existing equipment and that acquired in 1993.

• **Cleaning and Gardening Services**. Following the policy implemented in 1993, outside sub-contracting of cleaning and gardening services was continued in 1994.

5.4.4. Other Services and Units

• **Conference Centre and Unit**. The Conference Centre came into full operation during 1994 in its premises in the Civil Engineering building, and a considerable number of conferences, meetings and seminars were held there. It consists of an amphitheatre with a capacity of 320, and 4 halls, each with a capacity of 120. The Centre also has sophisticated audio-visual equipment, as well as large reception areas.

• **IST Social Support Centre (CASIST).** During 1994, an agreement was signed between the IST, AEIST and the SSUTL (Social Services of the Technical University of Lisbon) for the creation of CASIST. CASIST is an IST body, made up of a Medical Unit and a Social Unit, and is designed to promote the physical, social and psychological well-being of the IST's users.

• **Co-operation Unit.** A study was begun in 1994 for the future establishment of this unit, whose main objective will be to encourage international co-operation, in particular with African countries whose official language is Portuguese.

5.4.5. Services Provided by Outside Organisations

• Travel and Tourism

The *Agência Abreu* (travel agency) desk established at the IST in 1993 consolidated its activities in 1994, of particular interest being the special conditions offered to the IST's staff and teachers to participate in holiday programmes. The terms of the agreement previously established between the IST and the *Agência Abreu* were maintained, under which all travel and

accommodation services requested by students, teaching and non-teaching staff, and researchers at the IST are offered at a 7.5% discount.

• Banking Services

The IST, AEIST and the *Caixa Geral de Depósitos* (CGD Bank) signed an agreement in June 1994, the aim of which is to issue a University Automatic Cash Card.

Installation works for a CGD Bank branch at the IST were also carried out in 1994; the branch is intended for the *exclusive* use of the school, and would be opened at the beginning of 1995. The establishment of this branch is the result of an agreement between the CGD and the IST to be signed in March 1995.

• Cafeterias, Restaurants, Bookshops and Leisure Areas

In 1994, the following cafeterias, restaurants, bookshops and leisure areas were in operation on the IST campus, following agreements with outside organisations.

• *Central Building* -Cafeteria / Restaurant on 2nd Floor, run by APIST;

-Central Hall Bookshops, run by *Livraria Barata* (bookshop) under an AEIST concession;

• *Civil Building* -Cafeteria and Restaurant (opened in 1994), run by the company *Nutrirest,* following a public call for tenders;

• *Mechanical II Building* - Cafeteria, run by APIST;

• *Post-graduate Building* - Cafeteria, sporting and copying facilities, run by aeGIST;

• *Interdisciplinary Complex* - Cafeteria in the Entrance Hall ;

• *AEIST* - cafeteria with indoor and outdoor seating, sporting and other facilities run by AEIST;

- Canteen, run by SAS UTL (Social Action Services of the Technical University of Lisbon).

6. HUMAN RESOURCES

6.1. TEACHING STAFF

6.1.1 General Description

The excellence of the Técnico's teaching staff is one of the characteristics that lends prestige to the school and has contributed to its development. In fact, the scientific and technical capabilities of the IST's teachers have continued to play an important role at national and international level through increasing involvement in teaching activities, R&D projects and international networks.

Table 18 sets out the numbers of IST teachers by department and category, as at December1994, from which it can be seen that 10% are full professors, 16% associate professors, 30% assistant professors, and 41% lecturers (including invited teachers).

Table 18
Chart of IST Teachers as at December 1994*

Departments	VFP	IFP	FP	IAP	AP	IASP	ASP	IL	L	TL	MNT	**TOT**
Mathematics	0	2	6	0	14	3	17	7	34	32	15	**130**
Physics	0	5	10	0	13	4	39	0	10	2	3	**86**
Chemical Eng.	0	3	13	4	26	4	58	0	21	1	0	**130**
Naval Arch.(Auto.Sect.)	0	0	0	1	1	4	0	9	1	4	0	**20**
Mechanical Eng.	0	1	12	1	20	14	40	7	33	7	5	**140**
Elec.&Comp.Eng.	0	2	18	1	35	1	60	12	86	16	5	**236**
Civil Eng.	0	2	12	8	21	5	28	25	44	15	6	**166**
Econ.& Man.(Auto.Sect.)	0	0	1	1	2	1	3	5	7	5	0	**25**
Mining Eng.	0	0	4	1	6	0	6	2	7	2	2	**30**
Materials Eng.	0	0	4	0	5	1	4	0	3	4	0	**21**
Total	**0**	**15**	**80**	**17**	**143**	**37**	**255**	**67**	**246**	**88**	**36**	**984**

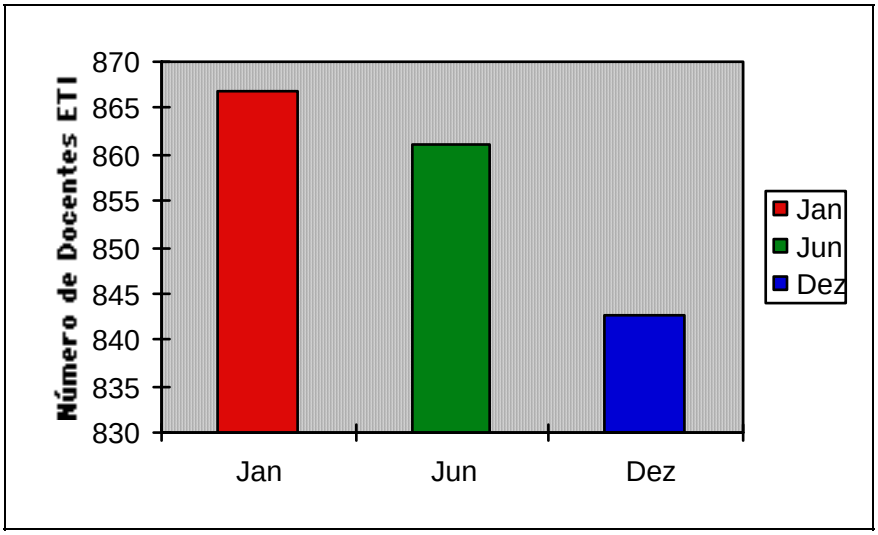
VFP-Visiting Full Professor
IFP-Invited Full Professor
FP-Full Professor
IAP-Invited Associate Professor
AP-Associate Professor
IASP-Invited Assistant Professor
ASP-Assistant Professor
L-Lecturer
IL-Invited Lecturer
MNT- Monitor (undergraduate teacher)
TL-Trainee Lecturer

* Refers only to contracted teachers

Including invited professors, the IST had 95 full professors, 160 associate professors, and 292 assistant professors in December 1994.

Between December 1993 and December 1994, the total number of contracted teachers varied as seen in Figure 30, which also shows that the number of teachers (FTE) over the year 1994 decreased from 866.8 in January to 842.6 in December. It should be noted that the evolution seen was affected by legislation in force, which limited new admissions to 40% of vacancies occurring, while the student/teacher (FTE) ratio was lower than the standard figure determined by the Ministry of Education.

Figure 30
Evolution in Number of Teachers (FTE)



Jan Jun Dec

Number of FTE Teachers

Table 19 shows the number of teachers (FTE) by category. As far as 'career' professors are concerned, it can be seen that the numbers increased over the year, from 67 full professors in January to 72 in December, from 127 associate professors in January to 136 in December, and from 228 assistant professors in January to 243 in December.

Figure 31

Evolution in Student/Teacher (FTE) Ratio **Jan**

Jun

Dec

Student/Teacher (FTE) Ratio **Standard**

The data show that the ratio of students per FTE teacher increased during the year from 8.8 in January 1994 to 8.9 in June, and finally, to 9.1 in December. Figure 31 compares these figures with the standard figure required by the Ministry of Education. The professor/teacher (FTE) ratio increased from 52% to a figure close to 57% (Figure 32).

Table 19

Number of Teachers (FTE) per Category

	Jan 94	**Jun 94**	**Dec 94**
Full Professors			
Career	67.00	67.00	72.00
Invited	6.20	6.20	5.20
Visiting	2.00	1.00	0.00
Associate Prof.			
Career	127.00	138.00	136.00
Invited	4.50	5.10	5.10
Visiting	0.00	0.00	0.00
Assistant Prof.			
Career	228.00	228.00	243.00
Invited	16.70	16.40	17.20
Visiting	0.00	0.00	0.00
Lecturers			
Career	237.00	239.00	236.00
Invited	39.00	36.00	32.70
Trainee	115.00	105.00	81.00
Monitors	24.40	20.40	14.40
Total	**866.80**	**862.10**	**842.60**

Figure 32 shows the evolution in the professor/teacher (FTE) ratio in 1994.

Figure 32

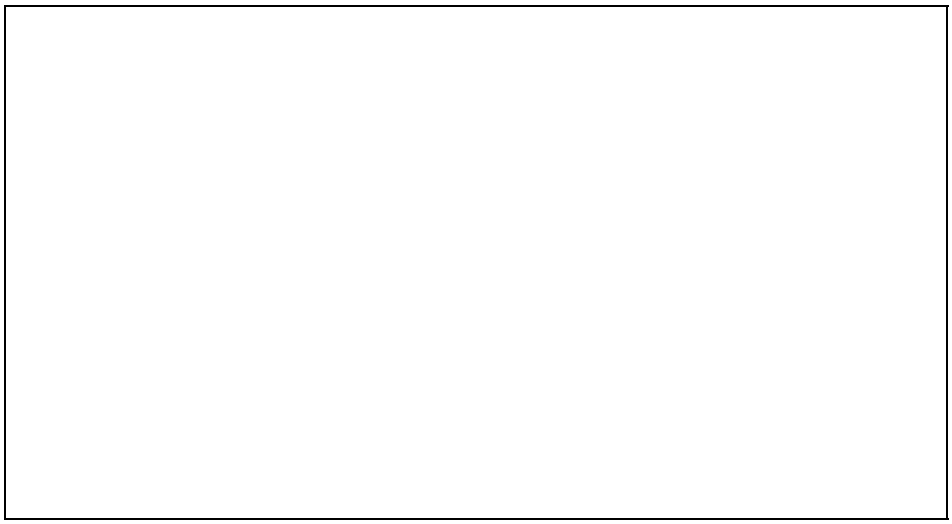
Evolution in Professor/Teacher (FTE) Ratio

Jan

Jun

Dec

% of Professors (FTE)



In addition to the teachers indicated, Master's students were also involved in teaching activities, as shown in Tables 20 and 21.

