

# The invention of the building industry in Britain

## *La invención de la industria de la construcción en Gran Bretaña*

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### **Resumen**

Cómo una actividad artesanal basada en el conocimiento de tipo universal y empírico se ha convertido en una industria globalizada tras la intervención de los gobiernos en el mercado de la vivienda después de la Primera Guerra Mundial. La respuesta la encontramos en el surgimiento de la elaboración de las estadísticas de vivienda y de la ciencia de la edificación. Durante el período

### **Abstract**

*How a universal, empirical craft-based activity has been turned into a globalized industry following government intervention in the housing market after World War I, and the emergence of building science and housing statistics in response. Evolution of statistics into construction economics, through which the performance of construction in the economy, may be measured. Wartime*

de la Guerra se dio la fusión de la arquitectura modernista y la construcción de las ideas científicas dentro de una economía dirigida. En el artículo se estudia el éxito, que durante la posguerra, logró la institucionalización académica de la ciencia de la construcción mientras se asistía al éxito económico y al surgimiento de las elites internacionales. Por último, se explica la consolidación y persistencia del paradigma industrial de la construcción.

**Palabras clave:** Gran Bretaña, ciencias de la edificación, arquitectura

*merging of modernist architecture and building science ideas within a command economy are developed. Post-war academic and institutional success of building science and economics and the emergence of international elites are studied. Consolidation of and persistence of the industrial paradigm of construction are explained.*

**Keywords:** *Britain, building science, architecture*

How has building, an ancient craft-based activity, come to be recognized as a modern industry and treated as an industry both intellectually and politically? The shape of today's construction industry results less from interventions of architects, engineers and entrepreneurs – the story we find in most narratives of modernism – than it does from government housing initiatives following World War I.

The techniques by which houses were built and the numbers of them that were built became politically salient in 1919, in the face of threats of social unrest. From these concerns was born government sponsorship of the new disciplines of building research, and building economics, both of which shaped the emerging industrial sector of construction. In this paper I explain the emergence of these disciplines to define today's construction industry.

# 1. The perceived backwardness of building

In 150 years a localised empirical art has been transformed into a global industry<sup>1</sup>. Building and its parent «field» construction are today counted with modern infrastructure and manufacturing industries. Nevertheless, they continue to disappoint those who take their benchmarks from manufacturing, who hope for industrial coefficients of «efficiency». It is a disappointment that fosters a rich literature about the relative «backwardness» of construction<sup>2</sup>.

Some defining attributes of construction, for example land as a condition of production, or the social division of production into *design* and *production*, might mark construction as *peculiar* with respect to the dominant manners of production, but not necessarily backward<sup>3</sup>. Nonetheless, most authors remain in some way shackled to the notion of construction-as-industry, and *construction industry* or *building industry* have entered the language as an idioms, certainly since the inter-war years. Thinking about construction is generally trapped within the industry paradigm. Relations in construction are poised between production and exchange leading building firms to act as merchant-producers who use capital to convert resources –land, plant, materials, labour– into profit<sup>4</sup>. Projects bought in the marketplace of resources, are sold on to clients or owners, subordinating production methods to the requirements of that marketplace. In other words, construction *is* an industry, but with distinctive characteristics unlike most other industries. It is left to others to situate this industry within the psyche of the principal actors<sup>5</sup>, or within the economy as a whole<sup>6</sup>. The positioning of construction within national accounts as a component of macroeconomic data is an aspect of what I am describing as the invention of construction. It certainly includes the definition of its exclusive activity – the erection of buildings and civil engineering structures, but should it also include their repair and eventual demolition? Does it include the activity of the secondary industries that support it? What is its

1. The most thorough analysis of this evolution in terms of the science and technology of building is SEBESTYEN (1998).

2. For example: WOODHUYSEN and ABLEY (2004).

3. CLARKE (1985).

4. BALL (1988).

5. TURIN (1966).

6. SUGDEN (1975).

proper universe of discourse? Is it perhaps the very woolliness of the edges of construction that colours and confuses the debate.

## 2. Growth in building during industrialization

Population in England and Wales doubled in 50 years from 10,164,000 in 1811 to 20,066,000 in 1861, and its growth quickly translated into demand for housing in response to household formation, but also for welfare, commercial and industrial buildings<sup>7</sup>. Building grew in prominence, as it did in all industrializing economies, providing a source of employment and support for many families and buildings of all types to sustain economic growth and provide for the comfort of a growing population, 77% of which was urban by 1901.

This growth and change entailed phenomenal expansion of the building sector, the 1851 census recorded 496,000 men occupied in building and construction out of a total male workforce of 6.5m<sup>8</sup>. Yet this would not include those industries for which building is the principal source of demand. It would not reflect the great demands building makes on transportation, whether by canal, railway or horse-drawn wagon. Nor would it count the skilled services of the middle classes in facilitating the decision to build, whether financiers, lawyers, surveyors, accountants or mere clerks. There was as yet no national consciousness of the scale and character of the activity, let alone its place in the economy.

The traditional informality and combined roles of the building world, with its casual craft and labour practices, were sorely tested by the shift in scale of building activity. As perceived risk escalated, owners naturally sought to protect themselves from uncertainty, most obviously from sharp practice and incompetence, by calling for estimates in advance of carrying out work, whether for rates to be charged or for a job as a whole. By the 1830s competitive tenders by builders for whole contracts –contracting in gross– became the favoured method of giving a project sponsor the benefits of competition, price certainty and administrative simplicity<sup>9</sup>.

