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EDITORIAL

The Sources of Value Creation: Companies, Entrepreneurs, Engineers, and Workers

The history of construction remains largely unwritten in Western European and North American countries.¹ This is even more the case in emerging and developing countries. Many factors have contributed to this: for example, the extreme dispersion and relatively small number of researchers interested in the field, apart from sociologists, architects, or engineers by training. The heterogeneity of the subject matter certainly contributes to this. The word “construction” is itself problematic and, depending on the approach adopted, the discipline and the era concerned, it is also variable. If we consider the field of the economy, for instance, the term covers very different circumstances depending on whether we consider the branch (the sum of the products of building and public works [“BPW”]), the sector (all the companies whose main activity falls in the field of BPW), or the field (from building materials to the finishing work, along with the structural work in the building).² This becomes even more apparent if the overall activity is broken down into specialties, many of which come under the heading of “Public Works” without often fully belonging to it (as in the case of the road industry in public works, for instance).

At the same time, the question of the boundaries of the industry quickly arises: to what extent should the operation of public works and, of course, building materials be included? In France, for example, civil

1 On this point, see the essential study by Antoine Picon (ed.), *L'art de l'ingénieur constructeur, entrepreneur, inventeur*, Paris, Le Moniteur-Centre Georges Pompidou, 1997; Dominique Barjot (ed.), “The Construction Industry in the 20th Century: an International Interfirm Comparison”, *Revue Française d'histoire économique – The French Economic History Review*, no. 1, September 2014.

2 Cf. our “Introduction” in Dominique Barjot, *La Grande Entreprise Française de Travaux Publics (1883-1974)*, Paris, Economica, 2006, p. 9–31.

engineering and structural works benefit greatly from their historical links with one of the world's most powerful cement industries (until its merger with Holcim³ in 2016, Lafarge was the leading company in the field worldwide).⁴ Similarly, the road industry has benefited and continues to benefit from the links it established early on with oil companies such as Shell-France (Colas, long the world leader in roads),⁵ CFP-Total (Eiffage Travaux Publics), Esso Standard, or Mobil (Jean Lefebvre). Finally, it is also important to consider whether the BPW sector is part of industry or services, although this question does not arise when it comes to building materials. In France's national accounts, the construction sector is classified as a service sector; in the Anglo-Saxon world, however, all production activities are defined as industries, even if they are services. This is why the most convenient, and probably the least inaccurate, solution is to define BPW, the dominant component of the construction sector, as an industrial activity with a service dimension.

CONSTRUCTION: A MAJOR ECONOMIC SECTOR

In France today, BPW remains a major sector: in 2019, it made up 7.7% of the national GDP and 6.7% of the workforce (compared to 8% and 6.5% in 2017, respectively). This amounts to half of industry (12.5% of the national GDP and 13.8% of the workforce in 2019, respectively). Contrary to the situation up until the 1960s, the construction industry is now characterised by average levels of labour productivity that are higher than the average for industrial activities. The construction

3 Dominique Barjot (ed.), "Holcim: from the Family Business to the Global Leadership: an International Interfirm Comparison", in Barjot (Dominique) (ed.), "The Construction Industry in the 20th Century: an International Interfirm Comparison", *Revue française d'histoire économique*, *op. cit.*, p. 56–85.

4 Dominique Barjot, « Lafarge: de l'internationalisation à la firme mondiale, une résistible ascension? (1947-2014) » in Champroux (Nathalie A.) et Torres (Félix) (ed.), « Les entreprises françaises face à la mondialisation ». "French companies facing globalisation", *Revue Française d'histoire économique – The French Economic History Review*, no. 15 (no. 1 - 2021), p. 38–60.

5 Dominique Barjot, « Un leadership fondé sur l'innovation, Colas: 1929-1997 », in Laurent Tissot, Béatrice Veyrassat (eds.), *Trajectoires technologiques, Marchés, Institutions. Les pays industrialisés, 19^e-20^e siècles*, Bern, Peter Lang, 2001, p. 273–296.

industry has thus clearly now become one of the strong points of the national economy.

