THE EVOLUTION OF THE ESTABLISHMENT OF THE RAILWAY NETWORK IN BRITAIN USING GIS

A INSTALAÇÃO DA REDE DE CAMINHOS DE FERRO NO REINO UNIDO, COM BASE EM SIG

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Nos últimos dez anos tem trabalhado em investigação sobre a integração europea.com base numa perspectiva histórica que inclua os aspectos geohistóricos.
Abstract Resumo
We reconstruct historical maps of the British railway network since its foundations in the 19th century using Geographical Information Systems (GIS).
We present a series of maps of the British railway network every 10 years, starting as early as 1830, and up to year 2000. This facilitates the study of the evolution of the network from a historical perspective. We have seen that there have been different construction phases. We have divided the period of study, 1830 to 2000, into 3 phases: The first one being 1830-1920, what we call the long 19th century. This first phase is characterized by the construction boom of the 19th century. The second phase comprises the years 1920 to 1950, and signifies the stagnation of the construction process. Finally, the third and final phase we have described runs from 1950 to 2000. This period sees the more drastic line and station closures in history, accounting to up to 50 percent of constructed network. We observe that since after the massive closures of the 1950s and 1960s, the main feature of the evolution of the network has been plain stability.

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Usando SIGs, reconstruímos os mapas históricos da rede britanica de caminhos de ferro desde a sua fundação no século XIX. Apresentamos uma série de mapas da rede britanica de caminhos de ferro por década, desde 1830 até 2000, que facilitam o estudo da evolução da rede numa perspective histórica. Dividimos o período de estudo em três fases. A primeira, de 1830 a 1920, caracteriza-se pelo boom de construção no século XIX. A segunda fase, de 1920 a 1950, mostra uma estagnação do processo de construção. Finalmente o terceiro período, de 1950 a 2000, conhece o encerramento linhas mais drástica da história, que afectou até 50% da rede até aí construída. Desde os encerramentos dos anos 50 e 60 do século XX, a estabilidade da rede ferroviária parece dominar.
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The evolution of the establishment of the railway network in Britain using GIS

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1. INTRODUCTION

Information technologies have brought the information revolution in the last decades, changing the way we process and assimilate information altogether. History is not an exception. Geographical Information Systems (GIS) have been a revolution in the way we analyse historical records. We can now assemble bits and pieces of information belonging to a certain spatial location, and then bring these bits and pieces together. This will result into a historical map, which will help us best interpreting historical records. This is the case for the building of the railway network in England and Wales during the 19th century, leading places in the world as for railway technology at the time, and key to understanding all railways’ building that came subsequently in other parts of the world.

Historical Geographical Information Systems Europe (HGISe) is a multidisciplinary project gathering engineers, geographers and economists altogether with the aim of assembling, diffusing and interpreting information on historical transportation networks across Europe (http://www.europa.udl.cat/). This project gathers historical information on population, urbanization, borders, and transportation networks. At the time of assembling all historical records regarding the British case, we realized that the British industrialization process starting in the last decades of the 18th century and running all the way through 19th century was articulated around a network
of existing and new means of transportation, most notably the railways. The railways started as a way of transporting coal in the context of the just-born manufacturing centers and turned into a means of transporting heavy goods, fresh products, postal service and people indiscriminately. The richness and historical importance of the British case makes it worth it a more detailed look.

We have produced a GIS that combines a system for validating information about railways and stations with the population data at the civil parish level. This opens a new window on studies of the historical geography of Britain and one that will enable conducting a detailed analysis of a series of factors, such as population changes at the parish level or changes in the work force, which will help to reveal the important role that railways played in determining the configuration of the British landscape in contemporary history. This set of key factors was already well-known, but it is only now that it will be possible to measure their respective influences. In the rest of this chapter we provide an overview survey of the evolution in the construction of the British railway network with the support of the GIS-constructed historical maps.

2. DATA SOURCES

The GIS software provides the technical platform we need, but we still need to compile detailed geographical information on the exact location of new and existing train stations and railway lines. “The Railways of Great Britain” (Cobb, 2005) constitutes an important empirical advance in existing knowledge concerning the expansion and subsequent decline of the British railway network. The Atlas provides very detailed information about the dates of opening and closure of both railway lines and stations and also about the companies that were most influential in these processes. This book shows the railways against the Ordnance Survey (OS) grid and contains additional detailed information in the appendices that has turned valuable for our mapping purposes.

Other contributions examine the importance of railway history at the national level. The Ian Allan series, for example, constitutes a very relevant example of this in Britain. Still, one of the reasons why Colonel Cobb’s contribution is so relevant is because the author has devoted great amounts of time to establishing an empirical infrastructure for further research. Thanks to its accuracy and the OS grid, this Atlas makes it possible to transfer information to a Geographical Information System (GIS). The methodology we use takes into account the principal options for the validation of the digitalisation process. This is an im-
The important step, as there are more than 8,500 stations in the complete structure of the British railway network. Technically, these constitute points at which people and goods have access to a regular service that provides transport connections for the whole country.