7. MITCHELL & DEANE (1962, p. 6).

8. MITCHELL & DEANE (1962, p. 60).

9. POWELL (1980, p. 28).

The development of contracting spawned new forms of organization and new labour processes<sup>10</sup>. Nor were novel divisions of labour confined to the building trades; from the 1820s architects increasingly separated themselves from direct building to represent and protect the owner's interests, while retaining design responsibility. The Institute of British Architects was founded in 1834 to enhance professional standing and to disparage old style design-and-build practices<sup>11</sup>. By 1887 the architects had passed a rule explicitly prohibiting its members from having any interest in building firms, a move that effectively forced professional indifference to new methods of construction that were being developed in other countries.

Following early establishment of the basic contractual transaction model, *modern* building roles and practices matured in the long period up to the First World War. Professional and craft associations were established, with their related practices and behaviours. The precedents of modern property and construction law were accumulated and embedded in the civil law. Byelaws and regulations to protect the public good were formulated. Schools and training programmes were set up for professionals and crafts alike. And of course the secondary industries supporting building began themselves to industrialize in order to meet growth in demand for their products.

Despite this commercial, social and institutional development, building itself remained largely traditional in its technology and craft practices. Tradition was experience crystallized into rules of practice that could be taught and passed on by master to apprentice. Only in structural engineering was the application of science apparent before the twentieth century.

The building industry up to 1914 showed little interest in any scientific understanding of the performance, compatibility and durability of materials. Apart from Portland cement and steel there were in 1920 no specifications for building materials<sup>12</sup>.

As the twentieth century opened, burgeoning demand for building led to a flood of new artificial building materials and inventive methods of construction, new remedies for old problems, techniques to improve productivity, lower costs, and allay anxieties about building (e.g. vulnerability to fire).

10. The development of the contracting system is particularly well described in Hermione Hobhouse's biography of one of its most celebrated practitioners, HOBHOUSE (1995).

11. KAYE (1960, p. 13).

12. LEA (1971, p. 3).

But were they any good? Could they be safely used in a regulated trade? How should they be evaluated? The structure of the building world with its recently divided responsibilities for architecture, engineering and execution, with its fragmented knowledge and experience, and with the diversity of its secondary industries, was obviously ill suited to become a modern science-based industry. Only the stress of wartime needs and the establishment of the Department of Scientific and Industrial Research (DSIR) in 1915-16, to direct government research led to the first of many committees, the *Building Materials Research Committee*<sup>13</sup>.

### 3. The political discovery of «housing»

Science entered building through the politicization of housing after 1918. In the record of national housing policy the Great War looms as a gigantic watershed between nineteenth and twentieth century ideas even though most of the ideas that influenced housing policy since 1919 date from before the war, including minimum standards embodied in building byelaws and the sanitary outlook. It was anticipation of difficult conditions that would follow the war that forced serious questioning of the adequacy of traditional approaches to building. Progressive minds saw the need for systematic research to tackle the challenges of reconstruction. Belief in subsidy from the centre as a remedy for most things was born.

Expedient meddling with the housing market through government rent controls *ensured* government involvement in an *inevitable* post-war housing crisis<sup>14</sup>. Attempts to boost war production had revealed 4 million working weeks lost each year to sickness attributed to bad housing. Housing became a defining issue for a new age of mass politics. Le Corbusier later summarised the issue as «Architecture or revolution?» crystallizing the fears of politicians who now understood the central position of housing policy for government, immortalized in the promise of «homes fit for heroes», and the

13. SAINT (1987, p. 12).

14. In Britain the Rent Restriction Act of 1915. France and Germany adopted similar legislation later in the war, by which time rents had reached four times pre-war values; the Russian revolution nationalised all urban housing in December 1917, and forced sharing of accommodation to overcome shortage. See PAWLEY (1971, p. 22).

ground breaking Addison Act of 1919, for the first time providing government subsidy to private builders as an «experiment»<sup>15</sup>.

Despite party differences about the balance between public and private housing or the extent and application of subsidies, the public political discourse turned on management of the national housing stock, expressed as numbers of new houses built, slums cleared, and substandard conditions improved. Lloyd George's «Homes Fit for Heroes», a key slogan amongst the promises of post-war social reform, represented a sudden change in attitudes to housing, a change brought on by the accident of war rather than the result of gradual growth of clear ideas<sup>16</sup>.

## 4. The arrival of science in housing politics

In 1919 there were two schools of thought about housing. Most believed that the housing problem was a temporary result of the war and that private enterprise would be able and willing to build all the houses required as before the war; everything would return to normal. Others held that although private enterprise would indeed re-enter the market, its achievements before the war had been unsatisfactory and would continue to be in the future; if government were to be responsible for housing, then design standards, products and processes would have to be improved<sup>17</sup>.

1919 saw the establishment of a Ministry of Health, taking over responsibility for housing from the Local Government Board. The new ministry's first legislation, the Addison Housing and Town Planning Act was strongly influenced by the work of a committee (chaired by Liberal MP Sir John Tudor Walters) previously set up in 1917 to investigate questions of building construction that would arise after the war<sup>18</sup>. Not only was there an immediate shortfall of 600,000 houses, but to balance supplies and needs by 1931, 190,000 houses would be needed each year, compared with pre-war average annual production of 84,000<sup>19</sup>. The number of skilled building craftsmen

15. MORGAN (2005).

16. BOWLEY (1945, p. 3).

17. BOWLEY (1945, p. 15).

18. The Local Government Board had departmental responsibility for housing until the creation of the Ministry of Health in 1919.