Among the major factors involved in this evolution, we might cite the establishment of the European market and, above all, the entry of large groups onto the market, notably from the civil engineering sector, where the productivity gains came much earlier. If Vinci is the archetype,⁶ Eiffage (which resulted from Fougerolle's takeover of SAE)⁷ and Bouygues (Colas, Dragages TP, Losinger)⁸ also fit this model, albeit to a lesser extent; Bouygues, for example, owes much to its success as a property developer. In fact, on a global scale, the three major French companies (Vinci, Bouygues, and Eiffage) appear to be the best able to resist Chinese competition, outperforming the large emerging or European companies in terms of their profit levels.⁹

This observation needs to be qualified, albeit without calling it into question. For while the French building industry is in an advantageous position when it comes to structural work, the situation is nonetheless uneven, with strong points (e.g., electrical networks and waterproofing work) and weak points (e.g., metal joinery, especially aluminium). Moreover, as in most European economies, there is a growing gap between general contractors and their subcontractors, a situation which is highlighted on foreign markets. In civil engineering, France remains in an extremely advantageous position when it comes to the construction of large concrete structures (Vinci and Bouygues are world leaders in prestressed concrete). With metal structures, however, it has suffered flagrant delays, despite the contributions of Eiffage and specialised companies such as Baudin-Chateaufort, which are efficient but very small.

This heterogeneity can also be seen in the field of engineering.¹⁰ While one of the most powerful engineering poles in the world has been set up around Solétanche and Freyssinet International,¹¹ Technip,

6 Dominique Barjot, *La trace des bâtisseurs: histoire du Groupe Vinci*, Vinci, 2003.

7 Dominique Barjot, *Fougerolle. Deux siècles de savoir-faire*, Paris, Éditions du Lys, 1992.

8 Dominique Barjot, *Bouygues. Les ressorts d'un destin entrepreneurial*, Paris, Economica, 2013.

9 Dominique Barjot and Hubert Loiseleur des Longchamps (eds.), *Penser le monde de demain. Livre du centenaire de l'Académie des sciences d'outre-mer*, Paris, Éditions du Cerf, 2021, p. 47.

10 Dominique Barjot (ed.), « Les entreprises françaises d'ingénierie face à la compétition internationale », *Entreprises et Histoire*, June 2013, no. 71.

11 Dominique Barjot, « Aux origines d'une vocation mondiale: la précontrainte de la STUP à Freyssinet International (1943-2000) », in Barjot (Dominique) (ed.), « Les entreprises françaises d'ingénierie face à la compétition internationale », *Entreprises et Histoire*, *op. cit.*, p. 83–99.

the third or fourth largest company in the world in the para-petroleum sector (about equal with the Italian group Saipem) has ceased to be dominated by French interests. More generally, the engineering sector in France is still too dispersed, especially compared to the American leaders (Bechtel, Schlumberger, Halliburton, and Fluor).

Finally, France has suffered a major loss in terms of its position in the building materials sector. Saint-Gobain remains the world leader in glass. It has also established itself as the global leader in gypsum, thanks to British Plaster Board (BPB), and developed its distribution activities (it competes for European leadership with the British company Wolseley, followed by Ferguson-Plc and the Danish company Rockwool).¹² The Lafarge-Holcim merger, however, largely went against French interests and instead benefitted those of the German-speaking Swiss market. As for other building materials, the establishment of Arcelor-Mittal, the disappearance of Pechiney,¹³ and, to a lesser extent, the bankruptcy of Matéris all attest to a general decline in this field. Sooner or later, this decline will have unfortunate consequences for construction costs in France. The Covid-19 crisis has reinforced these concerns.

CONSTRUCTION: A WORLD OF CONTRACTORS AND COMPANIES¹⁴

It is customary nowadays, largely as a result of the Anglo-Saxon influence but even more so that of North America, to place company

12 Marie de Laubier and Maurice Hamon (eds.), « Saint-Gobain 350 ans: histoire et mémoire de l'entreprise ». "Saint-Gobain 350 years: History and Memory of the Company", *Revue Française d'histoire économique – The French Economic History Review*, no. 6 (no. 2), November 2016; Maurice Hamon, *Du Soleil à la Terre. Une histoire de Saint-Gobain*, Paris, Jean-Claude Lattès, 2012.

