

The Portuguese schools of engineers in Lisbon and Porto: continuity and discontinuity of the models and the creation of the national and international networks

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ABSTRACT: In the 1910's, with the establishment of a Republican Regime, were created two new schools of engineering: The Instituto Superior Técnico (Technical Institute) in Lisbon in 1911, and the Faculdade Técnica (Technical Faculty) in Porto, in 1915. In this paper we want to analyse the new pedagogical projects of Instituto Superior Técnico and Faculdade Técnica of University of Porto, and identify the academic and business networks linked to these schools. For this approach we will try to make a comparison between the creation and teaching of the two schools and the professors of each one.

1. THE TECHNICAL SCHOOLS OF THE 19TH CENTURY AS A BACKGROUND TO THE IST IN LISBON AND FTP IN PORTO

The idea of the existence of a close relationship between technological advances and economic progress is the main key to understand the period following 1851 (which is called in Portuguese history *Regeneração* - the Regeneration Period). In this context a new ministry was created in 1852 – the Ministry of Public Works, Commerce and Industry (MOPCI) – of which the minister was the engineer – Fontes Pereira de Melo -, and the majority of the posts on this ministry was occupied by people with a technical education namely engineers.

In order to increase the technical education in the country, that was considered essential to economic development, it was created in Lisbon in 1852, the capital of the country, the *Instituto Industrial de Lisboa* (Industrial Institute of Lisbon), later on *Instituto Industrial e Comercial de Lisboa* (Industrial and Commercial Institute of Lisbon), and in the second most important city characterized by an important industrial development it was created the *Academia Politécnica do Porto* (Polytechnic Academy of Por-to) the successor of *Academia Real de Marinha e Comércio da Cidade do Porto* (Royal Academy of Navy of the city of Porto). In Porto we have also an industrial school, which in 1864 became *Instituto Industrial do Porto* (Industrial Institute of Porto) and later on *Instituto Industrial e Comercial do Porto* (Industrial and Commercial Institute of Porto).

With these two technical schools the government expected to answer the needs to educate the new working class of the emerging sectors such as textiles and metallurgy. In the *Instituto Industrial de Lisboa* there were established three levels of teaching: elementary, secondary and complementary. The theoretical training was combined with practical classes in an industrial setting, such as workshops, where the content learned in the theoretical courses was applied.

Throughout the years the *Instituto Industrial de Lisboa* had several reforms and teaching reformulations that intended to make the training offered in this school relate to the economic needs of the country. In 1892 the School Council proposed a new restructuration of the Institute, and the proposal was subscribed by every titular professor except Alfredo Bensaúde who submitted an individual report exposing the problems in the existent training methods, which has been published - *Projecto de reforma do ensino tecnológico para o Instituto Industrial e Comercial de Lisboa*.¹ In his proposal, Bensaúde presented a set of problems that prevented the school of being successful: the lack of professional “hands-on” experience of most of the teachers; the very few theoretical papers, articles or books written by the teachers; the theoretical minded classes which were precisely the opposite of a true technical teaching based on everyday practice; and the little attention paid to technical drawing, that was “in a way the written alphabet of the technician.”

Despite all the reforms, in the beginning of 20th

¹ *Projecto de reforma do ensino tecnologico para o Instituto Industrial e Comercial de Lisboa*. Lisbon: Academia Real das Ciências, 1892.

century Portugal continued to face a lack of technicians to answer the demands of the industry and of the significant public works, promoted by the government.

2. THE CREATION OF INSTITUTO SUPERIOR TECNICO IN LISBON AND OF THE FACULDADE TÉCNICA IN PORTO

The creation of two new schools of engineering created under the reform of higher education in the Republic Regime was regulated by the Decree Law - March 22, 1911, subscribed by important politicians and intellectuals of that time: Joaquim Teófilo Rego, António José de Almeida, José Relvas, António Xavier Correa Barreto, Amaro de Azevedo Gomes, Bernardino Machado e Manuel Brito Machado.

Alfredo Bensaúde a mines engineer that had made his education in Germany, was nominated as director of *Instituto Superior Técnico*, and he tried to put in practice the ideas that he had already developed in 1892 in *Projecto de reforma do ensino tecnológico para o Instituto Industrial e Commercial de Lisboa*.

The *Instituto Superior Técnico* offered a General Course that lasted two years and higher education courses of three years in the following engineering areas: mines; civil; mechanic; electro-technical and industrial chemistry. It also offered elementary courses, namely of mines and public construction conductors.

The new decree-law also created the University of Porto in the north of Portugal and from the new structure the Faculty of Science was founded and later on in 1915 the *Faculdade Técnica*². In the case of Porto, the Engineering degree was taught both at the Faculty of Sciences of the University of Porto, where the preparatory years of the engineering teaching were attended, and the Technical Faculty of Porto, with complementary training.

