The Portuguese railway network in the second half of the nineteenth century: main actors, debates, and outcomes

1. Introduction

The main lines of the Portuguese railway network were built during the second half of the nineteenth century, especially in the period between 1860 and 1890. The first contracts were signed in the 1850s, but their execution was compromised by the lack of experience of its promoters and Portuguese technocrats, whereas in the 1890s investment was hampered by a crippling financial crisis that led to a partial bankruptcy in 1892. By 1900, the grid extended throughout 2,356 km. It included five transnational tracks across the border with Spain and many others serving every district of the country (figure 1 and table 1).[1]

(FIGURE 1 HERE)

Figure 1 – Portuguese railway network. Black lines indicate the network before 1900; grey lines, after 1900

Source: Author's version based on sharemap.org

Table 1 *Extension of the Portuguese railway network (1856-1996), km/decade*

Decade	km added	km – total	Decade	km added	km – total
1850	68	68	1930	162	3,586
1860	651	719	1940	3	3,589
1870	458	1,177	1950	8	3,597
1880	894	2,071	1960	-34	3,563

[1] After 1900, the network continued to grow, reaching a maximum extension of 3,616 km (1982), mostly with feeder lines in the ultraperipheral areas of north-eastern and southern Portugal.

1890	285	2,356	1970	25	3,588
1900	542	2,898	1980	13	3,601
1910	370	3,268	1990	-530	3,071
1920	156	3,424			

Source: Nuno Valério (ed.), *Estatísticas Históricas Portuguesas* (Lisbon: INE, 2001), 372–76.

This paper aims to understand the reasons that explain the configuration of the Portuguese railway network by the end of the nineteenth century, by focusing on the inputs of two different types of system-builders: those with the expertise (engineers and army officers) and those with the power (decision-makers at a governmental level, financiers and entrepreneurs).[2]

The first Portuguese railway was inaugurated in 1856, between Lisbon and Carregado, a small village 36 km to the north. Previously, during the first half of the nineteenth century, political and financial instability prevented large investments in public works. In 1851, a coup d'état inaugurated a period of consensus in the Portuguese politics and set *progress* as the goal everyone should aim for. Three years later, Portugal joined the gold-standard, which facilitated the access to the European financial markets (especially London's and Paris'). This paved the way for the application of a large public works programme inspired in the Saint-Simonianist ideology, with which Portuguese technocrats were engaging since the 1820s.[3]

[2] I use here the concept of system-builders, as defined by Thomas Parker Hughes, *Networks of Power. Electrification in Western Society, 1880-1930* (Baltimore: The Johns Hopkins University Press, 1983), X.

[3] Ana Cardoso de Matos, "Asserting the Portuguese Civil Engineering Identity: the Role Played by the École des Ponts et Chaussées, 1825-1866", in Ana Cardoso de Matos, Maria Paula Diogo, Irina Gouzévitch, and André Grelon (eds.), *The Quest for a Professional Identity: Engineers between*

Saint-Simonianism proposed the construction of vast transport networks to promote circulation, international cooperation and the production of wealth. In the 1830s, one of its disciples, French engineer, Michel Chevalier, branded railways as the most effective technology to achieve those goals and as consubstantiation of progress itself.[4] Since the early nineteenth century (and even before), Portuguese thinkers identified the lack of a good transportation system as the main obstacle for the development of the country.[5] Unsurprisingly, the Portuguese public works programme was spearheaded by railways.

In the past decades, Portuguese historiography has discussed important features regarding the debate, construction and operation of railways in Portugal. However, when it comes to the intents behind the design of the network, these aspects are usually considered utterly technological. Different works move from the narrative of political rhetoric to the financing, construction and operation of the network, while taking it for granted,[6] or *black-boxed*, that is, focusing entirely on its

Training and Action (Lisbon: Colibri, 2009), 180–181. Magda Pinheiro, *Estudos sobre Finanças e Dívida Pública em Portugal no Século XIX* (Lisbon: ISCTE, 2013), 111–39.

[4] Erik van der Vleuten, "Understanding Network Societies", in Erik van der Vleuten and Arnje Kaisjer (eds.), *Networking Europe. Transnational Infrastructures and the Shaping of Europe, 1850-2000* (Sagamore Beach: Science History Publications, 2006), 289–90.

[5] Maria Fernanda Alegria, *A Organização dos Transportes em Portugal (1850-1910): as Vias e o Tráfego* (Lisbon: Centro de Estudos Geográficos, 1990), 37–43.

[6] António Lopes Vieira, "The role of Britain and France in the finance of Portuguese railways 1850-1890. A comparative study in speculation, corruption and inefficiency", PhD dissertation, Leicester university (United Kingdom), 1983. Magda Pinheiro, "Chemins de fer, structure financière de l'État et dépendance extérieure au Portugal: 1850-1890", PhD dissertation, Université de Paris (France),

inputs and outputs and not on its internal sociotechnical complexity.[7] Two recent papers list the main stakeholders involved in the planning of the network in the long-run, focusing on the role played by foreign agents and Portuguese engineers, but they do not analyse in detail the contribution of each of them (and other critical agents, like politicians or the military), and, again, do not open the *black box* of the implementation of the grid in the critical period of the second half of the nineteenth century.[8]

Many authors have shown that the planning of large technological systems is vastly dependent on the social context of the time, including, not only technical expertise, but also hierarchies of power, political manipulations (by different actors seeking different goals) and technological utopias – Kranzberg's Fourth Law: "Although technology might be a prime element in many public issues, nontechnical factors take precedence in technology-policy decisions".[9] In this paper, I will include

1986. Alegria, *A Organização*, 213–482. Hugo Silveira Pereira, "A política ferroviária nacional (1845-1899)", PhD dissertation, Universidade do Porto (Portugal), 2012.