An example of what type of result can we obtain using this technique is in the publication by Gregory and Schwartz (2009), who have combined an analysis of the evolution of population at the regional level with the evolution of the railway network in Wales.

### 3. Periodization of the General Evolution of the Railway Construction in Britain

We have divided the long period into 2 historical periods coinciding with what we call the long 19th century and the 20th century; and 3 construction phases. The break that divides the 2 historical periods is the First World War. All the way up to the Great War railways were seen as the future of freight transportation, and were increasingly considering the transportation of passengers as well. During the War, the government made an effort to keep the system running, given the importance of good communications in an emergency situation. By the 1920s, the automobile was the new and revolutionary form of transportation, and was spreading quickly in the United States, by then already the wealthiest nation in the world. Economically speaking, the end of the war in 1918 would mean the beginning of the next époque. From then onwards, 20th century Britain would be much better pictured by decadence of the railways than by the preceding construction boom. Parallel to this historical periodization, we make 3 clearly differentiated sub-periods, coinciding with the 3 phases in the evolution of the network. The first phase corresponds to what we call the long nineteenth century. This reaches up to the end of the First World War and is characterized by the railway construction mania. The second phase runs from the end of the Great War to 1948 (year of nationalization), and can be understood as a plateau phase. In British railway history we establish the break point at the time of the change in the ownership approach in 1948. This is a turning point from which closures of lines and stations are more characteristic of the coming decades than new openings. This brings a third period running from the beginning of the 1950s to the ending year in this study, the year 2000, and so comprises the second half of the 20th century. These 3 phases are well differentiated and are different in nature.
4. THE LONG NINETEENTH CENTURY: CONSTRUCTION OF THE NETWORK

Several authors have been studying the construction of the railway network in Britain from different perspectives: The physical process of formation of infrastructure (Casson, 2009), political and economic factors that conditioned it (Bogart, 2009), as well as effects in the territorial distribution of population (Schwartz, Gregory and Thevenin, 2011). Our contribution consists of a georeferenced analysis of the railways that allows both quantifying any aspect of the network and also provides a basis for combined analysis with other datasets.

In this chapter, we are going to limit ourselves to describe the evolution of the network in Britain, considering it a physical unity. We are not including the rest of the United Kingdom, due to the fact that it is not included in the Cobb’s Atlas.

The first railway was invented and implemented in Britain for the first time, as is known. Moreover, it experienced a rapid expansion during the first years, which implied gaining an advantage over other European countries. In 1860, density of the British network was fourfold that of the French, and in 1920 was still twofold. Despite posterior closures, Britain continues to enjoy the densest railway facilities in Europe. Of course, this broad service is in relation to high demand, determined by its density of population and economic activity.

Looking at the railway network in more detail, the design of the British network has certain peculiarities, the most relevant being the preeminence of private initiative in financing the railways. Private sector funding certainly conditions the global morphology of the network.

The role of the state was limited to warranting security and granting construction permissions, via previous discussion of the projects in Parliament. This facilitated the knitting of a complex spider net of local influences and tensions among competing enterprises. For this reason, each fragment of the rail map has their own particular history, often not applicable to the rest.

We can distinguish several phases in the development of the network according to not only expected transportation demand but also investors’ profit expectations. Investors’ dominant confidence was applied to regulate free markets in the United Kingdom. Differently from other countries, the general administration did not promote public lines, nor did it offer any warranty of profitability to private firms. On the contrary, the market was already offering enough stimuli so that we observe spectacular growth in construction and concessions in the 1840s. This was so up to the point that in 1847 railway investment accounted for 6.7 percent of the national income. This investment bubble soon burst to return
to more realistic levels. Still, the first big push was already given and made the British network the densest, as pointed by several authors:
“By the mid-1840s, investing in the railways had become an attractive proposition once again and schemes for new lines began to be drawn up in every region of the country. That financial climate had changed and there was optimism in the air with an upturn in the economic cycle. Interest rates had plummeted, encouraging people to look for a better rate of return and their savings (…) and by the spring of 1844 there was more money available for railway investment than ever before” (Wolmar, 2007: 87).

Some researchers have considered that “…the early railway network was by no means an aberration in the context of the national interest” (Fullerton, 1975, quoted by Turnock, 1998: 11). A qualified perspective makes us understand that such density favored rural areas (Schwartz, Gregory and Thevenin, 2011). Indeed, “… countryside distribution was also feasible for a wide range of manufacturers and enterprising firms like brewers in Burnon on Treant, marmalade producers in Dundee and sugar refiners in Greenock” (Turnock, 1998: 26).

The high density network favored then and conditioned ever since the organization of industrial production in all the country. By 1860 total railway length amounted to 15,000 kilometers, and continued growing. By the turn of the century it had doubled to more than 30,000 kilometers in a period of 40 years. The number of operative stations reached around 7,000 at the beginning of the twentieth century, which indicates wideness and permeability of the network, with numerous access points. Later on it had been stabilized below 3,000 stations, not only due to line closures but also to closure of stations within operative lines with the aim of raising commercial speed and diminishing maintenance costs. We will see this in the next section.