Considering each student as 0.4 FTE (a similar allocation to that applied to monitors), the total number of teachers and post-graduate students involved in teaching activities was 872.2 FTE in December 1994. This figure represents an average figure of 8.8 students per teacher (FTE).

Table 20

Number of Students Enrolled on Master's Courses in 1993/94 and 1994/95 involved in teaching on Undergraduate Courses in 1993/94 and 1994/95

	Involvement in Undergraduate Courses in 93/94	Involvement in Undergraduate Courses in 1994/95		
	Students Enrolled Master's 93/94	Students Enrolled Master's 93/94	Students n 1st year Master's 94/95	Total
Biotechnology (Biochemical Engineering)	0	0	1	1
Marine Resources Ecology, Man.& Mod.	0	2	1	3
Construction	1	0	0	0
Electrical & Computer Engineering	3	11	18	29
Structural Engineering	0	0	3	3
Materials Engineering	0	0	1	1
Mechanical Engineering	11	5	18	23
Chemical Eng. (Processes & Industry)	2	0	0	0

Physics	0	3	0	3
Operational Research & Systems Eng.	2	2	0	2
Applied Mathematics	0	2	0	2
Mineralogy and Mining Planning	0	1	2	3
Transportation	0	1	3	4
Total	**19**	**26**	**48**	**74**

The following table shows the distribution by undergraduate course of Master's students who were involved in undergraduate teaching in 1994/95.

Table 21

Number of Students Enrolled on Master's Courses involved in Undergraduate Teaching in 1994/95 (by undergraduate course)

	Comp. Sc.	Mech. Eng.	Elec. & Comp. Eng.	Tech. Phys. Eng.	Mat. Eng.	Chem. Eng.	Env. Eng.	Min. Eng.	Civil Eng.	**Total**
Biotechnology (Biochemical Engineering)			1							**1**
Marine Resources Ecology, Man. & Mod.		3								**3**
Construction										
Electrical & Computer Engineering	5	1	19	3			1			**29**
Structural Engineering									3	**3**
Materials Engineering					1					**1**
Mechanical Engineering	2	21								**23**
Chemical Engineering (Processes&Industry)										**0**
Physics				2					1	**3**
Operational Research & Systems Eng.									2	**2**
Applied Mathematics				1	1					**2**
Mineralogy and Mining Planning						1		1	1	**3**
Transportation									4	**4**
Total	**7**	**25**	**20**	**6**	**2**	**1**	**1**	**1**	**11**	**74**

6.1.2. Breakdown of Teaching Staff by Department

In the following, the evolution in teaching staff is shown, by department and autonomous section, in respect of the number of teachers (FTE), proportion of professors (FTE), and student/teacher ratio.

• Department of Civil Engineering (DEC).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	137	136.6	135.3
% professors (FTE)	43.28	45.61	47.15

The student/teacher ratio in the DCE in December 1994 was 8.58. 2 trainee lecturers were promoted to lecturers, and 4 lecturers promoted to assistant professors. 1 invited assistant professor, 1 lecturer, 2 invited lecturers, and 1 monitor terminated their appointments.

• Department of Electrical and Computer Engineering (DEEC).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	219.5	217.3	214.7
% professors (FTE)	46.38	47.31	50.21

The student/teacher ratio in December 1994 was 7.45. In this department, 12 trainee lecturers were promoted to lecturers, 9 lecturers to assistant professors, and lastly, 4 assistant professors to associate professors. 2 full professors were also appointed. 1 lecturer, 1 invited lecturer, 2 trainee lecturers and 9 monitors terminated their appointments.

• Department of Materials Engineering (DEMat).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	18.6	18.6	19.6
% professors (FTE)	56.99	62.37	64.29

The student/teacher ratio in December 1994 was 7.46. At the same time, the percentage of professors increased from 56.99 in January to 64.29 in December. During 1994, one lecturer was promoted to assistant professor.

• Department of Mining Engineering (DMinas).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	26.1	25.6	26.0
% professors (FTE)	58.24	55.47	62.31

The student/teacher ratio in DMinas in December 1994 was 4.54. In this department, 1 lecturer was promoted to assistant professor, 2 assistant professors to associate professors, and lastly, 2 full professors were appointed. Also, one invited lecturer's contract was terminated.

• Department of Mechanical Engineering (DEM).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	123.2	123.2	123.6
% professors (FTE)	55.44	57.06	61.17

In December 1994, DEM had a student/teacher ratio of 9.82. The number of teachers (FTE) in this department did not vary significantly during the year, although the percentage of professors varied between 55.44 in January and 61.77 in December. There were various promotions in 1994, namely 6 trainee lecturers promoted to lecturers, 6 lecturers to assistant professors, 1 assistant professor to associate professor, and lastly, 2 full professors were appointed. 1 visiting full professor, 1 invited assistant professor, 1 assistant professors, 1 trainee lecturer, 1 invited lecturer, and 4 monitors terminated their appointments.

• Department of Chemical Engineering (DEQ).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	120.5	118.7	117.3
% professors (FTE)	76.60	78.60	81.24

The student/teacher ratio in DEQ in December 1994 was 7.29. In this department, the number of professors (FTE) was 95.3 in December 1994, which represents 81.25% of teachers. There were various promotions in the department in 1994, namely 2 trainee lecturers promoted to lecturers, 4 lecturers to assistant professors, and 4 assistant professors to associate professors. 1 lecturer and 3 monitors terminated their appointments.

• Department of Physics (DF).

	Jan 94	**Jun 94**	**Dec 94**
No. teachers (FTE)	75.4	75	70.6
% professors (FTE)	77.45	79.20	81.30

The student/teacher ratio in DF in December 1994 was 9.77. There were various promotions in the department in 1994, namely 2 trainee lecturers promoted to lecturers, 2 lecturers to assistant professors, 4 assistant professors to associate professors, and lastly, 1 full professor was appointed. 1 invited full professor and 2 monitors terminated their appointments.

• Department of Mathematics (DM).

	Jan 94	Jun 94	Dec 94
No. teachers (FTE)	116.4	117	106
% professors (FTE)	34.36	34.19	38.68

The student/teacher ratio in DM in December 1994 was 14.73. In this department, 4 trainee lecturers were promoted to lecturers, and 3 lecturers to assistant professors. 1 visiting full professor, 5 trainee lecturers, and 9 monitors terminated their appointments.

• **Autonomous Section of Naval Engineering (SAEN)**.

	Jan 94	Jun 94	Dec 94
No. teachers (FTE)	9.8	10.6	9.1
% professors (FTE)	22.45	20.75	24.18

The student/teacher ratio in SAEN in December 1994 was 8.87. 1 invited lecturer terminated his appointment in 1994.

• **Autonomous Section of Economics and Management (SAEG)**.

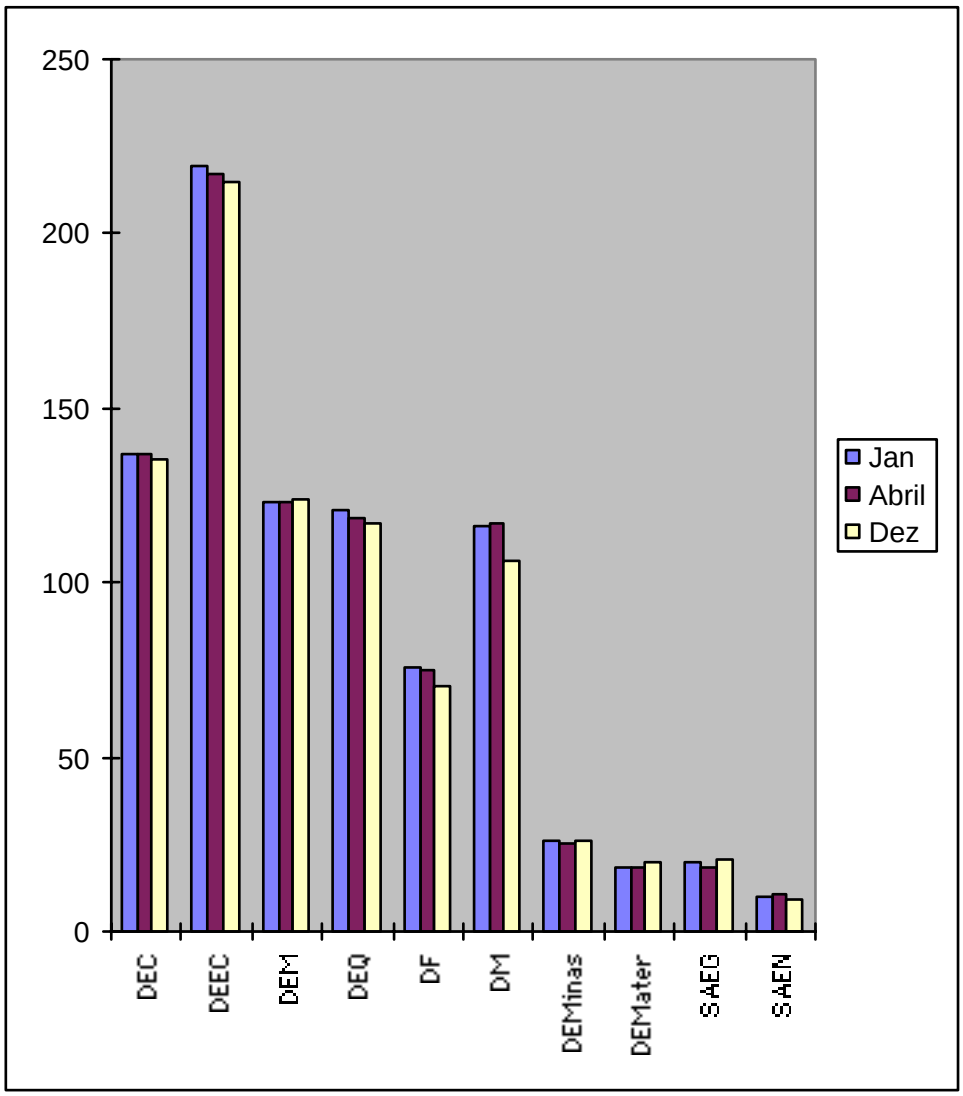
	Jan 94	Jun 94	Dec 94
No. teachers (FTE)	19.5	18.5	10.4
% professors (FTE)	27.18	30.27	32.35

