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The early emergence of European commercial education in the nineteenth century: Insights from higher engineering schools

Adrien Jean-Guy Passant

Interdisciplinary Research Centre in Management Sciences, University of Paris 1 Pantheon Sorbonne, Paris, France

ABSTRACT

The setting of European commercial education has traditionally been addressed with reference to higher schools of commerce and faculties of business. This has not taken into account empirical evidence showing that, historically, higher engineering schools also offered a mixed education in mercantile and technical subjects to students who wanted to devote themselves to business. However, this type of schooling has received little attention. This article investigates how commercial departments from higher engineering schools constituted an initial, yet ephemeral, public attempt to build an engineering model of commercial education that closely combined mercantile and technical instruction well before the twentieth century.

KEYWORDS

Commercial education;
higher engineering schools;
polytechnic institutes;
commercial departments;
Europe

Introduction

In Europe, the emergence of institutions for commercial education at the higher level has been a long-term process. The earliest steps toward an academic education for commercial endeavours began in the eighteenth century and continued until the twentieth century. Chairs were created in economics from the eighteenth century onwards, notably in the German cities of Frankfurt an der Oder (1727), Halle (1727) and Rinteln (1730), and in the Swedish universities of Uppsala (1741), Turku (1747) and Lund (1750),¹ yet none of these attempts to promote economics in university curricula had any long-lasting effects. It was only in the late nineteenth century that commercial education at the higher level began in Europe, with the bulk of its growth occurring towards the turn of the twentieth century.² While the incorporation of commercial studies into higher education systems occurred in parallel on both sides of the Atlantic, the way it was implemented was significantly different. In the USA, schools of commerce were established as parts of universities, whereas in most European countries they were created outside the university system.³ Moreover, from a pedagogical point of view, commercial education in the USA developed more out of economics than accountancy, contrary to most European countries.⁴ It was also characterised

by the incorporation of liberal studies, whereas European commercial curricula were based almost exclusively on vocational, practice-based learning.⁵

At that time, the increased supply of both commercial and engineering education was a response to increasing industrialisation. The emergence of new industries in fields such as electricity, shipbuilding, iron, steel and the manufacture of combustion engines, required better technical and commercial instruction in order to produce technical and commercial experts, directors and salesmen.⁶ In order to address the growing demand for well-educated engineers, higher education expanded into the field of engineering with the opening of higher engineering schools with names like 'technical institutes', 'schools of application for engineers' or 'polytechnic schools'.⁷ The latter provided industrial training to civilian personnel for the emerging industrial society.⁸ During the nineteenth century, European states designed a model for engineering training to cater for the growth in rail and road networks, hydraulic works, pipework, land registry and international seaports. While construction engineers were all that was needed when manufacturers were themselves artisans, the industrial revolution needed specialised engineers to run the new factories.⁹ Higher engineering education was in fact perceived as an important factor in the emergence and development of the industrial world's production apparatus.¹⁰ The aim of public authorities was to rescue higher technical education from the dominance of military engineers who were regularly required to undertake civil engineering tasks.¹¹ Higher technical schools trained civil engineers who were capable of understanding the world in the best interests not just of war but also of trade and the economy.¹² At the very beginning of the twentieth century, higher education was expanded into the field of trade, with the opening of faculties of business in order to address the growing demand for well-educated businessmen.

It is worth mentioning that before the rise of faculties of business, commercial education was already offered by schools of commerce in European countries. In reality, some of these were effectively secondary schools, despite their designation as 'higher', particularly in France and Germany.¹³ Yet in the minds of the European promoters of commercial education, a dividing line gradually appeared between secondary and tertiary commercial education, particularly after 1880, although some earlier examples can be found, such as the Superior Institute of Commerce of Antwerp (Institut Supérieur de Commerce à Anvers), and the Superior School of Commerce of Venice (Scuola Superiore di Commercio di Venezia).¹⁴ Simply put, secondary education was devoted to the education of businessmen and accountants, whereas tertiary commercial education was aimed at teaching captains of industry and business leaders.¹⁵ Students in tertiary commercial education institutions had, therefore, already completed their secondary education, and the curricula were intended to teach commercial skills for both routine trade and business innovation.¹⁶

Several researchers have shown that European managerial positions in the nineteenth century (and a considerable part of the twentieth century) were mainly filled by engineers and not by graduates from schools of commerce.¹⁷ This pattern was prominent in Italy, Great Britain, Denmark, Finland, Norway, Sweden and the Netherlands.¹⁸ This was due to the overwhelming importance of the technical aspect of businesses at the time.¹⁹ Other scholars have shown that nineteenth- and early twentieth-century engineers can be regarded as the original prototypes for managers.²⁰ It would be interesting, therefore, to study the commercial sections that were implemented within higher engineering schools. In that context, it should be noted that a number of European governments began to develop higher engineering schools with commercial departments, borrowing extensively from the Austrian

model. The Prague Polytechnic (Prag Polytechnisches Institute) and the Vienna Polytechnic (Polytechnisches Institute Wien), created in 1806 and 1815 respectively, exerted considerable influence on the development of similar institutions, particularly in Germany, Russia, Switzerland, the Netherlands and Sweden.²¹ Spain and Portugal also established higher engineering schools based on the French models represented by the Paris Polytechnic (École Polytechnique), which produced civil service engineers, and the Central School of Arts and Manufactures (École Centrale des Arts et Manufactures), which trained engineers for private industry; both were pioneers in higher technical education in Europe.²² However, they adapted the French model to meet their specific needs, and opened commercial departments in their polytechnics.²³

To date, few studies have dealt with these pioneering governmental efforts to establish commercial education in a European context throughout the nineteenth century. In his 1957 study, Redlich mentioned that commercial courses were temporarily taught during the nineteenth century at the institutes of technology of Braunschweig, Karlsruhe, Vienna and Riga but he did not provide details about this training.²⁴ Only a few investigations have addressed how commercial departments in higher engineering schools actually functioned. Some researchers, particularly Fauri, Gonçalves and Da Costa Marques, have shown that European commercial education initially developed in higher technical schools in the first part of the nineteenth century,²⁵ however, as they only focused on a single country, and did not cover the whole of the nineteenth century, they did not acknowledge the scope of this phenomenon.²⁶ In our view, this method of organising commercial training within higher engineering schools provides an interesting and under-studied model of commercial education. Although the schools differed across time and space, three common characteristics may be identified to define this model. First, from an organisational point of view, commercial education was offered by commercial sections within public higher engineering schools, not by independent educational institutions. Second, from a pedagogical point of view, the training offered by commercial sections was mixed, providing both commercial and engineering courses. Third, the training was intended for students who had completed their secondary education, i.e. students who had successfully graduated from the colleges, lyceums, athenaeums, gymnasiums, or other secondary schools. The minimum age for admission for new students was 16–17 throughout the nineteenth century and the beginning of the twentieth century.²⁷

The aim of this article is to analyse the early emergence, rise and decline of commercial departments within higher engineering schools in nineteenth-century Europe. Three research questions follow from this goal. Why and how were commercial sections created within higher engineering schools at the time? How did they evolve throughout the nineteenth century? Why did higher engineering schools finally abandon their commercial departments when they had previously promoted them?

The article is organised as follows. The first section analyses the reasons behind the creation of commercial sections within higher engineering schools in nineteenth-century Europe, and the way in which they were initially organised. The second section analyses how commercial sections within higher engineering schools evolved throughout the nineteenth and early twentieth century. Following on from this, the third section considers why higher engineering schools ultimately abandoned these commercial departments. The final section provides a conclusion.

Methodology and data

In order to identify higher engineering schools with commercial departments, we studied commercial training in the nineteenth century from a transnational perspective in terms of design, degree, syllabus, contents and qualifications. Hence our focus falls within the framework of 'commercial education' and not 'management education'. This is a significant semantic clarification. If the term 'management education' is commonly used as the equivalent of 'business' or 'commercial education', sometimes even among historians, it is worth mentioning that the notion of 'management education' did not exist in the nineteenth century.²⁸ At the time, the concept of 'commercial education' was used since the subject of management was not taught per se in Europe before the First World War.²⁹ A significant change in the content of commercial studies was made thanks to the dissemination of the works of Taylor and Fayol after the First World War, and even more so after the Second World War, when management began to be recognised both as a profession and as an academic discipline in its own right. It is therefore important to draw distinctions between 'commercial education' and 'management education'. Put simply, before the First World War, 'commercial education' was exclusively based on institutional subjects such as banking, insurance and industrial administration, and on functions such as accounting, legislation and personnel.³⁰ On the other hand, 'management education', which appeared during the twentieth century, and in particular in the United States after the Second World War, embodies additional subjects dedicated to management per se, such as decision theory, leadership, systems analysis, group dynamics, purchasing issues and related topics.³¹ Hence, given the period under consideration in this article, we will be dealing with 'commercial education'.

Which higher engineering schools are studied in this article? The population under consideration is composed of higher engineering schools which opened commercial sections in nineteenth-century Europe. Since national statistical data about the functioning of polytechnic commercial sections is sadly deficient, this study relies on data for individual schools. Our sampling methodology was based on three criteria. First of all, we selected educational institutions which had been identified from previous literature. Research published by Redlich, Leimanis, Gonçalves and Da Costa Marques identified some of the main higher engineering schools with commercial sections.³² The second criterion to be applied was national representativeness. We selected educational institutions that could be termed as 'model schools' with regard to the shaping of their national higher technical education systems. To this end, we examined published information provided by jurors' reports and catalogues from world exhibitions from the mid-nineteenth century, which had a vested interest in the development of professional education. Since the third world exhibition, which took place in London in 1862, every world exhibition included several sections dedicated to education, particularly commercial and engineering education. Finally, some individual schools were chosen on the basis of their historical importance within the field of technical education in Europe. The Prague and Vienna polytechnics, for example, were important in northern Europe in the early nineteenth century, where the first higher technical schools to be established adopted them as their model.³³ Similarly, in the second part of the nineteenth century various polytechnics were founded on the model of the Karlsruhe Polytechnic (Polytechnisches Schule Karlsruhe), particularly in Austria, Germany, Russia and Switzerland.³⁴ Our sampling methodology led us to identify 15 higher engineering schools located in several European countries. More precisely, the higher engineering schools chosen for the

study were the higher technical schools of Aachen, Karlsruhe, Lausanne, Lisbon, Madrid, Munich, Oporto, Prague, Riga, St Petersburg, Stuttgart, Trieste, Vienna and Zurich.³⁵ Other schools were candidates for inclusion in the study, such as the schools of application for engineers in Milan and Turin, and the Institute of Technology of Braunschweig, but, as we lacked precise information about them, they were not considered in this work. In fact, the aim of this article is not to provide a geographical overview of commercial departments in higher engineering schools in the nineteenth and early twentieth century, but to enhance insight into their operation.