[7] I use here the concept of Bruno Latour, *Pandora's hope: essays on the reality of science studies* (Cambridge: Harvard University Press, 1999), 304–306.

[8] Inês de Azevedo Isidoro, Teresa Marat-Mendes, and Vera Regina Tângari, "The Portuguese railway in time and space – mapping phases of growth, stagnation, and decline (1845–2015)", *Planning Perspectives*, 33:3 (2018), 365–71. Magda Pinheiro and Ana Cardoso de Matos, "La construction du réseau ferroviaire au Portugal: concepts, modèles et intervenants", in Dominique Barjot and Marie-Claude Esposito (eds.), *Globalization, national patterns of development and strategies of firms (19th-21st centuries)* (Paris: SPM, 2016), 34–53.

[9] Melvin Kranzberg, "Technology and History: Kranzberg's Laws", *Technology and Culture*, 27:3 (1986), 550. For a list of case-studies, see Greet de Block, "Designing the Nation: The Belgian Railway Project, 1830–1837", *Technology and Culture*, 52:4 (2011), 707–10.

these variables in the analysis of the design of the Portuguese railway network in the second half of the nineteenth century, by following those system-builders (engineers, army officers, stakeholders at a governmental level, financiers and businessmen) who debated and influenced its implementation.[10]

Portuguese engineers played a decisive role in this process, as they possessed not only the technical skills to survey the territory and build and operate railways, but also the knowledge to plan the economy and to project a new modern nation.[11] Army officers also wanted to have a say in the railway discussion, especially in the matter of the defence of the kingdom. These two groups provided the expertise (technical and military). However, the power to decide which lines to build laid elsewhere. The final decision was left to bureaucrats in the parliament and central government, who had their own (more or less legitimate) political agendas that might not cope with technical, economical, or military reasonings.[12] In parliament, legislators often voiced the concerns of different economic agents (merchants, industrialists), who otherwise

[10] As suggested by Bruno Latour, *Science in action: How to Follow Scientists and Engineers through Society* (Cambridge: Harvard University Press, 1987), 2–4.

[11] Marta Coelho de Macedo, *Projectar e Construir a Nação. Engenheiros, Ciência e Território em Portugal no Século XIX* (Lisbon: ICS, 2012), 125–31.

[12] Portuguese legislation stated that railways belonged to the State who could lease its construction and operation to private operators. Except for lines under 20 km that did not require any subsidy from the Treasury, all railways had to be approved by the parliament. See Pereira, “A política”, 329–31. It is also important to note here that in the Portuguese political system of the time absolute majorities in the lower house of parliament (elected) were common, as elections were organized (and to a large extent rigged) by the government, which had been previously nominated by the king. The upper house of parliament (by appointment) usually voted alongside the government, but if needed be, the king could appoint new members to guarantee a favourable vote to the ruling party.

could not have a say in the debate. Looming above these actors were sundry capitalists and entrepreneurs (Portuguese, British and French) who looked at railway construction and operation as a chance to invest and – more importantly – had access to financial capital for construction. With this, I do not mean to imply that these groups were locked and homogeneous. On the contrary, engineers and army officers often were elected to parliament or nominated ministers. Similarly, they were frequently hired or took managing positions in private companies. Therefore, they too had their own agendas that could impair their technical evaluations. For sake of argument, I will analyse those groups separately.

Primary sources include technical reports (civil and military, published in expert journals or kept in the Portuguese archives) and parliamentary debates, which will be combined with previous works about different details of Portuguese railway history. The structure of the text follows in the footsteps of those agents. I will start by analysing the prospects and goals they had in common (section 2), before examining the inputs of engineers and military (sections 3 and 4) and the lobbying of politicians, investors and industrialists (section 5). Section 6 wraps-up the paper with some final remarks.

2. Commonalities: expectations and challenges

The majority of the aforementioned agents was in favour of a strong investment in railways. They shared the technological utopia that railways would be crucial to revolutionise the archaic Portuguese transportation system (where obstructed rivers coexisted with Roman roads, traversed by oxcarts, stagecoaches, horses and pedestrians), and place Portugal on the path of progress and closer to the rest of

Europe.[13] The devil was in the want of cartographical and statistical information, and financial resources.

In mid-nineteenth century Portugal, decision-makers had to rely on maps from one hundred years before. Attempts to elaborate detailed maps were obstructed by the instability of the first half of the century. General perception was that the inland north of Portugal was rugged and most of the south and the shoreline was flat. In 1865, the first accurate map of Portugal was published. However, given its small scale (1:500,000), it was useless for detailed studies, including railway routes. In the following decades, railway surveys contributed more to Portuguese cartography than the other way around.[14]

As for statistics, by 1850, the best compilation was almost 30 years old (published in 1822 by Adrien Balbi). From 1850 onwards, the collection of data became more organised and frequent, but information about the different economic activities of the country was still insufficient.[15] Consequently, economic planning was left to common knowledge about some territories: grain and ore in the southern province of Alentejo, Port wine in the Douro region, or small industries located around Porto, Lisbon, Braga, Tomar, Portalegre or Covilhã (figure 1).

The deficiency of financial resources was also a problem. There were not enough savings within the economy to support the railway industry. The banking system only registered a sturdy evolution from the 1870s onwards. Portugal's inclusion in the gold-standard in 1854, albeit not crucial (Spain, for instance, invested

[13] Alegria, *A Organização*, 31–94.