19. BOWLEY (1945, p. 12).

had halved between 1901 and 1920, their already low wages eroded by inflation, their numbers reduced by war and the lure of more comfortable factory work. Rents were no longer sufficient to recover construction costs without subsidy, and there were acute shortages of traditional building materials such as brick, tiles and timber, although the cement and steel industries had ample capacity, a strong factor in stimulating innovative methods of building.

Prominent in Tudor Walters' committee was Raymond Unwin, leading architect and planner of the pre-war garden city movement. Unwin understood that traditional building would be insufficient to meet production needs. He believed that unconventional construction would be necessary and that therefore research, experiment and testing should be priorities, particularly research into «concrete as a substitute for brick or wood in the construction of cottages»<sup>20</sup>.

However the Local Government Board, threatened with loss of departmental responsibility for housing to the new Ministry of Health, fought a rearguard action for housing to remain the responsibility of local government. In April 1919 they even appointed a rival *Committee for Standardization and New Methods of Construction* to consider (a) standardization of materials and fittings, and (b) proposals made to the Board for new materials and methods of construction to be used in State-aided housing schemes. Unwin sat also on this committee which sought proposals for new materials and new methods through press advertisement. The committee's first report in 1920 listed some 75 techniques for constructing the shells of cottages that it had examined and approved as practicable. Techniques to overcome skill shortages were favoured, for example the search for larger and lighter bricks, but also some 61 proposals for building houses from concrete. The committee even drew up specifications for concrete, to be generally applied<sup>21</sup>. Proprietary processes and construction methods offered, for example for fireproof floor construction, prefigured later industrial production of patented products, but at a time when technical claims could not be certified; it was the birth of intellectual property in building, a concept from manufacturing industry, that later contributed to building being considered as an industry.

The tussle between the BMRC and the LGB's new research committee reflected the widespread confusion and political anxiety surrounding government

20. SWENARTON (2006).

21. BOWLEY (1966, p. 185).



involvement in housing, and thereby in building research. Opposing views reflected on one side the «progressive» Liberal government's apprehension about possible social unrest «the money we are going to spend on housing is an insurance against Bolshevism and Revolution<sup>22</sup>» and, on the other, «conservative» reaction to the government housing programme from the City, the Treasury and rural landowners who saw it as extravagant and financially unsound. Only when acute shortages of materials and labour threatened to bring the housing programme to a halt, was a Building Research Board (BRB) established, in June 1920 (to take over the building research interests of DSIR). Throughout 1919 BMRC had made the case to the Advisory Council of DSIR for increased government involvement in research:

There was no prospect that the architectural profession or the builders would, or could, become responsible for research. Building research must therefore be regarded as a matter of public interest and undertaken by the State as representing the community<sup>23</sup>.

By August the Advisory Council had agreed that government support would be cost-effective, and could declare:

If research were to lead to a saving of no more than £1 on each of the new houses to be erected the result would suffice to pay for more than the whole annual expenses of the DSIR... The monetary value in increased health to the community that will accrue from the more scientific use of materials and construction in building is beyond the powers of calculation<sup>24</sup>.

Lengthy wrangling over membership marred the founding of the Building Research Station. It finally opened in July 1921, just when the Addison Act housing programme was being axed by the Cabinet as being too costly. The building boom of the immediate post-war period had come to a violent halt in the summer of 1920 with the collapse of world prices and trade; building demand fell away rapidly and building unemployment climbed. These were the inauspicious circumstances under which BRB was finally able to start research on the topics of substitute materials and novel methods of construction.

22. *Parliamentary debates 1919*, quoted in SWENARTON (2006).

23. LEA (1971, p. 14).

24. LEA (1971, p. 15).

## 5. The establishment of government building research

Abandonment of the housing programme had serious consequences for fledgling government building research. As the official BRS history has it «The early years of the new Board and Station were not easy ones»<sup>25</sup>. Not until the new Labour government's Wheatley Act of 1924 did the future of government building research become assured. Discussion about the character, organization and functions of building had played a significant part in the establishment of the Labour party in 1918.

Wheatley's housing «experiment» consisted of a «treaty» with the building trades; they should build at least two thirds of a 2.5 million unit housing programme over fifteen years in return for increased local authority subsidies. Eventually 520,298 houses were produced by March 1939. Restriction on the use of traditional methods stimulated the appetite for innovative methods and research into materials. Wheatley responded by calling for yet another committee, on *New Materials of House Construction*. With ministerial underwriting of its scientific mission BRS's future was assured at Garston near Watford.

The twofold duties of the BRS were formalised in 1926 by the Building Research Board<sup>26</sup>

1. Increase knowledge of the fundamental processes that cause building materials to act as they do and to elucidate the reasons for the qualities, good or bad, that they exhibit.
2. Help solve immediate practical problems by the application of existing knowledge.