The article focuses on the entire nineteenth century. It begins in the early part of the century when the first industrial revolution was in its infancy, at a time when there were no higher institutions for commercial education in Europe. From this perspective, the opening in 1806 of the first higher engineering school with a commercial department in Austria (the Prague Polytechnic) constituted a first governmental response to meet firms' requirements for well-educated staff and, in particular, for businessmen. As the industrial revolution expanded the scope of application of commercial practices, the need to provide commercial education to would-be businessmen became more apparent, along with the need to provide higher engineering education.³⁶ The Prague Polytechnic was quickly imitated first by the central European states and, from the middle of the nineteenth century, by northern and southern Europe. The study ends after the First World War when the Riga Polytechnic (Polytechnisches Schule Riga), the last higher engineering school with a commercial department, closed its 51-year-old commercial section in 1919.

We decided to undertake a comparative study in order to address the emergence of early European commercial education within commercial sections in higher engineering schools. Locke, the initiator of this type of study on commercial education, showed that comparison is a useful analytical tool for examining how particular models of commercial education emerged and spread over time and space.³⁷ Archival data that supported this research were collected from a range of different sources. All of them reflected the importance of engineering and commercial education in Europe at a time when the industrialisation process was ongoing. Archival data from commercial education institutions provided useful information for establishing a comparative perspective, especially that from the St Petersburg Polytechnic (Polytechnisches Schule St-Petersburg) and from the Commercial and Nautical Academy of Trieste (Reale Accademia di Commercio e Nautica Trieste).³⁸ The nineteenth century was also a time when administrations in Western countries were comparing themselves to one another in order to reform existing national education systems. This is the reason why several contemporary comparative studies were consulted. The first were the scientific missions from surveys sponsored by the French Ministry of Trade between 1833 and 1865.³⁹ These documents were produced by the French government at a time when France was looking to modernise its technical and commercial education, drawing on pedagogical models used by its neighbours. The second were the reports published in the 1890s by the American Bankers Association, which had sent Professor Edmund James, then the director of the University of Pennsylvania's Wharton School, to investigate the European institutions for the education of businessmen. The third were the reports from the British special sub-committee on commercial education which was appointed in the late 1890s to suggest plans for establishing educational institutions in London dedicated to commerce, based on what was being implemented abroad.⁴⁰ The fourth was a report on European commercial education commissioned in the early 1900s by the Senate of the University of

Table 1. Dates of the opening of commercial departments within the main higher engineering schools in nineteenth-century Europe.

| Country | City | Institution | Opening of the school | Establishment of commercial departments |
|-------------|---------------|-------------------------------------|-----------------------|---|
| Austria | Prague | Polytechnic Institute | 1806 | 1806 |
| | Trieste | Commercial and Nautical Academy | 1754 | 1817 |
| Germany | Vienna | Polytechnic Institute | 1815 | 1815 |
| | Aachen | Institute of Technology | 1870 | 1898 |
| | Karlsruhe | Polytechnic School | 1825 | 1832 |
| | Munich | Polytechnic School | 1868 | 1868 |
| Portugal | Stuttgart | Polytechnic School | 1829 | 1835 |
| | Lisbon | Industrial and Commercial Institute | 1852 | 1869 |
| | Oporto | Industrial and Commercial Institute | 1852 | 1886 |
| Russia | Oporto | Royal Polytechnic Academy | 1837 | 1837 |
| | Riga | Polytechnic School | 1862 | 1868 |
| | St-Petersburg | Polytechnic Institute | 1899 | 1900 |
| Spain | Madrid | Royal Industrial Institute | 1850 | 1850 |
| Switzerland | Lausanne | Industrial School | 1869 | 1869 |
| | Zurich | Polytechnic Institute | 1855 | 1901 |

Note: All the schools' names appearing in the table below are those of the schools when a commercial section was opened. Source: Author's elaboration.

Sydney.⁴¹ The aim of such surveys was to improve the commercial educational systems of France, the USA, Great Britain and Australia, by observing the higher institutions for commercial education on the Continent. This literature enabled international comparisons of commercial education systems. Finally, official school histories and commemorative publications about higher engineering schools also provided meaningful insight.⁴²

The creation of the engineering model of commercial education within higher technical schools in nineteenth-century Europe

Public authorities: the first initiators of commercial education within higher engineering schools

In nineteenth-century Europe, political and cultural circumstances engendered a belief in the efficacy of higher education as a means of economic advancement. At the time, there existed a universal consensus that the practices of industry would benefit from a more intimate association with science. A number of technical schools created in nineteenth-century Europe included chemical, physical, maritime, architectural, metallurgical, postal and agronomic engineering sections, as well as commercial sections, since they had to train civil servants as well as businessmen to assist in the development of the country's nascent industries. European monarchs and governments therefore implemented educational policies to advance their national economies.⁴³

Table 1 provides an overview of the dates of the opening of commercial departments within higher engineering schools in nineteenth-century Europe. It shows that commercial sections were created throughout the nineteenth century, the first being within the Prague Polytechnic in 1806 and the last within the Zurich Polytechnic in 1901. All of these commercial sections were opened within higher technical schools. Some of these sections were opened

in long-established schools, such as the Commercial and Nautical Academy of Trieste which was founded in 1754 and opened a commercial section in 1817, whilst others were opened in more recently founded institutions such as the St Petersburg Polytechnic, which opened its commercial section in 1900, a year after it was established. Table 1 illustrates that the establishment of commercial sections within higher engineering schools took two overlapping forms. First, a commercial department could be created at the same time as the higher engineering school. In that case, the date of opening of the school coincided with the date on which the commercial department was established, as was the case in the Oporto Polytechnic Academy (Academia Politécnica do Porto), which opened in 1837 and offered commercial instruction from the start. Similarly, the Munich Polytechnic (Polytechnisches Schule München) offered four sections from its opening in 1868, one specifically mercantile and three technical. Second, commercial departments could be added to technical institutions already in existence, in which case the date of opening of the school was different from the date of establishment of a commercial department. That was the case with the Zurich Polytechnic established in 1855 in Switzerland. Originally the institution only had departments for training civil engineers, architects, chemists and agronomists, and the commercial department was not established there until 1901.

Higher engineering schools with commercial departments were exclusively public.⁴⁴ In fact, in some countries, the weakness of the private industrial sector forced the governments to play a crucial role in the modernisation of higher mercantile and technical education, as was the case in Russia and Portugal in the middle years of the nineteenth century.⁴⁵ State governments were engaged in the creation of commercial departments within higher engineering schools in towns and cities, generally in the country's commercial centres. They provided scholarships, subsidies or locations to meet the demands of businessmen who were determined to develop their countries. The same held true at the regional and municipal levels. Since they were familiar with local needs in terms of commercial education, regional and municipal authorities were best equipped to determine whether it was appropriate or not to open such institutions. For instance, the Riga Polytechnic was founded in 1862, after the Czar of Russia Alexander II approved its statutes, with the support of the Riga city council and Prince Suvorov, the Governor-General of the Baltic region. The parliamentary meeting of the landowners of Livonia allocated 2000 roubles annually for 12 years to the polytechnic institute, while the Governor-General of the Baltic region was appointed as its curator.⁴⁶

In fact, from an economic standpoint, the rise of higher technical schools with commercial sections must be linked to the emerging industrial society, in step with the first and second industrial revolutions. For instance, in Austria in 1806, Franz Joseph Gerstener, with the support of Emperor Franz I, created the Prague Polytechnic, the first higher engineering school with a commercial department, in order to introduce new production processes and support the design of new machinery so that domestic industrial products could successfully compete in international markets.⁴⁷ Similarly, in Spain, the first higher engineering school in the country, the Royal Industrial Institute of Madrid (Real Instituto Industrial de Madrid), was opened in 1850 with both a commercial and a technical department to address the industrialisation process that was under way in the country.⁴⁸

Yet on its own this economic factor was not a determinant one. The development of higher engineering schools with commercial departments cannot be explained as a mere mechanical response to economic growth, but must also be associated with national policies. For instance, in some industrialised countries, such as Great Britain, the national scholastic context was not favourably disposed towards that type of schooling. Until the late nineteenth

century, the British educational system was not really interested in higher professional studies such as mercantile or engineering studies.⁴⁹ This example reveals that higher technical education was not only a supporting part of industrialisation and the bureaucratisation of corporate life during the nineteenth century, but also a political construct that surfaced in response to these processes.⁵⁰ Hence, the establishment of higher engineering schools with commercial departments required a centralised state, well-disposed towards technical and commercial education and wealthy enough to build and maintain this educational infrastructure. That is the reason why the first higher technical schools were opened by governments in countries such as Austria and Germany at the very beginning of the nineteenth century whereas, for Russia, the phenomenon did not arise until the second part of the nineteenth century.⁵¹

Bringing the engineering and business elite together

As previously mentioned, until the late nineteenth century the distinction between secondary and tertiary education of future businessmen was not clear-cut. Under those circumstances the result was a lack of clarity for the higher engineering schools with commercial sections during the first three-quarters of the nineteenth century in terms of possible goals: training merchants or training business leaders. This statement is not true for the higher engineering schools with commercial sections created at the turn of the twentieth century. Germany, for instance, established a commercial section at the Aachen Institute of Technology (Technische Hochschule Aachen) in 1898 in order to develop engineering students and train business leaders for commerce and industry.⁵² It aimed to provide academic commercial training to serve the future heads of great mercantile and industrial concerns, as well as administrative officials.⁵³ Similarly, in 1900 Russia created a commercial section within the St Petersburg Polytechnic in order to train the Empire's future technical and commercial elite.⁵⁴

Higher engineering schools were created throughout the nineteenth century to train civil engineers, directors of chemical works and plant managers, as well as civil servants and public administrators. In Russia, the Riga Polytechnic trained not only would-be traders but also prospective commercial teachers, state factory inspectors and tax inspectors.⁵⁵ Likewise, the Lisbon Industrial and Commercial Institute (Instituto Industrial e Comercial do Lisboa) and the Oporto Industrial and Commercial Institute (Instituto Industrial e Comercial do Porto) aimed to train men who were destined to become exporters, bankers and consuls, as well as executive officers in the postal administration, directors of Portuguese customs, and directors in the Ministry of Foreign Affairs.⁵⁶ Why did the founders of higher technical schools with commercial departments decide to have future engineers and future businessmen in the same educational institution?