13 Dominique Barjot, « Alcan et Pechiney: une comparaison des processus de multinationalisation en période de croissance instable des marchés (de 1971 à la première moitié des années 1990) », in Dominique Barjot (dir.), « L'internationalisation de l'industrie française de l'aluminium », *Cahiers d'histoire de l'aluminium*, vol. 63, no. 2, 2019, p. 56–75.

14 Dominique Barjot, *Travaux publics de France. Un siècle d'entrepreneurs et d'entreprises*, Paris, Presses de l'École des Ponts et Chaussées, 1993, 288 p.; (dir.), « Entrepreneurs et entreprises de BTP », *HES*, n°2, 1995.

managers and contractors in the same category.¹⁵ This assimilation appears to be relatively recent, however. The Americanisation of Western Europe and its Far Eastern emulators (Japan, then the “Four Dragons”, and finally the “Asian Tigers”) has created the model of a business leader characterised by a taste for risk and, increasingly frequently, of innovation.¹⁶ While risk-taking is an easy concept to understand, the same cannot be said of innovation. Innovation is not limited to its technical or, more broadly, technological dimension. More frequently, it involves the launch of new products, for which the brand image or design aspect most often outweighs technological innovation. Moreover, recent historiography has shown that in Latin countries, modelled on French legislation (namely, the 1844 act on patents for invention), it is sufficient to establish proof of the “novelty” of the process or product to obtain one of these patents, without the requirement for an in-depth scientific examination of the applications filed, as is the case in Germany or the United States.

This semantic evolution has pushed the more classical understanding of the entrepreneur, as defined by Roman law, into the background. According to this view, the contractor is the person who, by obtaining a public contract, is responsible for carrying out a public work (works contracts), its operation (concession),¹⁷ or even a service (a rental contract, for example). This vision was maintained in France in particular, under the effect of Napoleonic legislation (act of 28 pluviôse year VIII), which defines the regime of public works. The law established a specific model for the contractor. It also contributed to the emergence of a marked divide between public works contractors on the one hand and building contractors on the other. In Anglo-Saxon countries, the division between civil engineering and building is primarily of a technical rather than legal nature, with Germany and German-speaking countries having

15 Dominique Barjot (ed.), « Où va l'histoire des entreprises? », *Revue économique*, vol. 58, no. 1, January 2007.

16 Dominique Barjot (ed.), *Catching up with America. Productivity missions and the diffusion of American Economic and Technological Influence after the Second World War*, Presses de l'Université de Paris-Sorbonne, 2002.

17 Dominique Barjot, Marie-Françoise Berneron-Couvenhes (ed.), « Concession et optimisation des investissements publics », *Entreprises et Histoire*, June 2005, no. 38; Dominique Barjot, Sylvain Petitet and Denis Varaschin (eds.), « La Concession, outil de développement », *Entreprises et Histoire*, no. 31, 2002.

witnessed an early appearance of mixed companies that combine building and civil engineering within the same entity.

In France, the clear division between building and public works has guided, if not partly determined, the configuration of production structures. In a centralised country such as France, the influence of the State (through its regulations and the volume of its demand) and of large public works concessionary companies, which were historically very strong, led to the early emergence – as soon as the July Monarchy – of large contractors capable of carrying out large-scale projects (e.g., the construction of a new building). Even earlier than this, other large contractors emerged that were capable of undertaking large-scale projects, such as the Dussaux brothers in Marseille and Algiers, Lavalley, Castor, Couvreur and Hersent,¹⁸ particularly for ports and canals, along with Cail, Gouin, Parent and Schaken for railway works, etc. By today's standards, these were still large medium-sized companies, apart from Schneider & Cie. However, the acquisition of large contracts abroad (Suez for Lavalley and Couvreur, the canalisation of the Danube, followed by the port of Antwerp for Hersent, and the Great Russian Railway Company for the Ernest Gouin Establishments) established them as European leaders. For companies such as the Grands Travaux de Marseille (GTM),¹⁹ the Société générale d'entreprises (SGE),²⁰ and the Société de construction des Batignolles (SCB),²¹ this was the situation on the eve of the First World War.