Its model of training engineers was similar with the IST.

3. THE RECRUITMENT OF PROFESSORS

3.1. A national and international network

The different disciplines of the curriculum of these two schools were supported not only by teachers that had previously taught in the Polytechnic Academy, in the Army School and the Industrial and in the

Commercial Institute that existed in both cities, but also by foreigner teachers coming from France, Switzerland, Germany bringing new methods and practices.

In 1919-1920 – eleven of the twenty-seven of the professors of *Instituto Superior Técnico* had pursued their studies abroad in famous schools such as the *École des Ponts et Chaussées* and the *École des Mines* of Paris, the *University of Liège*, the *University of Berlin* and the *University of Göttingen*.

Table 1. Professors of *Instituto Superior Técnico* (1919-1920)

Name	Graduation in Portugal	Graduation aboard	Industrial activity	Courses taught at the IST
Alfredo Bensaúde		University of Göttingen and School of Mines of Clausthal		Portuguese Mineralogy
Francisco Ferreira Roquete Charles Lepierre		École de Mines of Paris École de Physique et Chimique de Paris	Mines inspector. Consultant engineer of Enterprise Henry Burnay & C ^a	Mines and mineral waters Chemical analyses and Organic Chemical
António Lobo de Aboim Inglês	I.I.C.L. ³		Previous technical director of the Mine of S. Miguel (Huelva)	Metallurgy
António dos Santos Viegas	A.S.		Sub-director of Portuguese Railways	Roads and Railways
Maximiliano Gabriel Apolinário	I.I.C.L.	University of Liège (Institute Montefiore ⁹)	Entrepreneur et engineer of C ^a Eborensis de Electricidade; Fábrica promitente	Electricity in general; constructions and industrial establishments.
Léon Fech		Institute of Montefiori University de Liège – Electric engineering	Previous assistant of the de Montefiori Institute. Consultant engineer of the CRGE	Electricity (General Theory, and applications)

² PORTUGAL – *Diário do Governo*. Lei n° 410, de 31 de Agosto de 1915, art° 77°. See also: FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO (FEUP). *Faculdade Técnica da Universidade do Porto (1915-1926)* // *Faculdade de Engenharia da Universidade do Porto (1926)* – U.P. – FEUP. file:///C:/Users/Utilizador/Downloads/Faculdade-de-Engenharia-da-Universidade-do-Porto.

³ I.I.C.L. - Instituto Industrial Comercial de Lisboa

A.S. - Army School
P. A. - Polytechnic Academy
F.M.E. - Faculty of Mines of Engineer
T.F. - Technical faculty
U.T. - University of Toulouse
P.S. - Polytechnic School of Zurich
U.C. - University of Coimbra

António Vicente Ferreira	A.S.	Engineer of Portuguese Company of Railways	Materials. Stability of constructions, bridges
Raul Miguel de Mendonça	École des Ponts et Chaussées	Enterprise H. Burnay & C ^a – Hydraulic Section	General Hydraulic, Hydraulic machines
Júlio V. da Silva Pinto	I.I.C.L:	Enterprise H. Burnay & C ^a – Mining Section	Mineralogy and geology
Eduardo Augusto Valério Vilaça	A.S.	Engineer of the Company of Borralha Mines	Materials and the methods of construction
Tomás de Aquino de Almeida Garrett	Génie Naval - Paris	Engineer of the enterprise H. Burnay & C ^a	Technology of mechanic

Most of the foreign teachers were hired for their technical and scientific skills and had already taught in other schools, such as: Abram Droz, professor at the *Zurich Technical School*, León Fesch of Institute of Monteffiori of University of Liège

To better understand the presence of foreign professors we must refer that a part of the Portuguese professors had completed their studies abroad in some of the most reputed schools in France, Belgium or Germany, where they established personal and professional networks with other students coming from different countries.

4. THE CREATION OF UNIVERSITY OF PORTO IN 1911 AND THE TECHNICAL FACULTY IN 1915

4.1. From Polytechnic Academy to Technical Faculty

In the city of Oporto, the Polytechnic Academy, and the Medical-Surgical School, founded in 1837, was the structure from where was founded the University of Porto in 1911. The Polytechnic Academy since the first decades of the 19th century had been reinforcing its role in teaching science and engineering in detriment of commerce and navigation. In 1911, it became Faculty of Sciences. For the teaching of engineering Porto also wanted to have an identical education system like the one of IST with the same pedagogical frame and number of years. This requirement allowed for the Technical Faculty in Porto to be created in 1915, where in complementarity with the Faculty of Sciences, form engineers (Law n°410 of 31 August 1915).