In fact, the creation of a new commercial education option in these technical institutions had pedagogical advantages. The aim of such commercial schooling was to make the businessman a technically trained manufacturer, a scientific technologist.⁵⁷ Commercial education mixed with higher engineering education was supposed to have a synergistic effect on industrial performance, since the new technology firms created by engineers often required the new mercantile techniques.⁵⁸ Moreover, commercial education and engineering education were considered as complementary training, since technology was an auxiliary science for prospective businessmen. For instance, an export director or factory director was expected to be trained in office duties as well as in knowledge of the quality of the products or machinery they were to sell, thus presuming the combination of both commercial and

technical types of knowledge. As a result, the study of commodities composition required knowledge of natural history, chemistry, physics or even mineralogy in order to prepare would-be businessmen to not only be able to discover adulterations in either raw materials or manufactured products, but also to ensure that their employees mastered these skills. Thanks to a technological background, businessmen in the chemical industry could study the range and quality of competitors' products in order to improve their own. Consequently, commercial education strengthened itself by becoming industrial.

Of these pedagogical advantages, we may also mention bringing together students with similar educational needs who were potentially destined to work in the same economic environment. Higher engineering schools taught students who shared a common professional destiny, since businessmen could not be entirely separated from engineers. In the nineteenth century, specific commercial departments were established at certain naval academies to train students who would be called on to develop the port ecosystem. The Commercial and Nautical Academy of Trieste was one such example, founded in 1754 by Empress Maria Theresa, and originally dedicated solely to nautical science, under the name of the Royal Navigation School, before a commercial department was added to it in 1817. This institution had broad goals, with education geared both to future sailors who needed to be familiar with the principal aspects of trade which they would be called on to use on a daily basis, and to future exporters called on to conduct international transactions which, at a time when steam navigation brought major upheaval, would involve familiarity with, if not mastery of, shipping practices such as managing maritime logs, calculating and paying customs duties and producing bills of health.⁵⁹ The complementarity between engineering and commercial training was also promoted by the sponsors of this interdisciplinary commercial education. Eduard Hollander, president of the Administrative Council of the Riga Polytechnic in Russia, noted that the inclusion of a commercial department in the polytechnic institute, and not the establishment of a separate academy of commerce, was a means of encouraging graduates of the polytechnic school (whether destined for technical or commercial careers) not to become competitors, but to work together for the sake of the fatherland. This was all the more important given that most local factories belonged to traders.⁶⁰ The opening of commercial departments in higher engineering schools was, therefore, a public response strategy for industrial and commercial development.

The introduction of commercial departments within higher engineering schools can also be explained on material grounds. The addition of a commercial department to an existing multidisciplinary school required a smaller investment than would be required for a commercial department built from scratch. Sometimes the number of commercial students was insufficient to create an independent academy of commerce. The percentage of students receiving commercial education could be very low compared to the total number of students. For instance, in 1860–1861 the commercial department of the Stuttgart Polytechnic (Polytechnisches Schule Stuttgart) welcomed only 21 students out of a total of 270, comprising just 7.8% of the total number of students. In 1863–1864 the figures had risen to 53 out of 377, which represented 14% of the total number.⁶¹

The commercial department also offered the advantage of enabling resources to be pooled among the various departments. Facilities with their ancillary costs such as rent, insurance, maintenance, heating and light, as well as school resources such as sample collections, libraries and chemistry labs, could be shared. Even instructors were shared between commercial education and the other training that was offered. For instance, at the Vienna Polytechnic in the 1830s, the geography professor and the natural history professor, who

both held teaching positions in the engineering department, also taught, respectively, commercial history and commodities composition in the commercial department.⁶² In addition to financial considerations, pooling also reduced the risk of the institution having to close by diversifying the types of training offered. Whereas in an independent school of commerce a drop in student numbers could lead to major financial problems for the institution, even causing it to close its doors, the risk was reduced for a higher engineering school with a commercial department. If numbers declined in one department, the institution could shut this department rather than close completely.⁶³ For instance, in Austria, when the commercial sections of the polytechnics of Vienna and Prague were shut down in the 1860s for lack of students, the institutions were able to remain open.⁶⁴

A mixed educational orientation based on engineering and commercial courses

Pedagogically, the training offered in commercial departments in higher engineering institutes was mixed. The manifestation of this situation was twofold. In the first case, in commercial departments, students were obliged to attend commercial as well as some technical courses. For instance, at the Commercial and Nautical Academy of Trieste, one of the main seaports in the Austro-Hungarian Empire, cosmography and hydrography were mandatory courses for commercial students. As the school was committed to training would-be master mariners, future officers of shipyards and prospective directors of export companies, cosmography and hydrography were considered to be basic courses for all students, whether they were enrolled in commercial studies or not. The same held true for the commercial departments in the higher technical institutes in Lisbon and Oporto, where commercial students had to study metallurgy, hydraulics or mineralogy.⁶⁵

Secondly, in other commercial departments students were allowed to attend technical courses. At the Prague, Vienna, Aachen, Karlsruhe, Munich, Stuttgart and Zurich polytechnics, this opportunity was so culturally entrenched that all students from commercial departments attended non-commercial courses.⁶⁶ This situation was primarily due to the relative freedom students were allowed in attending classes in their department. In the spirit of 'Lernfreiheit' (the freedom of learning in Germanic polytechnics which allowed students to take whatever courses they wanted, whenever and wherever they wanted) students could, and usually did, follow interdisciplinary courses, i.e. courses not restricted to commercial courses.⁶⁷ Thanks to such flexibility in instruction, commercial students were able to learn not only about commercial issues but also about technological developments. For example, students in the commercial departments of the Karlsruhe, Stuttgart and Munich polytechnics could attend classes in trigonometry, hydraulics and stereotomy, or botany and zoology. Since commercial training was associative (both mercantile and technical), professors who taught in commercial departments were also more willing to keep their theoretical discourse within the limits of what was most directly useful for these departments.⁶⁸

Table 2 provides a comparative overview of the courses offered by commercial departments within four of the main higher engineering schools in the 1860s. Because of gaps in the archival data, only schools for which sufficient information was found are presented. The Karlsruhe, Stuttgart, Lisbon and Munich polytechnics can be considered as representative of higher engineering schools with commercial sections at that time. The Karlsruhe Polytechnic exerted considerable influence on the development of German-speaking polytechnics in Europe. Similarly, the Lisbon Polytechnic was emulated in Portugal.⁶⁹ Table 2 shows the high number of courses

Table 2. Comparative table of the courses offered by commercial departments within the Karlsruhe, Stuttgart, Lisbon, and Munich higher engineering schools in the 1860s.

| Courses offered at commercial departments in the 1860s | Karlsruhe Polytechnic School | Stuttgart Polytechnic School | Lisbon Industrial and Commercial Institute | Munich Polytechnic School |
|--|------------------------------|------------------------------|--|---------------------------|
| Commercial courses | | | | |
| Bookkeeping | X | X | X | X |
| Arithmetic | X | X | X | X |
| Political economy | — | — | X | X |
| Commercial geography | X | X | X | X |
| Commercial history | — | — | X | X |
| Commercial correspondence | X | X | X | X |
| Commodities composition | X | — | X | X |
| Commercial technique | X | — | X | — |
| Languages | X | X | X | X |
| Commercial legislation | — | X | X | — |
| Administrative legislation | — | — | — | X |
| Penmanship | X | — | X | — |
| Engineering courses | | | | |
| Botany | X | X | X | X |
| Zoology | X | X | X | X |
| Mineralogy | X | X | X | X |
| Metallurgy | X | X | X | X |
| Trigonometry | X | X | — | X |
| Telegraphs | X | X | — | X |
| Hydraulics | X | X | X | X |
| Stereotomy | X | X | X | X |
| Building materials | X | X | — | X |

Note: For the sake of clarity, and due to the variety of engineering courses that were offered by higher engineering schools, only the most frequently cited engineering courses in archival documents are included in the table.

Sources: Dias Costa, Institut industriel et commercial de Lisbonne. France, Enquête sur l'enseignement professionnel. Hoepke, Geschichte der Fridericiana. Author's elaboration.

available within the commercial sections. At the Karlsruhe and Munich polytechnics there were almost as many commercial courses as engineering courses. Some commercial courses were taught in all the schools surveyed, including bookkeeping, arithmetic, commercial geography, correspondence and foreign languages. Similarly, a number of engineering courses were taught at the Karlsruhe, Stuttgart, Lisbon and Munich polytechnics, such as mineralogy or hydraulics.

The evolution of the engineering model of commercial education throughout the nineteenth century

In response to the changing environment, the original curricula of the higher engineering schools with commercial departments underwent extensive changes over time. More specifically, the engineering model of commercial education evolved in terms of curriculum content, study organisation and status.

Course proliferation in support of the development of trade and industry

In the nineteenth century, the educational content dispensed as common-core training was invariably organised around a body of compulsory major commerce-related disciplines,

clearly shared among the higher engineering schools with commercial departments. These were, by order of priority, bookkeeping, political economy and the 'commodities composition' course.⁷⁰ Bookkeeping, when combined with political economy and arithmetic, was among the cornerstone subjects in the commercial curricula of higher technical schools because it could be used to keep track of successive transformations of funds, and the transactions of any business or bank. It was a natural part of doing trade. The objective of the 'commodities composition' course was to enable future businessmen to become familiar with the nature, quality and composition of marketable products, raw materials and by-products that they may be called on to speculate on in the future, as well as to identify any counterfeit or damaged products they might come across. Emphasis was also put on practical subjects such as commercial correspondence and even calligraphy.