The student/teacher ratio in SAEG in December 1994 was 15.5. During 1994, 2 trainee lecturers were promoted to lecturers, 1 lecturer to assistant professor, 1 assistant professor to associate professor, and lastly, 1 full professor was appointed.

Figure 33 illustrates changes in the number of teachers (FTE) for the months of January, April and December, for all departments and autonomous sections.

Figure 33

Teachers (FTE) by Department in 1994



Jan

April

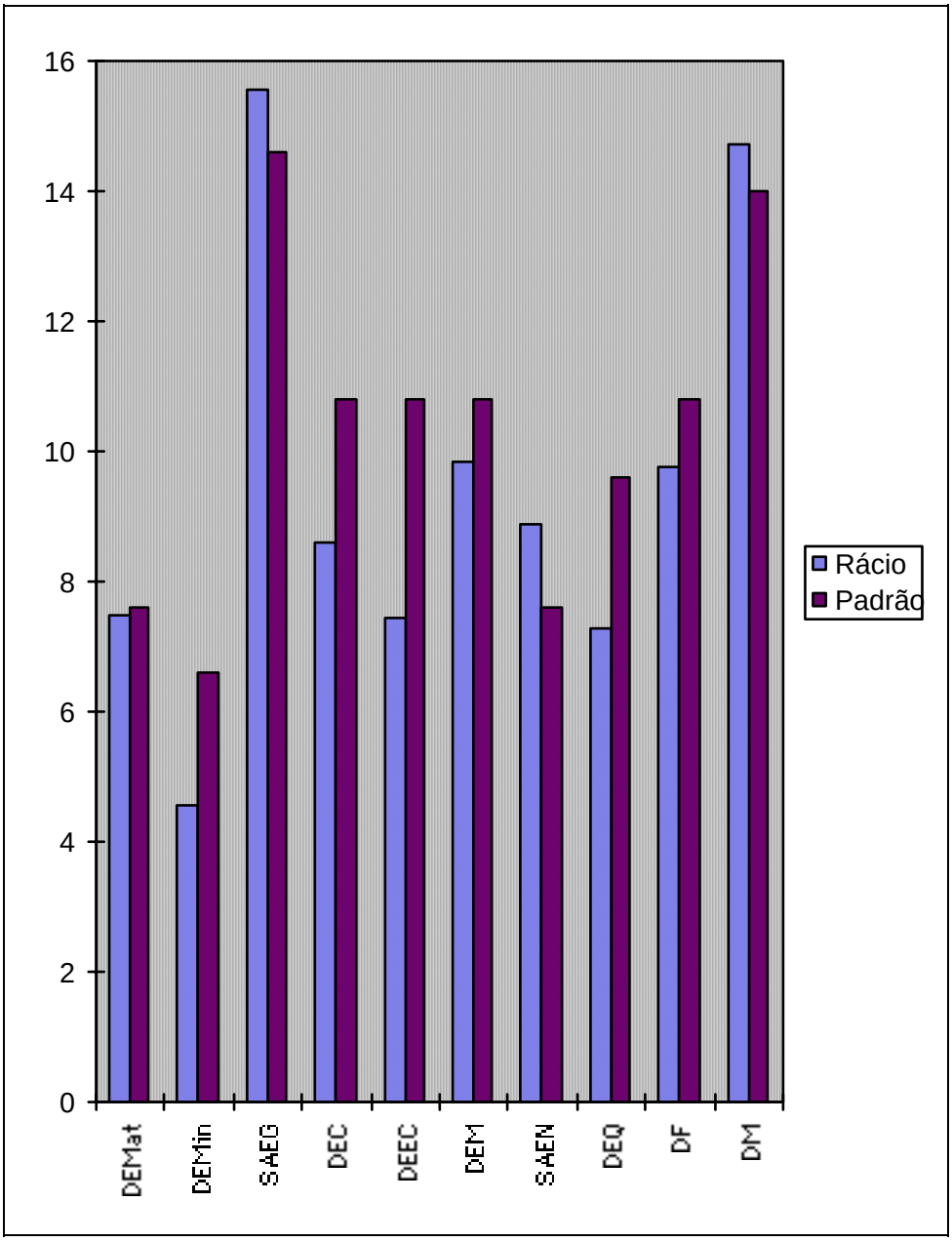
Dec

DEC, DEEC, DEM, DEQ, DF, DM, DEMinas, DEMat, SAEG, SAEN

Figure 34 illustrates the student/teacher (FTE) ratio for the month of January, compared to the standard figure determined by the Co-ordinating Committee of the Scientific Board.

Figure 34

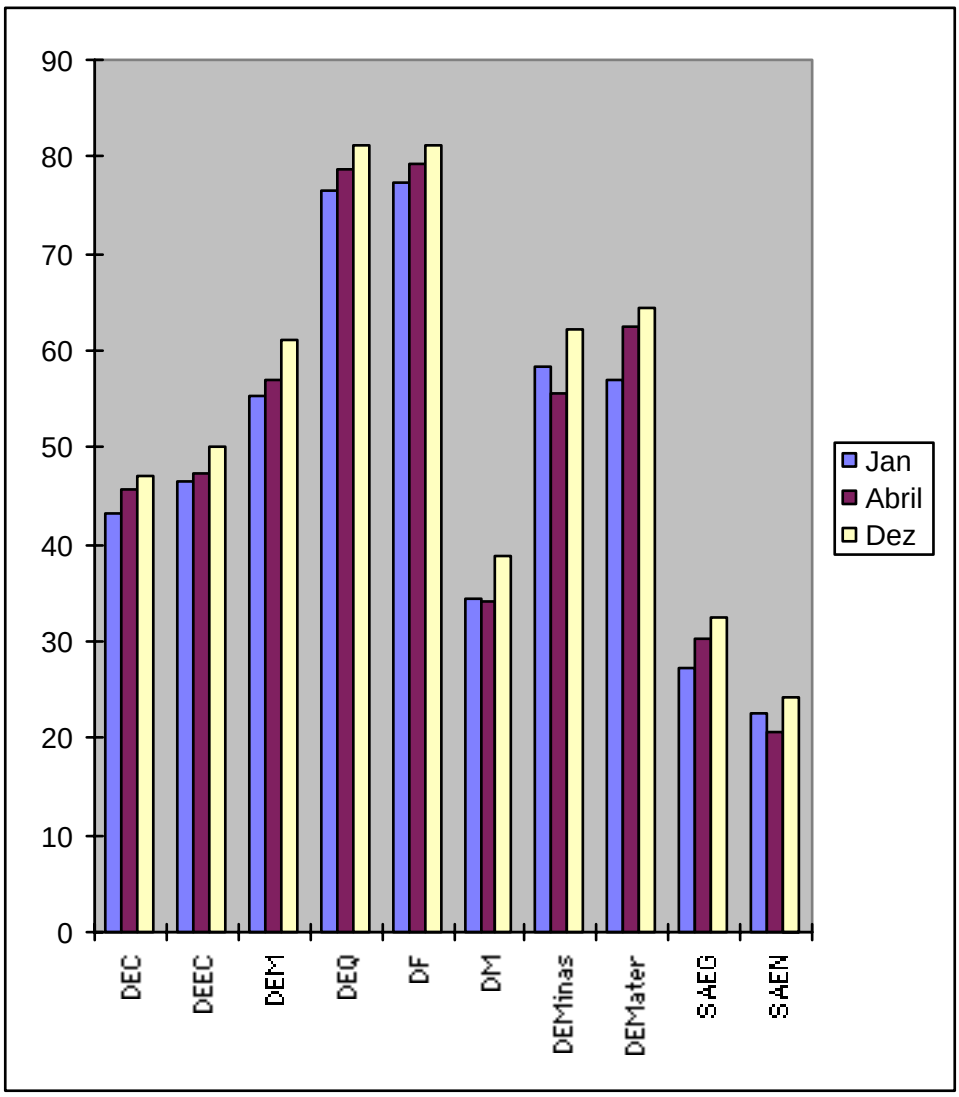
Student/Teacher (FTE) Ratio by Department in 1994



Ratio
Standard

DEMat, DEMinas, SAEG, DEC, DEEC, DEM, SAEN, DE, DF, DM.