[14] Rui Branco, *O Mapa de Portugal. Estado, Território e Poder no Portugal de Oitocentos* (Lisbon: Horizonte, 2003), 85–87, 110–25, and 154.

[15] Fernando de Sousa, *História da estatística em Portugal* (Lisbon: INE, 1995), 130–35 and 171–90.

in railways without adhering to it), promoted the credibility of its finances, decreased the risk of investing in the country, and increased the attractiveness of the Portuguese economy for foreign direct investment.[16] Even so, capital was not abundant, and it had to be applied wisely (either in building railways directly by the State or subsidising private initiative with guarantees of yield or allowances to construction).

The lack of capital and cartographical and statistical information about the country stimulated speculation about railway routes, and simultaneously reinforced the utopia touted by Saint-Simonianists that development followed railways closely. Particularly, it promoted the utopia that Portugal could take advantage of its location in the southeasternmost corner of Europe, between the Old and the New Worlds, and attract to its harbours (specially Lisbon's) transnational trade originating in the European core nations, which in the mid-nineteenth century reached an all-time high.[17] Therefore, priority was given to the construction of cross-border lines, although competing with established routes to other European harbours would be a difficult task. Moreover, Spain was more interested in building railways to promote internal circulation rather than to favour international trade.[18] Nevertheless, by the late 1880s, five transnational tracks had been laid down (table 2 and figure 1). Spain

[16] Luís Aguiar Santos, "A crise financeira de 1891: uma tentativa de explicação", *Análise Social* 36:158-159 (2001), 188–89.

[17] Paul Bairoch. *Commerce extérieur et développement économique de l'Europe au XIXe siècle* (Paris: EHESS, 1976), 33–36.

[18] Francisco Comín, *150 años de historia de los ferrocarriles españoles* (Madrid: Fundación de los Ferrocarriles Españoles, 1998), vol. 1, 37–41

played a key role in the choice of cross-border railways, as their extension in Spanish territory influenced their routes in Portugal.[19]

Table 2 *Portuguese transnational railways*

Name	Route	Inauguration
Eastern	Lisbon – Elvas/Badajoz	1863
Cáceres	Torre das Vargens (Eastern line) – Marvão/Cáceres	1880
Beira Alta	Figueira da Foz – Vilar Formoso/Salamanca	1882
Minho	Porto – Valença/Vigo	1886
Douro	Ermesinde (Minho line) – Barca d'Alva/Salamanca	1887

Source: Alegria, *A organização*, passim.

Considering the financial limitations to investment, the opinion that construction should be as inexpensive as possible was common, especially amongst government officials and managers of private companies, and overrode most technical ponderings. Engineers were more open-minded about spending more money during construction to assure a more efficient operation, but they also advocated contention of costs whenever possible.[20] For this reason, most concurred that the Eastern and

[19] The influence of Spain extended to the gauge used in Portuguese railways. Originally, Portugal chose the European standard (1.44 m), but it was forced to adhere to the Spanish standard (1.67 m). For the disputes about cross-border railways, see Magda Pinheiro, "L'Histoire d'un Divorce: l'Intégration des Chemins de Fer Portugais dans le Réseau Ibérique", in Michèle Merger, Albert Carreras, and Andrea Giuntini (eds.), *Les réseaux européens transnationaux XIXe-XXe siècles: quels enjeux?* (Nantes: Ouest, 1995), 335–49 and Hugo Silveira Pereira, "The technodiplomacy of Iberian transnational railways in the second half of the nineteenth century", *History and Technology*, 33:2 (2017), 178–86.

[20] Macedo, *Projectar*, 210.

Northern (Porto-Coimbra-Entroncamento-Lisbon – see figures 1 and 2) lines shared a 106-km common track between Lisbon and Entroncamento. In the same respect, all agreed that the first cross-border link should be the Eastern line that traversed a flatter territory, where construction expectedly was more cost-effective.[21] From 1870 onwards, engineers and policymakers also favoured narrow-gauge (in theory, less expensive), although the former considered it a last-resort solution, whereas decision-makers were more approving if it meant having a railway more rapidly and economically.[22]

Another consequence of the lack of financial resources was the preference for routes that served pre-existing commercial flows. This explains why construction until the mid-1860s focused on the flatland districts around Lisbon and on the connection to Porto (figure 2). From the 1870s onwards, the goal of taking trains to the peripheral areas of the countryside was consensual and the effort to do so was noticeable.

(FIGURE 2 HERE)

Figure 2 – Portuguese railway network in 1870

Source: Author's version based on sharemap.org

[21] Arquivo Histórico da Economia, Lisbon, Conselho Superior de Obras Publicas (hereafter AHE-CSOP), book 1 (1852-1853), fs. 291–301. F. Watier, "Relatorio do engenheiro francez monsieur Watier sobre a construcção dos caminhos de ferro em Portugal (tradução)", *Boletim do Ministerio das Obras Publicas, Commercio e Industria* (hereafter *BMOPCI*), 1860:1 (1860), 76–131.

[22] Hugo Silveira Pereira and Bruno J. Navarro, "The implementation and development of narrow-gauge railways in Portugal as a case of knowledge transfer (c. 1850–c. 1910)", *The Journal of Transport History*, 39:3 (2018), 362.

3. Experts planning the nation: the engineers' input

Portuguese engineers were the most prolific contributors to the discussion and implementation of railways in Portugal, although their technical input was often superseded by non-technical opinions.

