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IPR-BEACHHEADS.
BABCOCK & WILCOX'S BUSINESS AND INNOVATION STRATEGIES IN SPAIN

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1. Introduction

The last quarter of the nineteenth century gave rise to a new world that was industrially much more complex, economically more globalized, commercially more protectionist, and legally more linked. All these issues were a breeding ground for the resulting expansion of the first multinationals. Larger and larger North-Atlantic industrial and financial firms began to invest abroad in a growing effort to overcome commercial barriers and widen domestic markets. Such economic ventures required a minimum legal common security for both tangible and intangible asset protection. As corporate business strategies progressively shifted towards innovation and product differentiation, the international defense of knowledge advantages and intellectual property rights (IPRs) became crucial in the new global order.

Moreover, in fact, IPR globalization previously began during the mid-nineteenth century through the recognition of foreigners' rights in domestic patent and trademark legislation and through the emergence of bilateral IPR agreements among distinct countries. The 1883 *International Union for the Protection of Industrial Property* was the expected consequence. Initially signed by fourteen countries[1], it established basic principles regarding the national treatment of foreigners, priority rights for previous patents and trademarks, and temporal protection in international exhibitions and guaranteed that importing own protected objects would not forfeit domestic IPRs. Immediately, an International Bureau was founded, which would turn into the predecessor of the current World Intellectual Property Organization (WIPO). Continuous amendments[2] and adhesions[3], as well as several new significant international agreements[4] signed throughout the rest of the nineteenth and the twentieth centuries, completed the process.

Thus, from the 1880s onwards, the international scope of both business and IPRs enlarged. At the same time that firms from the most developed economies increased direct investments abroad, patents and trademarks from foreign investors soared everywhere. Furthermore, by World War I (WWI) total patent activity had exponentially grown amongst industrial nations.[5] Even during the difficult interwar period, through which barriers to the mobility of people, trade, capital, and knowledge

[1] Eleven countries signed in 1883 (Belgium, Portugal, France, Guatemala, Italy, the Netherlands, San Salvador, Serbia, Spain, and Switzerland) and another three (the United Kingdom, Tunisia, and Ecuador) in 1884, when ratifications were exchanged. For this and the following references, see http://www.wipo.int/treaties/en.

[2] Rome 1886, Madrid 1890, Brussels 1897–1900, Washington 1911, The Hague 1925, London 1934, Lisbon 1958, and Stockholm 1967 and 1979.

[3] Currently, the Paris Convention has 176 country members.

[4] From the 1891 *Madrid Arrangement for the International Registration of Trademarks* to the recent *Agreement on Trade-Related Aspects of Intellectual Property Rights* (TRIPS) within the 1994 *World Trade Organization* (WTO), to the significant 1970 *Washington Patent Cooperation Treaty* (PCT).

[5] I. Inkster, "Patents as Indicators of Technological Change and Innovation: An Historical Analysis of the Patent Data, 1830-1914", *Proceedings of the Newcomen Society*, vol. 73, nº 2, 2003, Table 1.

were erected, IPRs and patent records still increased, revealing new corporate strategies that announced what would come after World War II (WWII), during the so-called "golden age of capitalism". Similarly, patent owning had progressively reversed from total independent predominance before the 1880s to high corporate control at the end of the 1930s, when more than a half of patents were already taken by firms in practically all countries.[6]

As a consequence, firms, and especially multinationals, had to progressively develop global IPR strategies and management skills. Notwithstanding basic international agreements, distinct national patent laws came from different traditions and still kept particular constraints or requirements for defending domestic interests, such as compulsory working clauses, patents of introduction, and other legal specifications that foreign firms had to face and address. Although each and every patent system had its own peculiarities – from the existence or absence of previous technical exams to very disparate fees – apparently, IPR weakness was relevant in less developed economies. Hence, although there are very good analyses concerned with the evolution of corporate patent management in pioneering countries, as well as significant case studies, it is still not clear how multinationals progressed in latecomers. In fact, in previous works, we have completed general explorations on multinational patent activity in Spain, a lagging country on the European periphery, recipient of large foreign direct investment (FDI) throughout the nineteenth and twentieth centuries.[7] During most of that period, Spain maintained a hybrid patent system designed not only for fitting basic international standards and protecting foreign invention activity but also for fostering domestic innovation, technology transfer, and industrialization.[8]

In summary, the aggregate analysis of patent records in Spain before WWII revealed 1) that firms' patenting was scarce during the first three quarters of the nineteenth century and that it increased from 1880 onwards, especially driven by foreign corporations from the most advanced nations at that time; 2) that this amount of corporate monopolies had a limited impact because approximately 75% on average were extinguished within three years (85% within five years) due to compulsory working clauses or lack of payment; 3) that no more than 6% of those foreign corporate patents were licensed within Spain; and 4) that, as a consequence, the huge patent expansion seemed to be part of a first internationalization strategy of corporations for protecting innovations in any potential market, regardless of whether they had an intention to invest in it or whether they would be able to maintain the monopoly.

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[6] T. Nicholas, "The Role of Independent in U.S. Technological Development, 1880–1930", *Journal of Economic History*, vol. 70, nº 1, 2010, pp. 57–82; T. Nicholas, "Independent Invention during the Rise of the Corporate Economy in Britain and Japan", *Economic History Review*, vol. 64, nº 3, 2011, pp. 995–1023; P. Sáiz, "Social Networks of Innovation in the European Periphery: Exploring Independent versus Corporate Patents in Spain circa 1820-1939", *Historical Social Research*, vol. 37, nº 4, 2012, pp. 348–69; A. Nuvolari and M. Vasta, "Independent Invention in Italy during the Liberal Age, 1861-1913", *Economic History Review*, vol. 68, 3, 2015, p. 858-886.

[7] For a general view of FDI evolution in Spain, see R. Castro, "Historia de una reconversión silenciosa. El capital francés en España, c. 1800-1936", *Revista de Historia Industrial*, nº 33, 2007, pp. 81–118.

[8] P. Sáiz, D. Pretel, "Why Did Multinationals Patent in Spain? Several Historical Inquiries", in P.-Y. Donzé and S. Nishimura (eds.), *Organizing Global Technology Flows. Institutions, Actors, and Processes*, New York, Routledge, 2014, 39–59.

Finally, we suggested that, in addition to their geographical proximity, industrial sector, or type of technology, corporations' patent management strategies specifically depended on whether they had direct investments and interests in Spain.

This contribution extends the scope of this analysis by delving into the patent activities developed by one of the first modern multinationals, the American company Babcock & Wilcox (B&W), which mainly specialized in steam boilers and rapidly became global through a network of subsidiaries and affiliates that reached Spain in 1918. It constitutes an interesting case study because a) the parent firm and its main branches (and innovations) have been widely analyzed; b) the British B&W directly invested and established a factory in Spain; and c) its main business was run in a mature mechanical sector in which firms were more concerned with IPRs. However, it is still not completely clear how B&W managed such IPRs, especially in lagging countries with weak patent systems. Herein, I will attempt to shed some light through a detailed analysis of B&W's patent files and first technology transfer agreements in Spain, which are available from the historical archive of the Spanish Patent and Trademark Office (OEPM) in Madrid. Therefore, besides statistics, patent documents can also provide interesting data on patentees' IPR management skills and protection strategies by studying, for instance, compulsory working reports, assignment and license contracts, technical drawings and specifications, judicial suits, and other administrative memos and correspondence.

The following sections will briefly 1) summarize B&W conglomerate history; 2) explore its activity in Spain throughout the twentieth century; 3) analyze its patent strategies and their consequences; and 4) provide some conclusions.

2. The birth of the Babcock & Wilcox conglomerate

The history of the B&W group and its internationalization process is one of the best known in business administration. This is especially due to the outstanding work of economic and business historian Kristine Bruland,[9] as well as to that of others scholars[10] who have contributed to complete distinct aspects of the firm's history. In short, *Babcock, Wilcox, and Company* was originally founded in 1867 in the United States based on the previous work and inventions of George H. Babcock (1832-1893) and Stephen Wilcox (1830-1893). The firm's business was developed from an innovative and safer (non-explosive) steam boiler, patented the same year, 1867, as "improvements

[9] K. Bruland, "The Babcock & Wilcox Company: Strategic Alliance, Technology Development, and Enterprise Control, circa 1860-1900", in K. Bruland and P.K. O'Brien (eds.), *From Family Firms to Corporate Capitalism. Essays in Business and Industrial History in Honour of Peter Mathias*, Oxford, Oxford University Press, 1998, 219–46; K. Bruland, "The Management of Intellectual Capital in Transnational Engineering: A Study of Babcock & Wilcox 1860-1912", in *First International Conference on Business and Technology Transfer*, Kyoto, 2002; K. Bruland, "The Management of Intellectual Property at Home and Abroad: Babcock & Wilcox, 1850-1910", *History of Technology*, vol. 24, 2002, pp. 151–70; K. Bruland, "Managing Foreign Operations: Babcock & Wilcox in Europe, C. 1870-1920", in K. Bruland and J.-M. Olivier (eds.), *Essays on Industrialization in France, Norway and Spain*, Oslo, Unipub, 2005, 93–112.