An immediate difficulty for BRS in comparing new ideas to what had sufficed in the past was lack of scientific knowledge as to why traditional methods had proved satisfactory; a science of building had to be built, more or less from scratch. This resulted in a significant proportion of BRS' output consisting of worthy but dull scientific reports that were read by few<sup>27</sup>.

25. LEA (1971, p. 16).

26. LEA (1971, p. 19).

27. RICHARDSON and ALDCROFT (1968, p. 139).

## 6. The growth of science in British building

From the outset the need for government involvement in building innovation and research in Britain were closely associated with housing policy rather than architecture, particularly with the Fabian ideals of the early Labour governments seeking a more equitable distribution of resources. The thought was that government science would overcome shortages by validating substitute materials.

BRS had got off to a slow start in evaluating and promoting innovative materials and methods, and was further handicapped when steep falls in the costs of traditional materials, 25% between 1925 and 1934, suddenly made proprietary construction systems look expensive. Very few of those that had been offered to the various committees were put into volume production beyond an extended prototype stage, none underwent the scientific scrutiny originally intended, and few embodied any significant prefabrication<sup>28</sup>. Following the initial desperate material shortages of the immediate post-war period, falling prices and low interest rates fuelled a massive residential investment boom from 1923. And the housing products of this boom, Unwin-style semi-detached cottages, were substantially met by traditional construction techniques and practices.

The increase in output during the boom years, from 109,000 houses in 1922 to 223,000 in 1932 and 359,000 in 1938, forced technical developments in the production of most common building materials. For example in 1924 brick making was shared among 1,600 artisanal works. By 1937 overall output had doubled of which a third were the cheapest common brick, the first made by continuous industrialized processes from clay winning to packaging, and an early target for BRS evaluation<sup>29</sup>. Building science began to impinge on product manufacturing as processes began to be mechanised.

BRS thus concentrated from 1925 to 1939 mainly on the science of the most common materials: the weathering of natural stone and slate; sand-lime and clay bricks; cement and concrete, roofing tiles; gypsum plaster; asphalt

28. It is doubtful whether more than 50,000 «non-traditional» houses of all types were erected in the first post-war decade, WHITE (1965, p. 88). Many of the systems were to remain «dormant» until they re-appeared in the Burt committee report on housing produced during the second war, BURT (1944).

29. RICHARDSON and ALDCROFT (1968, pp. 141-144). The dominant manufacturer was the London Brick Company, which opened a research department in 1928.

and bitumen. The emphasis was mostly on the chemistry, physical properties and performance in use of materials, particularly through extensive exposure testing at Garston<sup>30</sup>. This aspect of BRS work began contributing significantly to British Standards committees for materials and to Codes of Practice for trade processes, bringing scientific objectivity to what had been little more than codified craft belief and custom. BRS work on materials did not, however, greatly affect the materials markets, which remained elastic in response to growing demand. Novel products, some using imported technology, did appear during this period, notably asbestos-cement sheeting, fibreboard and plasterboard, but they remained insignificant until the second war.

Although the basic work on materials science was helping builders understand the technological, it did not help them to design but BRS began work in two areas highly relevant to designers. The first, structures and civil engineering, helped Britain to catch up with Europe and the US in the validation and codification of steel and concrete structural design, and in soil mechanics. The second area, the physics of whole buildings, addressed heating and ventilation, daylighting and acoustics. The Station began to develop useful methods and tools for architects and engineers, and to publicize them through BRS Digests from 1931, through non-technical bulletins and technical papers. By 1933 Robert Fitzmaurice had set up a BRS enquiry service offering free expert advice and forging links with scientifically minded practicing architects and engineers. His *Principles of Modern Building* the first volume of which appeared in 1938, became a key text of science-based construction summarizing BRS work to date<sup>31</sup>.

## 7. The arrival of modernism in the inter-war years

Speaking to the Royal Institute of British Architects in 1937, the Cambridge crystallographer J.D. Bernal painted a picture of architecture as a tool in the vital business of overcoming anachronistic social and political forms<sup>32</sup>.

30. LEA (1971, pp. 35-70).

31. Despite a rather snooty reception by the BRS scientists themselves who saw it as needless popularizing (William Allen, an architect at BRS, reported in SAINT, 1987, p. 14). Ministry of PUBLIC BUILDING AND WORKS (1938; 1961).

32. BERNAL (1937, pp. 805-812). Based on a speech delivered to an Informal General Meeting of the R.I.B.A. A second speech was delivered in 1946, BERNAL (1946, pp. 155-158).

With science to inform the formal, the structural and the functional aspects of architecture, the world can at last become a better place; and architecture is an important agent of that change. He argued for a rational architecture to include large pre-formed factory-made components in strong and light materials with good insulation, sophisticated environmental services and controls; organizational control over planning and housing policy, and even totally enclosed spacious air-conditioned towns (Bernal, 1939, 350-353).

BRS appealed to Bernal as a precursor of the socialist industrialism he hoped for, a living testimonial to the interdependence of science and government in the service of society. In *The Social Function of Science* he brought the authority of science to thoughts about architecture that progressive architects were already discussing.