The Technical Faculty presented some differences in the recruitment of professors. Like the Faculty of Sciences of Porto, also the Technical Faculty

recruited internal professors for the teaching of engineering directly made through the Polytechnic Academy and at the Industrial Institute / Industrial and Commercial Institute. A small number came from University of Coimbra. In this way, there was only one transition from one institution to another, only new contracts were made, without a concern to seek new teachers abroad. In this sense we must notice the continuity of the Academic "Elite" in the university and in the new school.

Table 2. Professors of Technical Faculty (1919-1920)

Name	Graduation in Portugal	Graduation Abroad	Other activity	Courses teach at FT
Vitorino Laranjeiro	U.C.+A.S.		Railway	Thermal Machines Construction and Roadways Roads and railways Mechanic Technology Mechanics;
Thomas Joaquim Dias	P.C.			Electric Machines Construction and roads; Topography;
Roberto Alves Sousa	UC			Political Economy Industrial chemistry
António Ferreira da Silva	P.A.			
Francisco Xavier Esteves	P.A.		Deputy Minister of commerce	Concrete Reinforced ; Bridges
Manuel Rodrigues de Miranda	PA			Mines Docimasia
Bento Sousa Carqueja	P.A.		Founder of the newspaper <i>O Comércio do Porto</i>	Political economy. Legislation and accounting
António José Rodrigues	A.S+ T.F. +			Mines
Luís Couto dos Santos	F.M.E. P.A.		Owner of <i>Fábrica Electra</i> Director of <i>C^a de Carris de Ferro do Porto</i> .	Electro mechanics - Thermal Machines; Electricity Measures
Miguel Machado		P.S. Z.	Internship Brown Boveri & C ^a	Hydraulics
Albano Pacheco Coelho		U.T		

Most of the professors were transferred to the Technical Faculty of the University of Porto from Polytechnic Academy or Industrial Institute. In the research project we found that the Technical Faculty

had some isolated cases of teachers who completed studies abroad with degrees in engineering branches by European universities. This last one is evidenced with the most internationalized school of the nucleus with the presence of Miguel Luís Machado Guimarães (Polytechnic School of Zurich), and Albano Pacheco Coelho (University of Toulouse).

In other sense the local and international network operated in a similar way, as can we see in the command of equipment's labs and workshop as the companies that provides internship to the students, most of them related to important technological projects.

4.2. Between teaching and professional activity

The founder of *Instituto Superior Técnico*, Alfredo Bensaude, wanted to transfer to Portugal the German model, well known by him, through his studies in Hanover, in Clausthal and later at Georg-August University in Göttingen. He propositioned the creation of a more practical teaching model betting not only on mathematics but also on the drawing discipline. The new school and the pedagogical framework of the training was based on the configuration of the skills that were foreseen for the engineer at the beginning of the twentieth century, regarding their role in public works projects and in the industrialization process.

Bensaude considered that the engineers that already had professional experience in their field of expertise were better professors, because beyond the theoretical knowledge they also had experience in resolving unexpected practical problems therefore important lessons to the students about practical knowledge that many times was not present in even the best books.

He also defends that the teachers that are engineers and are already in the industrial 'milieu' could be a sort of "a bureau de placement". That means that they could help the best students to find a job at the end of their academic education.

4.3. Others networks

Regarding the relations established between these new schools and the companies dedicated to public works or private companies, we have verified that both schools promote their students' internships in the *Companhia de Caminhos de Ferro*, in the *Carris de Lisboa* and Porto or in companies in the national panorama; such as CUF - *Companhia União Fabril*. Another similarity we find in both schools is the network of companies and enterprises where pupils did their training, most of them local and national companies.

The installation of schools promoted important acquisitions of equipment for workshops and laboratories in the new schools, not only deepening

the lessons and practical experiences, but also developing relations with companies, associations, societies, libraries that became suppliers of these schools. In general terms we find mechanisms for laboratories coming from abroad, books and magazines for their libraries from associations and societies, machines. and utensils acquired from various national and foreign companies.

5. CONCLUSIONS

We must conclude that both schools transferred and improved the model of the Polytechnic Academy and Industrial Institute, schools of late 19th century. The IST developed the model with the recruitment of foreign professors and the University of Porto and the Technical Faculty transferred their professors from the Polytechnic Academy and from the Faculty of Science. Concerning the training of students, both schools benefit of a local and national network, emphasizing academic education, and connections with foreign countries: acquisition of equipment for laboratories, publication in foreign academic journals, training from foreign teachers, participation in Congresses and celebrations. Both Schools during 1911-1926 developed their internal organization: updated course plans and equip laboratories and libraries, actions directed by the members of the board.

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