Figure 35
Professor/Teacher (FTE) Ratio by Department in 1994



Jan
April
Dec

DEC, DEEC, DEM, DEQ, DF, DM, DEMinas, DEMat, SAEG, SAEN

A general increase can be seen in the proportion of PhDs among teachers compared to the previous year, the Departments of Chemistry and Physics showing the highest ratio of professors/teachers, 80.5% and 81% respectively, as at December 1994.

6.1.3. Retirements

Special mention should be made in this 1994 Report of the retirement of Professors Manuel de Abreu Faro and José Quintino Rogado, whose retirement ceremonies were attended by a considerable number of teachers, non-teaching staff, students and former students.

Professor **Manuel José Castro Petrony de Abreu Faro** was born on 26 November 1923. He graduated from the IST in Electrical Engineering in 1948, and gained a further engineering qualification (*Engenheiro Diplomado*) in 1949, becoming a lecturer at the IST in 1947, and a Full Professor in Telecommunications following a public competitive examination in 1956. He held various managerial posts in scientific and government organisations, such as the presidency of the "Education and Research" group during the preparation of the *Plano Intercalar de Fomento* (Periodic Development Plan) and in this connection, was the representative of the Minister for National Education (1963-67); he was also vice-president of the *Instituto de Alta Cultura* (Institute of High Culture) (1964-66), president of the Commission for Nuclear Energy Studies (1966-72), and president of the *Instituto de Alta Cultura* (1967-72). He was the director of the Interdisciplinary Complex (1972-74), and president-elect of the Provisional Directing Commission of the Interdisciplinary Complex (1974-75). With regard to his scientific output, mention should be made of research work published in the following fields: Non-linear Systems, Special Relativity, and Relativistic Electrodynamics. He is the author of numerous teaching works in the field of telecommunications, and propagation and radiation, including the following three books: *Ondas e Meios Materiais* (Waves and Material Means) (1979), *Radiação* (Radiation) (1980) and *Propagação Guiada* (Guided Propagation) (1984), published by AEIST Técnica, as well as *Peregrinação de um Sinal* (Journey of a Signal), published by Gradiva (1995). He is a permanent member of the *Academia das Ciências de Lisboa* (Lisbon Academy of Sciences).

Professor Abreu Faro retired on 26 November 1993, having delivered his last lecture on 8 June 1994 on the subject of "***Telecomunicações. Uma Síntese. Uma Perspectiva (Telecommunications: A Synthesis, A Perspective)***". This lecture presented a coherent, interlinked and comprehensive vision of telecommunications from the beginnings of electromagnetic telegraphy up to fibre optics, based on the fundamental principles of electromagnetism and information theory.

Professor **José Quintino Rogado** graduated from the IST in Mining Engineering in 1947 and gained a further engineering qualification (*Engenheiro Diplomado*) in 1959. He became a lecturer at the IST in 1947, and reached the level of Full Professor in 1961. He held various posts in companies in the mining sector, notably Head of Exploitation for the *Minas da Serra da Lousã* (1950-52), and consultant and chief engineer for the *Arouca* group of mines, *Companhia Portuguesa de Minas* (1952-53). He was head of the Centre for Exploitation of Mineral Resources from 1975 to 1994. A professor at the IST since 1961, he was also invited professor at the University of São Paulo, in Brazil in 1976, and co-ordinator and teacher on the Master's course in Mineralogy and Mining Planning (1982-94). He co-ordinated the Mineralogy and Mining Planning Section from 1980 to 1994, and was president of the Executive Commission of this section from 1988 to 1994. He is the author of various publications, among which the following should be mentioned: *Cash-Flow vs Cut-off grade Criteria for Mining Planning and Production Scheduling, Case Study on an Underground Gold Mine* (1988), *Computer Aided Design and Planning for Mine Exploitations* (1990), *Planeamento Integrado de Exploração de Minas Subterrâneas: o Exemplo da Mina de Aljustrel* (Integrated Planning of Exploitation of Underground Mines: The Example of the Aljustrel Mine) (1993).

Professor Quintino Rogado retired in 1994, having delivered his last lecture on 19 November 1994 on the subject of **"*Geosistemas (Geosystems)*"**.

6.2. NON-TEACHING STAFF

In this chapter, the actions carried out in 1994 in respect of Non-teaching Staff are reported, and deals with matters relating to Employees on the IST's Staff, Employees Seconded to the IST, in particular those from the Rector's Office (Ex INIC), and Other Contracted Staff.

6.2.1 Employees on the IST's Staff

During 1994, the number of non-teaching employees on the IST's staff varied between 385 in January, 378 in June, and 387 in December.

The inadequate resources of the IST's staff having been noted over a period of years, a study was begun in 1994 on the need for enlargement and restructuring

With the aim of upgrading and training the IST's non-teaching staff, a vocational training plan was implemented in order to respond to the needs detected in the various services and offices. The training was intended primarily for employees involved in the process of administrative modernisation, related to the areas of accounting and information technology. In addition, participation was arranged for IST employees in the continuous training programme for employees promoted by ADIST. This initiative covers the areas of information technology, human resources, organisation, accounting, auditing and management, quality, secretariat and public relations, library and documentation, and languages.
An Efficiency Regime for Non-teaching Staff was also prepared.

6.2.2. Employees Seconded to the IST from the Rector's Office (Ex INIC)

In April 1994, the Rector's Office seconded to the IST the staff allocated to the Research Centres of the Ex-INIC, and who perform the same duties and enjoy the same benefits as IST employees.

6.2.3. Other Contracted Staff

As a result of the inadequate levels of IST staffing, the school also relied in 1994 on other staff on fixed-term contracts with ADIST, who worked either in support of research associated with projects, or in administrative activities.

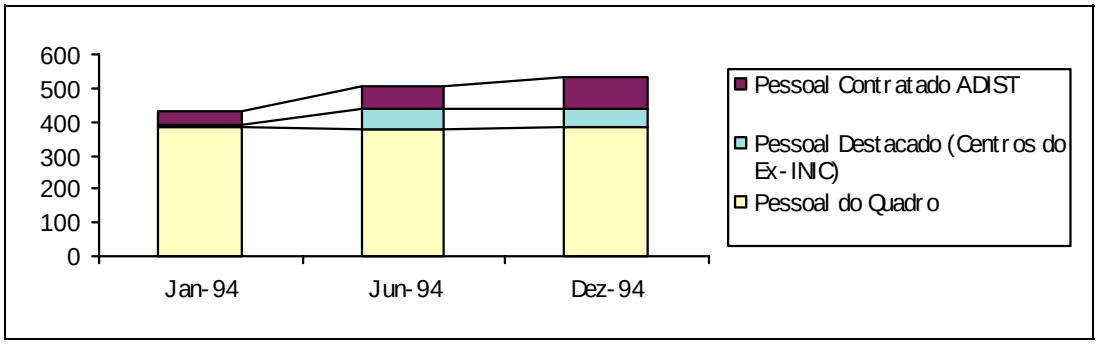
There are other situations, in particular those related to the generation of own income, which require a provision of services, which by their nature are not accounted for here.

6.2.4. Total Staff

Figure 36 shows the total number of non-teaching staff, including employees on the IST's staff, employees seconded from the Rector's Office/ex-Inic, and employees contracted by ADIST.

Figure 36

Evolution in Total Non-teaching Staff



Jan 94 Jun 94 Dec-94

ADIST Contracted Staff

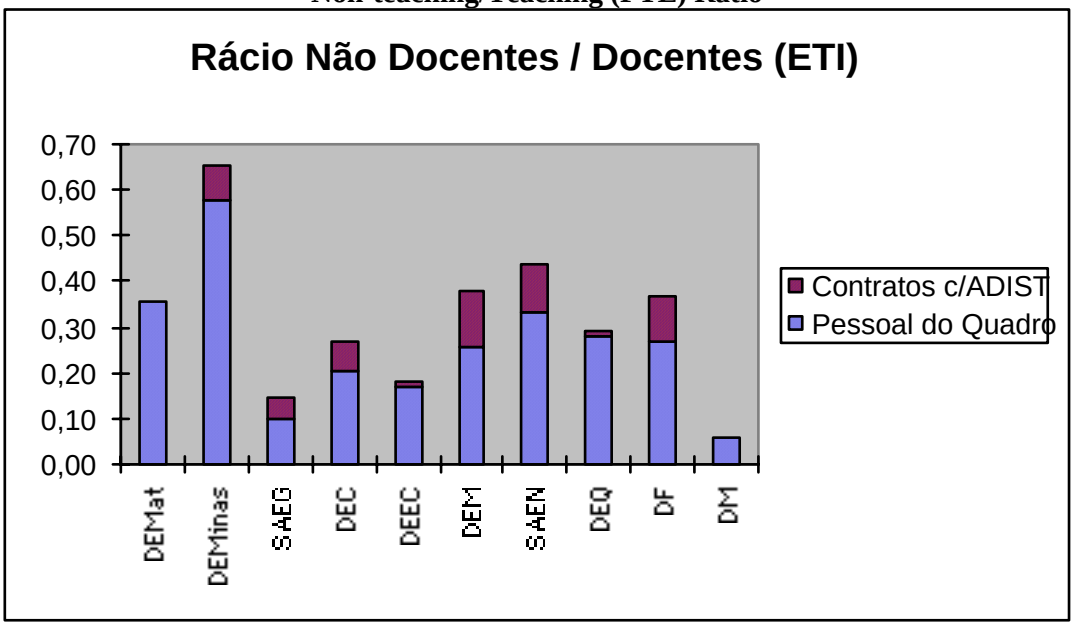
Seconded Staff (ex-INIC Centres)

IST Staff Members

Figure 37 shows the non-teaching/teaching (FTE) ratio as at December 1994 by department, including staff members and staff contracted by ADIST.