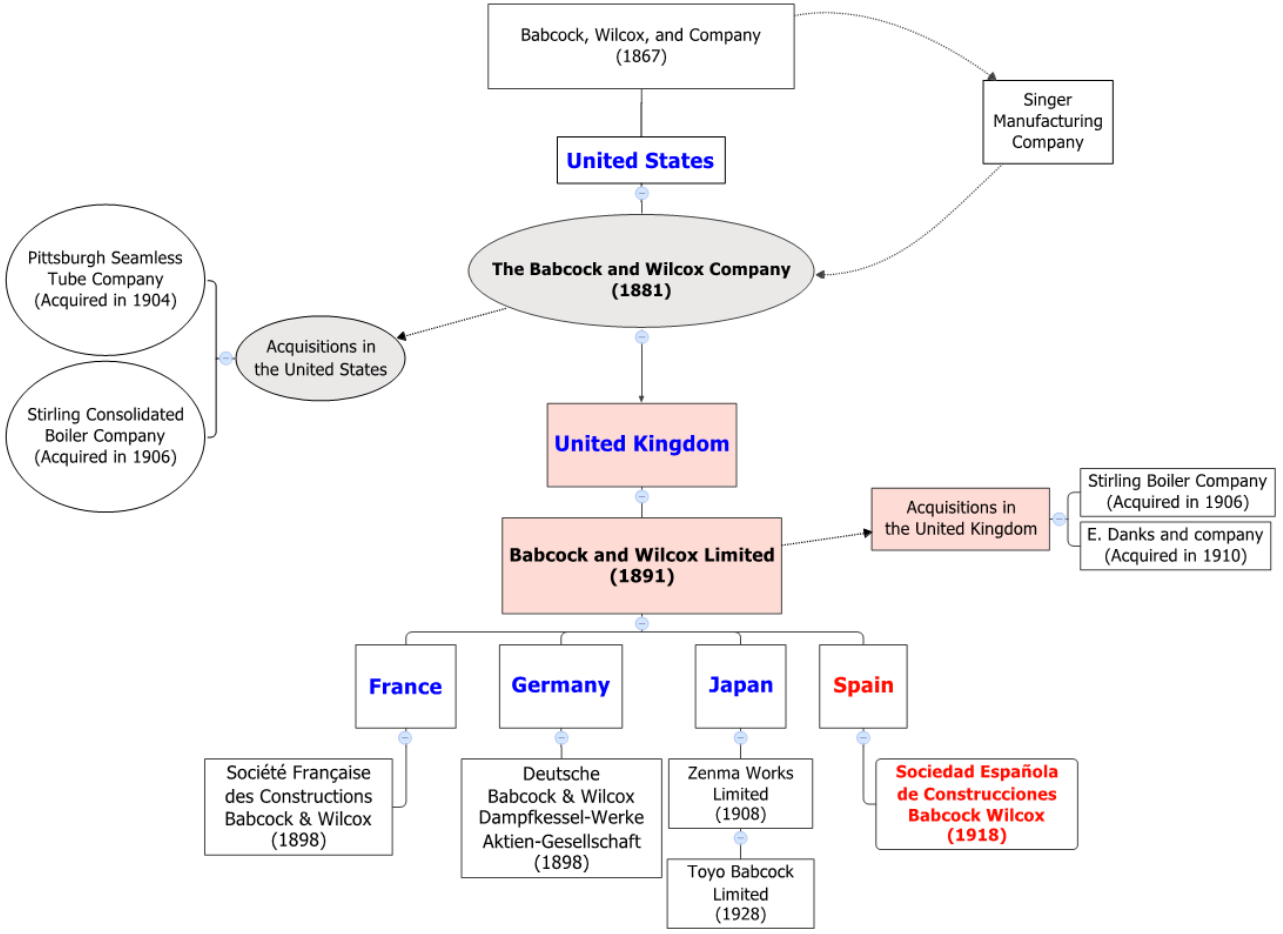
[10] Such as G.H. Boyce, *Co-Operative Structures in Global Business: Communicating, Transferring Knowledge and Learning across the Corporate Frontier*, London and New York, Routledge, 2001, c. 7.

in steam generators",[11] which would lead to new steam engine configurations.[12] The initial design was progressively enhanced throughout the 1870s, due to technical agreements with the *Singer Manufacturing Company* – which was first a customer and then a partner for improving the delicate mechanisms of the boiler. Finally, the firm was incorporated into *The Babcock and Wilcox Company* in 1881, which rapidly initiated the international expansion of its business.

In fact, in 1881, the firm had already opened two international offices in Europe, one in Glasgow (Scotland) and the other in Clichy-la-Garenne (France).[13] Furthermore, before 1914, B&W had established almost 30 offices and/or agents outside the United States in main global cities.[14] In 1891, the British *Babcock and Wilcox Limited* was created as an independent firm for expanding sales in Europe and the rest of the world, while the parent American company retained the US and Cuban markets. Subsequently, in 1898, the British company founded two subsidiaries: the German *Deutsche Babcock & Wilcox Dampfkessel-Werke Aktien-Gesellschaft* and the French *Société Française des Constructions Babcock & Wilcox*. Ten years later, in 1908, it created a Japanese firm called *Zenma Works Limited*,[15] which would give rise to *Toyo Babcock Limited* in 1928.[16] Finally, the Spanish affiliate *Sociedad Española de Construcciones Babcock Wilcox* was founded in 1918. Meanwhile, the American B&W expanded its operations by acquiring the *Pittsburgh Seamless Tube Company* in Beaver Falls, Pennsylvania, in 1904, and the *Stirling Consolidated Boiler Company* plant in Barberton, Ohio, in 1906. The Beaver Falls plant led to a new section: *The Babcock & Wilcox Company, Tubular Products Division*, sometimes referred to as *The Babcock & Wilcox Tube Company*.[17]

[11] US patent n. 65,042.
[12] For an accurate and detailed description of B&W's technological evolution until 1939, see R.W.M. Clouston "The Development of the Babcock Boiler in Britain up to 1939", *Transactions of the Newcomen Society*, vol. 58, n° 1, 1986, pp. 75–87.
[13] See http://cnum.cnam.fr/CGI/redir.cgi?M367 for the French reference (January 2015).
[14] Bruland, "The Management of Intellectual Capital…", Table 3.
[15] Bruland, "The Babcock & Wilcox Company…", pp. 239–240.
[16] See http://www.bhk.co.jp/english/about/history/index.html (January 2015).
[17] See http://www.lawrencecountymemoirs.com/lcmpages/76/babcock-wilcox-company-bw-beaver-falls-pa (January 2015).

Figure 1: Entrepreneurial evolution of the Babcock & Wilcox group (1867-1939)



***Source*:** Bruland, "Managing Foreign Operations…" Table 6.4; and information available at http://www.bhk.co.jp/english/about/history/index.html and http://www.lawrencecountymemoirs.com/lcmpages/76/babcock-wilcox-company-bw-beaver-falls-pa (January 2015).

Thus, by the end of WWI, B&W had already established a complex and successful international structure. In addition to the business's enlargement in America, the British firm had founded a manufacturing plant in Scotland and acquired the English *Stirling Boiler Company* and *E. Danks & Company* in 1906 and 1910, respectively. In 1923, it also established a manufacturing plant near Sydney (Australia), which would give "employment to more than 600 hands" by 1929.[18] The German subsidiary opened a plant in Oberhausen, bought a factory in Gleiwitz, and would build another in Friedrichfeld in 1921; beginning with just 30 employees in 1898, it would employ 3,000 by 1939.[19] The French branch established a factory in La Courneuve, where it grew – acquiring land and opening new works – from just 150 workers in 1900 to 1,600 during the 1960s.[20] As we will see in the following section, the Spanish B&W also organized a significant factory in Bilbao, linked to mechanical construction and railway businesses that would grow from 300 workers in 1918 to 1,653 in 1922 and a maximum of 5,250 in 1976.

After WWII, the B&W conglomerate continued with its activities in mechanical engineering and began new ventures, especially in the emerging nuclear sector.[21] During the 1960s and first 1970s, a period of sustained economic and entrepreneurial growth, the group expanded by opening new branches and by participating in numerous firms in related business within each country. The corporate and entrepreneurial evolution of the group during the 1980s and 1990s led to a diversification of activities, although Babcock's prestigious name was maintained in the new firms, divisions, mergers, and business alliances, especially in the US, the UK, and Germany, where these goals can be still realized in the 21st century.

The globalization processes led to crucial changes in B&W's structure: during the first process, it rapidly evolved from an outstanding original firm specialized in innovative boilers to a technologically integrated multinational corporation, which extended the business to distinct kinds of steam engines and power plants, metal tube production, mechanical construction, railways, and naval works. The second globalization process expanded the traditional business and influenced the group's entrepreneurial diversification and financial evolution, as well as the opening of new technological trajectories and businesses such as nuclear facilities. Given this long-term history, a significant part of B&W's success hinged on strategic technological agreements – within and outside the group – and on the early and unbroken development of intangible asset management skills.

