# **The Colombian Standard Steam Locomotive:**

The transmission and circulation of technical knowledge and technology transfer. The case of British engineer Paul C. Dewhurst's designs and its manufacture at Škoda (1923-1929).

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Abstract. The steam locomotive became a technological innovation in the early 19th century, that not only had implications for technical development and engineering, but transformed social and economic life around the world; it reduced distances and facilitated the incorporation and articulation of markets into international trade. It also created a locomotive trade that connected distant geographies, diverse interests and put technological innovation in front of the search for economic benefits, and to adapt to the rapid changes and demands of customers who demanded a product according to their requirements. The article focuses on the presentation of this technical innovation in Columbia in the period between the two world wars with a link to the technical cooperation with the Czechoslovak company Škoda and with the important British engineer Paul C. Dewhurst.

#### **Keywords**

History of Technology, History Contemporary (1920-1930), Transport History, Transfer technical knowledge, Steam locomotive, Colombia, Czechoslovakia, Paul C. Dewhurst, Škoda Company.

# 1. Introduction

The article *The Colombian standard steam locomotive:* the transmission and circulation of technical knowledge and technology transfer. The case of the designs of the British engineer Paul C. Dewhurst and its manufacture in Škoda (1923-1929) points to the presentation of the object of study and the advances so far. It starts from the railway development as the epicenter of technological change and the circulation of technical knowledge; as a crossing point of three distant geographies and the promoter of a one-time powerful industry and dynamize of a commercial practice; as a transformer of social and economic life, and not least, as a project for the construction of national identity and historical memory.



Fig. 1. Design by P. C. Dewhurst, the Colombian steam standard locomotive, type 4-8-0, 1925. [1]

The main objective of this research is to study the circulation of technical knowledge and the transfer of technology that contributed to the development of a locomotive designed to the conditions of Colombia's difficult geography, as well as to analyze and evaluate its results.

This will imply examining the trajectory of the British engineer Dewhurst in Colombia as the holder of a technical know-how that favored technological change and had an impact on the awakening of nationalism in local engineering. It will be essential to analyze the international relations, both commercial and political, between Colombia and Czechoslovakia through Škoda, that is to say, in the terms in which the contractual relationship took place.

The previous thing framed in a historical context of significant political and economic changes at world and local level, especially, with respect to the technological and strategic-commercial change inside the railway development, with the loss of ground of the standardization in the production of steam locomotives in favor of a manufacture to the measure of the consumer, as well as the incursion of the diesel locomotive and of electric traction that began to dispute a space in the market.

This general objective underlies the author's intention to value and make this subject visible from a heritage point of view, that is, this railway development that occurred in particular circumstances for Colombia, which allowed it access to specialized technical knowledge and high technology. This was an experience that demonstrates the interest of a nation under construction that was looking for a way to incorporate the ideal of progress.

The problem that will be the path of the research raises the following questions: What was the impact of the Colombian standard steam locomotive, designed by P. C. Dewhurst and manufactured by Škoda, on the economic development of the country? Can this development be evaluated quantitatively? What were the motivations of the Colombian government to hire the services of the engineer Dewhurst and Škoda? What was the impact of Dewhurst's departure from the Ministry of Public Works and, of course, the technological change with the appearance of diesel locomotives and electric traction locomotives?

# 2. Methodology, concepts, state of the art and sources

From the methodology of the history of technology, a perspective that proposes an interdisciplinary work -in particular with economic and business history- and that places technological change in its historical, political and cultural context, as a product influenced or shaped by culture, where interests and power relations intersect [2]. With respect to the perspective of business history, we would like to point out its contribution in analyzing the production of steam locomotives articulated to a profit maximization and cost minimization logic, to a competitive market restricted to the potencies and exposed to the impacts due to technological change and market transformation. Likewise, this perspective addresses the role of *firms* -their organization and business management- in the industry and trade of steam locomotives and their relationship with governments. From the history of knowledge,

understood as a recent perspective that problematizes knowledge as its role in society and in human life, a knowledge with the capacity to circulate, to transform and adapt to particular contexts [3], but which is influenced by power relations. That is, know-how in terms of its potential to transform reality and represented by the engineer, a remarkable figure characterized by his heterogeneity [4] -at the end of the 19th and beginning of the 20th century-, who could be both engineer and contractor, who had to develop financial insights, expertise in construction, ability to manage a varied workforce, as well as a certain political capacity [5], that is, purely technical functions and managerial responsibilities. Also, to decipher the distance separating civil engineering from mechanical and railway engineering, which at the time seemed to dissolve the boundaries. This engineer must be placed in a wide network that determined his work, from the institutional framework that constituted him and favored his labor circulation, as well as the industry that promoted his creative skills and the commerce that coerced him to think from the logic of profitability.