Figure 37

Non-teaching/Teaching (FTE) Ratio



Contracted by ADIST

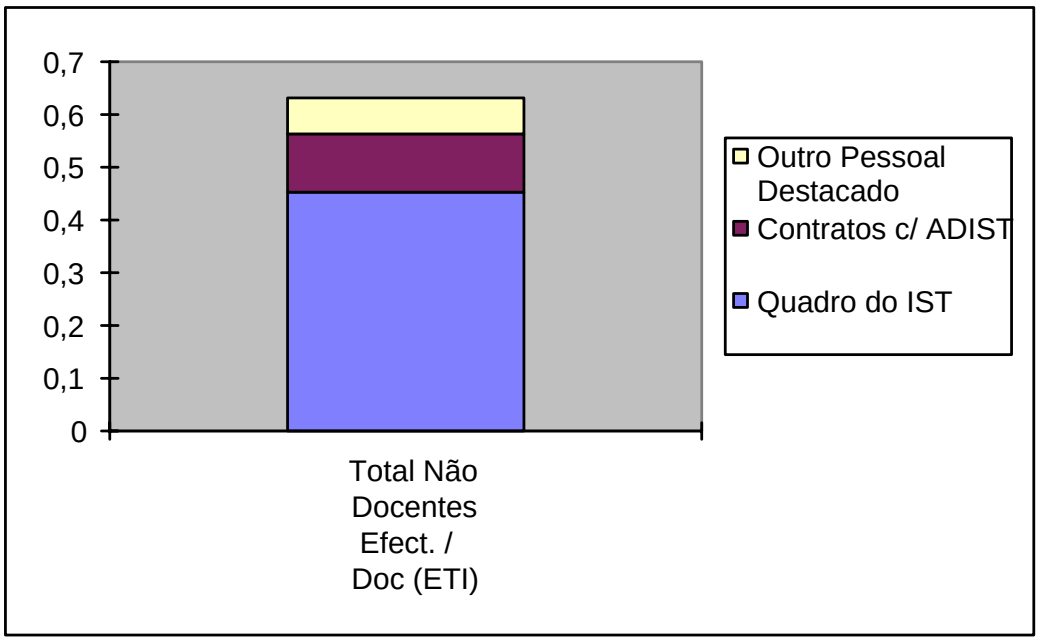
IST Staff Members

DEMat, DEMinas, SAEG, DEC, DEEC, DEM, SAEN, DEQ, DF, DM.

Figure 38 shows the ratios of non-teaching staff members and total permanent staff members to teachers (FTE) as at December 1994.

Figure 38

Ratios of Non-teaching Staff Members and Total Permanent Staff Members to Teachers (FTE)



Other Seconded Staff

Contracted by ADIST

IST Staff Members

Total Permanent Non-teaching Staff Members / Teachers (FTE)

7. INFRASTRUCTURE, CONSTRUCTION AND REPAIR

The IST university campus, designed at the end of the 1920s by Porfírio Pardal Monteiro, was intended to have a working life of 40 years and to accommodate five undergraduate courses, in addition to the General Engineering Course, and was to have included two buildings intended to house the Machinery and Hydraulics laboratories, although these were never in fact built. The development strategy followed by the *Técnico* in the 1960s led to the construction of the Interdisciplinary Complex facing Rua Alves Redol. Finally, recent years have seen the completion of the **Civil Engineering Building,** the **Post-graduate School**, adjacent to the **CIENCIA Building**, and the **North Tower**.

The completion of these works meant that, in December 1994, there were approximately 29,000 m^2 available for teaching and research, 13,000 m^2 for offices, and 9,500 m^2 for recreational areas.

The work carried out in 1994 was divided between the following general areas:

a) New Buildings, namely the North Tower, Post-graduate Building, Science Building, and Civil Engineering Building. At the beginning of 1994, these buildings were at an advanced stage of completion; in some cases, certain areas had already been provisionally accepted and partially occupied. The main works carried out are described below.

North Tower

Construction work inside the building was completed and air conditioning equipment, lifts and security equipment were put into operation. Teaching equipment and furniture that had already been acquired were installed. Provisional acceptance from the contractors was effected and responsibility transferred to the Maintenance Service of the Works Office, in collaboration with the manager of the building.

With this building becoming operational, the usable area of the IST has been increased by approximately 6,200 m^2, of which 3,000 m^2 is destined for pedagogic and scientific infrastructures, 1,700 m^2 for teachers' offices, and 1,500 m^2 for administrative services and support units.

Post-graduate School

The following was carried out: completion of finishing works on all floors, including the ground floor, and the required modifications to Floor 2; completion of works related to special installations.

With this building becoming operational, the usable area has been increased by approximately 5,000 m^2, of which approximately 1,700 m^2 is destined for pedagogic and scientific infrastructures, 1,900 m^2 for teachers' offices and meeting rooms, and 1,400 m^2 for administrative services and support units.

CIENCIA Building

During 1994, work was completed related to tenders launched in 1993 in respect of contractors for: “Masonry, Architectural Finishing Works, Water and Drainage Installations and Equipment”, and “Electrical and Mechanical Installations and Equipment”.

When the whole of this building becomes operational, the scientific area will extend over approximately 2,900 m^2 (destined for laboratories, computer rooms, other rooms and offices), and the support units (library, cafeteria, etc.) over approximately 400 m^2, the total usable area being approximately 3,300 m^2.

Civil Engineering Building

During 1994, work was carried out to remedy certain defects in contracted work for the finishing works of Phase 2. Provisional acceptance was also effected in relation to Phase 2. Work was also completed on alterations required in order to meet the needs of users.

The Civil Engineering Pavilion has a usable area of approximately 15,000 m^2, of which approximately 8,100 m^2 is for the pedagogic and scientific area, 2,900 m^2 for offices and meeting rooms, and 4,000 m^2 for various other purposes - administrative services, libraries, social support units, workshops, and storerooms, among others.

b) Preparation of the Final Programme in respect of the **Pedagogic Infrastructure** and Parking on the *Alameda Central* (Central Promenade) of the IST.

c) Preparation of the **South Tower** Programme (Chemistry) and monitoring the execution of the project.

d) Preparation of the Programme for the **IST's Installations at the Science and Technology Park** at Oeiras (TAGUSPARK), and preparation of the related call for tenders.

e) Preparation of the Preliminary Programme and monitoring the Basic Architectural Programme for the **Extension of the Workshop Pavilion** (Mechanical).

f) Monitoring the preparation of the IST Classification Plan

g) Initial preparation of the Preliminary Programme for the IST campus **Landscaping Project**.

h) Preparation of **applications to PRODEP** in respect of:

- Pedagogic Infrastructure and Parking on the *Alameda Central*.
- South Tower (Chemistry).
- Science and Technology Park at Oeiras: "TAGUSPARK".
- Extension of Workshop Building (Mechanical).
- Renovation of original buildings: Central Building, Mechanical Building, Chemistry Building, Mining Building, Workshop/Master's Building, and the AEIST Building.

i) University Residences

Applications were also made to PRODEP in respect of university residences, to be located in the TAGUSPARK, Campo Pequeno, and Telheiras.

j) Execution of **Conservation and Renovation Work** and related projects, including that programmed for 1994 and additional work of the same type subsequently requested. This work was carried out either following requests made by the various IST departments and approved by the Board of Directors, or prompted by deterioration in buildings or equipment, as well as the need to equip new installations for students and teachers.

k) Other Works

In addition, various other work was carried out, following requests made by various Departments, Autonomous Sections, and central services of the IST, as listed in the Works Co-ordination Office Report.

8. IST STUDENTS

The quality and dynamism of a university's students is one of its main "intangible assets". For this reason, university institutions should recognise the importance of providing areas for action which allow students to develop their enterprising spirit and creative potential, and thus feel themselves to be an active and integral part of the educational process, and not passive elements in a system which is remote from them. In line with its policy of openness, the IST sought throughout 1994 to provide opportunities for the development of its students. In particular, the inclusion of undergraduates in research and development activities co-ordinated by IST teachers was significantly increased, as well as their participation in extra-curricular activities (assistance in libraries and study rooms).

In the area of student activities, AEIST, either through the autonomous sections, or under the direct co-ordination of its management, organised a series of initiatives in 1994 in which students played a leading part; among these, special mention should be made of '20000 Minutes of Art', the Lunchtime Conversations, the 6th Jobshop, the Reception Week for Freshmen, and the second IST *Super Arraial* (Festival).

Through AEIST, students also had the opportunity to take part in sporting activities such as football, handball, basketball, rugby, water-polo, tennis, archery, volleyball, and chess. The IST Car Club (*Motoclube do IST* - MIST) was also launched in 1994. Lastly, mention should be made of the services provided to students, particularly by the Temporary Placements Office and the Document Section. The latter greatly improved the quality of its services in 1994, especially by setting up a processing service for lecture notes.

In addition, the Association of IST Graduates (aeGIST) provided graduates with a meeting place, in new, extensive premises located in the Post-graduate School building, which include a gymnasium, a photocopying centre, and a cafeteria.

Mention should also be made of the activities of the BEST Local Group in the field of international relations, which in 1994 organised the fourth summer course for foreigners at the IST, and promoted the participation of more than 72 IST students in similar courses abroad, as well as arranging the participation of 40 students in related initiatives.

Lastly, the IST's 'Junior Company' (Junitec) was involved in various activities in 1994 to promote a spirit of enterprise and development in the field of information technology. In this context, special mention should be made of the PHYSICS LABORATORY project, which

consists of a computer-simulated laboratory, and is being publicised and marketed in collaboration with *Texto Editora* (publishing house).