[18] *The Sydney Morning Herald*, Saturday, 14 September 1929. See also the same newspaper of Friday, 26 January 1923, pp. 7-8.
[19] Boyce, *Co-operative Structures.*…, p. 118.
[20] See http://www.ville-la-courneuve.fr/5_regards/archives/160/pages/hier.html (January 2015)
[21] Bruland, "The Babcock & Wilcox Company…", p. 221.

3. Babcock & Wilcox in Spain

Since the beginning of B&W's activities, Spain and its remaining colonial territories in America were significant targets for the company.[22] For instance, from the 852 total export contracts signed by the Glasgow branch between 1881 and 1891, 162 were to Spain and Cuba, which became the second largest market for the company outside the UK after France.[23] Thus, it is easy to understand why the American headquarters retained the Cuban market when the British company was created in 1891 and why peninsular Spain was a significant possibility for establishing a British continental branch as the protectionist turn of events extended throughout Europe.

In fact, after the 1891 protectionist tariff and the 1898 loss of Cuba, Puerto Rico and Philippines, Spain progressively turned toward a nationalistic path that boosted domestic industrialization and the substitution of imports. Distinct laws and decrees passed in 1907, 1909, 1915, and 1917 strongly supported domestic industry and national production,[24] which encouraged foreign companies to open affiliates and subsidiaries within the country's borders. Particularly, the 1917 law for the protection of new industries set up a pull of measures for facilitating such investments by direct support, loans, or State-guaranteed interest. In that context, and looking for such protection, the *Sociedad Española de Construcciones Babcock Wilcox* was created on the 1st of March, 1918.

The constitutional deeds[25] were originally signed between the British B&W managing director, Sir James Kemnal Rosenthal, and the six Spanish founder partners,[26] all of whom were very well-known, wealthy industrials involved in the most significant firms in iron and steel, machinery and equipment, railway, electricity, and banking sectors. As a matter of fact, they were on the Boards of Directors of distinct Spanish firms and banks and had strong political connections and even noble titles. The share of capital was established in 20 million *pesetas* divided into 40,000 shares. In compliance with the aforementioned 1917 law, which required no more than 1/3 foreign stockholding, 80% of the shares were issued only for Spanish investors, while the other 20% went directly to the British parent company. This same ratio was established for the Board of Directors, which was chaired by a Spaniard and composed of twenty

[22] D. Pretel, N. Fernández-de-Pinedo, "Circuits of Knowledge: Foreign Technology and Transnational Expertise in Nineteenth-Century Cuba," *The Caribbean and the Atlantic World Economy, 1650-1914*, Basingstoke, Palgrave Macmillan, 2015, p. 274.

[23] Bruland, "Managing Foreign Operations…", Table 6.2.

[24] Law of the 14th of February, 1907, for the protection of the national industry (establishing that the State contracts would preferably acquire domestic goods and services); Law of the 14th of July, 1909, supporting the domestic naval industry; Royal Decree of the 18th of July, 1915, supporting the establishment of industries for manufacturing non-existing products within the country (a measure related to the outbreak of WWI); and Law of the 2nd of March, 1917, for the protection of new domestic industries and the development of existing ones (see P. Escribano, *El fomento del comercio interior*, Sevilla, Universidad de Sevilla, 1978, pp. 77–78).

[25] AHBBV, *La Sociedad Española de Construcciones Babcock & Wilcox. Su constitución y los primeros ejercicios sociales (1918-1923)*, Informaciones: Cuadernos de Archivo, Archivo Histórico del Banco Bilbao Vizcaya 10 1993, pp. 16–29.

[26] Tomas de Zubiría e Ibarra; Pedro Mac Mahón y Aguirre; Ernesto Ugalde y Echevarría; Emilio de Ibarra y de la Revilla; Víctor de Chávarri y Anduiza; and Juan Urrutia y Zulueta.

members, of which four were designated by the British firm.[27] Among the first-share subscribers, there were 63 significant Spanish businessmen, industrials, and bankers, including those herein mentioned, and three firms: the *Banco de Vizcaya* (2.2%), the bank *Aldama y Cía* (4.4%), and the main iron and steel Spanish producer *Altos Hornos de Vizcaya* (8.7%).

The Board of Directors' annual reports for the years 1918-1923 reveal the initial frenetic activity.[28] During those years, the total capital was paid out, and the first bond issuances took place, all subscribed for by the British B&W.[29] One million square meters of land was acquired, and the buildings and workshops (ten sheds) were progressively raised and gradually opened, occupying an area of 35,000 m^2. The iron foundry was established in 1920, and during the summer of 1921, the boilers, metal constructions, forging, locomotives, and assembly plants were definitively launched. The machinery was imported from the parent company, which also provided almost all business technology and technical assistance. The British also helped with qualified human capital and engineering.

From the beginning, the firm opened offices in main Spanish and Portuguese towns and received several orders[30] that were first attended by turning to the British B&W. From 1922 onwards, the Spanish affiliate was able to manufacture and fully attend to the demand. The net profit slowly increased throughout the period, and the first dividends were distributed in 1923 (15 *pesetas* by share), when the accumulative income statement, amortizations discounted, exceeded one million *pesetas.* Moreover, the firm's business experienced sustained growth from 1918 to the outbreak of the Spanish Civil War in 1936, especially during the 1920s. Those were years of nationalism and protectionism that increased domestic industrial production and triggered a substantial volume of orders from distinct industries and sectors. Between 1920 and 1935, the Spanish B&W built 469 distinct models of their famous boilers, 301 railway locomotives, and hundreds of industrial cranes.[31] With boilers and steam generators as B&W's core technological activity, the Spanish affiliate was also linked to the railway business, which actually turned into one of its main branches over the course of the twentieth century. The firm also manufactured other equipment goods, such as gas industrial tanks, road rollers, or hydraulic turbines, and took numerous orders for machinery and equipment repairs. Similarly, the B&W workshops in Bilbao turned into the main producers of seamless steel pipes, taking advantage of the raw materials provided by one of the principal shareholders: *Altos Hornos de Vizcaya*.

[27] Besides the aforementioned six founding members, the first Board of Directors was composed of similar wealthy Spanish industrials, bankers, and personalities such as José Luis de Oriol, José María de Palacio, Enrique Ocharan, Fidel Alonso Allende, Fernando María de Ibarra, César de la Mora, José Luis de Ussia, Carlos Prado, Tomás de Urquijo, and later Federico Echevarría and Pedro de Orúe. The British B&W designated James Kemnal Rosenthal, Charles Albert Knight, Francis German Cowlrick and one of the Spanish founders Juan Urrutia y Zulueta. The Board was chaired by Víctor de Chavarrí.
[28] AHBBV, *La Sociedad Española.…*, pp. 36–57.
[29] 10 million *pesetas* in 1912 and 2 million more in 1923.
[30] For a total value of 3 million pesetas in 1918 and 8.5 million pesetas in 1919.
[31] F.J. Abarrategui, *Babcock & Wilcox y el patrimonio histórico-industrial vasco*, Bilbao, Fundación Babcock para la Innovación Tecnológica, 2000, pp. 16–35.

During the 1930s, the economic, political, and social situation deteriorated rapidly, leading to a three-year Civil War that culminated in a dictatorship and economic autarky during the 1940s, while the rest of the world went through a second devastating global war. In this context, B&W Spain experienced a progressive decline in sales, as well as raw material shortages. Nevertheless, it went on manufacturing and especially repairing railway locomotives, wagons, and other hauled material, as well as distinct machinery and equipment, while they began to produce their own steel in 1944. They also extended the production activity to steam generators for thermal power plants, pipes and other parts for hydraulic jumps, and even truck motors, farm tractors, and boat diesel engines.[32] During the 1950s, still under the autarky but with increasing openness to foreign trade, the firm recovered sales and expanded activities and investments, which would favor outstanding and sustained growth during the 1960s and the first years of the 1970s, which occurred in general in the Spanish economy.

The 1959 "stabilization plan" definitively broke the autarky, favoring FDI, exchange rate stability, trade openness, and industrial and economic growth. Indeed, during the 1960s, the Spanish B&W expanded the business with new and modern industrial boilers, diesel-electric locomotives, high-quality seamless steel pipes, large cranes for ports and industrial complexes, and distinct machinery and equipment developments for classic power plants and even for nuclear plants in the first years of the 1970s. During this period, the firm enlarged businesses, sales, buildings, workshops, partners, and investments, participating in the creation or acquisition of several related firms,[33] reaching its maximum size and number of employees (5,250), and even beginning to export to Latin America and the North of Africa. In 1974, the company changed its name to *Babcock & Wilcox Española S.A.*

From this point onwards, the situation became worse. The mid-1970s oil price shocks and the political situation in Spain at the end of Franco's dictatorship harshly affected the company. In the middle of one of the most difficult economic and political crises of the Spanish economy, B&W's sales, investments, and payments to suppliers and employees halted, provoking the immediate emergence of financial and labor problems. In 1977, the firm's director, Javier Ybarra y Berge, was kidnapped and killed by the Basque terrorist group ETA.[34] In February of 1978, the firm filed for bankruptcy protection and was put into receivership and under judicial administration until mid-1979.[35] The 1980s gave way to deep industrial restructuring and rationalization, especially in heavy industries, such as those related to B&W, which went to 100% public ownership after several increases in capital. In 1984, the firm was split into four businesses (power plant facilities; railways; tubular products; and special steel sheets) from which the firm would definitively abandon the production of railway material and special steels in 1986, the year of the Spanish entry in the European Economic Community (EEC).