Their action developed in three distinct stages: (1) in the field, surveying the land, supervising the contractors' work, or building railways themselves; (2) in travels of learning abroad, acquiring new knowledge about building and operating railways; and (3) in the comfort of the offices of the Ministry of Public Works or the assemblies of the Civil Engineers Association, evaluating the proposals offered to or by the government, redacting the terms of the leasing contracts, or suggesting the role of railways in broader plans to modernise and develop the country.[23]

Since mid-1850s, they roamed the country surveying railway routes or regional networks, accumulating knowledge about the territory they traversed. From 1872 onwards they oversaw the construction and extension of the Minho, Douro, and

[23] The Ministry of Public Works was created in 1852. It had an advisory board (*Conselho Superior de Obras Públicas e Minas* – High Council of Public Works and Mines – later renamed to *Junta Consultiva de Obras Públicas e Minas* – Advisory Committee of Public Works and Mines) to aid governmental decision-makers. However, the government was not obliged to follow its suggestions. The Civil Engineers Association was created in 1869 to lobby against budget cuts in the Ministry of Public Works. It was a place for debates about the Portuguese public works programme, which were often divulged in the Association's journal, *Revista de Obras Publicas e Minas* (hereafter *ROPM*). Maria Paula Diogo, "A construção de uma identidade profissional. A Associação dos Engenheiros Civis Portuguezes (1869-1937)". PhD dissertation, Universidade NOVA de Lisboa (Portugal), 1994, 129–30.

South-Eastern lines (linking Lisbon to Évora and Beja – figure 2).[24] In the 1880s, they suggested regional networks for the northern provinces of Portugal.[25] Most of their surveys were evaluated by the *Conselho Superior* or the *Junta Consultiva*.[26] All the lines that were eventually laid down were previously surveyed by Portuguese engineers (sometimes more than once and in different directions), but many others were never built.

Their skills were up to date to the general practice in Europe. Since the 1850s, they were sent abroad at government expenses, in travels of learning.[27] These missions were particularly important to learn about narrow gauge, a low-cost technical solution to build lines in rugged landscapes. Narrow gauge was applied in Portugal from 1875 onwards and it would become very important throughout the twentieth century (accounting for roughly 20% of the network's extension).[28]

An important contribution was the debate about a general railway plan, which was a major concern of Portuguese engineers throughout the second half of the

[24] Originally hired to private companies in the 1850s, the South-Eastern lines were nationalised in 1869. See Vieira, "The role", 204–26.

[25] Francisco Maria de Sousa Brandão, "Estudos de caminhos de ferro de via reduzida ao Norte do Douro", *ROPM*, 11:125-126 (1880), 145–83. João José Pereira Dias. *Memória ácerca dos caminhos de ferro de segunda ordem no districto de Braga* (Lisbon, Imprensa Nacional, 1881). Augusto Pinto de Miranda Montenegro, "A rede complementar dos caminhos de ferro ao norte do Mondego", *ROPM*, 20:237-238 (1889), 315–41.

[26] For a detailed list, see Pereira, "A política", 458–80.

[27] Ana Cardoso de Matos and Maria Paula Diogo, "Bringing it all back home: Portuguese engineers and their travels of learning (1850-1900)", *HoST – Journal of History of Science and Technology*, 1 (2007), 161 and 168–74.

[28] Pereira and Navarro, "The implementation", 358–72.

nineteenth century. A complete list of all the proposals does not fit in the limits of this article. Suffice is to say that the first suggestion was offered as soon as 1851,[29] and the *Conselho Superior* or the *Junta Consultiva* elaborated several railway maps in 1854, 1858, 1862, 1865, 1871, 1873 and 1875. In one occasion, one was sent to parliament, but it was never discussed.[30] In parliament, engineers often called for the need to draw a general railway plan, to no avail.[31] Between 1876 and 1878, the Civil Engineers Association promoted a lively debate amongst its associates. The different views on what the network should look like were evident.[32] Some engineers recommended lines that served their areas or political influence or the goals of their employers.[33] In August 1877, the Association presented its final report (figure 3a). The proposed network served three different goals: (1) to serve the main centres of production and consumption, (2) to promote cross-border traffic, and (3) to favour the defence of the country in case of invasion.[34] One of the discussants, Lourenço de Carvalho, did not agree fully with this report, and he used his position as minister of

[29] Albino Francisco de Figueiredo e Almeida, *Vias de comunicação* (Lisbon: Tipografia da Revista Popular, 1851), 7–17 and 21–23.

[30] *BMOPCI*, 1854:3 (1854), 209–18; 1858:1 (1858), 96–101; 1862:1 (1862), 43–45. AHE-CSOP, book 22 (1865), fs. 18-29v; book 32 (1871), fs. 280–99; book 32-A (1871), fs. 1–8v; book 34 (1873), fs. 97v–100v; box 18 (1875), report 6418, 7 January 1875.

[31] *Diario do Governo*, 22 May 1857, p. 691; 28 March 1859, pp. 571–72. *DCD*, 18 March 1857, pp. 157–67; 18 April 1857, pp. 198–203; 10 August 1861, pp. 2226–27. *Diario de Lisboa* (hereafter *DL*), 7 March 1862, p. 727; 23 December 1865, pp. 3004–3005; 17 January 1866, pp. 189–91; 21 June 1867, 2010–11.

[32] *ROPM*, several issues between 1876 and 1878.

[33] Pereira, “A política”, 341.

[34] *ROPM*, 9:102–103 (1878), 289–304.