Bernal's sort of technocratic romance, combining Soviet centralism with American efficiency and consumerism did not convince everyone. Anxiety about over-valuing science-driven industrialism echoed the earlier socialist critiques of William Owen (architect of Port Sunlight for Lever Brothers), William Morris and, of course, John Ruskin. His friend Lancelot Hogben mocked his vision: «it may be a chemist's paradise, but it has no attraction for me», and Joseph Needham worried about socialist industrialism as a sort of «scientific opium»<sup>33</sup>. Nonetheless the new left's faith in the liberating possibilities of science, technology and planning captured the imagination of young architects in the inter-war years, more so than the social tyranny and degradation of industrialization, which the previous generation of British, German and French socialists had sought to escape through a reversion to craft values. In the event the economic and political urgencies of the impending Second War gave decisive impetus to the view of building as an exercise in technological production, eclipsing earlier gentle movements for a social architecture of the Arts and Crafts, often decried as «architectural humanism».

At the time of Bernal's speech architects were already in excited debate about the future. Le Corbusier's 1923 polemic, *Vers Une Architecture*, had appeared in English as early as 1927<sup>34</sup>. The debate was fuelled by committed modernists in both the general and the specialist press, who were then ahead of general practice and what was being taught in schools. Books by

33. Quoted in WERSKEY (1988, pp. 202-203).

34. LE CORBUSIER (1927).

British authors such as Herbert Read<sup>35</sup>, John Gloag<sup>36</sup> and F.R.S. Yorke<sup>37</sup> began to appear, often collections of articles previously seen in the *Architectural Review*. Yorke, talking about prefabricated homes, captures the tone of excitement:

The low cost house will be manufactured as a whole, or in parts, in central factories and assembled on site. Production will be similar to that of the automobile. Design will be dictated not only by convenience and efficiency, but by economical machine production, handling and distribution of parts, and speedy erection by unskilled labour<sup>38</sup>.

The lurching quality of the inter-war economy, the severe depression of staple industries alongside the exceptional performance of new manufacturing industries, the poverty alongside the prosperity, added a strand to the growing belief of politicians, architects and scientists that rational planning was the way to achieve stability and a fairer distribution of the fruits of new technology. It was a sensibility strongly consonant with the Modern Movement in architecture:

One of the great ambitions of the twentieth century has been to find ways of sharing the proceeds of material, technical and cultural development equitably among all. In architecture this was the driving social dynamic behind the Modern Movement, at constant odds with issues of style, meaning and appearance<sup>39</sup>.

Among young architects the idea of planning was given force in the inter-war years initially by the teachings of Patrick Geddes, the Scottish city planner and philosopher, preparing a handful of enthusiasts to benefit from the arrival in Britain of Erich Mendelsohn and Marcel Breuer from Germany, Berthold Lubetkin from Russia via Paris and Walter Gropius himself, who delivered his gospel on the work of the Bauhaus at Liverpool University in 1934, before practicing in England for a couple of years, en route to becoming Chairman of Harvard's Department of Architecture. For Gropius the scope of architecture was to be total, and for everyone. The archetype of the architect shif-

35. READ (1934).

36. GLOAG, ed. (1934).

37. YORKE (1934).

38. YORKE (1934, p. 168).

39. SAINT (1987, viii).

ted «from the idea of the independent gentleman-architect serving a select clientele to that of a profession answerable to the whole community»<sup>40</sup>.

The First World War had proved to scientists and governments that they needed each other, but it was the depression and its aftermath that caused ideas of a scientific planned society to be taken seriously. In the early 1930s the examples of Russia and Germany reinforced, in their different ways, the need for planned economy, whether in emulation of the one or defiance of the other.

## 8. Science digs into architecture and politics

For architects, enthusiasm for science was manifest in an ideal of «research», the systematic investigation of design problems. It became a (largely rhetorical) weapon of progressives to distance themselves from the amateurism and individualism of the architectural establishment. Research was even built into the name of the pressure group MARS (Modern Architecture Research) Group founded in 1933. It was an enthusiasm that led better-informed architects to discover that there was already an appreciable amount of research going on in construction, most of it at BRS<sup>41</sup>.

The fact that architects were poorly equipped to do scientific research was often forgiven both through the urgency of preparation for war and because in general terms scientists and architects shared social and political views. There was mutual curiosity and a belief in the invigoration of the sciences by exposure to the arts, particularly painting and architecture. Architects and structural engineers were active in the Air Raid Protection (ARP) campaign of the popular communist sympathiser and geneticist J.B.S. Haldane, a campaign that led to direct collaboration between Bernal, Zuckerman and other scientists with the BRS, following grudging government recognition in 1939<sup>42</sup>.

Movement towards collective action can be seen in the meshing of three components: emerging building science, progressive architectural ideas and political necessity. In the inter-war years, several projects exemplified the

40. SAINT (1987, p. 241).

41. SAINT (1987, p. 11).

42. SAINT (1987, p. 12).

aspiration for research-led progressive design, particularly in the area of public health, where post-war anxiety about the «health of the race» was being reinforced by lower birth rates and productivity in Britain than in other countries. Universities were as yet of little help in social or technical support, and research organizations were not well established<sup>43</sup>. For historian Elizabeth Darling, both projects were examples of modernist propaganda; an original approach to design stressing the architect's engagement with the client's functional requirements<sup>44</sup>. It was a new approach to the selling of architectural service. Facing unprecedented problems, public clients were increasingly susceptible to such persuasion. Soon government ministers, the military and local authorities, under the pressures of war, would be open to the categories of new thinking so enthusiastically promoted.