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[32] Id. Ibídem, pp. 36–37.
[33] Such as *Babcock-Kellog*; *Equipos Nucleares S.A.* (ENSA); *Accesorios Babock-Tubos Reunidos* (ABT); *Bilbainas de Montajes* (BILME); *Instalaciones Siderúrgicas S.A.* (INSISA); or *Proyectos e Instalaciones de Desalación S.A.* (PRIDESA). See Abarrategui, *Babcock & Wilcox…*, p. 61.
[34] *El País*, 23rd of June of 1977.
[35] *El País*, 24th and 25th of February of 1978.

Although orders and sales increased during the following years, the firm situation remained critical. Since 1976, B&W Spain lost workers year by year, and in 1997, it employed only 1,188 persons. Between 1983 and 1997, all the increases in capital were subscribed by the public *Instituto Nacional de Industria* (INI), for a total amount of 57,187 million *pesetas* (343.7 million euros), losing approximately 85% of the investment. In 1998, the European Union considered the intervention as an incompatible public assistance and challenged it. Afterwards, the Spanish National Audit Office developed an exhaustive report on B&W's 1993-1997 accounting years, which led to a devastating decision in 2003: B&W Spain was technically bankrupt and went into receivership.[36] Eventually, a complicated privatization process had begun. The final total cost for the Spanish State reached 212,000 million pesetas (1,274 million euros).[37] The first purchaser, *Babcock Borsig Power GmbH*, went into administration in 2002, and the second one, Austrian Energy (ATB), began an insolvency process in 2010.[38] In that year, the firm reached only 400 employees.

4. Babcock & Wilcox's IPR management strategies and the Spanish patent system

During these almost one hundred years of history, the Spanish B&W – as occurred with the whole domestic system of innovation – strongly depended on foreign technological advances. Thus, technology transfer and patent agreements were common throughout the whole twentieth century, either within the entrepreneurial group or with other technology-leader firms. The company's foundation itself in 1918 was based on a contemporary official agreement through which the British B&W assigned patents to the Spanish affiliate and provided "unlimited technical assistance and industrial expertise". In fact, the British company, in concert with the Board of Directors, had the attribution of appointing a technical director, who would remain in charge of technical issues.

The patent-transfer strategy was not new to B&W. Indeed, as we already know, the firm's initial success was based on a superior technology patented in 1867, and from that moment onwards, protecting inventive and innovative activity and negotiating IPRs was crucial to B&W's business. During the last decades of the nineteenth century and the first of the twentieth century, the machinery and equipment sector grew and expanded. Steam production technology, in which B&W first operated, was already a mature industry with many competitors in a context that boosted patenting. Furthermore, there is strong evidence that in certain sectors, such as chemical and mechanical engineering, patenting has traditionally been more significant than in other industries, especially during internationalization processes. For instance, US, German, and Japanese firms in the chemical and machinery and equipment industries reported

[36] See *Boletín Oficial del Estado. Suplemento, n. 99*, Friday, the 25th of April of 2003: *Resolución de 11 de marzo de 2003, aprobado por la Comisión Mixta para las relaciones con el Tribunal de Cuentas, en relación al informe de fiscalización de la Sociedad Babcock y Wilcox Expañola, S. A., ejercicios 1993-1997.* See also *El País. Negocios*, 11th of February of 2001.
[37] *El País*, 25th of October of 2001.
[38] *El Mundo*, 31st of October of 2010.

during the 1990s that IPRs strongly influenced their FDI decisions, while companies in transport, metals, food, sales, and distribution did not.[39]

Since its founding, B&W not only registered all technological advancements but also learned to very well manage such intangible assets, especially for participating in affiliates and subsidiaries. The initial founders' patents and knowledge were turned over to the incorporated American firm in 1881, which rapidly began to take patents all over the world. When the independent British B&W was created ten years later, it purchased all non-US IPRs to begin with for £140,000 (85 patents in 12 countries), which constituted more than 50% of the starting capital.[40] Subsequently, the two companies shared their patents, agreeing to use them in their respective areas of influence (the United States and Cuba for the American firm and the rest of the world for the British firm).[41] Similarly, in 1898, the German B&W was founded on the grounds of an exclusive license to sell the innovative boilers and to sublicense B&W patents within the German Empire and its colonies. As would occur in the Spanish case, at the same time that the German subsidiary was created, a separate contract with the parent British firm was signed to establish the terms of technology licensing, knowledge sharing, and further patenting.[42]

Hence, IPRs were used not only as monopolies for technology that favored a firm's technical leadership but also as tools for corporate spread and internationalization. In the case of B&W, intangible assets played a significant role in the group's spread and in linking parent and affiliate firms in a global innovation strategy. B&W progressively achieved strong IPR management skills, and a distinct range of patent strategies were constantly debated and developed by the Boards of Directors (concerning litigation, assignments, license agreements, employees' inventions, country-specific legal requirements, etc.), as K. Bruland demonstrated for the British company.[43]

Indeed, thanks to the research already carried out, we know quite a lot about B&W's patent performance in the United States, the United Kingdom, and Germany. At the end of the nineteenth century, all these countries had strong systems of innovation that fostered inventive activity, guaranteed valuable IPRs, and enhanced active markets for technology. Although they had distinct characteristics, fees, and legal traditions, the three countries had reliable patent systems oriented toward boosting original innovation.[44] However, there are no specific and detailed analyses of how multinationals, and particularly B&W, conducted FDI and patent management in

[39] E. Mansfield, *Intellectual Property Protection, Direct Investment, and Technology Transfer: Germany, Japan, and the United States*, World Bank Publications, IFC Discussion Papers 27 1995, p. 23; J.-Y. Lee, E. Mansfield, "Intellectual Property Protection and U.S. Foreign Direct Investment", *The Review of Economics and Statistics*, vol. 78, n° 2, 1996, pp. p. 182.
[40] Bruland, "The Babcock & Wilcox Company…", p. 220 and 238.
[41] Bruland, "The Management of Intellectual Property…", p. 155.
[42] Boyce, *Co-operative Structures…*, p. 118.
[43] Bruland, "The Management of Intellectual Property…", pp. 160–161.
[44] For instance, the United States introduced previous technical exams very early in the nineteenth century (1836), Germany in 1877, and the United Kingdom in 1905, while the last two also maintained higher fees in an attempt to discourage low-quality invention patents (see J. Lerner, "150 Years of Patent Office Practice", *American Law and Economics Review*, vol. 7, n° 1, 2005, pp. 112–43, tables 1 and 4).

backward economies with weak or hybrid patent systems designed to boost industrialization, technology transfer, and innovation. This was the case of the Spanish patent regime throughout the last two centuries (until 1986), which lacked previous technical exams, had patents of introduction that allowed anyone to register foreign inventions not established in the country, and maintained compulsory working clauses for manufacturing the inventions protected within the borders.[45]

[45] See Sáiz and Pretel, "Why Did Multinationals Patent in Spain?...", p. 40.

Table 1. Babcock & Wilcox related patents in Spain (1891-1917)

	Location	Patents of Invention	Patents of Introduction	Certificates of Addition	Technology Protected	Implemented %	Duration ≥ 5 y. %	Duration ≥ 10 y. %	Assignments & Licenses %
Babcock, George Hermann	Plainfield (USA)	1	--	--	Constructive Elements	100.0	0.0	0.0	0.0
Pratt, Nathaniel Waterman	New York (USA)	2	--	--	Machinery and Furnaces	50.0	50.0	50.0	0.0
Knight, Charles Albert	Lanark (UK)	2	--	--	Steam Generators	50.0	50.0	50.0	0.0
Rosenthal, James Hermann	London (UK)	1	--	--	Steam Generators	0.0	0.0	0.0	0.0
Babcock & Wilcox Ltd.	London (UK)	20	11	2	Boilers, Furnaces, Heaters, Steam Generators, Cranes; and related Components	84.8	78.8	54.5	0.0
Babcock & Wilcox Ltd. / J. Samuel White & Company Ltd.	London and Cowes (UK)	1	--	--	Fuel Spraying	100.0	100.0	100.0	0.0
TOTAL PATENTS	--	*27*	*11*	*2*	*Boilers, Steam Generators, Heaters etc.*	*80.0*	*72.5*	*52.5*	*0.0*

***Source*: P. Sáiz, F. Cayón, and F. Llorens (Dirs.) *Base de datos de solicitudes de patentes de invención. España 1878-1939*, Madrid, OEPM, 2000 onwards; and original files at OEPM's Archive.**

The first Spanish patents related to B&W were filed between 1887 and 1892 by well-known members of the American and, later, the British firms' Boards of Directors: the own G. H. Babcock, N. W. Pratt, Ch. A. Knight, and J. H. Rosenthal (sir James Kemnal). Once the independent British company was established in 1891, it immediately took over the patent program in Europe. As a result, *Babcock & Wilcox Ltd*. registered 33 more patents in Spain between 1894 and 1917, mainly during the 1900s.[46] A quick examination of Table 1 indicates that, the weaknesses and complexities of the Spanish patent system notwithstanding, B&W very efficiently managed their intangible assets in the country from the beginning. Compulsory working clauses, the main reason of foreign patent extinction, were systematically beaten. More than 70% of B&W's initial patents reached a 5-year duration, and more than 50% passed 10 years, which was quite rare in the Spanish system. Furthermore, a significant percentage of B&W's first intangible assets in Spain were "patents of introduction", which could last just 5 years and could apparently be used to protect others' technologies.