It is worth mentioning that the commercial curriculum was further developed and gradually updated throughout the entire nineteenth century. The traditional commercial courses (bookkeeping, political economy and commodities composition) were maintained while an expanded set of new subjects was added to serve as the background for commercial training. Courses on colonial administration, commercial geography, economics, finance, foreign languages, legislation and statistics were introduced. Table 3 provides a comparative overview of the evolution of the number of courses offered by commercial departments within the Karlsruhe, Riga and Lisbon higher engineering schools in nineteenth-century Europe. For the sake of clarity, we have chosen to show the number of courses within the most

Table 3. Comparative table of the evolution of the number of commercial courses offered by commercial departments within the Karlsruhe, Riga, and Lisbon higher engineering schools in nineteenth-century Europe.

| Commercial course-offered at commercial departments | Karlsruhe Polytechnic School | | Riga Polytechnic School | | Lisbon Industrial and Commercial Institute | |
|---|------------------------------|------|-------------------------|------|--|------|
| | 1830 | 1865 | 1868 | 1900 | 1869 | 1900 |
| Administrative legislation | – | – | – | 1 | – | 1 |
| Arithmetic | 1 | 1 | 1 | 1 | – | 1 |
| Bookkeeping | 1 | 1 | 1 | 1 | 1 | 1 |
| Calligraphy | 1 | 1 | 1 | 1 | 1 | 1 |
| Colonial administration | – | – | – | – | – | 1 |
| Commercial correspondence | 1 | 1 | 1 | 1 | 1 | 1 |
| Commercial geography | 1 | 1 | 1 | 1 | 1 | 1 |
| Commercial history | – | 1 | 1 | 1 | 1 | 1 |
| Commercial legislation | – | 1 | 1 | 1 | 1 | 1 |
| Commodities composition | 1 | 1 | 1 | 1 | 1 | 1 |
| Economics | – | – | – | 1 | – | – |
| Finance | – | – | – | 1 | – | 1 |
| Foreign languages | – | 1 | 1 | 1 | – | 1 |
| Political economy | 1 | 1 | 1 | 1 | – | 1 |
| Statistics | – | 1 | – | 1 | 1 | 1 |
| Total number of commercial courses | 7 | 11 | 10 | 14 | 8 | 14 |

Sources: Dias Costa, Institut industriel et commercial de Lisbonne. France, Enquête sur l'enseignement professionnel. Dumont and Jourdan, Étude sur les écoles de commerce. France, Exposition universelle internationale de 1900 à Paris. Hoepke, Geschichte der Fridericiana. Author's elaboration.

influential polytechnics in Europe at the time, i.e. the Karlsruhe Polytechnic for German-speaking countries, the Riga Polytechnic for Russia and the Lisbon Polytechnic for Portugal. As shown in Table 3, the instructional programme for the commercial department of the Karlsruhe Polytechnic rose from seven commercial courses per week in 1830 to 11 in 1865, not counting engineering courses. As this school served as a model for polytechnics in Germany, Russia and Switzerland, this trend had repercussions for the Stuttgart, Munich, Riga and Zurich polytechnics.⁷¹ Likewise, at the Riga Polytechnic, the commercial department's instructional programme grew from 10 commercial courses in 1868 to 14 commercial courses per week in 1900. Table 3 also shows that in the commercial department of the Lisbon Industrial and Commercial Institute, the curriculum grew from eight commercial courses in 1869 to 14 in 1900.

This proliferation of courses resulted from changes in the economic environment, as the needs of European governments in 1810 were not the same as those in either 1860 or 1895. The growing internationalisation of trade prompted higher technical schools with commercial departments to increase the time spent studying foreign languages, maritime law and international law. For instance, at a time when seaborne trade was stimulated by the opening of the Suez Canal (1867), which turned the Mediterranean into a primary sea route towards the Orient, the commercial section of the Commercial and Nautical Academy of Trieste was offering Turkish lessons.⁷² Moreover, in Europe at this time there was a system of domestic-foreign commercial education under which commercial students acquired formal education and work experience abroad.⁷³ Accordingly, institutions offering commercial education had to teach international subjects such as modern languages and legislation in order to make their curricula more attractive. Most of the higher engineering schools with commercial departments in Austria, Germany, Russia, Switzerland and Portugal taught both domestic and foreign students.⁷⁴ For instance, in 1862 the commercial department in the Karlsruhe Polytechnic was already hosting five foreign students out of a total of 30.⁷⁵

Finally, the specific demands of local or national commerce could also drive the proliferation of courses taught by higher engineering schools. For instance, the Riga Polytechnic, located in one of Russia's main ports, initially required its commercial students to take maritime law, which was not on offer in the other schools. The Riga traders had strengthened their trade and financial links with the rest of the world and, by the end of the century, the city had become the third largest industrial centre in the Russian Empire.⁷⁶ Consequently, by 1900 the scope of commercial subjects had been broadened by division into more specific disciplines, while four new subjects had also been introduced, namely finance, statistics, civil legislation and commercial geography.⁷⁷ The introduction of these courses reflected the type of training in commercial education that the authorities were encouraging. Since Riga had become a newly influential actor in world trade, a demand had arisen for leading businessmen trained in all commercial issues, not just maritime ones. Similarly, in the 1890s in Portugal, the commercial section at the Lisbon Industrial and Commercial Institute offered lessons dedicated to colonial administration and tropical hygiene. At the time, Portugal had just expanded its colonial empire in Africa by conquering Guinea-Bissau (1879). As the school taught future engineers and future businessmen in the fields of civil works, i.e. mining, mechanical and chemical engineering, as well as civil servants to work for the colonies, it had to provide colonial education.⁷⁸ The proliferation of courses was, therefore, a sign of up-to-date training and the attention devoted by higher engineering schools to the development of industry and trade.⁷⁹

Table 4. Comparative table of duration of studies at the commercial departments within the Prague, Vienna, Trieste, Lisbon, and Riga higher engineering schools in Europe throughout the nineteenth century.

| Duration of studies at the commercial departments of some higher engineering schools | in the 1830s | in the 1860s | in the 1880s | in the 1890s |
|--|---------------|--------------|---------------|---------------|
| Prague Polytechnic School | 1 year | 3 years | Not concerned | Not concerned |
| Vienna Polytechnic School | 1 year | 3 years | Not concerned | Not concerned |
| Trieste Commercial and Nautical Academy | 2 years | 3 years | 3 years | 3 years |
| Lisbon Industrial and Commercial Institute | Not concerned | 1 year | 3 years | 5 years |
| Riga Polytechnic School | Not concerned | 3 years | 5 years | 4 years |

Note: For the sake of clarity, the table only takes into account commercial sections that have existed for more than thirty years. Due to a lack of archival data, the commercial departments from the Karlsruhe and Oporto polytechnics which have been existing for sixty years are not included in the table. The latter only takes into account the years of specialisation: the preparatory years, which could be optional depending on the school, are not included in the table.

Sources: Archivio di Stato di Trieste, Governo Marittimo. Atstaja et al., "The case of the Baltic region". Dias Costa, Institut industriel et commercial de Lisbonne. Dumont and Jourdan, *Étude sur les écoles de commerce*. Kurrer and Ramm, *The History of the Theory of Structures*. Author's elaboration.

The lengthening of commercial studies

The duration of commercial studies increased significantly during the nineteenth century. Table 4 provides a comparative overview of the duration of studies at the commercial departments within the Prague, Vienna, Trieste, Lisbon and Riga higher engineering schools in Europe throughout the nineteenth century. For the sake of clarity, the table only takes into account commercial sections that existed for more than 30 years. Due to a lack of archival data, the commercial sections in the Karlsruhe and Oporto polytechnics are not included in the table. As depicted in Table 4, in Prague and Vienna in the 1830s, commercial students at higher engineering schools with commercial departments completed their schooling within a single year, whereas it was two years in Trieste. In the last third of the nineteenth century, the duration of commercial studies increased to two or three years. This became the new standard. The majority of commercial departments established in higher engineering schools after 1870 extended the term of their commercial courses to at least three years. In Portugal, in the commercial department of the Lisbon Industrial and Commercial Institute, the length of studies was one year in 1869, then two years until 1886, and four years until 1898, when it was extended to five years.⁸⁰ Similarly, in Russia, an 1878 reform extended the duration of the commercial curriculum at the Riga Polytechnic from three to five years. Since the commercial curriculum was overloaded with new subjects, in reality it took six to eight years to finish, with the consequence that many Russian students got married during their studies. For this reason, the length of studies was finally reduced to four years in the 1890s, as per the German model.

More generally, the extension of the period of commercial education within higher technical schools was a consequence of three factors. First, higher engineering schools increased the number of years of study for commercial students in order to accommodate the proliferation of courses. Second, higher engineering schools aligned the effective duration of commercial studies with that of engineering studies. Originally, the curriculum of commercial departments was shorter than those offered by the technical departments at these engineering institutes. Table 5 provides a comparative overview of the duration of studies in the Karlsruhe, Lisbon, Munich, Stuttgart and Trieste higher engineering schools in Europe in the 1860s. Due to a lack of archival data, only schools for which sufficient information was found

Table 5. Comparative table of duration of studies within the Karlsruhe, Lisbon, Munich, Stuttgart, and Trieste higher engineering schools in Europe in the 1860s.

| Duration of studies in the 1860s | Com- mer- cialde- part- ment | Building depart- ment | Mechan- ical depart- ment | Chem- ical depart- ment | Civil Engi- neering depart- ment | Forestry depart- ment | Postal depart- ment | Mar- itime depart- ment |
|---|--|-----------------------------|------------------------------------|----------------------------------|---|-----------------------------|---------------------------|----------------------------------|
| Karlsruhe Polytechnic School | 1 year | 4 years | 2 years | 2 years | 3 years | 2 years | 1 year | – |
| Lisbon Industrial and Commercial Institute | 1 year | – | – | – | 3 years | – | – | – |
| Munich Polytechnic School | 1 year | 2 years | 2 years | 2 years | – | – | – | – |
| Stuttgart Polytechnic School | 1 year | 3 years | 3 years | 3 years | 3 years | – | – | – |
| Trieste Commercial and Nautical Academy | 2 years | 2 years | – | – | – | – | – | 3 years |

Note: For the sake of clarity, the table only takes into account the years of specialisation: the preparatory years, which could be optional depending on the school, are not included in the table.

Sources: Dias Costa, Institut industriel et commercial de Lisbonne. Dumont and Jourdan, Étude sur les écoles de commerce. France, Enquête sur l'enseignement professionnel. Hoepke, Geschichte der Fridericiana. Author's elaboration.

are presented. As shown in Table 5, at the Stuttgart Polytechnic in the 1860s, students took two years of preparatory classes and then three years of specialist classes in the departments of architecture, civil engineering and chemistry, whereas the commercial department required only one year of specialist studies, and no preparatory classes. The same held true for the Munich Polytechnic, where the commercial curriculum included only one year of specialisation, and no preparatory classes, whereas the departments dedicated to construction and mechanics required two years of preparatory classes and two years of specialisation. At the Karlsruhe Polytechnic, the commercial department required only one year of specialisation whereas the departments of architecture, civil engineering, forestry, mechanics and chemistry required between two and four years. Such brevity was perceived as evidence that studying commerce was easier than studying applied sciences.⁸² Hence, business could be perceived as less academically demanding compared to technical sciences, which called into question the very idea of 'commercial education' being comparable to 'higher engineering education'. Third, psychologically, the brevity of this commercial instruction did not satisfy the desires of the middle classes to have prestigious instruction for those sons going into business.⁸³ Consequently, in order to prove that commerce was also a noble discipline worthy of lengthy studies, the Prague, Vienna, Trieste, Lisbon and Riga higher engineering schools extended their commercial study programmes.⁸⁴ Syllabus expansion and the extension of the period of study in commercial departments had the desired effect of bringing higher engineering schools closer to the level of traditional universities. This in turn implied a status upgrade for the engineering model of commercial education, as discussed further below.