9. ACCOUNTS

9.1. Accounts Report, Balance Sheet and Breakdown of Results

This chapter deals with the accounts of the IST for 1994, in accordance with the accounting principles established in the Official Accounting Plan, Decree-Law 410/89 of 21 November, consolidating the various sources of funding.

I. The main **sources of funding** which have provided for the development of the different activities carried out by the IST in 1994 were the following:
   - State Budget;
   - Structural funds for teaching and training (PRODEP Programme);
   - Community R&D projects;
   - JNICT R&D projects;
   - Long-term JNICT funding for R&D Centres;
   - Provision of Services and other R&D projects with industry;
   - Income from Secretariat (undergraduate and post-graduate tuition fees)
   - Income from copying and other services

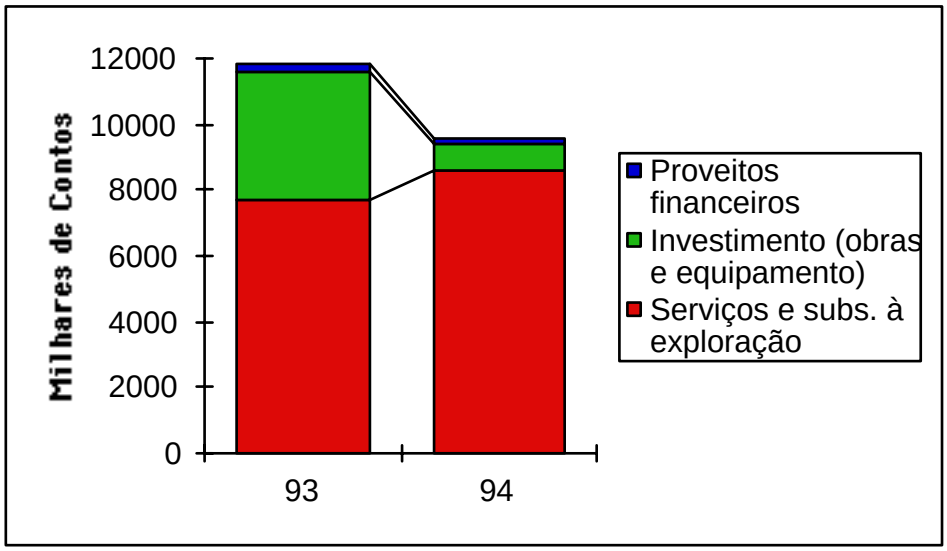
Total income is made up of 9,370 million escudos in respect of supply of services, operating subsidies, and contracts, 57.5 million escudos of investment funds (construction work and equipment), and 136 million escudos of financial profits, and amounts to a total of 9,564 million escudos.

Figure 39

Evolution of Funding to the IST between 1993 and 1994

Financial profits
Investment (Construction work and equipment)
Services and operating subsidies

Millions of Escudos



Compared to 1993, these figures represent an increase of 11% in financial resources deployed by the IST for teaching and research activities, in spite of an overall reduction of 19% in total resources due essentially to the absence of structural funds for construction work and equipment in 1994. Financial operations under these headings are analysed in detail in the following paragraphs.

II. In 1994, total **income** in respect of **provision of services and operating subsidies** includes 8,575 million escudos, distributed as follows: 62.8% funding from State Budget, 12% from the European Union, 3% from JNICT, 15.9% from supply of services, 1.7% from structural funds from the PRODEP programme, and 4.7% from income from secretariat.

This income differs from that previously described due to the fact that 795 million escudos were used in the acquisition of fixed goods.

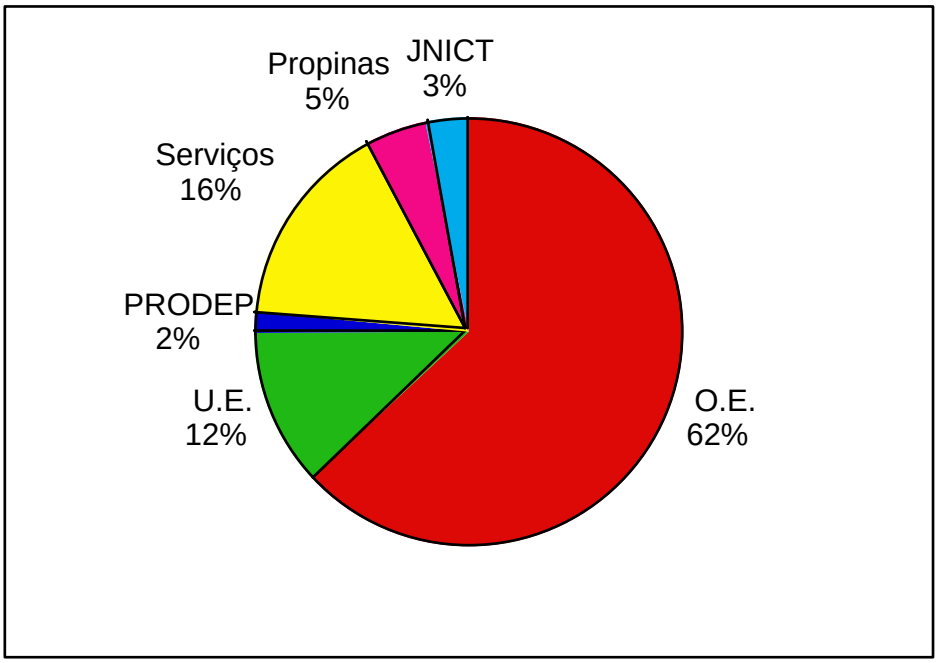
Figure 40

Provision of Services and Operating Subsidies

(Income in 1994, excluding construction works)

8,589 million escudos

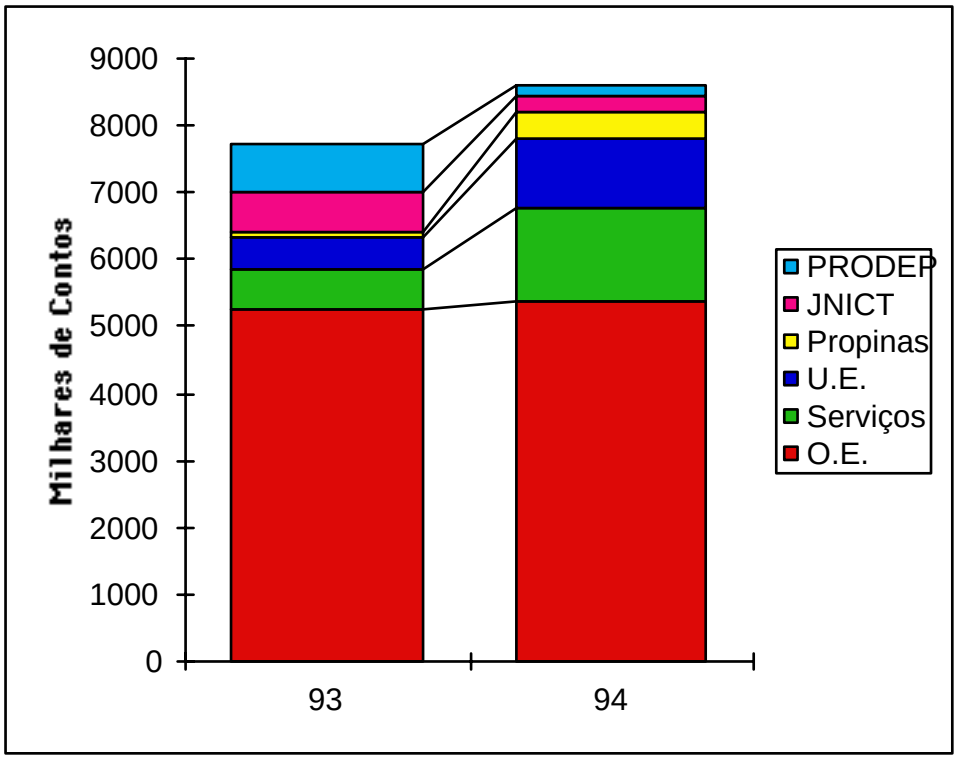
State Budget, EU, PRODEP, Services, Tuition Fees, JNICT


Propinas
5%
JNICT
3%
Serviços
16%
PRODEP
2%
U.E.
12%
O.E.
62%

II.1. The above data show that funding from the **standard State Budget** in 1994 for current expenditure (staff and purchase of goods and services) represents only 62.8% of the total from operating subsidies and provision of services. This percentage has decreased over recent years, as can be seen when compared to 86% and 69% for the years 1992 and 1993 respectively.

Figure 41

Evolution of funding from provision of services and operating subsidies between 1993 and 1994



PRODEP
JNICT
Tuition Fees
EU
Services
State Budget

Millions of Escudos

II.2. It should be noted that in 1993, around 93% of **state funding** was channelled into covering expenditure on staff, leaving only 7% available for operating expenses, whereas in 1994 expenditure on staff took around 91% of the State Budget.