Thus, before arriving on the Spanish territory, the British B&W had already developed an "IPR-beachhead" – taking advantage of the local legal system – that would later be used for subsequent direct investments in the country. Indeed, as we have mentioned, the constitutional deeds of the Spanish B&W were signed with a technology transfer contract that established patent and technical assistance agreements until 1940. Basically, the British firm transferred 16 pre-1918 Spanish patents,[47] assigned the use of all further patents granted before the end of the agreement, and allocated all the physical assets in Spain and Portugal to the new firm. The British provided various kinds of technical support and assumed the technical direction of the Spanish plant construction as well as staff's technical instruction and training.[48] Moreover, the British B&W was even in charge of machinery purchases for the Spanish firm during the period of plant construction in order to guarantee the quality of supplies. As compensation for the technical agreement, the Spanish firm paid 2,500,000 *pesetas* in two years and attempted to limit its business to the Spanish Peninsula, as well as to reciprocally assign any patent obtained to the parent company.

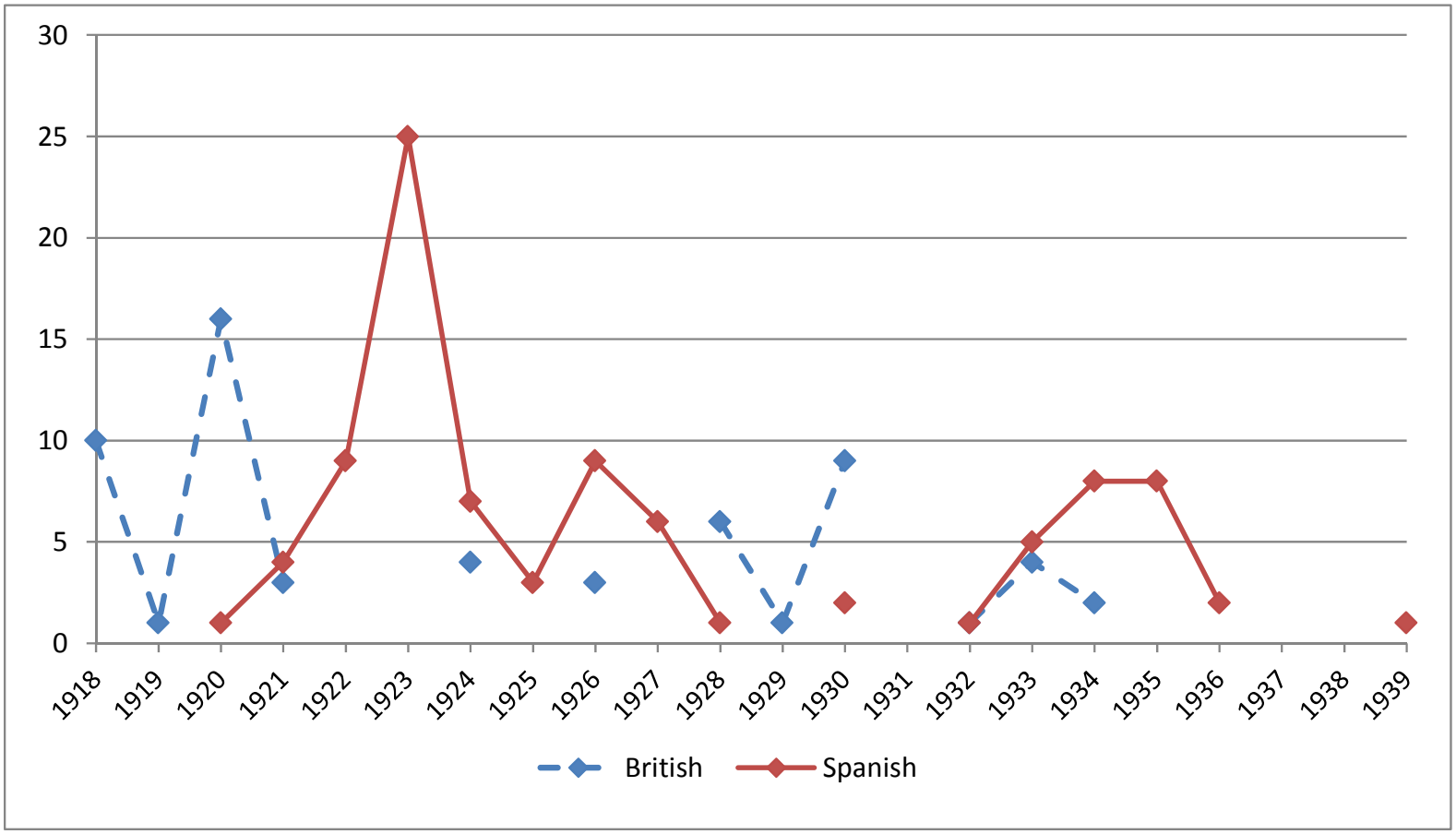
[46] Half of the patents were filed in 1901, including mainly the patents of introduction.
[47] Patent numbers: 28,258; 28,539; 31,399; 35,591; 39,500; 43,539; 44,339; 44,241; 46,095; 46,101; 46,369; 48,957; 50,190; 52,906; 54,106; and 63,751.
[48] Spanish Patent and Trademark Office (OEPM), Patent 28,258. This file has the agreement and patent assignment deeds between the British and Spanish B&W.

Table 2. Babcock & Wilcox related patents in Spain (1918-1939)

	Location	Patents of Invention	Patents of Introduction	Certificates of Addition	Technology Protected	Implemented %	Duration ≥ 5 y. %	Duration ≥ 10 y. %	Assignments & Licenses %	Assignees
Babcock & Wilcox Ltd.	London (UK)	46	10	1	Boilers, Steam Generators, Furnaces, Welding, Metal Works, Fuel Spraying and Crushing, Cranes, Constructive Elements, Industrial Cleaning, Tube Production; and related Components	86.0	82.5	70.2	66.7	Spanish B&W
Babcock & Wilcox Ltd. / Davidson & Company Ltd.	London and Belfast (UK)	1	--	--	Separation of Materials	100.0	100.0	100.0	100.0	Davidson & Co. Ltd.
Babcock & Wilcox Ltd. / Hall-Brown, Archibald / Jones, Edwin Walter	London (UK)	1	--	--	Airship Berths	0.0	100.0	0.0	100.0	British B&W
Babcock & Wilcox Ltd. / Parker, Alfred Edward / Davy, Christopher Samuel / Meiklereid, Duncan Graham	London and Lee (UK)	1	--	--	Furnace Components	100.0	100.0	100.0	100.0	Spanish B&W
Deutsche Babcock & Wilcox Dampfkessel-Werke A. G.	Oberhausen (DE)	1	--	--	Drying of Materials	0.0	0.0	0.0	0.0	--
Sociedad Española de Construcciones Babcock & Wilcox	Bilbao (ES)	71	20	3	Boilers, Steam Generators, Furnaces, Heaters, Tube Production, Water Treatment, Welding, Metal Works, Fuel Spraying, Cranes; and related Components	93.6	93.6	83.0	0.0	--
Société Française des Constructions Babcock & Wilcox	Paris (FR)	1	--	--	Furnace Components	100.0	100.0	100.0	100.0	Spanish B&W
The Babcock & Wilcox Tube Company	Beaver Falls (US)	1	--	--	Seamless Tube Production	0.0	100.0	0.0	0.0	--
TOTAL PATENTS	--	*123*	*30*	*4*	*Boilers, Steam Generators, Heaters, Furnaces, Welding, Metal Works, Tube Production, etc.*	*89.2*	*89.2*	*77.1*	--	--

***Source*: See Table 1.**

Figure 2. British and Spanish Babcock & Wilcox patents in Spain (1918-1939)



***Source*: See Table 1**

Table 2 shows that B&W's IPR management improved after establishing the Spanish affiliate in 1918, with almost 90% of the group's patent grants implemented and in force after 5 years and 77% valid after 10 years. Figure 2 depicts clearly how the patent program evolved in Spain, driven by the British parent and the Spanish affiliate companies in an apparently coordinated way. During the initial years in which the Bilbao factory was established, the British B&W continued registering patents of invention and introduction until the Spanish firm took over. In reality, 50% of the British patenting in the whole period occurred between 1918 and 1921. During the 1920s, a decade of quick and heavy industrialization in Spain, the Spanish B&W patent activity was substituted for the British. Indeed, the affiliate's patenting was concentrated in that decade (67%). The British also registered several patents from 1929 and 1934, while the Spanish registered another 25% between 1933 and 1936. Both firms patented in the same technological groups, apparently without huge differences, protecting technological advances linked to boilers, steam generators, furnaces, cranes, metal works, fuel spraying, tube production, and related components. A close examination of B&W's patents in Spain during this period reveals a process of incremental innovation in the production of their machinery and equipment (especially in boilers, steam generators, furnace components and cranes) that fully fit with Bruland's analysis of B&W patents in the United Kingdom and the Utterback and Abernathy model of innovation dynamics (to quickly summarize: first, product development and, second, process incremental improvements).[49]

However, after reading the technology transfer agreement and analyzing the patents, it is quite clear that the technology flowed from the British company to the Spanish company. The patent assignment column in Table 2 demonstrates that innovation came from the parent company, which systematically assigned to the affiliate all its IPRs in Spain.[50] Most of the affiliate's patents were probably innovations achieved in the British or other plants and directly registered by the Spanish firm, as the patent sequence in Figure 2 strongly suggests. This strategy in Spain fits the global patent program spread by B&W. IPRs were carefully managed by the group in each and every country as tools for fighting competence in a mature sector but especially as an organizational device for internationalization. Each affiliate or subsidiary was in charge of the group's IPRs in the area of the domestic firm's influence, in this case, Spain and Portugal, no matter where the innovation was developed. The links among companies were established through particular agreements that would evolve over time. The British parent firm, the most dynamic during this period, acted as a technological hub.