Alongside these companies, more specialised medium-sized ones also emerged (Eiffel, Moisant [metal constructions],²² Chagnaud and Fougerolle [tunnels], Boussiron, Fourré and Rhodes, Limousin [reinforced concrete]). Apart from a few exceptions, such as Thome in Haussmann's Paris during the 1860s of the Second Empire, nothing of the sort

18 Dominique Barjot, « L'entreprise Hersent: ascension, prospérité et chute d'une famille d'entrepreneurs (1860-1982) », in Jean-Claude Daumas, *Le capitalisme familial: logiques et trajectoires*, Presses Universitaires franc-comtoises, 2003, p. 133–160.

19 Dominique Barjot, « Contraintes et stratégies: les débuts de la Société des Grands Travaux de Marseille (1892-1914) », *Provence historique*, fasc. 162, 1990, p. 381-401.

20 Dominique Barjot, « L'analyse comptable: un instrument pour l'histoire des entreprises. La Société Générale d'Entreprises », *HES*, 1982, no. 1, p. 145–168.

21 Rang-Ri Park-Barjot, *La Société de Construction des Batignolles: des origines à la première guerre mondiale (1846-1914)*, Presses de l'Université de Paris-Sorbonne, 2005.

22 Bertrand Lemoine, *L'architecture du fer: France XIX^e siècle*, Champ Vallon, coll. « Milieux », Seyssel, 1986.

happened in the building industry, which – unlike public works – was extremely resistant to technological innovation.²³ With rare exceptions, which were not always positive (SNC, SNCT, Grands Travaux de l'Est), the building industry was still very traditional around 1950, except perhaps when it came to roofing or plumbing. In fact, this dualism in the production structures of the BPW sector continued until the great cycle of real estate construction which characterised France from 1954 to 1967, and even as late as 1976.

Major changes took place in the 1960s with the era of decolonisation, the formation of the Common Market and, above all, the liberalisation of international trade in goods, capital, technology, and even people (immigrant workers). The speed of growth at the time was largely driven by the scale of investment in housing, functional buildings for agricultural, industrial or tertiary use, and public facilities. For their part, public works companies increasingly turned to foreign countries. They were successful in this regard, to the point that France became the world's second largest exporter of works; it was behind the United States with its great engineering, but ahead of Italy, Germany, and the United Kingdom. All things combined, this situation precipitated the establishment of groups in which the figure of the entrepreneur was replaced by the model of the large multi-divisional and managerial company, following the American model, of which Spie Batignolles was for a time the prototype.²⁴ There were some noteworthy exceptions to this trend, however; Francis Bouygues²⁵ and the Pierre and André Chauffour (Dumez)²⁶ brothers are the most emblematic.

23 Dominique Barjot, « Innovation et travaux publics en France (1840-1939) », in Dominique Barjot, Emmanuel Chadeau, Michèle Merger, Girolamo Ramunni (ed.), « L'Industrialisation », *HES*, no. 3, 1989, p. 403–414; « L'Innovation dans les travaux publics: une réponse des firmes au défi de la demande publique », *HES*, 1987, n° 2, p. 403–414.

24 Dominique Barjot, Rang-Ri Park, « SPIE: de l'entreprise multidivisionnaire à l'ingénierie de haute technologie », *Les bureaux d'études, Entreprises et Histoire*, n° 58, avril 2010, p. 101-128.

25 Dominique Barjot, « L'ascension d'un entrepreneur: Francis Bouygues (1952-1989) », *XX^e siècle*, no. 35, July-September 1992, p. 42–59.

26 Dominique Barjot, « L'ascension d'une firme familiale: Dumez (1890-1990) », *Culture Technique*, n° 26, spécial Génie civil, 1992, p. 92-99; « À la recherche des clés de la compétitivité internationale: la Société Dumez », in Jacques Marseille, *Les Performances des entreprises françaises au XX^e siècle*, Paris, Le Monde Éditions, 1995, p. 130–149.