Raising the academic prestige of the engineering model of commercial education

Higher engineering schools with commercial departments gradually attempted to affirm their higher status. From an administrative point of view, while the configuration of some institutes was in fact close to that of the universities, especially in Russia and Portugal, higher engineering schools with commercial sections lacked prestige in society at large.⁸⁵ This was true in Germany where higher engineering schools were perceived as having a lower status than universities, even though they were not secondary schools.⁸⁶ For this reason, university status was sometimes granted to them by law. In 1865, after a great deal of negotiation, the title of 'higher technical institute' (Technische Hochschule) was bestowed on the Karlsruhe Polytechnic by Grand Duke Frederick I.⁸⁷ This is not an isolated case: in the late 1870s, most of the higher engineering schools in Germany became Technische Hochschulen.⁸⁸ Subsequently, responsibility for them was shifted from the Ministry of Commerce to that of Education, and efforts were made to appoint teachers with good scientific credentials.⁸⁹ For instance, in the 1860s, at the Stuttgart Polytechnic, supervisory authority was assumed by the Ministry of Education, which was in charge of all Württemberger universities. The senior teachers were subsequently given a status equal to that of university professors.⁹⁰ Similarly, in Russia some attributes of public authority were granted to the staff of such institutions. The St Petersburg Polytechnic was placed under the responsibility of the Ministry of Finance, and its teachers, including those teaching in the commercial department, had to wear the uniform of the Ministry.⁹¹

From an academic point of view, in the second half of the nineteenth century higher engineering schools offered a new commercial course in commercial history, which pursued more ideological than genuinely operational goals for would-be businessmen, in order to raise the social prestige of their commercial students. According to Maffre, commercial history was taught to enhance the prestige of commercial careers whilst demonstrating to the students the historical importance that commerce and businessmen have exercised since antiquity.⁹² The teaching of commercial history at higher engineering schools with commercial departments pursued ideological goals. It was taught to enhance the prestige of commercial education, which was not then highly regarded, as compared to education in the humanities, experimental science and engineering.⁹³ In other words, commercial history could enhance the status of would-be businessmen by showing them examples of successful businessmen from history and therefore helping them to realize that they were crucial to the prosperity of businesses. Such a course was also a means for higher engineering schools with commercial departments to underline the advanced level of their teaching and to enhance their academic stature.

It is worth mentioning that two higher engineering schools with commercial sections succeeded in issuing their commercial students with doctoral degrees. Although the German higher engineering schools had been unable to award doctorates (a privilege of the universities) for most of the nineteenth century, they were eventually granted the right to award them at the turn of the twentieth century. In 1898, the Aachen Institute of Technology, which included a commercial department, won the right to grant doctorates.⁹⁴ Similarly, the Zurich Polytechnic, in conjunction with the Faculty of Law and Economics at the University of Zurich, awarded its first 'Doctor Juris (Economici)' doctorates to its commercial students at the beginning of the twentieth century.⁹⁵ The prestige attached to the awarding of research degrees was important for the status of the higher engineering schools with commercial sections

and, consequently, for the status of the engineering model of commercial education. Even though we do not know precisely how many commercial students from Aachen and Zurich succeeded in earning such doctorates, the right to confer them entailed the formal recognition that these higher engineering schools were of equal status to universities.⁹⁶ In these two cases, commercial graduates could achieve parity with university graduates, who were traditionally designated as 'doctors'.

Finally, polytechnics with commercial sections succeeded in gaining professional advantages for their commercial students. Some students were granted greater access to consular or customs careers, as was the case for the higher engineering schools of Lisbon and Oporto. Others were given partial dispensation from military service.⁹⁷ From the 1860s onwards, the Kingdom of Württemberg allowed the Stuttgart Polytechnic to issue a certificate of fitness for just one year of volunteer duty in the state's army. The same held true in Austria-Hungary, where, from December 1868, the diploma issued by the higher engineering school of Trieste afforded the student one year of service in the Austro-Hungarian army. Similarly, in Russia the diploma issued by the Riga and the St Petersburg polytechnics permitted the volunteer to serve only one year in the Russian army.⁹⁸ In all cases, the students would otherwise have had to serve for three years. At the turn of the century, commercial graduates from Russian polytechnics also enjoyed the same rights and privileges as the state technical schools for entering government employment.⁹⁹ The privileges granted to graduates of higher engineering school commercial departments reveal the growing awareness among nineteenth-century governmental authorities of the need to promote commercial personnel.

Table 6. Dates of the closure of commercial departments within higher engineering schools between 1862 and 1919 in Europe.

| Country | City | Institution | Closure of commercial departments | Transformation of commercial departments into independent educational institutions |
|-------------|---------------|-------------------------------------|-----------------------------------|--|
| Austria | Prague | Polytechnic Institute | 1863 | Not concerned |
| | Trieste | Commercial and Nautical Academy | 1895 | Not concerned |
| Germany | Vienna | Polytechnic Institute | 1865 | Not concerned |
| | Aachen | Institute of Technology | 1908 | Not concerned |
| | Karlsruhe | Polytechnic School | 1885 | Not concerned |
| | Munich | Polytechnic School | 1877 | Not concerned |
| | Stuttgart | Polytechnic School | 1862 | Not concerned |
| Portugal | Lisbon | Industrial and Commercial Institute | 1911 | Higher School of Commerce |
| | Oporto | Industrial and Commercial Institute | 1918 | Higher School of Commerce |
| | Oporto | Royal Polytechnic Academy | 1897 | Not concerned |
| Russia | Riga | Polytechnic School | 1919 | Faculty of business |
| | St Petersburg | Polytechnic Institute | 1918 | Faculty of business |
| Spain | Madrid | Royal Industrial Institute | 1867 | Not concerned |
| Switzerland | Lausanne | Industrial School | 1901 | Higher School of Commerce |
| | Zurich | Polytechnic Institute | 1908 | Not concerned |

Note: All the schools' names appearing in the table below are those of the schools when a commercial section was opened. Sources: Table 6 has been compiled from a variety of sources: Archivio di Stato di Trieste, Governo Marittimo. France, Enquête sur l'enseignement professionnel. France, Exposition universelle internationale de 1900 à Paris. Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal". Hoepke, Geschichte der Friderician. Lechner, Geschichte der Technischen Hochschule in Wien (1815-1940). Leimanis, "The Polytechnical Institute of Riga and its role in the development of Science". Lomič, Vznik, Vývoj a Současnost. Pavón, "El Real Instituto Industrial de Madrid". Playfair, Industrial Instruction on the Continent. Author's elaboration.

The demise of the engineering model of commercial education in Europe

Was the engineering model of commercial education successfully carried out? It must be noted that most commercial departments within higher engineering schools suffered from low attendance. Even if the averages recorded by archival data might hide large inter-annual variations, they provide useful information. For instance, there was an average of 20–30 students per year in the commercial departments of the German polytechnics in the 1860s, and an average of 50 students in the commercial department of the Industrial and Commercial Institute of Lisbon in the 1870s.¹⁰⁰ For the time the commercial department of the Riga Polytechnic existed, from 1868 to 1919, the average annual number of students was just under 30, which gives a total of 1500 students in just over 50 years.¹⁰¹ At the Oporto Polytechnic, between 1840 and 1880, the average number of students per year was less than 13.¹⁰² These figures contrast sharply with those of the main higher schools of commerce at the tertiary level during this period. From 1860 to 1880, an annual average of 103 students attended the Superior Institute of Commerce in Antwerp, and from 1868 to 1918, the Royal Superior School of Commerce of Venice had an annual average of 164 students.¹⁰³

All commercial departments also had an ephemeral existence. As depicted in Table 6, most of them disbanded during the nineteenth century. Between 1862 and 1897, the higher engineering schools of Stuttgart, Prague, Vienna, Madrid, Munich, Karlsruhe, Trieste and Oporto closed their commercial departments. In 1901, the commercial department of the Lausanne Industrial School disbanded. The Aachen, Lisbon, Riga, St Petersburg and Zurich polytechnics followed suit a few years later. By the end of the First World War, all of them had disappeared. Table 6 also shows that the majority of commercial sections were not transformed into independent educational institutions. Some of them were, however, converted at the beginning of the twentieth century into higher schools of commerce, such as the commercial sections in the industrial and commercial institutes of Lisbon and Oporto, and others were transformed into faculties of business, like the commercial sections in the St Petersburg and Riga polytechnics.

What could be the reasons for such a situation? Some of the contemporaries of the engineering model of commercial education criticised this organisational form of mercantile education. As Professor Edmund James noted in his 1898 report on the education of businessmen in nineteenth-century Europe, 'The commercial courses in the technical schools ... did not succeed in obtaining the hoped-for influence in those circles whose interests they were intended to serve, nor could they correspond to the varied demands of the mercantile classes.'¹⁰⁴ Commercial sections within higher engineering schools probably disappeared because of an increasingly competitive environment. Due to the opening and proliferation of educational institutions specifically oriented towards commercial education, i.e. higher schools of commerce and faculties of business, competition in commercial education strengthened in Europe from the second half of the nineteenth century into the beginning of the twentieth century.¹⁰⁵ Sometimes, the opening of a new higher school of commerce in a city where a higher engineering school with a commercial section was already established resulted in increased competition or even to the disappearance of the commercial section. It should be noted that the 50-year-old commercial section at the Vienna Polytechnic was closed in 1865, only a few years after the opening of the Vienna Commercial Academy in 1858.¹⁰⁶ Commercial sections within higher engineering schools have disappeared while higher schools of commerce and faculties of business have survived. Their disappearance

can be attributed to their weaknesses. In this section, we will look at the reasons why the engineering model of commercial education was ultimately unsuccessful.