Depending on the technical capabilities of each affiliate and on learning-by-doing processes, new incremental or even radical inventions may be developed in any plant, but the knowledge would then be shared through crossed patent licenses and technological agreements in which the British company was always involved. Although

[49] For further details, see Bruland, "The Management of Intellectual Property…", pp. 156–157 and Appendix.

[50] Patent-assignment contracts are in OEPM, Historical Archive, patents 67,472; 72,684; 73,525; and 89,702.

the proximity of WWII would entangle the relationship between the British and the German firms,[51] collaboration in the management of innovation always prevailed, becoming a long-term characteristic of the B&W conglomerate. Furthermore, as the original B&W's patents expired, inter-firm collaboration extended. During the 1930s, staff from the British parent company and all the European affiliates, including the Spanish affiliate, met annually to discuss technical matters and widen the agreements.[52] All this would contribute later to elaborate common R&D strategies and to maintain B&W's international leadership of the business.

[51] See Boyce, *Co-operative Structures.…*, pp. 123–124.
[52] Id. Ibídem.

Table 3. Spanish patents owned by other companies and assigned to B&W (1918-1939)*

Patents	Patentee	Assignee	Assignment Years	Price (Pts.)	Technology
7	*The Stirling Boiler Company Ltd.*	Spanish B&W	1933	1,500	Improvements in Water-Tube Boilers
3	*Fuller Engineering Company*	British B&W*	1930-1931	1,200	Improvements in Furnaces and Fuel Spraying
3	*Fuller Fuel Company*	British B&W*	1930	1,200	Improvements in Crushing Mills and Drying Procedures
2	*Fuller Lehigh Company*	British B&W*	1930	800	Improvements in Furnaces and Crushing Mills
2	*Bailey Meter Company*	British B&W*	1930	800	Improvements in Furnaces and Apparatus for Powdery-Material Distribution
1	*Egui Irizar, Manuel*	Spanish B&W	1927	5,000	Moving Grate for Furnaces
1	*Lejeune, Jules*	Spanish B&W	1928	1,500	Valve Control
1	*Merz & MacLellan*	British B&W*	1931	4,500	Fuel Distillation at Low Temperature
1	*Smith, George Z. / Herbert, Edwin B.*	British B&W*	1930	500	Feeding Device for Crushed Fuel

* Most of these patents were reassigned to the Spanish B&W in 1931, as stated in OEPM, Patent 73,525.

***Source*: See Table 1.**

Technological agreements and exclusive licenses were signed not only within the conglomerate but also with other companies. The Spanish affiliate, for instance, developed technical contracts during the 1920s and 1930s with *The British Mannesmann Tube Co. Ltd.*, with *G. & J. Weir Ltd.*, or with *Lassen Hjorl & Menzies*, respectively specialized in tube production, boilers' feeding pumps, and feed-water treatment.[53] During those two decades, 21 patents filed in Spain by other firms were licensed to the British or the Spanish B&W companies (Table 3). Specific improvements in boilers, furnaces, and fuel feeding and control were bought from *The Stirling Boiler Company Ltd.* (UK),[54] the distinct *Fuller* fuel and engineering companies (US), the *Bailer Meter Company* (US), *Merz & Maclellan* (UK), and several independent inventors, for a total amount of 17,000 *pesetas*. Again, most of the patents assigned to the British B&W were finally reassigned to the Spanish, which corroborates that the parent company led IPR and technical issues. Therefore, the B&W group not only invested in its own technological developments but also, as a leader in innovation, paid close attention to others' inventions and patents in the sector or in convergent specialized technologies, which could contribute to the enlargement of the business and to the maintenance of technological leadership.

During the 1940s, B&W Spain signed license agreements with the Swiss *Sulzer* and the Danish *Burmeister & Wain* to produce maritime diesel engines. In 1956, B&W affiliates in the UK, Germany, France, and Spain committed to contribute to research expenses, independent of the plant in which the activity was developed; this accord was extended to the payments for a technological interchange agreement with the US that Babcock signed in 1958.[55] Thus, during the 1960s and 1970s, the Spanish B&W was constantly supported by innovation and technical agreements within the group, which also signed technological contracts with other firms. Moreover, in the mid-1960s, the distinct European B&W created a common firm for the development of a technological center in Holland for R&D purposes: *Babcock & Wilcox Technische Maatschappij N.V.* From 1982 onwards, just when the economic situation for the Spanish B&W had irremissibly worsened, a small own R&D center was created near Bilbao.[56]

[53] Abarrategui, *Babcock & Wilcox…*, p. 30.
[54] A firm previously acquired by the British B&W in 1906.
[55] Boyce, *Co-operative Structures…*, p. 126.
[56] Abarrategui, *Babcock & Wilcox…*, p. 38 y 74.

Table 4. Babcock & Wilcox-related patents in Spain (1940-2000)

1940-1959

Company	**Country**	**Patents (%)**	**Technology Protected**
Babcock & Wilcox Ltd. (*)	UK	28.0	Nuclear Reactors and Facilities, Steam Generators, Power Stations
Sociedad Española de Construcciones Babcock & Wilcox	ES	49.3	Steam Generators, Boilers, Furnaces, Heat Exchangers, Metal Works, Welding, Tube Production, Conveyor Belts, Engines, Tractors, Crushing Mills, Fuel Feeding; and related Components
The Babcock & Wilcox Company	US	20.0	Nuclear Reactors and Facilities, Steam Generators, Melting Refractory Metals, Pressure Vessel and Generators
The Babcock Wilcox Tube Company	US	2.7	Metal Casting Processes
Total Babcock Patents (1940-1959)		**75**	

(*) Includes 1 patent with the UK Atomic Energy Authority and another with The English Electric Company Ltd.

1960-1986

Company	**Country**	**Patents (%)**	**Technology Protected**
Acco Babcock Inc.	US	1.6	Traction Cable Production
Babcock & Wilcox Ltd.	UK	1.6	Furnaces, Fuel Spraying, Metal Works, Reverse Osmosis
Babcock Controls Ltd.	UK	0.4	Control Systems
Babcock Electronics Corporation	US	0.2	Relays
Babcock Krauss-Maffei Industrieanlagen GmBH	DE	0.8	Waste Treatments
Babcock Power Ltd.	UK	0.4	Burner Control
Babcock Textilmachinen KG-GmBH & CO	DE	1.4	Textile Drying
Babcock-Atlantique	FR	0.2	Steam Power Plants
Babcock-BAU GmBH	DE	0.2	Chimney
Babcock-Brown Boveri Reaktor GmBH (*)	DE	1.6	Nuclear Reactors and Equipment, Pressure Vessels
Babcock-BSH A. G., Vormals Buttner	DE	0.2	Gypsum Calcination
Babcock-Moxey Ltd. (**)	UK	0.8	Bucket Conveyors
Fives-Cail Babcock, S. A. (***)	FR	12.2	Steam Power Plants, Casting and Metal Works, Cement Production, Sugar Industry, Centrifuge Dryers, Crushing Mills, Presses, Evaporator Devices, Separation Procedures, Heat Exchangers, Conveyor Belts; and related Components
Deutsche Babcock & Wilcox, AG (****)	DE	3.4	Wastewater Purification, Iron Ore Treatment, Mechanical Devices

Isolite Babcock Refractories Company Ltd.	JP	0.2	Refractory Materials
Sociedad Española de Construcciones Babcock & Wilcox (Babcock & Wilcox Española, S. A.)	ES	3.0	Steam Power Plants, Gas and Steam Turbines, Boilers, Steam Generators, Gasogene Devices
Société Française des Constructions Babcock & Wilcox	FR	0.2	Gas and Steam Turbines
Samifi Babcock S. P. A.	IT	0.4	Refrigeration Devices, Controlled Atmosphere for Fruit Conservation
Samifi Babcock Samifi Internationale, S. A.	FR	0.4	Refrigeration Devices
The Babcock & Wilcox Company (*****)	US	70.5	Nuclear Reactors and Fuel, Nuclear Facilities and Safety, Power Plants, Steam Generators, Boilers, Furnaces, Heat Exchangers, Cleaning Devices, Tube Production, Metal Works, Welding, Refractory Products, Crushing Mills, Ultrasonic Systems for Crack Detection, Control and Testing Devices, Solar Energy; and related Components
Tubos Reunidos, S. A. (Babcock Wilcox - Tubos Forja)	ES	0.4	Tube Production
Total Babcock Patents		**501**	

(*) Includes 1 patent with Brown Bovery & Cie. (**) Includes 1 patent with BTR Industries Ltd. (***) Includes 3 patents with Generale Eucriere, Commissariat a L'Energie Atomique, and Sucrerie & Distillerie de Souppes-Ouvre Fils, S. A. respectively. (****) Includes 2 patents with Metallgesellschaft A. G. and 1 with Portland Zementwerk Dotternhausen and Rudolf Rohrbach. (*****) Includes 2 patents with ARMCO Inc.