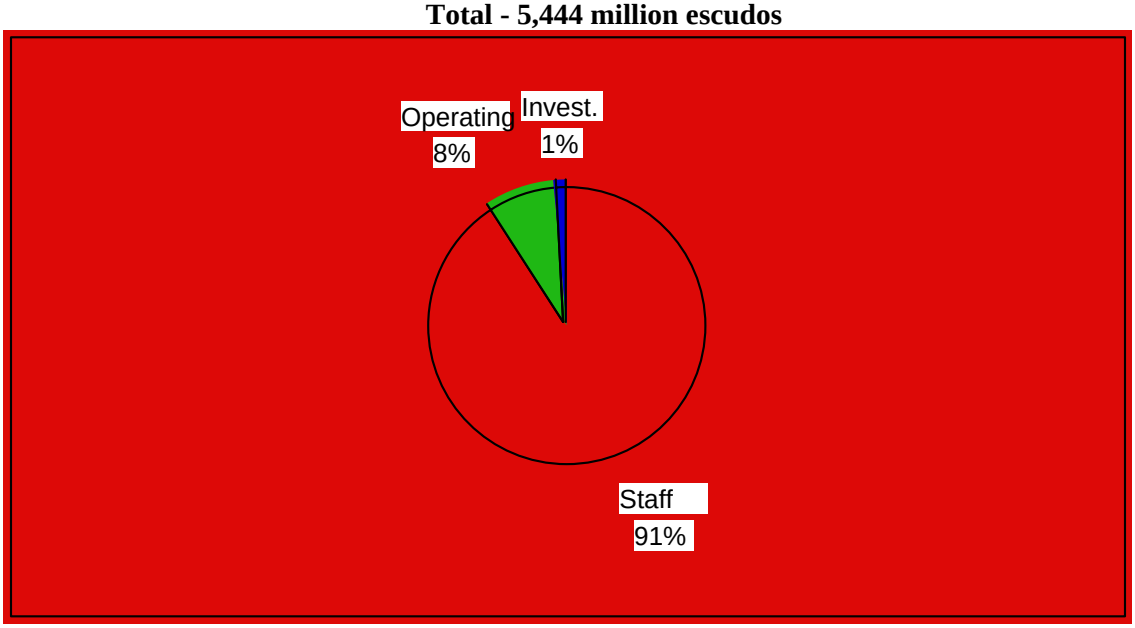
Figure 42

Total expenditure borne by the State Budget - 1994

5,386 million escudos - Staff and Operating Expenses

57.5 million escudos - Investment

Total - 5,444 million escudos



The figures show that state funding increased by only 2% from 1993 to 1994, whilst the total received by the IST for Provision of Services and Subsidies increased, as previously stated, by 12%. The 2% increase corresponds, in percentage terms, to the same increase applied to Public Administration salaries.

It should also be noted that the difference between actual budget performance for state funding and the original budget was only around 2%, which was due to the fact that the application of the rules for Public Budgeting did not allow the original budget to take account of the above mentioned salary increase.

Table 22

Budget performance for state funding in 1994

(millions of escudos)

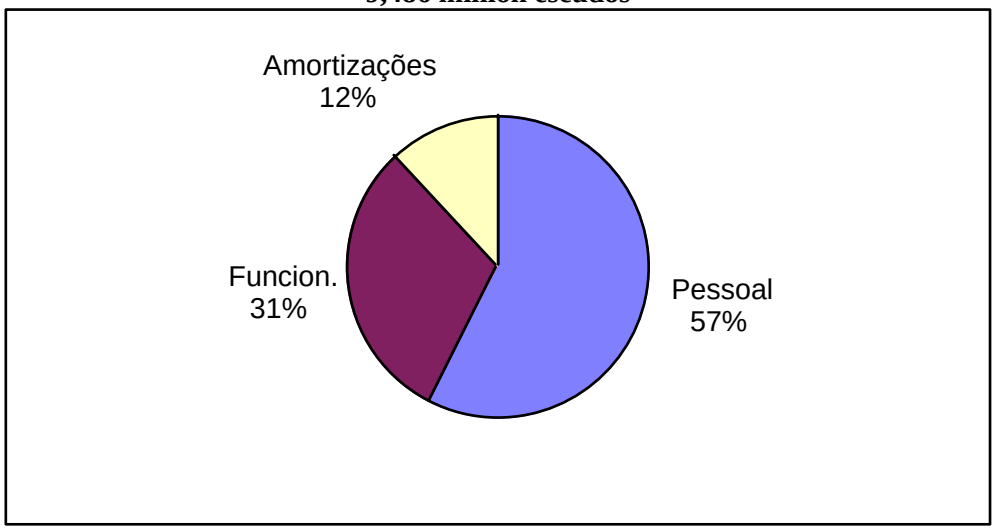
Items	**Budget**	**Final Performance**	**Difference**
Staff	4,814	4,932	2%
Goods and Services	482	454	5%
Capital	58	58	0%
TOTAL	5,354	5,444	2%

II.3. **Total costs** in 1994 rose to 9,486 million escudos, including 1,132 million escudos in amortisations and 48 million in extraordinary losses. These losses are in respect of the renegotiation of pre-1991 Social Security debts, agreed under Decree-Law 225/94 of 5 September. This renegotiation led to the reduction of the IST's Social Security debt by 92 million escudos.

Figure 43

Total Costs (staff, operating expenses and amortisations)

9,486 million escudos



Staff 57%, Operating Expenses 31%, Amortisations 12%

Outgoings rose to 2,921 million escudos, which includes supplies from third parties to the value of 1,894 million escudos (see Section 9.2), and 911 million escudos in operating costs, mainly for research scholarships awarded by the IST and transfers of community funding. These transfers rose to 429 million escudos and are related to funding for partners in European R&D consortiums led by the IST.

II.4. **Alternative financial resources** obtained by the IST to supplement the State Budget represent 37% of overall funding (31% in 1993).

II.5. Income from undergraduate and post-graduate tuition fees rose to 402 millions escudos, representing 4.7% of total income. From this amount, a Support Fund for Education and Promotion of Educational Success was set up to the value of 368 million escudos, equivalent to the amount of undergraduate fees.

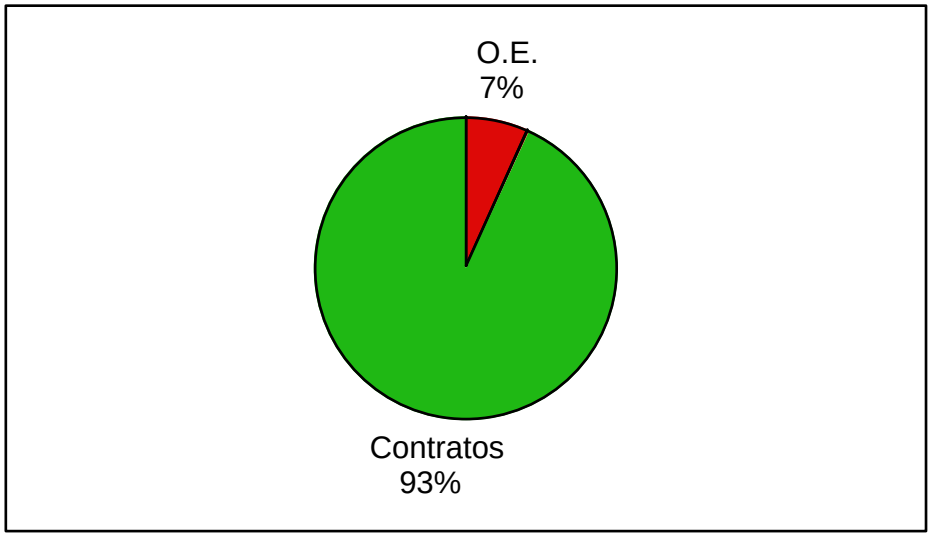
II.6. Interest on financial operations carried out in 1994 was approximately 136 million escudos (233 million escudos in 1993), of which 27 million represented tax on income borne by the IST. This goes against the spirit of the *Lei da Autonomia das Universidades* (law governing the autonomy of universities), but it is the reality that has resulted from legal requirements, as was stated in the accounts for 1993.

III. The total amount of specific funds for **investment in construction works and equipment** is limited to state funding only, to the value of 57.5 million escudos. However, overall investment rose to 852 million escudos due to the contribution of contracts and other subsidies. It should be noted that total investments in 1993 represented 24% of the IST's fixed assets, whilst in 1994 this was only 5%.

Figure 44

Funding for Investments (Construction Works and Equipment) in 1994

852 million escudos



State Budget 7%, Contracts 93%

IV. The analysis of **fixed assets** includes the up-dating of the values included in the 1993 accounts, following the appraisal carried out at the IST. This appraisal was submitted to the Directorate-General of State Property, being approved in 1994. In additional, an appraisal was carried out on the Interdisciplinary Complex Building, following the integration of this R&D facility into the IST in April 1994.