This led to major external growth operations, including the acquisition of holdings such as SGE by the Compagnie Générale d'Électricité in 1966, or SCREG²⁷ by Bouygues in 1985, and mergers and takeovers such as those of CITRA,²⁸ Schneider's public works subsidiary, by Spie Batignolles in 1970. The giants of today are the product of these mergers. Several examples could be cited here. Vinci, for example, is the result of the merger of SGE with Sainrapt et Brice, the public works branch of Saint-Gobain, then Campenon Bernard, part of GTM, following its entry into the capital of Entreprise Jean Lefebvre, and with Entrepose, followed by Dumez, before the two groups SGE and GTM finally merged to become Vinci in 2000. Another example is Bouygues, which resulted from the takeover of the Compagnie Française d'Entreprises and its subsidiary Boussiron, then of SCREG and its subsidiaries Dragages TP and Colas and, finally, of the Swiss company Losinger. One might also cite Eiffage, which resulted from Fougerolle's takeover of SAE.²⁹ There were also some failures, however, such as the dissolution of Spie Batignolles between 1992 and 1995. This does not mean that entrepreneurs have disappeared, however: we could cite Xavier Huillard, at the head of Vinci, for instance, or Jean-François Roverato and Alain Dupont, at the head of Fougerolle, then Eiffage, and Colas, respectively.

The results are clear. Today, France's leading companies are not only major exporters (Vinci and Bouygues rank third and fifth in the world, respectively, behind Spain's ACS and Germany's Hochtief); above all, thanks to their concessions³⁰ and in-house engineering, they generate margins that are much higher than those of their major global competitors, including the Chinese.³¹ However, the environment has hardly been favourable since the global crisis of 2008–2009. The large

27 Dominique Barjot, « Performances, stratégies, structures: l'ascension du groupe SCREG (1946-1974) », in Pierre-Jean Bernard, Jean-Pierre Daviet, *Culture d'entreprise et innovation*, Paris, Presses du CNRS, 1992, p. 171–187.

28 Compagnie industrielle de travaux.

29 Société auxiliaire d'entreprises.

30 Dominique Barjot, "Public utilities and private initiative: The French concession model in historical perspective", in *Business History*, vol. 53, no. 5, August 2011, p. 782–800; Barjot (Dominique), « Services publics et initiatives privées: le modèle français de concession en perspective historique (XIX^e-XXI^e siècles) », « La concession: un outil pour la relance? », *Revue politique et parlementaire*, 122th year, no. 1097, October-December 2020, p. 3–22.

31 Dominique Barjot, "Why was the world construction industry dominated by European leaders? The development of the largest European firms from the late 19th to the early

French companies had to face the rise of huge Chinese firms (the world's five largest construction companies are Chinese), after having confronted Japanese firms, particularly in the 1970s and 1980s, and competition from American (Bechtel, Fluor, KBR, Foster Wheeler, etc.), Brazilian (Odebrecht), British (Balfour Beatty Plc.), Korean (Samsung Engineering), Italian (Saipem), German (Hochtief, Bilfinger und Berger), Scandinavian³² and, above all, Spanish (ACS Dragados, Ferrovial, Acciona, FCC) firms. Even today, the BPW sector remains a privileged area for entrepreneurship, especially in France, particularly because the non-capitalist nature of these activities values the role of the individuals. To this day, the value of these companies still lies in the people who make them up.

MEN IN CONSTRUCTION: CONTRACTORS, ENGINEERS, AND WORKERS

The role of the individuals is not limited to the construction industry. It also plays an essential role in the building materials industry, despite its not being very capital-intensive.³³ This is the case at Saint-Gobain, especially since its merger with Pont-à-Mousson, as is demonstrated by the influence of strategic chairmen such as Roger Martin, a mining engineer and founder of the new group in 1970, Roger Fauroux, a graduate of the Ecole Normale Supérieure and finance inspector, Pierre-André de Chalendar, a graduate of the ESSEC business school and then a finance inspector, and above all, Jean-Louis Beffa, dean of the Mining Corps. This can also be seen at Lafarge, which has been heavily influenced by personalities as diverse as those of Marcel Demonque, a civil engineer from the Mines, Olivier Lecerf, a graduate of Sciences Po and

21st centuries", *Construction History International Journal of the Construction History Society*, vol. 28, no.3 (2013), p. 89–114.