## 9. Government wakes up to the significance of planning and construction

Meanwhile builders were becoming increasingly reliant on the burgeoning availability of proprietary factory produced materials and components such as windows and doors, sanitary goods, as well as mechanical and electrical equipment. A burst of commercial and industrial building from 1932, offsetting a fall in local authority and private subsidized housing, introduced many builders to the use of structural steel and concrete in large buildings for the first time. Site mechanisation became increasingly common, mostly in site preparation and materials handling. The share of building investment in gross domestic capital formation grew from 38% in 1923 to 58% in 1933, a dominating position even to the point of starving other industries of capital needed to modernize. The position of building in the national economy became impossible to ignore, if only for its effect on employment. Even though the significance of building was felt most in the capital markets, in employment it

43. Experiments included the doctor-led Peckham Experiment, begun in 1926, and the later Finsbury Plan of 1935, both resulted in innovative health centre buildings based on extensive user-research largely done by the architects themselves. Peckham's Pioneer Health Centre, completed in 1935 was funded by the Sainsbury family and designed by Owen Williams. The Finsbury Health Centre, initiative of the Labour-led borough, opened in 1938, designed by Tec-ton architects led by the emigré Russian, Berthold Lubetkin.

44. DARLING (2007, p. 73).



went from 947,000 employed in 1921 (recovery to 1901 levels), to 1,277,000 in 1931 (9.6% of male workforce).

Within government towards the end of the 1930s it was realised that classic long building cycles under free market conditions had been shattered by the random shocks of the war and government interference via housing policy «experiments». Economics texts and theories were geared to a pre-1914 world that had obviously changed, often in quite dangerous ways. The spasmodic character of policy that attempted to deal with unfamiliar tendencies –rising incomes combined with high unemployment, a secular fall in prices and costs, middle class flight to the suburbs, developments in transport and novel industries– led to complex and often baffling new readings among the vital signs of industrial activity<sup>45</sup>.

Two things were, however, now clear. First, planning had been ineffectual; the rural poor were still streaming into the cities, local authorities were apathetic towards planning and lacked skills, there was no effective regional planning and laissez-faire strip developments of semi-detached self contained cottages were covering the countryside. Second, it was realized that construction is very significant within the economy, that demand for construction fluctuates and is sensitive to small changes in cost and availability of resources, particularly capital, and hence to interest rates. Most significantly it was noticed that government behaviour reduces or amplifies fluctuations in demand for construction, yet the mechanisms of the relationship were not understood. Construction begins to be described as an *industry*, but the definition of construction remains unclear. Construction economics has yet to be born.

Pleading by scientists and modernist architects for a planned economy was well timed. Wartime was propitious for strategic and logistical planning of every sort of construction. Young architects gained early experience in the various directorates of Lord Reith's Ministry of Works, forming alliances with bright administrators who were to become prominent public-sector clients after the war, and they worked ever more closely with the BRS. In 1941 J.D. Bernal, with BRS employees contributed a short section on building to *Science in War*, a hastily edited anonymous Penguin polemic that had an impact on ministries within the Churchill administration, already alive to the

45. The understanding of inter-war building fluctuations and business cycles is thoroughly analysed in RICHARDSON and ALDCROFT (1968, pp. 213-269).

inadequacies of links between science and government<sup>46</sup>. For J.D. Bernal himself:

While this (wartime scientific problem solving) was going on, organisation was drawing the scientists more and more closely in with the practical people. It was an experience which was common, I think, to all branches of science and led to an entirely new and wider view of the relations of science and practical things<sup>47</sup>.

## 10. The road to post-war reconstruction

The challenges of post-war construction were engaged long before the end of the war.

In 1942 Lord Reith's Ministry of Works set up a Directorate of Post-War Building to review problems likely to affect post-war building and made up mostly of professional architects and engineers, but not builders<sup>48</sup>. Even the conservative RIBA formed an influential Architectural Science Group in 1941 to liaise with BRS and others, and to promote a *Rebuilding Britain* exhibition in 1943<sup>49</sup>. Architects were actively involved in all of the reconstruction initiatives, with BRS acting as an informal faculty of building science; Fitzmaurice's pre-war dream of influencing the whole national practice of construction seemed within reach.

But what does government know about construction? Does the recasting of a large-scale universal craft activity in scientific terms suggest a new economic model? How should construction be reflected in the national accounts? Is there any intellectual construct of building practices? What might be the prerequisites for understanding and managing the sector fluctuation phenomena witnessed during the inter-war years? It was obvious that construction would play a big part in reconstruction, but in order to plan construction

46. SAINT (1987, p. 20).

47. BERNAL (1946).

48. Churchill disliked Reith but brought him into the cabinet as Minister-Designate of Works from 1940-42, where he did much to shape post-war construction in Britain, particularly the powerful planning legislation of 1944 and 1947.

49. Installed at the National Gallery. Planned by architect Jane Drew, newly married to the important modernist Maxwell Fry.

two things are necessary, consistent statistical knowledge about each of the variables relevant to construction and an understanding of the mechanisms by which they are related. Before such understanding was developed into a discipline of construction economics during the 1960s, planners relied on national information<sup>50</sup>, supplemented by sectoral reports<sup>51</sup>, ministry memoranda and the trends analyses of the *Builder* and the *Economist*.