Commercial departments as dependent institutions within higher engineering schools

From an administrative point of view, as commercial departments were mainly or totally controlled by the national, regional, or municipal governments, they were not independent institutions. Consequently, they were subject to the decisions taken by their supervisory authority. Due to their public origins, public intervention in supporting higher engineering schools with commercial sections was critically important during this period. For example, during the 1880s, the average annual subsidy paid by the Austro-Hungarian government to the higher engineering school of Trieste was 53,000 out of a total of 60,000 guilders, which was more than 88% of its overall annual expenditure.¹⁰⁷ Subsidies were an important factor in the emergence and development of these educational institutions, but had the disadvantage that higher engineering schools with commercial sections were heavily dependent on public authorities. Political and economic conditions therefore determined the development of commercial education in public institutions. In Spain in the 1860s, the economic crisis and political unrest justified the closure of the Royal Industrial Institute in 1867, a few months before the revolution erupted in 1868.¹⁰⁸ A similar situation arose in Portugal, where the downfall of the monarchy in 1910 enabled the Republicans in power to reorganise the higher educational system.¹⁰⁹ Under such circumstances, public authorities were little inclined to support the costly commercial sections they had implemented within their higher engineering schools.

Irrespective of political and economic crises, public authorities could take measures in support of national education policies without taking into account the interests of commercial departments. For instance, in 1896 the Russian Empire changed the Riga Polytechnic's statutes, as well as the language of tuition. German was replaced by Russian, which led to the exodus of teachers and students who came from German-speaking countries and were unable, or unwilling, to work in Russian.¹¹⁰ This subordinate relationship could threaten not only the interests of commercial departments but also their existence. When public authorities considered that the commercial sections no longer met the requirements of the time, they were likely to reform or close them, and they did not have to account for their decisions. On 8 October 1897, for example, a Royal Decree was issued in Portugal to transform the Oporto Polytechnic Academy into a new polytechnic institute, without a commercial department.¹¹¹ The Oporto Polytechnic therefore closed its 60-year-old commercial section, which had trained several generations of businessmen, because the administration judged that such training had become unnecessary.¹¹²

Moreover, as most people in the nineteenth century were not favourably disposed towards commercial education and stigmatised those who received it (they were considered 'grocers'), commercial departments sometimes maintained tense relations with engineering departments.¹¹³ Indeed, the development of commercial courses alongside technical courses in the same educational institution may have generated misunderstanding or even serious opposition among teachers and administrative staff, and thus imperilled the successful establishment of such commercial departments. As Holme stated in 1906, the introduction of commercial departments within higher engineering schools

is already showing that this coupling process is unsatisfactory. There is an impediment, somewhere, to the marriage of the true minds. One partner, perhaps, fails in duty, and the other is compromised; one grows and the other languishes; one manages more cleverly, and the other sinks in prestige.¹¹⁴

Consequently, the technical departments within higher engineering schools usually grew at the expense of the commercial section, leading to a weakening of the latter, as was the case in the Vienna and Prague polytechnics.¹¹⁵ As stated by the British special sub-committee on commercial education in 1899, 'it is difficult to get a proper combination of sciences and business education [within the same educational institution]. The commercial institution requires a special council of its own, otherwise the probability is that the commercial side will suffer'.¹¹⁶ At the Aachen Institute of Technology, for instance, the commercial department created in 1898 was given the title of 'Commercial University in connection with the Royal Technical University' in 1904, indicating increased independence.¹¹⁷ Even so, the Aachen commercial section finally disbanded in 1908.¹¹⁸

Table 6 shows that the closure of commercial sections within higher engineering schools was sometimes followed by the opening of independent institutions for commercially oriented education. In 1901, the commercial department of the Industrial School of Lausanne was transformed into an independent entity which became the Higher School of Commerce of Lausanne (École Supérieure de Commerce de Lausanne). Similarly, in 1911 the commercial department of the Lisbon Industrial and Commercial Institute became an independent higher school of commerce, under the designation Higher Commercial Institute of Lisbon (Instituto Superior de Comércio do Lisboa). In 1918, the commercial department of the Oporto Industrial and Commercial Institute also became an independent school of commerce, under the designation Higher Commercial Institute of Oporto (Instituto Superior de Comércio do Porto).¹¹⁹ A similar situation applied in Russia, where the commercial departments of the St Petersburg and Riga polytechnics were transformed into faculties of business, in 1918 and 1919 respectively.¹²⁰ The independence of these new educational institutions (schools of commerce or faculties of business) was a means for them to pursue growth and development, unconstrained by technical departments.

An imperfect educational curriculum

From a pedagogical point of view, the complementarity between commercial training and technical training had inherent limitations. As noted in 1856 by Karl Arenz, director of the Commercial Academy of Prague (Prager Handels-Akademie),

The union of technical and commercial courses leads ... to what is, from a pedagogical point of view, a wrong treatment of the students, and this is the moral ground which compels us to urge a separation of the commercial schools from the technical institutions, and an independent organisation of the former.¹²¹

The engineering model of commercial education had the disadvantage of being more theoretical than its technical counterpart. If future engineers could visit industrial buildings and facilities such as real bridges, real mines and real farms as part of their schooling, they could get a certain amount of practical experience in their chosen career. Prospective architects could make scale models, future pharmacists could produce medicines, and would-be manufacturers could produce cloth on a daily basis. For instance, at the Riga Polytechnic, students from the agricultural department were taught in a farm environment, working with practical

Table 7. Comparative table of commercial curricula between the Riga Polytechnic and the Superior Institute of Commerce of Antwerp in 1885.

| Courses in 1885 | Riga Polytechnic School Commercial Department | | | | | | Superior Institute of Commerce of Antwerp | | | |
|-------------------------------------|---|----------------|----------------|----------------|----------------|----------------|---|----------------|----------------|----------------|
| | First year | | Second year | | Third year | | First year | | Second year | |
| | Hours per week | % of the total | Hours per week | % of the total | Hours per week | % of the total | Hours per week | % of the total | Hours per week | % of the total |
| Model Office | 0 | 0% | 0 | 0% | 0 | 0% | 12 | 33% | 12 | 35% |
| Bookkeeping | 2 | 8% | 4 | 14% | 4 | 20% | 0 | 0% | 0 | 0% |
| Arithmetic | 4 | 15% | 2 | 7% | 0 | 0% | 3 | 8% | 3 | 9% |
| Political economy | 5 | 19% | 5 | 17% | 3 | 15% | 2 | 6% | 0 | 0% |
| Commodities composition | 0 | 0% | 3 | 10% | 3 | 15% | 2 | 6% | 2 | 6% |
| Commercial geography | 0 | 0% | 0 | 0% | 0 | 0% | 3 | 8% | 0 | 0% |
| Commercial history | 1.5 | 6% | 1.5 | 5% | 0 | 0% | 0 | 0% | 2 | 6% |
| Commercial and maritime legislation | 0 | 0% | 4 | 14% | 0 | 0% | 0 | 0% | 2 | 6% |
| Private and customs legislation | 0 | 0% | 0 | 0% | 0 | 0% | 1 | 3% | 1 | 3% |
| Physics | 3 | 12% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| Chemistry | 1.5 | 6% | 0 | 0% | 0 | 0% | 1 | 3% | 0 | 0% |
| Mechanics | 0 | 0% | 2 | 7% | 2 | 10% | 0 | 0% | 0 | 0% |
| Introduction to Riga trade | 0 | 0% | 0 | 0% | 1 | 5% | 0 | 0% | 0 | 0% |
| Maritime construction and equipment | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 1 | 3% |
| Languages | 9 | 36% | 8 | 27% | 7 | 35% | 12 | 33% | 11 | 32% |
| Engineering courses | Variable | Variable | Variable | Variable | Variable | Variable | 0 | 0% | 0 | 0% |
| Total | 26 | 100% | 29.5 | 100% | 20 | 100% | 36 | 100% | 34 | 100% |

Source: Dumont and Jourdan, *Étude sur les écoles de commerce*, 154–158; 208–210. Grunzweig, *Histoire de l'Institut Supérieur de Commerce de l'État à Anvers*. Author's elaboration.

farming operations that enabled them to conduct experiments with fertilisers, and develop new varieties of seeds and methods of soil tilling, etc.¹²² The reverse was not true for would-be businessmen. They could visit places of commerce on weekly or monthly excursions, but they could not study real accounts, real documents or real transactions on an everyday basis.¹²³ This training gap was outlined in 1906 by Holme when he visited the European schools dedicated to commercial education. He deprecated the engineering model of commercial education because it neglected

some purely commercial subjects that should be held indispensable, giving far too little time to others, and generally being quite over-theoretical ... This experiment threatens failure perhaps because it takes the form of a loose and multifarious outgrowth from a differently useful institution. The main lack is that of a more independent organisation with a single purpose. Adapted teaching is never the best.¹²⁴

The lack of practice in commercial departments can be contrasted with higher schools of commerce at the tertiary level. From the mid-nineteenth century, the latter offered practical commercial courses called the 'office model'.¹²⁵ This was based on a simulated commercial

venture and was not taught in most higher engineering schools, whereas it was offered in the internationally renowned higher schools of commerce of Antwerp and Venice.¹²⁶ Table 7 provides a comparative overview of commercial curricula between the Riga Polytechnic and the Superior Institute of Commerce of Antwerp in 1885. These educational institutions have been selected because they were considered to be among the most prestigious institutions for commercial education at the end of the nineteenth century in Europe.¹²⁷ Table 7 shows that, in 1885, the commercial department in the Riga Polytechnic offered a commercial curriculum that, in terms of diversity, was comparable to the mercantile courses in the curricula offered at the Superior Institute of Commerce of Antwerp: both of them offered 11 commercial courses to their students. Moreover, modern languages may have represented up to one-third of study time in such institutions. In the commercial department of the Riga Polytechnic, language learning represented between 27% and 36% of study time, whereas these figures ranged from 32% to 33% at the Belgian school. Similarly, commercial history represented between 0% to 6% of the total curricula in both educational institutions. However, Table 7 also reveals that the Superior Institute of Commerce of Antwerp offered a more practical curriculum to its commercial students than that of the Riga Polytechnic, since the 'office model' course accounted for 33% to 35% of study time at the Belgian school.