32 Dominique Barjot, "Skanska (1887-2007): The rise of a Swedish Multinational Company [Skanska (1887-2007): l'essor d'une multinationale suédoise]", in « De l'idée d'Europe à la construction européenne dans les pays nordiques et baltes (xix^e-xx^e siècle) », *Revue d'Histoire Nordique, Nordic Historical Review*, no. 8, 2009, p. 225–256.

33 Dominique Barjot, « Imprenditori e autorità imprenditoriale: il caso dei lavori pubblici in Francia (1883-1974) », *Annali di Storia dell'impresa*, 9, 1993, p. 261–286.

the University of Lausanne, and Bertrand Collomb,³⁴ an engineer from the Ponts et Chaussées. Both groups owe their rise to the rank of world leaders largely to the quality of their research and development and to their intensive recruitment of high-level engineers: Lafarge's research centre in Rillieux-La Pape is the largest in the world in the cement industry, benefiting in particular from its close collaboration with the CNRS (for instance in the field of nanotechnologies).³⁵

This technological culture can of course also be seen in the field of public works. Many entrepreneurs were also exceptionally inventive engineers: one might cite Gustave Eiffel and his successor Maurice Kœchlin³⁶ or Henri Daydé for metal constructions, for instance, or François Hennebique, Edmond Coignet, Simon Boussiron, and Alexis and Louis-Pierre Brice in the field of reinforced concrete. Nevertheless, with the increased size of companies and the heavier management constraints caused by both rising inflation and increased competition, a new type of model gradually emerged: the association of the contractor and the engineer. Examples include Léon-Joseph Dubois and Marcel Caquot, and Marcel Ballot and André Coyne, particularly for large dams; and Henry Lossier³⁷ and the contractors Ferdinand Fourré and Fernand Rhodes for long-span structures and bridges. We must of course also cite Edme Campenon and Eugène Freyssinet, who were responsible for France's technical pre-eminence in the field of prestressed concrete,³⁸ even if Germany also contributed greatly to this with Franz Dischinger and Ulrich Finsterwalder, technical directors at Dyckerhoff und Widmann, thanks to Grands Travaux de Marseille (GTM), which acquired and then disseminated the processes of the Germany company in France and abroad.

34 Dominique Barjot, « Lafarge: l'ascension d'une multinationale à la française (1833-2005) », Les mondialisations, *Relations internationales*, no. 124, Winter 2005, p. 51–67.

35 *Ibid.*

36 Bertrand Lemoine, *Gustave Eiffel*, Paris, Ed. Fernand Hazan, 1984.

37 Dominique Barjot, « L'ingénieur et l'entrepreneur, un mariage fécond. L'exemple de Henry Lossier et Entreprises Fourré et Rhodes (début du xx^e siècle-milieu des années 1960) », in Philippe Pâris and Dominique Barjot (eds.), *Le bangar à dirigeables d'Écausseville. Un centenaire plein d'avenir*, Rennes, Éditions Ouest-France, 2021, p. 192–209.

38 Dominique Barjot, « Le rôle de l'entreprise et de l'entrepreneur dans l'introduction du béton précontraint: Eugène Freyssinet et les Entreprises Campenon ou l'histoire d'une rencontre (1920-1939) », in Michel Lette and Michel Oris (eds.), *Technology and Engineering, Proceedings of the XXth International Congress of History of Science* (Liège, 20–26 July 1997), vol. VII, Brepols, Turnhout (Belgique), 2000, p. 185–191.

More generally, the companies that succeeded were those able to attract the best engineers. Some of them recruited or owed their creation to polytechnicians (such as Ernest Gouïn³⁹ and Alexandre Lavalley, major figures of the first French industrialisation from the 1840s to the 1880s), quite remarkable engineers from the Ponts, such as the public works department of Schneider et Cie up until 1949, followed by CITRA, between 1949 and 1970 (Charles Laroche, Victor Benezit, Gérard Le Bel), GTM (Charles Rebuffel, Marcel Chalos, Roger Gonon, Jean Charpentier, Maurice Craste, successive chairmans and CEOs), SGE (Henri Laborde-Milaa, Jean Matheron, Raymond Soulas, and Roger Lacroix), as well as X-Maritime engineers (such as André Berthon and Paul Royer, the founders of SPIE, and later of Spie Batignolles).