Public Works to take his own proposal to parliament (figure 3b).[35] Nevertheless, neither were ever discussed and Portugal remained without a general railway plan.[36]

Given the lack of detailed topographical and statistical data, one may argue that those plans lacked substance and therefore were disregarded. More importantly, however, was that without a general plan the government had more flexibility to build or subsidise the railways it wanted, according with the circumstances (political, financial, economic) of the moment. It could hire any company that wanted to invest in Portugal, accept any proposal from Spain for cross-border links, or indulge the whims of local caciques, instead of being confined to a technical plan devised by its engineers. With this I do not mean to imply that the input of the engineers was completely ignored or useless. If we compare the network proposed by the Civil Engineers Association and the grid that was actually built (figures 1 and 3a) this becomes clear. Many of the main lines suggested by the engineers were constructed. However, many important recommendations (including cross-border tracks, defensive lines, or the ramification of the network in the northwest) were disregarded, whereas other lines the engineers did not suggest were added to the network.

(FIGURE 3 HERE)

Figure 3 – (a) The Portuguese network as suggested by the Civil Engineers Association (left) and (b) by Lourenço de Carvalho (right)

Source: Adapted from Alegria, *A organização*, 287

[35] *DCD*, 7 February 1879, 345–53.

[36] A plan would only be approved by parliament in the first years of the twentieth century, when the network was almost 2,500 km long. Alegria, *A organização*, 294–304.

In sum, Portuguese engineers had the newest technical expertise and a profound knowledge of the Portuguese territory, which they added to their growing social prestige as agents of modernity.[37] However, their input was everything but homogeneous, as the debate about the general plan proved (no consensus about the best routes or the best network). They had different technical opinions and they often gave into the temptation of favouring their places of origin or political influence or the companies they worked for. I will get back to this on section 5 of this paper.

4. Experts defending the nation: the military angle

Army officers wanted to show that they could be an asset to the modernisation of the nation, too. Many had a specialisation in Engineering, which granted them some authority to discuss railways, but they focused mainly on their impact in the defence of the kingdom.[38]

Civilian experts were aware of the importance of railways for war, but they were more concerned about their role in the development of the economy and the modernisation of the country and shared an idealistic perspective on the issue. For instance, in the 1840s, economist Silvestre Pinheiro believed that the mere existence

[37] Diogo, “A construção”, 167.

[38] On the other hand, most civil engineers had a military background (the Engineering course was taught at the Army School in Lisbon), although many got their training in civil schools in Europe, most notably the *École des Ponts et Chaussées* in Paris. Macedo, *Projectar*, 50–62 and 78–82.

of a railway discouraged any invasion.[39] Additionally, most civil engineers and other stakeholders believed that even in case of invasion, the infrastructure could be easily sabotaged.[40]

Military experts were far more pessimistic. The first debate was motivated by the hiring of Spanish financier José de Salamanca to build and operate the Eastern line in 1859. Supported by French capital, Salamanca created the Royal Company of Portuguese Railways (hereafter RCPR) that would become the largest player in the sector. By then, Portugal had dealt with businessmen from Britain, the old and faithful ally – one of which had even joined the liberals in the Portuguese civil war against the absolutists (1828-1834). But then the government decided to hire a Spaniard, who – to make matters worse – was financed by French bankers.

The most spirited critic was the Marquis of Sá da Bandeira, a veteran general, who in his teens had fought French and the Spanish during the Napoleonic Invasions. Afterwards, he battled in the civil war, having lost his right arm. Moreover, he was intimate with the Portuguese king, Peter V, and therefore his opinion was especially valid. Motivated by his prejudice and mistrust towards Spain and France, the old war hero revealed his worries in the parliament, in the press, and in private correspondence with the government and the king. In his opinion, it was imperative to build railways with a different gauge from Spain, otherwise the nation would be

[39] José Luís Cardoso, "A economia como solução (1821-1974). Da Revolução Liberal à Revolução Democrática", in José Luís Cardoso and Pedro Calafate (ed.), *Portugal como problema* (Lisbon: Fundação Luso-Americana, 2006), vol. 6, 137.

[40] Pereira, "A política", 417–22.

exposed to foreign aggressions.[41] He recommended a different route for the Eastern line, another location for the bridge across the Tagus, and that the line passed under the cannons of the fort of Elvas, near the border (figure 1).[42] In the end, only the latter suggestion was accepted by the government. Even the king agreed that Sá da Bandeira's concerns were exaggerated.[43]

In the following years, in different parts of the world, railways were decisive in many conflicts (American Civil War, Franco-Prussian, Russian-Turkish, and First Boer wars), which encouraged Portuguese army officers to resume the efforts of Sá da Bandeira. In 1875, general Avelar Machado regretted that construction of railways in Portugal had had no regard for the defence of the territory.[44] Many agreed, adding that from a strategic point of view, the network had some dangerous flaws. At the same time, sundry reports set a list of precautions the government should take when building or hiring new lines, which should be: (1) protected by nearby forts; (2) built away from the coast, to avoid bombardments from enemy warships; (3) double-

[41] Marquês de Sá da Bandeira, *Notas sobre o plano de defesa de Lisboa* (Lisbon: Imprensa Nacional, 1867), 7–8. He erroneously claimed that the Spanish had chosen a different gauge from France for the same reason, when that choice was due to technical reasons. See Jesús Moreno Fernández, *El ancho de la vía en los ferrocarriles españoles de Espartero a Alfonso XIII* (Madrid: Toral, 1996).

[42] Arquivo Histórico Militar, Lisbon (hereafter AHM), Arquivo Particular de Sá da Bandeira, div. 3/18/9/16/16, letters by Sá da Bandeira, 29 March 1860; div, 3/20/23/44, inquiry to the government. *DL*, 17 February 1860, 183–84 and 528–29. Clemente José dos Santos (ed.), *Caminhos de ferro. Pareceres parlamentares de 1845 a 1884* (Lisbon: Parlamento, 1884), inquiry to the government.