5. THE TWENTIETH CENTURY: DECADENCE AND NEW MEANS OF TRANSPORTATION

Generally speaking, we can argue that railway infrastructure had three big construction phases. The first phase (1830-1910) corresponds to the dawn and later sustained rise of the network. Expansion was however slower in the last part of the period. This phase shaped the geography of the network, with two differential features in comparison to that of other European countries. The first difference is high density of the network and the second one is the strong variation of this agglomeration in favor of urban areas, such as London or Manchester-
Liverpool, among others. The provision of the railway infrastructure facilitated the processes of dispersion of urban areas departing from their central nuclei. This feature was maintained all the way during the 20th century.

The 20th century implied the decadence of the railways due to new means of transportation, i.e. the automobile from the 1920s onwards. Although the automobile was not generalized until much later, the expenses of maintaining such a high density network were starting to reveal during this period, and were already heavy to sustain before that, especially during the Great War. Precisely because of this saturation process, the second period of division of the evolution of the railway network (1918-1948) is characterized by the stability of the network. The railway network length was maintained well above 30,000 kilometers of line until the 1950s. Still, some lines were opened during the first years, but the beginning of line closures was already starting to show towards the end of this period. In the 1940s, some areas of Scotland and Wales were already affected by line closures. Nevertheless, it is remarkable the fact that between 1910 and 1920 the government made an effort to keep the whole network functioning during the Great War, in detriment of good maintenance though.

The problem of high density remained until what we consider to be the third phase of construction, 1948 to 2000. Or maybe should we say de-construction in this case, since this period is characterized by massive line and station closures and posterior maintenance of the status quo of the layout until present day. After nationalization in 1948, in the 1950s the alternatives were either making a great investment effort or closing down a great deal of the network. The main result of the official studies conducted at the time was the Beeching Act of 1963, which opted for the second option. The result was that around 50 percent of the railway layout was closed down. This was the most drastic line closure in the history of European railways. The reduction was even larger in percentage terms if we take as reference the number of stations in service, since many stations in operative lines were closed too; the reason being that speed was given preference in detriment of connectivity in less populated areas.

Finally, during the last 2 decades of the study (from 1980 onwards), we can observe a new phase of stability, with isolated closures and only one significant opening: the high-speed train line from Waterloo station in London to the French coast. Year 2000 displays similar railway network length as the mid-1860s. But beyond crude numbers that stabilize the total length of the network above 16,000 kilometers at the end of the 20th century, we need to emphasize that this was a move towards efficiency. Although isolated, the high-speed new line opening has required a vast amount of investment and technology update, together with international coordination, and so it has brought a new percep-
tion of travelling by train and signifies a true modernization of this 19th century means of transportation.
CONCLUSIONS

Geographical Information Systems (GIS) techniques and new software have brought the opportunity to do research in a new way. Mapping historical information making use of GIS software has made it possible to address the old questions in a new way. In this case, we have been able to reconstruct historical maps of the British railway network since its foundations in the 19th century and all the way up to present day, departing from a series of coordinates in a map. This facilitates the study of the evolution of the network from a historical perspective.

We present a series of maps of the British railway network every 10 years, starting as early as 1830, when we can observe something of a more significant railway construction activity; more than some isolated or anecdotal lines, and
up to year 2000, when we already have the most sophisticated high-speed train linking central London to the French coast.

Almost 200 years have elapsed since the construction of the first railway as is known today to nowadays, and we have seen that there have been different phases. We have divided the period of study, 1830 to 2000, into 3 phases: The first one being 1830-1920, what we call the long 19th century. This first phase is characterized by the construction boom of the 19th century, with some stagnation periods in between but that runs until the end of the First World War. The second phase comprises the years 1920 to 1950, and signifies the stagnation of the construction process. This does not mean that there were no new lines open, since this was not the case. Indeed, we observe new lines open, especially in the initial years of the period, but effervescence in construction stopped. Actually, in the last decade of this second phase we can already find some line closures. Finally, the third and final phase we have described runs from 1950 to 2000. Right after nationalization, this period sees the more drastic line and station closures in history, accounting to up to 50 percent of constructed network. This is done for efficiency reasons and the initiative lies entirely in the governments’ decision. In the last decades of this period we still find a remarkable opening: the high-speed train, connecting the British railway network to the continent through a tunnel under the English Channel. But this is clearly the exception, not the norm, since after the massive closures of the 1950s and 1960s, the main feature of the evolution of the network has been plain stability.

The network reached around 33,000 km of line during its peak years in the 1920s and 1930s, and had almost 7,000 operative stations. Nowadays, the network is half that length and less than half that number of connectivity points. It has evolved towards a more speedy and efficient configuration.
BIBLIOGRAPHY


Wolmar, Ch., 2007, Fire and Steam, London: Atlantic books.