Much has been written about the major contribution of the “Centraliens” (graduates of the Ecole Centrale Paris), which cannot be reduced to the canonical examples of G. Eiffel, E. Coignet, or the engineers of the Société de construction des Batignolles (namely, Gaston and Ernest II Gouïn and Paul Bodin).⁴⁰ Centraliens clearly played – and continue to play – a major role in the rise of French civil engineering companies, such as Francis Bouygues and the Chaufour brothers. Some companies have even become strongholds of Centraliens, such as Campenon Bernard and, in particular, Dumez.

However, many entrepreneurs preferred to take a more diversified approach by recruiting both from France (including engineers from the Arts et Métiers schools, and particularly the schools of Châlons-sur-Marne [now Châlons-en-Champagne] and the École supérieure des travaux publics or ESTP) and from abroad (e.g. from the Polytechnic Institutes of Lausanne, like Maurice Cochard at Chagnaud, and Zurich, such as H. Lossier). This Arts et Métiers schools and the ESTP have both trained leading entrepreneurs – including Léon Chagnaud, Léon Ballot, and L. J. Dubois for the former, and A. Dupont for the latter – as well as inventive engineers such as S. Boussiron and Nicolas Esquillan, at Boussiron. However, the ability to diversify training has often resulted in superior performance: such was the case, for instance, at SGE, Campenon

39 Dominique Barjot, « Un grand entrepreneur du XIX^e siècle: Ernest Gouïn (1815-1885) », *Revue d'Histoire des Chemins de Fer (RHCF)*, no. 5-6, Autumn 1991, p. 65–89.

40 Dominique Barjot, Jacques Dureuil (ed.), *150 ans de génie civil: une histoire de centraliens*, PUPS, 2008.

Bernard, and, even more so, Bouygues. The latter has successfully trained excellent sales engineers, establishing STIM, the group's property development subsidiary, as the only French property developer capable of maintaining its high levels of profitability over the long term.

In companies with a site-based structure, engineers must also be excellent site managers. Yet to achieve this, such companies cannot rely solely on low-skilled workers. It is now well known that in the 19th century, technical progress was driven by skilled workers, especially masons, who were required to build the magnificent Séjourné bridges or the quays of the ports. However, alongside these generalists, new trades emerged: for example, the metal carpenters who built the Maria Pia viaducts over the Douro in Portugal, the Garabit viaduct or the famous 300-metre tower, using standardised assembly procedures admired by the Anglo-Saxons themselves. The promotion of new processes (such as foundations using compressed air caissons) and new equipment (such as bucket dredgers, aspiring and pouring dredgers, excavators such as those used by Couvreux or Hersent, the shovel, introduced in France by Gaston Deschiron, and, finally, the Caterpillar bulldozer, promoted by the company Razel, which introduced it in Europe) also gave rise to new professions. These include, for example, tubers working under compressed air or miners working with compressed air-powered jackhammers in the great Alpine tunnels from the mid-19th century to the present day.

It is true that the labour shortage caused by the long depression of 1883 to 1904–1905 led to a significant movement of well-trained workers to other professions, and that the low birth rate in the last third of the 19th century forced companies to rely largely on immigrant workers (first Belgians and then Italians), but they were not always unskilled workers (one might cite the Piedmontese masons, for instance).⁴¹ However, it was the First World War that was the decisive turning point. The construction industry had a particularly high rate of war deaths and casualties, and the reduction in the number of workers was much greater in this sector than in agriculture, for instance, which is often cited as an example.⁴²

41 Dominique Barjot, Mariela Colin (ed.), « L'émigration-immigration italienne et les métiers du bâtiment en France et en Normandie », *Cahier des Annales de Normandie*, Caen, Musée de Normandie, no. 31, 2001.