The lack of job opportunities and social support networks for commercial graduates

Theoretically, by the end of the nineteenth century graduates from higher engineering schools were supposed to hold leading positions in business and industry. However, in most cases it is difficult to know what became of commercial students after graduation. Playfair, in his *Industrial Instruction on the Continent*, wrote about the Vienna Polytechnic that 'notwithstanding the large number of students, the demand for them by industrial establishments is greater than can be readily supplied'.¹²⁸ As for the Karlsruhe Polytechnic, he noted that 'The formal certificates of the Special Technical schools are said to be in the highest estimation, and command immediate employment to the possessors'.¹²⁹ Because of the small number of commercial graduates, higher engineering schools rarely published annual employment reports about them, with the exception of the Riga Polytechnic. Numerous former students of this school set up new factories or found jobs in the growing industrial sectors both locally and outside the region. One of them, Zigfrīd Meierovics who studied trade from 1907 to 1911, became the first Minister of External Affairs in 1918 and later became Prime Minister of Latvia.¹³⁰ When they did not become entrepreneurs, graduates from the commercial section of the Riga Polytechnic often ended up as officers or administrative directors of an industrial concern.¹³¹

In any case, higher engineering schools with commercial departments could have experienced difficulties in placing their commercial graduates within companies and state administrations. The lack of job opportunities was discernible in the public sector where, except in Portugal and Russia, no special corps had been effectively established for commercial graduates, as opposed to civil engineers. As for the private sector, the local and national labour markets were not always mature enough to welcome commercial graduates from higher engineering schools. Higher technical education did not create either modern industries or businesses by itself: a demand for engineers and businessmen was also required.¹³² For instance, in the mid-nineteenth century, the Spanish labour market was not yet

sufficiently balanced for the highly qualified graduates from the Madrid Royal Industrial Institute. Due to the scarcity of public and private jobs for businessmen and engineers at the time, the Royal Institute had few students. This led to its closure in 1867.¹³³

Finally, most commercial departments within higher engineering schools disbanded well before the end of the nineteenth century for want of social networks. They offered commercial education at a time when the merchant and industrial bourgeoisie made its living through property ownership rather than through their labour on the open market. The strength of family networks should not be neglected. Businessmen with a father in business were more likely to take employment in an already-existing firm.¹³⁴ Sons and heirs could achieve positions thanks to their family and social relationships without requiring any great demonstration of talent.¹³⁵ Moreover, throughout business, the growing prominence of higher education graduates was viewed with suspicion by the skilled businessmen who had relied on experience. Consequently, businessmen continued to look for employees with a more modest educational background than the training provided by the engineering model of commercial education.¹³⁶ In other words, commercial education, diplomas and degrees could provide efficient access to lower- and mid-level business positions but not to the highest ones. This situation was particular to higher engineering schools with commercial departments because higher schools of commerce at the tertiary level established professional support networks very early on to give graduates a better chance of entering the highest positions in the business world. For the main higher schools of commerce, business sponsors and former students were brought together to form a support network. While higher schools of commerce at the tertiary level had set up development boards, valuation committees and employment committees consisting of businessmen, in order to contribute to the financing or growth of the schools' programmes and employment of their alumni, commercial departments of higher engineering schools did not succeed in permanently involving companies and individual sponsors in their day-to-day management.¹³⁷

In addition, at the end of the nineteenth century the university spirit asserted itself in the establishment of student fraternities in higher schools of commerce. Former students from commercial departments did not, however, create alumni associations. The brevity of schooling in commercial departments (initially one or two years) may have prevented students from developing a sense of belonging to a commercial graduating class, which might explain the lack of identification of alumni with their alma mater. Beyond a mere sentimental attachment to the higher engineering schools, one can assume that the lack of community spirit had implications for the recognition of the social usefulness of the engineering model of commercial education. Since only a small proportion of commercial graduates from the same higher engineering school were active in trade, they could not constitute a unified and powerful pressure group to defend their interests. This is one of the main differences between commercial graduates from polytechnics and their technical counterparts. Unlike civil engineers who created associations of engineers, particularly in Austria, Germany and Portugal, graduates from commercial departments did not build a professional identity.¹³⁸ Consequently, their status was rather different from civil engineers, for whom official corps existed. As they did not succeed in building a well-grounded corpus of commercial knowledge in order to establish the scope of the professional field, and failed to show to the general public how technical businessmen could play an important role in a modern society, commercial graduates from higher engineering schools might have contributed, to a greater or lesser extent, to the demise of this original pattern of commercial education in Europe.

The disappearance of commercial departments from higher engineering schools in nineteenth-century Europe is testimony to the failure of the engineering model of commercial education that was based on the close association of mercantile and technical instruction for would-be businessmen and future engineers. This does not mean that commercial subjects were not taught to engineering students within higher technical schools. As a matter of fact, even though commercial sections were themselves disbanded, at the beginning of the twentieth century a number of lectures on political economy and industrial economics were introduced in higher engineering schools such as the Aachen Institute of Technology.¹³⁹ However, since these commercial lectures were aimed at broadening the curricula of future engineers, they were considered as additional courses and not as a common core of training.

Conclusions

In Europe, higher engineering schools with commercial departments constituted the first generation of higher educational institutions devoted to commerce, well before the advent of both higher schools of commerce at the tertiary level and faculties of business. Some, like the Prague Polytechnic, emerged as early as the start of the nineteenth century, while others were not established until the 1900s, such as the St Petersburg Polytechnic.

The role of public authorities was fundamental to the establishment of the engineering model of commercial education. In response to the national need for well-educated engineers and businessmen, national, regional and municipal authorities supported higher engineering schools with commercial sections in a pioneering initiative which would eventually lead to the recognition of commercial education as an academic discipline. This phenomenon was part of a larger European movement for social respectability among businessmen. The establishment of higher engineering schools with commercial sections represented an important step, as it marked the point at which, for the first time, higher educational institutions managed to officially embrace commerce as an academic discipline worthy of educational credit. At the time, a belief that mercantile and industrial management would mutually benefit from higher education developed by engineering schools with commercial departments was fundamentally an act of faith.

From another perspective, the emergence of commercial education through higher engineering schools did not achieve the expected success in the nineteenth century. This article emphasised three factors that contributed to the changing fortunes of the engineering model of commercial education. First, the lack of administrative independence imperilled the successful development of commercial departments within higher engineering schools. Second, the limited complementarity between commercial training and technical training, and also the lack of commercial practice in the commercial departments, contributed to the demise of this type of schooling. Third, while the low demand for highly qualified businessmen with technical training created a lack of job opportunities, the weak development of professional networks (combined with a lack of cohesive organisations to further the social and economic interests of commercial graduates) contributed to the failure of this model of commercial education. Even though the engineering model of commercial education was not ultimately successful, it constituted a first educational attempt to build an outline of commercial training that closely combined mercantile and technical education. The study of scientific management came to the fore in the twentieth century, with works such as those

by Taylor and Fayol showing how useful such an educational combination can be. Scientific management was, however, taught in higher engineering schools in Europe before it was taught in business schools.¹⁴⁰

Research into the emergence of higher engineering schools with commercial sections raises new questions. Further research will be necessary to better understand the dissemination of this educational model during the nineteenth century, not only throughout Europe but also in America. In the second part of the nineteenth century, in the USA, the Worcester Polytechnic Institute also educated future businessmen in close proximity with would-be engineers.¹⁴¹ Similarly, in nineteenth-century Brazil the commercial department of the São Paulo Polytechnic offered the first higher commercial teaching curriculum in the state.¹⁴² To our knowledge, these educational institutions have not yet undergone a comparative investigation. This could provide productive angles for further exploration of the history of commercial education in Western countries.

Notes

1. Liedman, "Anders Berch"; Engwall, *Mercury meets Minerva*, 26.
2. Engwall, Kipping, and Üsdiken, "Public Science Systems," 328.
3. Engwall, Kipping, and Üsdiken, *Defining Management*, 41.
4. Locke, *The End of the Practical Man*, 155.
5. Engwall, Kipping, and Üsdiken, "Public Science Systems," 329–32.
6. Grelon, "The Training and Career Structures of Engineers"; Pombo and Ramirez, "Technical Education."
7. Locke, *The End of the Practical Man*.
8. Capecchi and Ruta, "European Polytechnic Schools."
9. Locke, *The End of the Practical Man*, 37.
10. Ahlström, *Engineers and Industrial Growth*.
11. The adjective 'technical' is used throughout the article in the sense of 'engineering', where 'engineering' is defined as the science of making practical applications from the knowledge of pure sciences.
12. Minesso, "L'ingegnere dall'età Napoleonica al fascismo."
13. Redlich, "Academic Education for Business," 70; Locke, *The End of the Practical Man*, 133–4.
14. Redlich, "Academic Education for Business," 71, 77; Longobardi, "Higher Commercial Education in Italy"; Tagliaferri, "Profilo Storico di Ca'Foscari," 53–4.
15. Redlich, "Academic Education for Business," 77; Locke, *The End of the Practical Man*, 142.
16. Locke, *The End of the Practical Man*, 134.
17. Engwall, Kipping, and Üsdiken, "Public Science Systems," 327.
18. For Italy and Great Britain, see Fauri, "British and Italian Management Education." For Denmark, Finland, Norway and Sweden, see Engwall, "The Making of the Viking Leaders." For the Netherlands, see De Man and Karsten, "Academic Management Education."
19. Engwall and Zamagni, *Management Education*, 6.
20. Khurana, *From Higher Aims to Hired Hands*; Guillén, *Models of Management*; Jordan, *Machine-Age Ideology*.
21. Ahlström, *Engineers and Industrial Growth*, 96.
22. Capecchi and Ruta, "Strengths of Materials."
23. Diogo, "Portuguese Engineers, Public Works."
24. Redlich, "Academic Education for Business."
25. Fauri, "British and Italian Management Education"; Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal."
26. Fauri, "British and Italian Management Education"; Atstaja et al., "The Case of the Baltic Region"; Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal."