This research represents a novelty in the academic production in Colombia, both as an object of study and for the methodology to approach it. Most of the research in Colombia on railroads has been carried out by historians and architects, where the former has approached it from political and economic contexts, such as De Buenaventura al Caribe: el ferrocarril del Pacífico v la conexión interoceánica (1872-2012) by Juan Correa (2012). Architects, on the other hand, focused on the heritage elements of railway architectural structures, such as Arquitectura del Ferrocarril Pacífico. Planos and dibujos, by Carlo Botero (1995). A text that approaches the technological change in the railway workshops is La disputa por el taller de Chipichape del Ferrocarril del Pacifico en el final de la república conservadora y el ascenso de la república liberal, by Carlos Mejía (1997). It is essential to mention two authors who for the first time make mention of the designs of the Colombian steam standard locomotives of P. C. Dewhurst and their manufacture at Škoda: Un momento estelar de la ingeniería mecánica en Colombia: los desafíos de locomotoras de P. C. Dewhurst, by Jorge Arias de Greiff (1989), and La mula de hierro (1989) and La segunda mula de hierro. Historia de los ferrocarriles colombianos a través de sus Locomotoras (2008), by Gustavo Arias de Greiff. Both authors were related not only by family connection but also by their relation to the Colombian railroads as engineers. The two works -which are the inspiration for

the research presented in this article- make a general inventory of locomotives in Colombia, providing valuable photographic sources and data regarding their characteristics, however, it lacks an analysis of these in their historical context.

Three key points have been identified to carry out the search for sources. The first, located in Colombia, is the Archivo General de la Nación (AGN), which has the Ministry of Public Works and the National Railways archives at its disposal. The search for documents in this archive has already produced a positive result, revealing documents, photographs and plans regarding the trajectory and designs of engineer P. C. Dewhurst in Colombia. Also, documents related to the locomotives manufactured in Škoda have been discovered, and even other issues of this relationship have come to light, which will be worked on in other articles. In addition to the AGN, work is being done with the documentation centers of the Biblioteca Nacional and the Luis Ángel Arango Library of Colombia, which has contributed reports and photographs. On the other hand, the library of the Sociedad Colombiana de Ingenieros contains periodical material that sheds light on the situation of Colombian engineering in the context being studied.



Fig. 2. Drawing design by P. C. Dewhurst, the Colombian steam standard locomotive, Kitson-Meyer Type, 1925 [6]

The second is located in the Czech Republic, in the archives: Lokomotivka Škoda Plzeň, Archiv ministerstva dopravy (NA Praha), , ČKD Praha, Archiv Národního technického muzea Praha, Česká republika.

The third, corresponding to engineer Paul D. Dewhurst: located in London, *National Railway*. *Museum Library and Archives* is his personal archive of documents and photographs. On the other hand, the prolix written production of the engineer Dewhurst and published both in the *Journal of The Institution of Locomotives Engineers* and in *The Engineering* magazine. Finally, the diversity of specialized magazines is an important source: *The Locomotive, The Engineer, Railway Age, Mechanical Engineering, American Engineer and Railroad Journal*, among others.

# 3. Context

The research is set in the course of the twenties of the twentieth century. It is essential to identify the changes that took place and the various dynamics that articulated the network created around the Colombian steam standard locomotive.

There is no doubt that the arrival of the steam locomotive was a symbol of modernization, but importing railway technology to underdeveloped countries also implied that of experts to install, maintain and manage it, which implied the role of the government in stimulating technological change and developing public projects.

It is a fundamental decade in the development of the Colombian railroad, since the government, favored by the coffee production and the millionaire indemnity made by the United States as a result of the loss of Panama, allowed the greatest investment to expand the railroad infrastructure and, of course, to hire the services of the British engineer Paul C. Dewhurst trained at the *London Polytechnic & Engineering School* and at the *Midland Railway* and who had just been part of the Jamaica Railway - to take over as chief mechanical engineer at the Ministry of Public Works in Colombia.



Fig. 3. Paul C Dewhurst in Colombia crosses the Cordillera Central in 1923 [7].

It is essential to understand the circulation of British engineers in a context of capitalist modernity, where Dewhurst, who was part of The Institution of Locomotives Engineers, an institution that was an authority on railway development issues and served as a vehicle for the transmission of technical knowledge. was part of a diaspora of British engineers that began in the second half of the 19th century and was part of a larger project of seeking investment in the construction of railways in overseas territories -Latin America-, since it not only favored the manufacture of locomotives and rolling stock, but also employment opportunities for the numerous British engineers [8]. This caused the first generation of overseas railroad construction, during the mid-19th century, to favor the hiring of foreign engineers. However, a second generation allowed for changes in recruitment methods, for as governments improved their experience with railroads and technical resources, they undertook and employed local labor [9].