[43] D. Pedro V, "O Caminho de ferro de Leste. A razão economica, e a razão estratégica", in *Escritos de El-Rei D. Pedro V* (Coimbra: Imprensa da Universidade, 1927), vol. 4, 173–93.

[44] Avelar Machado, "Os caminhos de ferro portuguezes", *Revista Militar* (hereafter *RM*), 27:3 (1875), 69.

tracked with long side-lines to allow the formation of long trains; and (4) fortified in cross-border stations; additionally, troops should be trained to use railways efficiently and to sabotage them, in case of need. A few added that the gauge should be different from Spain, at least in transnational tracks. Finally, many railway routes were recommended to the government, for their strategic value. Three gathered the largest consensus: a circular line around Lisbon, a connection between the lines north and south of the Tagus, and a railway parallel to the border. Only the first of those lines was built before 1900, not for military reasonings, but to facilitate urban mobility in Lisbon.[45]

Similarly to civil engineers, the opinion of army officers was varied. Their recommendations depended on the circumstances of a hypothetical invasion. In some occasions, political ties also influenced the military experts' opinions. The case of the Western line (originally planned to connect Lisbon to Pombal, ended up linking Lisbon to Figueira da Foz) is a good example. It traversed the famous lines of Torres Vedras, a set of fortifications that protected Lisbon during the Napoleonic Invasions, therefore, its project was thoroughly analysed from a martial perspective. In and out of parliament, commissions of military experts, including members of different political parties, unsurprisingly had opposing opinions about the line, depending on which side of the political spectrum they stood.[46]

[45] Pereira, "A política", 418–20 and 429–30.

[46] AHM, div. 3/20/25/29, report by Pinheiro Borges countering the report of majority of the commission nominated to evaluate the Western line.

5. Hierarchies of power: technical authority vs. political and economic influence

The experts I analysed thus far provided the technical argument. However, the decision to build or hire railways was left to parliament or, in fact, to the government, considering the control the latter exerted over the former (see note 12). In multiple occasions, for different non-technical reasons, the government decided to disregard the opinion of the experts to submit to more powerful political and economic agendas.

As I said before, money for the investment was not abundant, which influenced the planning and construction of new lines. Often the less expensive solutions were chosen (either in the State sector as in the private sector), regardless of the experts' advice. In the Northern line (hired to the RCPR), engineers suggested a route through Tomar (a small industrial town), which was disregarded for financial reasons.[47] North from Aveiro, the railway was laid down close to the coast to save money, against the recommendations of the military and civil specialists.[48] Further north, it was decided to build a common track between the Douro and Minho lines, although the engineer who surveyed the former, recommended a different solution.[49] The Tua line (to Mirandela in the north-east) was originally surveyed in the right margin of the Tua river, but the concessionaire, for budgetary reasons, preferred to build it on the left bank, and the government acquiesced.[50] Finally, some suggested the Beira Alta railway began in Coimbra, an important university-city in the centre of

[47] The line passed 7 km away from Tomar, a substantial distance, considering there were no roads linking the town to the nearest station.

[48] AHE-CSOP, book 10 (1860), fs. 215–16.

[49] AHE-CSOP, book 21 (1865), fs. 58v–62v.

[50] Pereira, "A política", 246.

Portugal; other engineers, anticipating the priorities of the government, suggested a cheaper solution, beginning in Pampilhosa, a small village nearby, which was accepted by policymakers in Lisbon.[51]

A corollary of the lack of capital to invest was that governments could hardly turn down those entrepreneurs who had broader access to financial resources. Additionally, in nineteenth-century Portugal, railways meant progress; hesitations to build them were met with criticism. Therefore, any proposal to implement railways was received with enthusiasm, especially those that required no financial aid from the State, although many were merely speculative ventures and/or disavowed by experts. A telling case involved an MP, who supported the ruling Regenerator Party (Filipe de Carvalho), who wanted to build and operate an extension of the South-Eastern line. The majority of experts advised against the deal, but the government leased him the work, nonetheless, arguing that it would cost nothing to the Treasury. Only the gaudy contestation of the opposition in parliament impeached the concession.[52] Another significant example is the Cáceres line (table 2 and figure 1), built to exploit more efficiently the ore mines of Cáceres, in Spain, and simultaneously provide a straighter route to Madrid.[53] Engineers opposed its construction, arguing that it was not the best choice for a transnational track (they preferred a route further to the north, following the Tagus valley).[54] Regardless, the government leased it to the RCPR, without any public subsidy. Furthermore, despite

[51] Companies too tried to cut down costs during construction, but since their work was overseen by Portuguese engineers, most of the times they were not successful. Pereira, “A política”, 264–69.

[52] Pereira, “A política”, 125–26.

[53] Alegria, *A organização*, 289.

[54] Pereira, “The technodiplomacy”, 184–85.

being a cross-border link that should be prepared for high speeds, it was one of the most curvilinear and up-and-down tracks of the network. MP António Augusto de Aguiar, a renowned Portuguese scientist, used it as an example to illustrate how senseless the national railway policy was.[55] Similar situations occurred in the Lisbon–Cascais line and in a couple of narrow-gauge railways in the north.[56]

The dominance of influential businesspersons and railway companies and their impact in the design of the network (sometimes at the expense of technical expertise) can be witnessed in other moments. An expressive example is provided by Henry de Burnay, one of the wealthiest Portuguese financiers, who used his financial and political power to persuade the government to lease the Western line (Lisbon–Figueira da Foz), doubling the offer of rail services in the westerner provinces of Portugal, when at the same time experts recommended that the investment should be directed to those areas without railways. After the contract was signed, he transferred it to the RCPR, with a substantial profit.[57] This and other leasing contracts granted monopoly areas around the tracks (40-km radius). The RCPR used this prerogative several times and in one occasion it even vetoed the connection between Évora and the Eastern line, in Portalegre, recommended by engineers and policymakers.[58]

Private businessmen and companies also had an indelible effect on cross-border lines. Since the 1870s that Madrid lost interest in transnational railways, after realising that its goal to promote a political union with Portugal (in which railways

[55] *DCD*, 8 July 1882, p. 1124.