42 Dominique Barjot, « Travaux publics et biens intermédiaires 1900-1950 », in Maurice Lévy-Leboyer (ed.), *Histoire de la France industrielle*, tome 2. *Les trente glorieuses*, Paris, Larousse, 1996, p. 296–319.

This led to an acceleration in the substitution of capital for labour and a de-skilling of the construction workforce, which was clearly visible in the road industry. On the other hand, the introduction of ever more sophisticated construction equipment gave rise to new skills (such as those of machine drivers, mechanics, and spare parts and equipment managers). Initially noticeable in the public works sector, this evolution accelerated with the Americanisation of the 1950s and 1960s⁴³ and the strong reliance upon an increasingly diversified immigrant workforce (including Portuguese, North Africans, Yugoslavs and Turks, nationals of sub-Saharan African countries, etc.), and subsequently extended to the construction sector, which in turn saw significant productivity gains.

The building trades and, to a lesser extent, the public works sector both act as bastions of corporate traditions (masters, journeymen, and apprentices) and *Compagnons* (Tour de France).⁴⁴ While it is true that the evolution of the labour market has tended to call these traditions into question, it has also weakened the workers' struggle, which remained very strong until at least the First World War and continues to this day, in close connection with the Confédération Générale du Travail (CGT – General Confederation of Labour). The de-skilling of tasks played a major role in this. However, it has – and continues to – come up against some barriers, as demonstrated by the French experience with large-scale housing projects. It is true that heavy prefabrication made it possible to build quickly in response to the post-war housing shortage. However, the application of the automobile (or Fordist) model to the construction industry led to a dead end in terms of the living environment, without achieving productivity gains as high as expected. This was largely due to the impoverished working standards.⁴⁵

43 Dominique Barjot, Isabelle Lescent-Giles, Marc de Ferrière le Vayer (ed.), *L'Américanisation en Europe au XX^e siècle: Économie, Culture, Politique*, 2 vol., Centre de Recherche sur l'Histoire de l'Europe du Nord-Ouest, Université Charles-de-Gaulle-Lille 3, 2002.

44 Dominique Barjot, « Apprentissage et transmission du savoir-faire ouvrier dans le BTP aux XIX^e et XX^e siècles », *Revue d'Histoire Moderne et Contemporaine*, 40-3, July-September 1993, p. 480-489; « Entreprises et patronat du bâtiment (XIX^e-XX^e siècles) », in Jean-François Crola and André Guillerme (eds.), *Histoire et métiers du bâtiment aux XIX^e et XX^e siècles*, Ministère de l'Équipement, du Logement, des Transports et de l'Espace, Séminaire de Royaumont, 28-29-30 November 1989, Paris, CSTB, 1991, p. 9–37.

45 Dominique Barjot « Les industries d'équipement et de la construction 1950-1980 », in Maurice Lévy-Leboyer (ed.), *Histoire de la France industrielle*, tome 2. *Les trente glorieuses*, *op. cit.*, p. 412–433.

Groups such as SAE and Bouygues, on the contrary, have built their leadership structures on more traditional methods, relying first and foremost on the qualifications of their workforce (substituting tool-based approaches for heavy prefabrication in factories).⁴⁶ Combining high salaries and a return to a corporate organisational structure (following the “Compagnons du Minorange” [young builders] model), F. Bouygues introduced a more motivational – and, consequently, more efficient – organisational method for both its workers and its managers (site managers, works supervisors, design engineers, etc.). These new management methods have permeated the entire group (having been successfully adapted within the Colas group) and even the profession as a whole. They also tended to result in a closer alignment between performance in public works and construction sectors.

The history of construction companies cannot therefore be limited to the study of technical or architectural factors, however necessary these of course are. It must set itself a broader objective by also taking into account economic and financial, social and legal, political and cultural dimensions. This cannot be achieved, however, without preserving the archives, heritage and, in a broader sense, memory of these companies. Nowadays, at a time when production structures are undergoing profound transformations, construction historians face an enormous challenge.

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⁴⁶ Pierre Jambard *La Société Auxiliaire d'Entreprises et la naissance de la grande entreprise française de bâtiment*, PUR, 2008.