In another scenario, one should place the newly created Czechoslovakia, a product of the end of the First World War, which was in tune with Western Europe, that is, open to capitalism and foreign investment mainly French-, which strengthened its industry, its international relations and its place in the international market. With regard to Škoda, as a strategy of towards peaceful diversification engineering production, as a consequence of the decline of the arms industry in post-war times, a major expansion of production: "The locomotive works, which was founded in 1918, has 4 large buildings to manufacture and repair of locomotives and to boiler making. Over 200 modern tools produce the mechanical parts (...) already employs over 1,100 men and turns out and rebuilds 300 locomotives each year" [10]. The first locomotives were delivered to the Czech-Slovak State Railways in 1920 and subsequently began to be exported. [11]

It is the decade of transformations in the locomotive industry and trade. It is vital to realize that the business began with the standardization of production to maximize profits by reducing costs. However, the trend changed at the end of the 19th century and beginning of the 20th century to production customized to the customer's needs. Added to this the number of had locomotive producers narrowed making competition increasingly harder and in 1920 "the industry consisted of five companies and locomotives began to reach a physical limit in size" [12], British production, characterized by its effort in the quality of its product, began to cede its place in the business to the United States, which was more open to the design

demanded by the customer, faster delivery and lower prices, in addition to having a clearer marketing strategy: "American firms employed their own experts who were constantly visiting the railway officials, and their catalogues were to be found in every office" [13]. In addition to the mentioned above, from 1925 diesel locomotives and electric traction locomotives were introduced, which put the steam locomotive in trouble: "(...) the operating economies of the diesel locomotive could not be denied. The diesel locomotive was also safer." [14]

# 4. The Colombian Steam Standard Locomotive

It is necessary to know the conditions imposed by the Colombian geography in order to understand the circumstances that favored the emergence of the standard locomotive: steep gradients, sharp curves, heavy rains on the mountain tracks, high altitude above sea level and a narrow gauge with a narrow, lightweight rail structure.

For Dewhurst, the locomotive had to be designed and built to adapt to the track, give the engine maximum ease of turning curves, make maximum use of the locomotive's weight to counteract the limitations of topography, use basic steel boilers instead of acid steel, a larger firebox volume, be equipped with a pressure brake to control the train's speed of descent, and use three cylinders to optimize the locomotives' pulling capacity. [15]

Several companies participated in the construction of the Colombian steam standard locomotives, where the prominent place went to Baldwin. However, this paper focuses its attention on those produced by Škoda. Technical and performance aspects of these locomotives have yet to be explored.

The only allusion to this is that on the Pacific Railroad line the Škoda proved not to be as strong as those of other makes and were destined for service in the Valley [16]. Škoda was the smallest producer in number of locomotives, but ranked third in the number of 4-8-0 "Docerruedas".

Overall, they produced 33 units of the Type 2-6-2 "Prairie" and 2-6-2t (7 pcs.), Type 4-8-0 (22 pcs.) and Type 2-4-0t (4 pcs.).



**Fig. 4.** Passenger train arriving in Giradot station from Neiva. #91 Škoda (ex Giradot #50). Type: 4-8-0, #456. [17]



**Fig. 5.** Type 2-4-0T FC del Pacifico no. 4 before despatch from Škoda's factory [18]



Fig. 6. Type 2-6-2 FCN-C no. 33, built by Škoda, 1928. [19]

Two locomotives built by Škoda are currently on exhibit as monuments:



Fig. 7. Locomotive-monument, type 2-6-2, 1928, Tolima, [20]



Fig. 8. Locomotive-monument, type 4-8-0 "Docerruedas" of 1928, in Girardot. [21]

# 5. Conclusions

The object of study, that is, the Colombian standard steam locomotive, approached from the perspective of the history of technology, allows us to analyze technological change as a phenomenon articulated in a specific historical context where diverse dynamics political, economic, cultural and geographic-, from the local and international levels, and interests are in dispute. This Colombian locomotive, which represents a technological change, is framed in an even greater change, that is, the emergence of diesel and electric traction locomotives that enter to competition in the market, which implied not only an impact on the technical know-how but also a transformation in the industry and the locomotive business.

As could be observed, the Colombian standard steam locomotive makes it possible to contribute from a local case to a global history, demonstrating how in the context of capitalist globalization networks are created both in the circulation of knowledge, technological transmission and lucrative logics.

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