[56] Alegria, *A organização*, 289.

[57] Pereira, “A política”, 133.

[58] *BMOPCI*, 7 (1866), 26–29.

would play a decisive role) did not gather enough supporters amongst the Portuguese elites. Portugal, on the other hand, wanted more lines towards the border, and it counted with the support of private initiative to achieve this goal. I already mentioned how the Eastern and the Cáceres lines were the result of the initiative and lobbying of the RCPR. Similarly, the connections of the Douro and Beira Alta lines with the Spanish town of Salamanca were the result of the lobbying of the aforementioned Henry Burnay, who swayed the government to grant a guarantee of yield to a consortium of Portuguese banks.[59]

The significant financial power of those investors and firms supported by foreign capital, together with the financial dependence Portugal had on them, brought about some undesirable consequences, which indirectly affected the construction of the network. The supporters of those enterprises could be found in the financial markets of London and Paris, where the Portuguese Treasury also found buyers for its bonds. Whenever those firms faced financial difficulties during railway operation, they usually applied for help from the State. If the government refused to comply, the companies lobbied in the financial markets to prevent the emittance of Portuguese bonds. This happened twice, with the RCPR and the company operating the South-Eastern line (South Eastern of Portugal Railway Company). In both cases, the government was forced to allocate financial resources to those corporations and divert them from investment in new lines.[60]

Another factor that frequently prevailed over technical arguments was the political lobbying of local caciques, who often acted as more or less reliable

[59] Comín, *150 años*, vol. 1, 8, 11 and 145–46.

[60] Vieira, “The role”, 204–26 and 269–85.

extensions of the central government in the peripheral areas of the country.[61] Arguably the best example is the detour in the Northern line to Aveiro (figure 1). The route was not recommended by any of the engineers who surveyed the line, but the lobbying of local MP José Estêvão, one of the most influential parliamentarians of the 1850s-1860s, convinced the government to accept it.[62] Further south, two wealthy landowners (Eugénio de Almeida and the count of Ficalho) used their influence to persuade the government to hire the first section of the South-Eastern line (Montijo–Vendas Novas – figure 2). Shortly afterwards, the starting point of the line was moved to Barreiro, due to the lobbying of former prime-minister, Joaquim António de Aguiar, who held some properties and political influence there.[63] The machinations of landowners Clemente Menéres and Manuel Vaz Preto Geraldes in favour of the Tua and Beira Baixa lines (Entroncamento–Guarda) are well-documented.[64] The aforementioned Lourenço de Carvalho may also be included in

[61] For the concept of *caciques* and their role in the Portuguese political system, see José Manuel Sobral and Pedro Ginestal Tavares de Almeida, "Caciquismo e poder político. Reflexões em torno das eleições de 1901", *Análise Social*, 18: 72-74 (1982), 649–71.

[62] José Ferreira da Cunha e Sousa, "Estradas e caminhos de ferro", *Boletim da CP*, 13:145 (1941), 123. It is interesting to point out that Aveiro municipality has recently paid tribute to Estêvão, unveiling a tile panel in the city's new station, lauding his political lobbying. *Terranova*, April 11 2018, www.terranova.pt/noticia/politica/aveiro-jose-estevao-perpetuado-na-estacao-da-cp-como-pai-disto-tudo.

[63] Manuel Raimundo Valadas, "Memoria apresentada á associação dos engenheiros portuguezes, refutando a opinião do sr. Miguel Carlos Correia Paes, relativamente á posição que deve occupar a estação terminus d'aquellas linhas", *ROPM*, 9:98 (1878), 85.

[64] Albano Viseu, "Clemente Menéres: the skilful strategist of the Tua railroad", in Anne McCants, Eduardo Beira, José Manuel Lopes Cordeiro, and Paulo B. Lourenço, *Railroads in Historical Context: construction, costs and consequences* (Porto: Projeto FOZTUA, 2012), 79–80. Nuno Manuel Camejo

the list, considering that he lobbied for the extension of the line across the Douro valley, where his family owned several properties.[65] Anecdotal evidence includes the story of the bishop of Braga, who allegedly demanded a terminal station in his city and therefore engineers decided to build the Braga embranchment (instead of just having the line traversing the city);[66] or the tales of different caciques in the Viseu region, each trying to bring the line closer to their constituencies.[67] These two stories are merely hearsay, but they hint that these practices were common at the time.

With this, I do not mean to imply that the input of engineers was completely disregarded. In different instances, the decision to build new lines followed their recommendations. On the contrary, almost all contributions of military experts were ignored. Previously, I mentioned how Sá da Bandeira convinced the government that the Eastern line should be covered by the artillery of Elvas. That precaution was invalidated when the government hired the Cáceres line that circumvented those batteries. In the Beira Alta line, military experts suggested that it crossed the border near the fort of Almeida;[68] instead, the line traversed the frontier in Vilar Formoso, where there was no defensive structure whatsoever. Additionally, the military strongly recommended that the Beira Alta and Douro lines merged in Portuguese

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Carriço Pousinho, "Pretos e Brancos. Liberalismo e Caciquismo no distrito de Castelo Branco (1852-1910)". PhD dissertation, Universidade NOVA de Lisboa (Portugal), 2016, 92–94 and 103–107.