1986-2000 (National path)

Company	**Country**	**Patents (%)**	**Technology Protected**
Babcock & Wilcox Española, S. A.	ES	20.8	Gas Filters, Electricity Generator
Babcock Lentjes Kraftwerkstechnik GmBH	DE	4.2	Carbon Combustion
Deutsche Babcock Energie- und Umwelttechnik AG	DE	4.2	Carbon Transport
Fives-Cail Babcok, S. A. / Denis Sertac, S. A.	FR	4.2	Boat Load System
The Babcock & Wilcox Company	US	66.7	Optical Fiber Transmission, Casting Control, Safety Control, Boiler and Tube Components
Total Babcock Patents		**24**	

1986-2000 (European path)

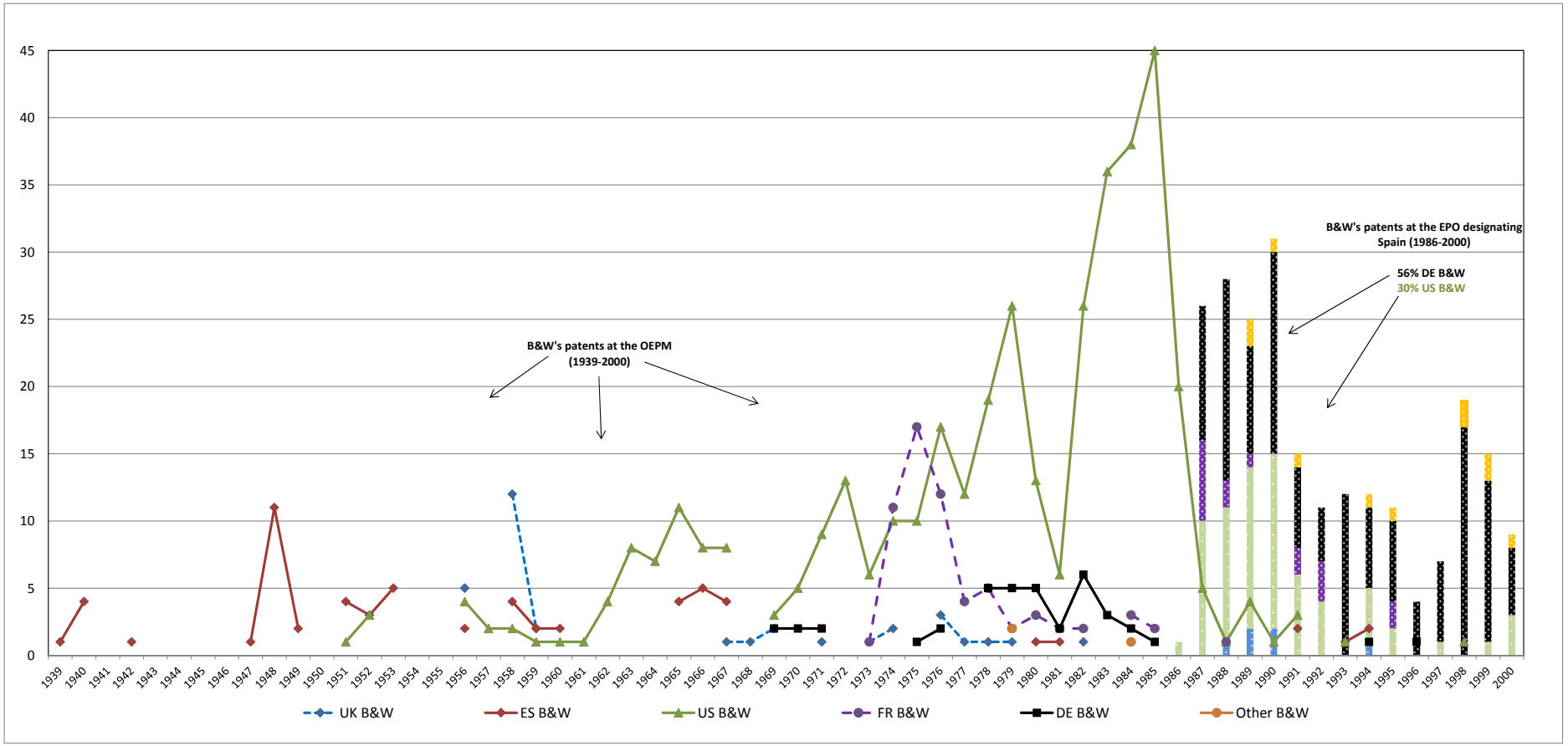
Company	**Country**	**Patents (%)**	**Technology Protected**
Acco Babcock Inc.	US	0.9	Cable Adjustment Control
Babcock Construction Ltd.	UK	0.4	Metal Tube Repairing
Babcock Energy Ltd.	UK	1.8	Tube Production, Load Systems for Ships and Aircrafs, Crushing Mill Components
Babcock Entreprise (*)	FR	3.5	Combustion Processes, Heat Exchangers, Air Injection, Heat Generation and Desulfurization

Babcock Industries Inc.	US	6.1	Cable Adjustment Control, Break Systems, Mechanical Devices
Babcock Kraftwerkstechnik GmBH	DE	5.3	Combustion Processes, Burners, Combined Cycle Power Plants, Steam Generators
Babcock Lentjes Kraftwerkstechnik GmBH	DE	0.9	Grates, Fuel Feeding
Babcock Materials Handling AG	DE	0.4	Bulk Material Loading
Babcock Materials Handling Division GmBH	DE	0.4	Bulk Material Loading
Babcock Prozessautomation GmBH	DE	0.4	ElectroFilter Optimization
Babcock Textilmaschinen GmBH	DE	10.5	Conveyor Belts Textile Treatment (washing, drying, impregnation, tensioning…)
Babcock Transformers Ltd.	UK	0.4	Polymeric Material Casting
Babcock-BSH AG Vormals Buttner-Schilde-Haas AG	DE	4.8	Gypsum-Fiber Board Production, Tools
Babcock-BSH GmBH	DE	2.6	Gypsum Board Production and Treatment
Babcock-Hitachi Kabushiki Kaisha (**)	JP	4.4	Combustion Processes, Burners, Fuel Treatment
Babcock-Omnical Industriekessel GmBH	DE	0.4	Boilers
Bristol Babcock S. A.	FR	0.4	Electric Coil
Deutsche Babcock Anlagen AG	DE	1.3	Flue Gas Cleaning
Deutsche Babcock Anlagen GMBH (***)	DE	15.4	Flue Gas Cleaning, Waste Treatment and Incineration, Grates, Welding Procedures,
Deutsche Babcock- Borsig AG	DE	2.6	Heat Exchangers, Pump Components
Deutsche Babcock Energie- Und Umwelttechnik AG (****)	DE	8.8	Steam Generators, Combustion Processes, Gas and Steam Turbines, Gas Filtering, Burners, Grates
Deutsche Babcock Werke AG	DE	0.9	Furnaces, Mechanical Devices
Fives-Cail Babcock, S. A.	FR	3.1	Cement Production, Sugar Production Machinery
LLB Lurgi Lentjes Babcock Energietechnik GmBH	DE	0.9	Burners, Filters
Spaans Babcock B.V.	NL	0.4	Storing Devices
The Babcock & Wilcox Company (*****)	US	22.8	Damage Detection in Boiler Tubes, Emission Control in Coal Boilers, Tube Production, Control and Measure Systems, Flue Gas Cleaning, Spraying, Burners, Steam Generators, Boilers, Nuclear Equipment; and related Components
Total Babcock Patents		**228**	

(*) Includes 4 patents with the Institu Français du Petrole. (**) Includes 5 patents with Hitachi Ltd. and 1 with The Hokkaido Electric Power Company Inc. (***) Includes 2 patents with Air Products GmBH and Sobotta GmBH Sondermaschinenbau respectively; 1 patent with Rheinische Kalksteinwerke GmBH & Co. KG and Stadt Hagen; and 1 patent with Doina International Ltd., Richard Weiss, Minnesota Mining and Manufacturing Company, Linde Aktiengesellschaft, and Epm Handels A.G. (****) Includes 2 patents with Deutsches Brennstoffinstitut GmBH Freiberg and Noell-Dbi Energie- Und Entsorgungstechnik GmBH respectively. (*****) Includes 3 patents with McDermott Technology Inc.