Planning to meet national objectives for post-war reconstruction was not particularly quantified beyond the setting of high-level political objectives (e.g. numbers of houses to be built or slums to be cleared). But in 1948 a Standard Industrial Classification (SIC) was adopted in the United Kingdom to classify business establishments and other statistical units by the type of economic activity in which they are engaged. The SIC made an industrial category of construction defining the core activity as contracting; site preparation, building the structure, installations and completion. Land transactions, design (architecture and engineering) and the secondary industrial categories that underpin construction lie elsewhere within the classification. The definition of construction within the industrial classification was not in itself operationally significant, but it did encourage a view of construction as a homogenous industry on a par with manufacturing industries. The capabilities of this industry were of great interest to post-war government because the welfare state created huge demand for buildings to house the expanded social services as well as for housing. Furthermore, full employment policy and nationalization brought continuous demand for industrial, commercial and educational buildings. In 1948, of all building and works, the public sector accounted for 71%, and public housing 43.4%; government now dominated construction<sup>52</sup>.

It was clear that the complex fluctuations in construction parameters experienced between the wars resulted from attributes peculiar to construction, for example the absolute inelasticity of supply of its basic resource, land, with the supply of other resources dependent on administrative *fiat*; or again the erratic cost of capital tied to the risky obligations of general contractors. The challenges in understanding construction were already apparent in Marian

50. Principally from the *Census Reports on Population*, the *Census of Production*, the *Statistical Abstract of the United Kingdom* and the *Annual Abstract of Labour Statistics*.

51. Such as the *Local Government Financial Statistics*, the *Building Societies Yearbook* or the *Hospitals Yearbook*.

52. BOWLEY (1966, p. 399).

Bowley's pioneering analysis of housing *Housing and the State*<sup>53</sup>. By analysing the economic evidence of housing activity, she was able to illustrate the consequences of state intervention in the housing market and to define the mechanisms and parameters of the activity<sup>54</sup>.

## 11. Post-war invention of the «building industry»

After the war the Building Research Board became increasingly interested in the application of operational research methods to craft processes<sup>55</sup>. By 1950 BRS had taken over responsibility for technical and economic investigations on the mechanisation of building operations, on building methods and new techniques, and on productivity and costs. The work was a natural outgrowth of wartime investigations.

The maturing of construction statistics was boosted by the development of national and international bodies interested in construction, and particularly in productivity for reconstruction. In 1951, for example, BRS undertook a nine-country study of methods of organizing building work<sup>56</sup>. The study highlighted the importance of communication between designer and builder, and within the building firm itself. Later in 1963 this finding was echoed in a very influential study that brought OR concepts into an analysis of the building industry as a system of exchanges<sup>57</sup>. «This operational research approach could provide a means by which (project) control could be taught as a science rather than as an art»<sup>58</sup>.

Development of institutional muscle within the building research community was rewarded by powerful governmental clients wanting a better performing industry to serve their needs; industry reviews were commissioned<sup>59</sup>. Such reviews increasingly diagnosed the shortcomings of construction in terms of its dissimilarities to manufacturing industry: competitive tendering

53. BOWLEY (1945).

54. Bowley, later delivered a paper on her difficulties in developing coherent housing statistics, BOWLEY (1950).

55. LEA (1971, p. 126).

56. For the European Productivity Agency, LEA (1971, pp. 135-136).

57. *Communications in the Building Industry* published by the Tavistock Institute of Human Relations (set up in 1946), HIGGIN and JESSOP (1963), 2<sup>nd</sup> Edition, 1965.

58. LEA (1971, p. 135).

59. THE SIMON REPORT (1944).

was seen as inefficient; clients needed better control of the process; builders needed improved continuity of work.

Such were the wishes of absolute or near monopoly government clients, and they persist in latter-day industry reviews up to 1998<sup>60</sup>. The yearning for industrially efficient construction was fuelled also by the fact that the state war machine had given birth to a new breed of large contractor, unprecedented in size, organizational and technical expertise<sup>61</sup>. By 1942 there were ten firms employing over 10,000 operatives each<sup>62</sup>. They presented what seemed to be a paradigm of efficiency and productivity; they were intimate with government and its plans and they had already proved their worth during the war. Most contracting firms in Britain however, perhaps 100,000 in all, were small, unaffiliated to national federations, and relatively impervious to BRS or ministry advice. They served to represent the craft rump of traditional building, irritating permanent reminders of what the planners were determined to transform into efficient industry.

The focus on science-led industrial transformation was helped in a number of ways throughout the 1950s. BRS started working more closely with industry on specific projects (e.g. nuclear power plants) and through its information and enquiry services; BRS undertook research into productivity, costs and management for ministries and their in-house development groups; BRS scientists, architects and engineers eventually left the Station to join industry, other government departments, professional institutes, universities and technical colleges, building up «a web of influence, often at high level»<sup>63</sup>. That building should enter the academy was not immediately obvious at that time, except that it was a natural outcome of the prominence of construction within the government's development planning, and the growing maturity of building science. For example, although Imperial College had run a one-year post-graduate course for selected teachers of building in 1933-34 (most of the lectures given by BRS staff), only the Universities of Manchester and Wales (Cardiff) accepted building subjects as part of a degree course in the 1930s.

60. A useful compendium of these reports has been published: LANGFORD and MURRAY (2003).

61. KOHAN (1952).

62. Significant individuals included G.W. Mitchel (Wimpey), John Laing and Frank Taylor (Taylor Woodrow). Laing and Mitchel sat on the Burt Committee on housing.