[65] Maria Isabel Soares, "Carvalho, Lourenço António de (1837-1891)", in Maria Filomena Mónica (ed.), *Dicionário Biográfico Parlamentar* (Lisboa: Imprensa de Ciências Sociais, 2005-2006), vol. 1, 658.

[66] *Gazeta dos Caminhos de Ferro* (hereafter *GCF*), 79 (1891), 104.

[67] *GCF*, 71 (1890), 362–63.

[68] Joaquim Emídio Xavier Machado, "A praça de Almeida e sua influencia sobre o caminho de ferro da Beira Alta"*, RM*, 31:11 (1879), 333–41.

territory;[69] but the government accepted a junction in Fuente de San Esteban (midway between the Portuguese border and Salamanca). Only the Minho line was effectively protected in the border (by the fort of Valença), however, an invasion from the north was extremely unlikely (table 2 and figure 1).

As for internal railways, many experts observed that the best way to defend the Beira Baixa province was not to build any railway at all, and use the rugged landscape as a natural defence system.[70] Nevertheless, in 1884, the government hired the line between Entroncamento and Guarda (across that province) to the RCPR (figure 1). A comical situation happened during a debate in the upper house of parliament about the Lisbon–Cascais line. The minister of War argued that the railway was merely touristic, but, in case of war, it could be adapted to military purposes, to which general Câmara Leme sarcastically retorted: "if the Spaniards disembark in Cascais to attack Lisbon, we could shout: «Hold it right there, Mr Enemy, while we turn this touristic line into a military railway!»".[71]

Three non-technical reasons explain the disdain for military concerns: (1) meeting the recommendations of the military was very expensive; (2) Portuguese policymakers were certain that war was a very unlikely scenario that could be averted by diplomacy; and (3) even in case of an invasion, the best defensive strategy was to barricade Lisbon and wait for military support from abroad.

[69] Arquivo Histórico-Diplomático, Lisbon, box 1036, pack 5 (Entroncamento da linha ferrea do Douro), memos, 8 December 1878 and 20 December 1878. Archivo Histórico Ferroviário, Madrid, C/1188/010, project of a bridge across the Águeda river.

[70] AHM, Lisbon, div. 3/20/38/1 (Comissão de Defesa de Lisboa e seu Porto), undated report.

[71] *Diario da Camara dos Dignos Pares do Reino*, 10 February 1888, 212.

6. Conclusion

The planning and implementation of railways in Portugal in the second half of the nineteenth century was much more than just a mere technoscientific matter. To begin with, planning a railway network as an entirely technical challenge was not possible at the time, given the lack of topographical and statistical data. Moreover, and more importantly, it involved a diverse array of actors whose concerns, expectations, and priorities were not restricted to technical matters. All were in favour of equipping the country with railways and all shared, to a larger or lesser extent, the Saint-Simonianist utopias regarding circulation, most notably the capability of railways to promote transnational fluxes (hence the strong investment in cross-border tracks). However, they had different perspectives of what specific goals railways should seek.

Engineers provided the expertise to plan the network (as part of a wider strategy to modernise the nation) and oversee construction and operation; overall, they preferred solutions that promoted economic activity. Army officers intervened to prove their usefulness to the Portuguese modernisation programme, arguing that railways should be prepared for war and not only for peace. Private firms and entrepreneurs sought opportunities to invest their money. Finally, decision-makers in the central government tried to balance the technical input provided by engineers and army officers, the lack of capital to invest (and the need to rely on foreign investment), and the necessity to appease and maintain the loyalty of caciques in the periphery.

Each of these stakeholders occupied different positions in the hierarchies of power, which evidenced in the final design of the network. Military experts were the biggest losers in the debate. It was a general belief that war could averted by

diplomacy and therefore there was no need to invest large sums of money in preparing the railways for armed conflict. Therefore, their expertise was not overly valued, which left them with little power to impose their views.

Engineers were much more influent in the design of network, considering that they possessed not only the technical authority, but also a profound knowledge of the country. However, their opinions were not consistent nor homogeneous – it was not difficult to find an opinion that supported a given railway. Moreover, if decision-makers at governmental level shared the same ideology with engineers, they hesitated to share the power of decision with them. This is visible in the matter of the pre-elaboration of a network plan, which was recommended by engineers since the 1850s, but always rejected by policymakers. Finally, disregarding the opinion of engineers did not entail any practical consequences, besides some remonstrations in parliament that eventually faded away.

Quite on the contrary, to counter the ambitions of private foreign investors or companies could bring about more serious penalties, ranging from losing or delaying an opportunity to add a new line to the network, to facing difficulties in the European money markets that financed the Portuguese economy. In this sense, they had substantial power, which also determined the design of the network. Caciques could be denied more easily, but there was always the risk that they might turn their cloaks and join rival political parties. In any case, their influence was restricted to short sections of some lines. In this regard, it is easy to point corruption as an explanation of the power of caciques and private firms. I do not mean to exclude the influence of corruption in this process, but it seems to me that giving in to their demands was more a case of practicality rather than one of fraud.

To conclude, this paper illustrates that, despite the influence of technological arguments in the debate about large transportation systems (a term that attracts historians of transportation and historians of technology alike), the design of transport networks is strongly determined by social, political, and economic factors. Transportation grids are tools of power, not only after its inauguration, but also during its planning. In either, different actors struggle to gain prominence, thus altering the features of those systems accordingly.

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