27. Atstaja et al., "The Case of the Baltic Region"; Järvesoo, "Agricultural Program," 247; Leimanis, "The Polytechnical Institute of Riga"; France, *Enquête sur l'enseignement professionnel*; Dumont and Jourdan, *Étude sur les écoles de commerce*.
28. See for instance Amdam, "Foreign Influence on the Education," 86–8; Fauri, "British and Italian Management Education," 45; Godelier, "Social Sciences and Management Sciences," 6–8; Sanderson, "French Influences."
29. Locke, "Business Education in Germany."
30. *Ibid.*, 236.
31. Locke, "Business Education in Germany," 236–240; Engwall, *Mercury meets Minerva*, 9–16.
32. Redlich, "Academic Education for Business"; Leimanis, "The Polytechnical Institute of Riga"; Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal."
33. Ahlström, *Engineers and Industrial Growth*, 96.
34. Before the unification of Germany in 1871, there were approximately 35 separate German sovereign states. For this reason, the word 'Germany' is used in this article not in its political sense but in its cultural and economic context, in the sense of 'Deutscher Zollverein', which then consisted of some 35 member states. Schnabel, "Die Anfänge des technischen Hochschulwesens"; Schödler, *Die höheren technischen Schulen*.
35. In the nineteenth century two higher engineering schools with commercial sections were opened in Oporto: the Royal Polytechnic Academy and the Industrial and Commercial Institute.
36. Engwall and Zamagni, *Management Education*.
37. Locke, *The End of the Practical Man*.
38. Izvestija, *Peterburgskago politechni eskago Imperatora*; Archivio di Stato di Trieste, *Governo Marittimo*.
39. France, *Enquête sur l'enseignement professionnel*; Girardin, *De l'instruction intermédiaire*.
40. London County Council, *Report*.
41. Holme, *Aspects of Commercial Education in Europe*.
42. Dias Costa, *Institut industriel et commercial de Lisbonne*; Hoepke, *Geschichte der Fridericiana*; Kurrer and Ramm, *History of the Theory of Structures*; Lechner, *Geschichte der Technischen Hochschule*, 75–195; Leimanis, "The Polytechnical Institute of Riga"; Lomič, *Vznik, Vývoj a Současnost*; Pavón, "El Real Instituto Industrial de Madrid"; Grunzweig, *Histoire de l'Institut Supérieur de Commerce*.
43. Fox and Guagnini, *Education, Technology and Industrial Performance*, 70–84.
44. For instance, in Germany, local governments financed the establishment of polytechnic institutes in their own state. See Pombo and Ramirez, "Technical Education."
45. Diogo, "Portuguese Engineers, Public Works," 81–2.
46. Atstaja et al., "The Case of the Baltic Region."
47. Lomič, *Vznik, Vývoj a Současnost*.
48. Pavón, "El Real Instituto Industrial de Madrid."
49. Roderick and Stephens, *Education and Industry in the Nineteenth Century*; Buchanan, *The Engineers*.
50. Larsen, "The Masculine Foundation of Business Education."
51. Hoepke, *Geschichte der Fridericiana*.
52. Kähler, "Die Auflösung der Aachener Handelshochschule."
53. Holme, *Aspects of Commercial Education in Europe*, 77–8.
54. Izvestija, *Peterburgskago politechni eskago Imperatora*.
55. Atstaja et al., "The Case of the Baltic Region," 669.
56. Dias Costa, *Institut industriel et commercial de Lisbonne*, 43.
57. James, *Education of Business Men in Europe*, 39.
58. Locke, *The End of the Practical Man*, 29.
59. Archivio di Stato di Trieste, *Governo Marittimo*.
60. Atstaja et al., "The Case of the Baltic Region."
61. France, *Enquête sur l'enseignement professionnel*, 399–400.
62. Girardin, *De l'instruction intermédiaire*, 265.
63. Archivio di Stato di Trieste, *Governo Marittimo*.
64. Lechner, *Geschichte der Technischen Hochschule*.

65. France, *Exposition universelle internationale*, 199.
66. Girardin, *De l'instruction intermédiaire*, 257–8.
67. Baudoin, *Rapport sur l'état actuel de l'enseignement*, 453.
68. France, *Enquête sur l'enseignement professionnel*, 29.
69. Dias Costa, *Institut industriel et commercial de Lisbonne*; France, *Enquête sur l'enseignement professionnel*; Hoepke, *Geschichte der Fridericiana*.
70. Dumont and Jourdan, *Étude sur les écoles de commerce*.
71. Schnabel, "Die Anfänge des technischen Hochschulwesens"; Ahlström, *Engineers and Industrial Growth*, 67.
72. The first ship passed through the Suez Canal in February 1867 even though it was not officially inaugurated until November 1869. De Lesseps, "The History of the Suez Canal." See also Archivio di Stato di Trieste, *Governo Marittimo*.
73. Amdam, "Foreign Influence on the Education."
74. Dias Costa, *Institut industriel et commercial de Lisbonne*; France, *Enquête sur l'enseignement professionnel*; Holme, *Aspects of Commercial Education in Europe*; Léautey, *L'Enseignement commercial*; Lechner, *Geschichte der Technischen Hochschule*.
75. France, *Enquête sur l'enseignement professionnel*, 419, 437.
76. Atstaja et al., "The Case of the Baltic Region."
77. *Ibid.*, 668.
78. Dias Costa, *Institut industriel et commercial de Lisbonne*, 91.
79. Capecchi and Ruta, "European Polytechnic Schools," 18.
80. Dias Costa, *Institut industriel et commercial de Lisbonne*.
81. Schnabel, "Die Anfänge des technischen Hochschulwesens."
82. Izvestija, *Peterburgskago politechni eskago Imperatora*.
83. *Ibid.*
84. Atstaja et al., "The Case of the Baltic Region," 667–9; Dias Costa, *Institut industriel et commercial de Lisbonne*.
85. Locke, "Business Education in Germany," 238.
86. Hoepke, *Geschichte der Fridericiana*.
87. Locke, "Business Education in Germany," 238.
88. Capecchi and Ruta, "European Polytechnic Schools."
89. Schödler, *Die höheren technischen Schulen*.
90. Izvestija, *Peterburgskago politechni eskago Imperatora*.
91. Maffre, "Les origines de l'enseignement supérieur commercial."
92. A large number of people at the time thought that commerce could be learnt only 'on the job,' and therefore considered that a formal commercial education was unnecessary. In the middle classes, many families wanted their children to acquire a classical education in the humanities rather than embark upon a commercial career. See Garnier, *De l'Enseignement industriel*, 53.
93. Kähler, "Die Auflösung der Aachener Handelshochschule"; Capecchi and Ruta, "European Polytechnic Schools."
94. Holme, *Aspects of Commercial Education in Europe*, 3–14.
95. Ahlström, *Engineers and Industrial Growth*, 56.
96. Dias Costa, *Institut industriel et commercial de Lisbonne*.
97. Izvestija, *Peterburgskago politechni eskago Imperatora*.
98. Leimanis, "The Polytechnical Institute of Riga."
99. For the German polytechnics, see France, *Enquête sur l'enseignement professionnel*, 307–13, 391–7, 437–47. For the Industrial and Commercial Institute of Lisbon, see Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal," 201–20.
100. Atstaja et al., "The Case of the Baltic Region," 669.
101. Gonçalves and Da Costa Marques, "O Porto e a instrução contabilística."
102. For the Superior Institute of Commerce of Antwerp, see Léautey, *L'Enseignement commercial*, 583. For the Superior School of Commerce of Venice, see Tagliaferri, "Profilo Storico di Ca'Foscari," 53–4.
103. James, *Education of Business Men in Europe*, 2.

104. Redlich, "Academic Education for Business," 79; Engwall, Kipping, and Üsdiken, *Defining Management*, 41.
105. Gstraunthaler, "The History of the Austrian Commercial Colleges."
106. Dumont and Jourdan, *Étude sur les écoles de commerce*, 110.
107. Pavón, "El Real Instituto Industrial de Madrid."
108. Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal"
109. Atstaja et al., "The Case of the Baltic Region," 668.
110. Dias Costa, *Institut industriel et commercial de Lisbonne*.
111. Basto, *Memória Histórica da Academia Politécnica*.
112. Garnier, *De l'Enseignement industriel*, 53.
113. Holme, *Aspects of Commercial Education in Europe*, 67–8.
114. Lechner, *Geschichte der Technischen Hochschule*, 75–195; Lomič, *Vznik, Vývoj a Současnost*.
115. London County Council, *Report*, 12.
116. Kähler, "Die Auflösung der Aachener Handelshochschule"; Holme, *Aspects of Commercial Education in Europe*, 68.
117. Redlich, "Academic Education for Business," 54.
118. Gonçalves and Da Costa Marques, "Evolução do ensino da contabilidade em Portugal," 214.
119. Leimanis, "The Polytechnical Institute of Riga."
120. Cited in James, *Education of Businessmen in Europe*, 38.
121. Järvesoo, "Agricultural Program," 247.
122. *Ibid.*, 139.
123. Holme, *Aspects of Commercial Education in Europe*, 79–80.
124. During the course, all students were divided into groups, each representing a fictitious business house from leading places of commerce around the world. Inside each business house, students were trained to become merchants capable of comprehending large commercial transactions. Numerous operations were given to them and students had to keep a complete account of the fluctuations of price in the various markets, undertake correspondence relating to the operations of the house in a foreign language, keep books and make inventories. These exercises were a means for the practical application of the different theoretical courses.
125. James, *Education of Businessmen in Europe*, 173; Grunzweig, *Histoire de l'Institut Supérieur de Commerce*; Longobardi, "Higher Commercial Education in Italy"; Tagliaferri, "Profilo Storico di Ca'Foscari," 53–4.
126. Dumont and Jourdan, *Étude sur les écoles de commerce*; Atstaja et al., "The Case of the Baltic Region"; Järvesoo, "Agricultural Program," 247; Leimanis, "The Polytechnical Institute of Riga."
127. Playfair, *Industrial Instruction on the Continent*, 20.
128. *Ibid.*, 25.
129. Leimanis, "The Polytechnical Institute of Riga," 122.
130. *Album Academicum des Polytechnikums zu Riga*.
131. Ahlström, *Engineers and Industrial Growth*, 47.
132. Pavón, "El Real Instituto Industrial de Madrid."
133. Foreman-Peck, Boccaletti, and Nicholas, "Entrepreneurs and Business Performance."
134. Meuleau, "From Inheritors to Managers," 134.
135. Fox and Guagnini, *Education, Technology and Industrial Performance*, 77–88.
136. For instance, in 1875, the Superior School of Commerce of Venice established a committee of employment to help its graduates find positions. See James, *Education of Businessmen in Europe*, 193. In Germany, most of the higher schools of commerce in the nineteenth century were supported, managed and even examined by practical commercial men. See James, *Education of Businessmen in Europe*, 214.
137. The German engineering fraternity was founded in 1856 to raise the status of the technical profession. In Austria, the Society of Engineers and Architects in the Bohemian Crown lands was opened in 1866. See Locke, *The End of the Practical Man*, 33. See also Diogo, "Portuguese Engineers, Public Works," 75–6; Van Meer, "The Nation is Technological!"
138. Kähler, "Die Auflösung der Aachener Handelshochschule."

139. Fauri, "British and Italian Management Education," 34–49; Godelier, "Social Sciences and Management Sciences."
140. Redlich, "Academic Education for Business," 89.
141. Martins, Silva, and Ricardino, "Escola Politécnica."

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Notes on contributor

Adrien Jean-Guy Passant works on comparative studies on business education for the nineteenth century and twentieth century at University of Paris 1 Pantheon Sorbonne, in the Interdisciplinary Research Centre in Management Sciences (Prism). He has been Lecturer at ESCP Europe Business School and at EMLYON Business School. His research interests include strategic management within European business schools in the long run, time and temporality in strategy, and longitudinal approaches in organisation studies.

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