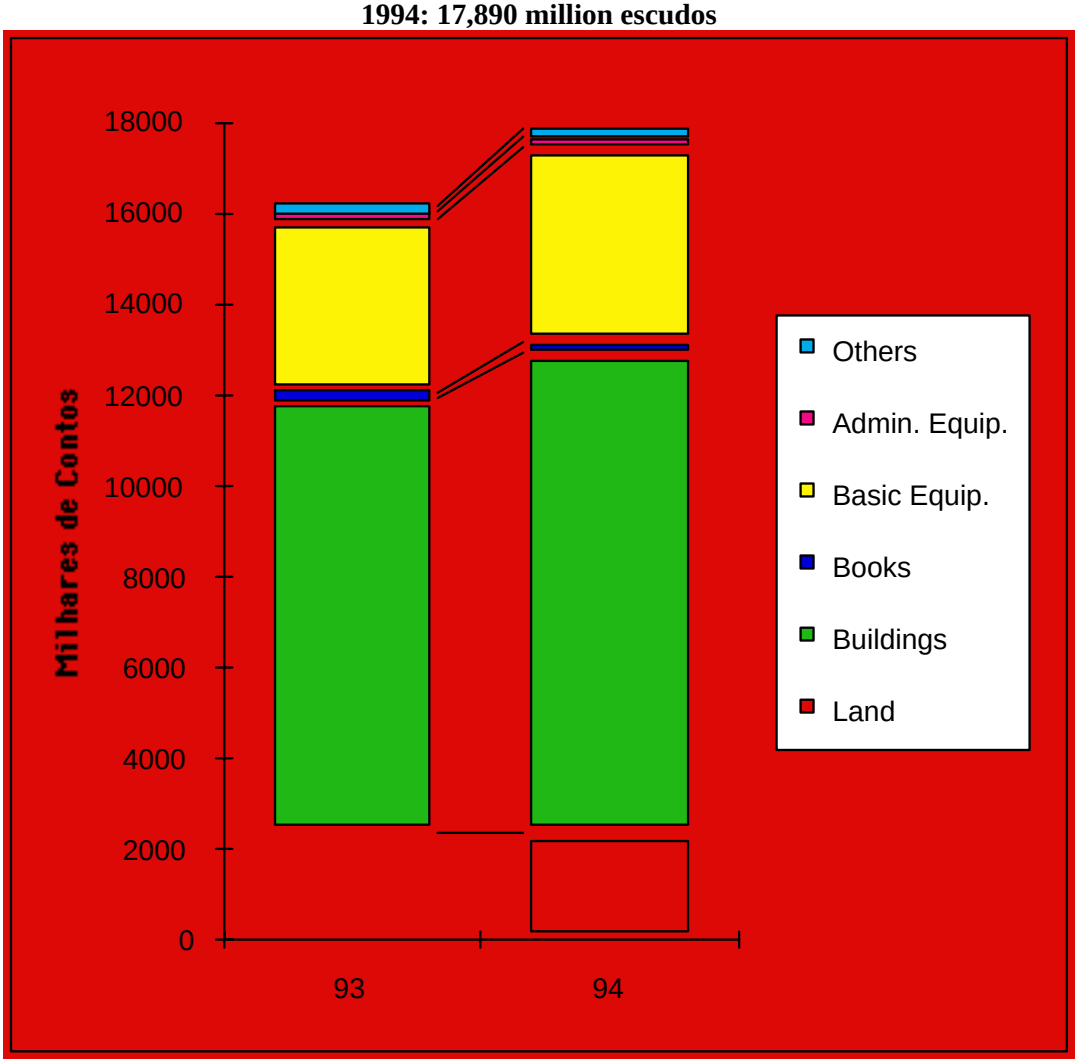
In the analysis of the structure of tangible fixed assets, it should be borne in mind that the amount for cultural material corresponds to books acquired in 1993 and 1994 only.

Figure 45

Evolution in Tangible Fixed Assets (Gross Assets)

1993: 16,795 million escudos

1994: 17,890 million escudos



Other

Admin.Equip.

Basic Equipment

Books

Buildings

Land

Millions of Escudos

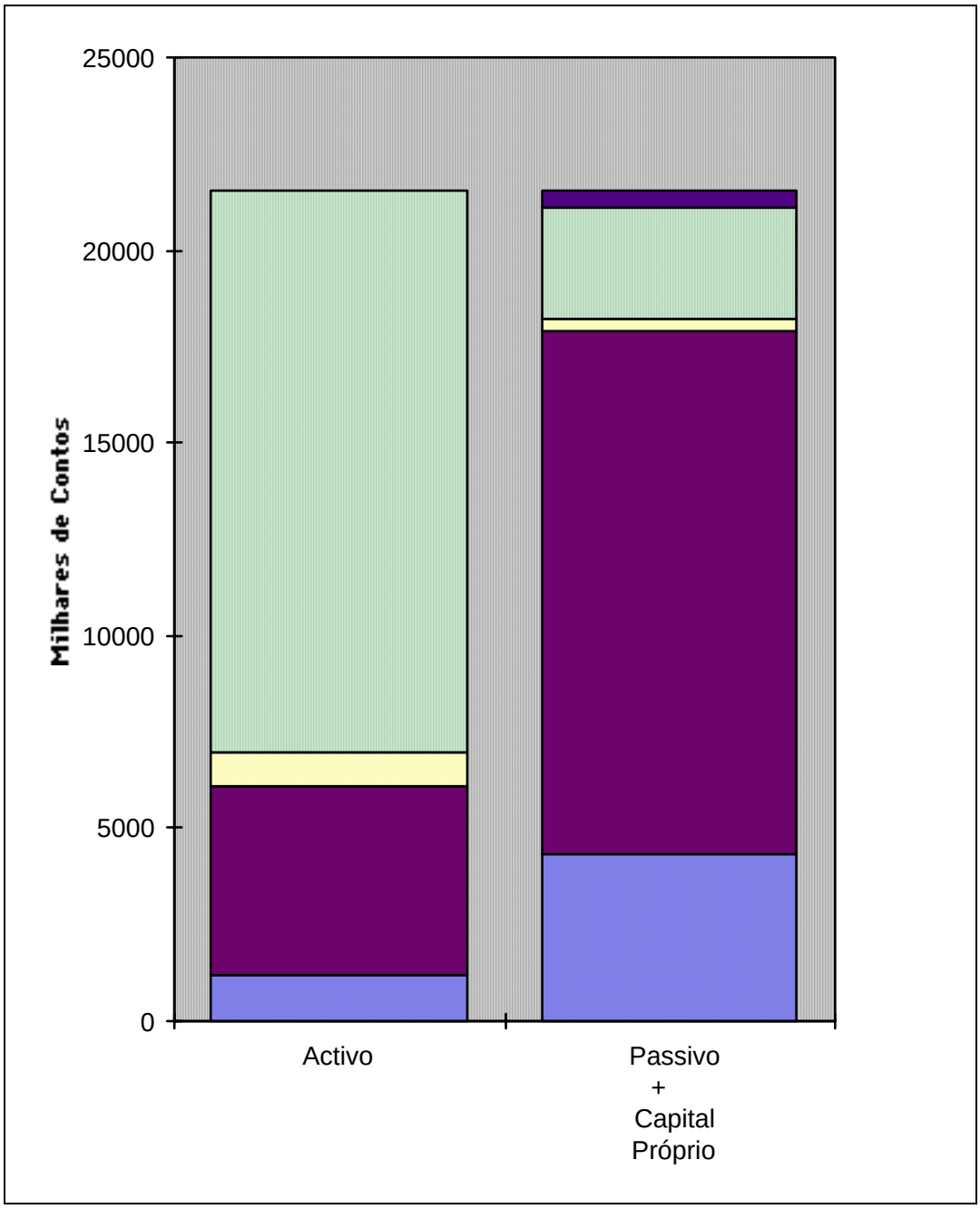
V. Analysis of third-party debtors and creditors leads to the conclusion that the current investment programme is being temporarily self-financed, as a result of significant delays in the receipt of grants awarded to the IST, in particular from JNICT and the PRODEP programme. As a consequence, there has been a negative impact on the IST's income.

VI. Deferred profits basically represent funds obtained under past and current investment programmes, and also include advance payments for projects funded by the European Union.

VII. The **balance sheet** as at 31 December 1994 is presented in the following bar chart, and shows the final financial balance.

Figure 46

1994 Final Balance Sheet



Other Reserves and Results

Tangible Fixed Assets **Initial Property Allocation**

Investments **Capital Adjustments**

Debts from Third Parties **Additions and Deferments**

Bank Deposits **Debts to Third Parties**

Assets **Liabilities + Equity**

Millions of Escudos

9.2. BREAKDOWN OF SUPPLIES AND SERVICES FROM THIRD PARTIES

The following table shows the breakdown of expenditure for supplies and services from third parties in respect of 1993 and 1994.

Table 23

Supplies and Services from Third Parties

Actual Budget Performance for 1993 and 1994

	93		**94**	
	Thousands of Escudos	**%**	**Thousands of Escudos**	**%**
Subcontracts	152138	9.70%	139753	7.38%
Energy	119288	7.61%	123289	6.51%
Water	45865	2.92%	43740	2.31%
Fuels	8099	0.52%	11710	0.62%
Other Fluids	756	0.05%	845	0.04%
Tools	50461	3.22%	55025	2.91%
Books and Documents	24396	1.56%	18683	0.99%
Office supplies	81652	5.21%	104104	5.50%
Articles for Gifts	52	0.00%	6555	0.35%
Rents and Hires	253900	16.19%	113135	5.97%
Representation Expenses	4977	0.32%	3962	0.21%
Communications	74744	4.77%	100000	5.28%
Insurance	3079	0.20%	3982	0.21%
Royalties	8961	0.57%	20563	1.09%
Staff Transport	7	0.00%	257	0.01%
Travel and Accommodation	196474	12.53%	277041	14.63%
Fees	254143	16.21%	296265	15.64%
Legal and Notary Costs	9	0.00%	72	0.00%
Conservation and Repairs	130520	8.32%	152142	8.03%
Publicity	35651	2.27%	28039	1.48%
Cleaning	45147	2.88%	146011	7.71%
Security and Safety	1408	0.09%	61174	3.23%
Specialist Works	32248	2.06%	114243	6.03%
Other Services	44190	2.82%	73307	3.87%
Total	1568165	100%	1893897	100.00%

The following main points should be noted:

I. The increase seen between 1993 and 1994 under the heading of Cleaning is the result of the exclusive contracting-out of cleaning for the whole of the IST area, whilst in 1993 part was

done by its own services. Moreover, the increase was also affected by the expansion of the IST's usable area which occurred during the last four months of 1994.

II. The reduction seen under the heading of Rents and Hires is related to the fact that there were considerably fewer operations under the PRODEP programme in 1994.

III. The other fluctuations seen between 1993 and 1994 are related to the level of budget performance of the IST's own income, as well as to the expansion of the usable area mentioned above.