***Source*: See Figure 3.**

Figure 3. Babcock & Wilcox's patents in Spain (1939-2000).
Domestic path of the OEPM and designations at the European Patent Office (EPO)



Source: A. Hidalgo (Dir) *Base de datos de patentes concedidas y publicadas en el Boletín Oficial de la Propiedad Industrial. España 1930-1966*, Madrid, OEPM, 2003-2004; and official Spanish patent databases (1966-2000) in *CIBEPAT-CD*, Madrid, OEPM, June 2002.

The evolution of patent activity during the second half of the twentieth century confirms the Spanish lack of innovative capabilities. Figure 3 and Table 4 demonstrate that during the 20 years of autarky (1940s and 1950s), patent records decreased. Half of them were filed by the Spanish B&W in the traditional business (boilers, steam generators, furnaces, tube production, tractors, etc.), while the other half were filed by the British parent company and the US firm, as both of them were focused on nuclear technologies. Between 1960 and 1986, B&W's patents soared and diversified, but neither the economic expansion nor the oil crisis activated domestic invention activity. Patents from the Spanish affiliate almost disappeared, representing just 3% of the records in the core technologies of the business. Furthermore, the British company, which was the most dynamic before WWII and responsible for the European internationalization of the group, registered only another 3% of patents in Spain during this period,[57] a tendency that would worsen until the end of the century. From the 1960s onwards, the US B&W progressively took over the British B&W as center of innovation and patent registering, making up approximately 70% of the records of the OEPM. The technologies registered by the American corporation were connected mainly to nuclear reactors, facilities, and control devices and to the historical core business (power plants, boilers, steam generators, furnaces, and tube production), as well as to several new prospections, such as those linked to solar energy.

From the 1970s onwards, the French and German B&W firms also began to increase their patent activity in Spain, especially *Fives-Cail Babcock S. A.* (result of the merger between the previous *Babcock Atlantique* and *Fives Lille-Cail* in 1973), which registered technological improvements in steam power plants and metal works, as well as inventions related to the sugar and cement industries. Nevertheless, the American B&W was consistently in charge of the patent business, at least through the national path of the OEPM. However, in 1986, Spain entered the EEC and signed the European Patent Convention (EPC), creating the possibility of designating the country through a common application to the EPO. The effects are clearly depicted in Figure 3, which shows how B&W's patents strongly decreased in the OEPM and were recorded mainly by the European path from 1986 onwards. B&W's European patents (designating Spain) also show the increase in the German presence through distinct firms strongly specialized in certain technologies (50% of total records through the period), although the American corporations, and especially *The Babcock & Wilcox Company*, still contributed 30%. Moreover, after 1986, both paths (the domestic and the European) gave birth to a new legal regime in Spain, with previous technical exams and no patents of introduction or domestic compulsory working clauses, which reduced transaction costs and increased IPR effectivity and patent value for firms and multinationals.

[57] Adding patents from the original Babcock Ltd. and from the new affiliates created in the UK.

Figure 4. Spanish B&W advertisement.

***Source: Vertice*, nº 4 (ext.), 1937**

5. Conclusion

This article summarizes the internationalization process of the B&W group and analyzes the development of the Spanish B&W affiliate throughout the twentieth century, paying special attention to the role of IPRs and patent management in the organization of the multinational. B&W was one of the first American corporations to spread throughout the world and to develop early skills in intangible asset management. In the late nineteenth century, the mechanical engineering business related to B&W was already a mature sector in which patent protection became essential.[58] Indeed, thanks to other scholars' work,[59] we already knew how the British and the German B&Ws were founded and how they used patent licenses and technology transfer agreements to organize the firms. Nevertheless, we lack evidence on how multinationals in general and B&W in particular operated in lagging countries with weak or hybrid IPR systems, such as Spain.

The Spanish patent system was developed to fit international standards, allowing the protection of foreign inventive activity, and also to foster domestic innovation, industrialization, and technology transfer through patents of introduction and compulsory working clauses. Our previous findings strongly suggest that it was difficult for foreign firms to maintain long-lasting monopolies in Spain (75% of corporate patents granted between 1880 and 1939 were extinguished within 3 years). If we add that there were no previous technical exams, it is easy to conclude that these kinds of systems generated low-value patents compared to those filed in the United States, Germany, or the United Kingdom. Therefore, how did B&W face the Spanish IPR system? Was the group able to successfully administrate its intangible assets in the region? Did B&W use the same strategies followed in other countries?

The case study demonstrates that this multinational had a strong internal coherence in its patent program. Once all B&W's patents in Spain from 1890 to 2000 are analyzed, it can be stated that the group administrated its intangible assets with great expertise. Years before arriving in Spain, patents were systematically registered and nursed by the British parent company, which achieved a high percentage of success in maintaining the monopolies and beating compulsory working clauses. Thus, the British B&W developed what I call an "IPR-beachhead"; an intangible asset portfolio of enduring patents that added to existing sale offices and agents meant an interesting pattern of assuring a previously strong business position to facilitate further FDI. Indeed, as occurred with the German subsidiary and previously with the foundation of the independent British B&W from the United States, the Spanish affiliate was established in 1918 on the grounds of a technology assistance agreement with the British B&W that unavoidably included the transference of all previous patents, expertise, and commercial facilities.

Since then, the patent sequence has demonstrated a coordinated action within the group. The British firm continued protecting technologies during the first years until the Spanish affiliate was ready for registering and taking over (Figure 2). At any rate, patents from the former were always licensed to the latter during the whole interwar period, in which compulsory working and duration data corroborate B&W's success in IPR management, even

[58] See note 39.
[59] See notes 9 and 10.

improving pre-1918 results (Table 2). Innovations consistently flowed from the British to the Spanish, although each subsidiary or affiliate was in charge of the patent business in its area of influence. Indeed, B&W's international structure and organization suggest a strong technological integration among affiliates, in which the British section acted as the main hub before WWII.

In such an innovation strategy, patents were essential not only for fighting competitors but for organizing and uniting the group. Moreover, technical prestige – the Babcock mark – and industrial collaboration were other intangible assets as valuable or more valuable than the patents themselves. All the boilers and machinery sold in Spain, for instance, had a very visible registered Trademark with the text (in Spanish) "Patented in Every Country".[60] In 1933, during a joint business conference among the European and American B&W units talking about the expiration of original patents, the British managing director, Archibald McKinstry, stated, "*We have no longer a monopoly … We have, however, still the name and the prestige which belong to nearly half a century of successful, and until the recent slump, ever-increasing business*".[61] Thus, in addition to patents, logistic support, knowledge, intra-group collaboration, and engineering prestige were the main components of the group's intangible capital and largely the source for its productive competence and success.[62]

Technical agreements and patent cross-licensing were also frequent with companies outside the group in an effort to maintain long-term business and technological leadership. After WWII, the collaboration within the B&W group deepened through common R&D plans and increasing links between the original US and the European branches. Beginning in the 1950s, new technological trajectories related to nuclear facilities were opened, while entrepreneurial diversification was expanded through mergers, acquisitions, and business alliances. Invariably, the group continued filing patents and administrating its intangible assets across the world.

The analysis of B&W's patents in Spain during the second half of the twentieth century shows the following findings: 1) The Spanish affiliate, strongly dependent on foreign inventions before WWII, was not able to develop any innovative skills and demonstrated a long-term lack of technical dynamism, especially after the Spanish Civil War and the 20-year economic and social autarky imposed by Francoism. Patents from the Spanish division tended to simply disappear; which totally matches the general evolution of the Spanish System of Innovation to today. 2) Similarly, patent records from the British B&W, the most dynamic during the first globalization and internationalization process of the group, constantly decreased after WWII, just when the American business management model spread. In reality, in a "Chandlerian" way, Spanish evidence (Figure 3) confirms that the original American B&W was substituted for the British B&W in the group's innovation program (connected to nuclear technologies) from the 1960s onwards. 3) The European integration also facilitated increasing patent activity from the French and German Babcock firms, especially from the Spanish entry in the EEC, the enforcement of the EPC, and the subsequent domestic IPR reform from 1986 onwards.

[60] A reproduction of the Spanish Trademark can be found in Abarrategui, *Babcock & Wilcox.*…, p. 16.
[61] Quoted from Boyce, *Co-operative Structures.*…, pp. 123–124.
[62] Bruland, "The Management of Intellectual Property", p. 162.

Overall, and to sum up, a long-term analysis of B&W's patent management in Spain suggests an enduring group's ability in intangible asset administration, even among latecomers with weak IPR systems. This group's technological integration and adaptation skills, together with technical prestige, intra-group collaboration, knowledge sharing, and productive competence, have been essential for its internationalization and organization processes and for its business success. Unfortunately, throughout the past one hundred years, the Spanish affiliate lost not only the possibility of developing technological capabilities but also, since the oil crisis in the mid-1970s, the business itself, in an industrial collapse from which it has not been able to recover.

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