63. LEA (1971, p. 185).

When Marian Bowley started teaching at UCL in 1947 it was as an economist. There, based on her earlier interest in housing, she developed a large-scale investigation into construction innovation, publishing an important book<sup>64</sup>. Analysis of the conditions surrounding innovation later led to her most important work in 1966, the first broad evolutionary account of the whole of the British building industry from pre-First World War to post-1945<sup>65</sup>. A year before its publication Duccio Turin had been appointed to a Chair of Building at UCL within the Bartlett School of Architecture<sup>66</sup>, where he established a *Building Economics Research Unit*. Turin (1926-76) was an influential technical adviser to the UN, ECE and other international organizations. In 1975 he published a benchmark collection of papers, many by ex-BRS scientists and economists, including Donald Bishop's «Productivity in the Construction Industry»<sup>67</sup>.

Increasing use of the tools of economics to analyze construction, starting within BRS and later dignified by the academy, allied to preoccupations of building science that had grown out of operations research, led to ideas that came to dominate construction from the late 1950s onwards. The most obvious of these is that construction, if it was to meet the challenges of reconstruction, needed to become more industrialized, more like manufacturing industry, and less craft-based and dependent on *ad hoc* project coalitions. OR and industrial research would help construction to achieve much higher productivity, as well as responsiveness to demand and efficient use of resources.

The subsequent treatment of construction as an industry has been more than a wishful terminology of convenience, it has affected the analysis of construction and the conduct of policy debate about construction since the late 1950s. Increasingly, an analytical consensus has been built on models of the construction sector based on assumptions of generalized, essentially repetitive and systemic processes. Key ideas were formulated, with broad

64. BOWLEY (1950).

65. BOWLEY (1966).

66. Endowed by the London Master Builders' Association.

67. TURIN, ed. (1975). Donald Bishop was a leading advocate of quantitative techniques to manage building, and of industrialized building methods. He had been Director of Management Services at the Ministry of Public Building and Works, and had begun his career at the BRS as a quantity surveyor.

international consensus, as «the construction process» and its relative «the structure of the industry»<sup>68</sup>.

The conceptual industrialization of construction led governments to attempt management of the total effective demand placed on it, especially by the dominant public sector. The public client would use its clout to induce good industry-like behaviors from construction. Backwardness would be overcome. But this conceptualization was flawed. It was built on what Groak characterizes as three types of confusion:

- It encouraged inappropriate comparison of construction with other forms of manufacturing industry, notably the mass-production of cars, distracting attention from important new linkages outside conventional construction;
- It led us to regard certain inherent characteristics of construction processes as «problems», to whose «solution» unnecessary resources were allocated;
- It muddled our thinking about the extent to which macro-level planning is possible, especially around the role of R&D and innovation as engines of better productivity and quality.

Industrialization nevertheless gained political traction through large-scale public building programmes fostered by elite development groups within ministries and through specialist public-sector bodies, such as the National Building Agency (founded 1960). The Ministry of Works was renamed the Ministry of Public Building and Works in 1962, acquiring the extra responsibility of monitoring the building industry. The 1964 Labour Party election manifesto was technically optimistic about construction:

The crucial factor governing the number of new houses that we can build –and indeed the schools, hospitals, factories, offices and roads that can be completed– is the output of the construction and building supply industries.

Here we shall need new machinery to put through a series of long-delayed reforms designed, above all, to increase the number of men –and particularly of trained men– in the industry and to secure the more rapid use of the new techniques of industrialized building.

68. GROAK (1994).

This impulse culminated in *The National Plan* of 1964, a plan that included the promise to build 500,000 houses a year by 1970-71<sup>69</sup>, greatly in excess of the previous best of 338,000 in 1938. The demise of the National Plan in the 1965 economic downturn did little to dim the power of the industrial model of construction. Issues of quality and efficiency continued to be transformed into issues of *management, information and feedback*. Genuine areas of conflict were recast as *problems of communication*. Building economists explored the notion of the industrial *capacity* of construction<sup>70</sup>.

## 12. Challenges to the industrial paradigm of construction

The vision of construction as industry and its political consequences have not been seriously attacked. Criticism has tended to stress attributes considered exclusive to construction, as if to excuse the failures of industrialized building. I have already alluded to the land component as a condition of production and the separation of design and production as the most obvious handicaps to direct analogy with manufacturing industry, mentioned by several authors<sup>71</sup>. A 1959 critique of the car industry model for construction showed that the bureaucracy necessary for mass-production depends on business stability usually absent from the craft administration of building projects<sup>72</sup>.

Some choose to compare construction with a broader spectrum of manufacturing methods than mass-production, seeking a better analogy from industry. For example, Graham Winch argues that modern construction increasingly resembles the processes of *complex systems industries* (e.g. electricity supply), dependent on a coordinating function provided by *project management*, and sharing the design and make-to-order characteristics of such industries; the convergent force is a management technique<sup>73</sup>.

Two interesting critiques of the industrial paradigm point out that construction is not as generalized and repetitive as it is painted for comparison with manufacturing. One insists on the wide variety of sub-cultures within construction defined by building type; the other takes the project as the

69. CROSSMAN (1975, p. 268). *The National Plan* (Cmnd 2764, 1964).

70. HILLEBRANDT (1975).

71. CLARKE (1985); GRAVETAT (1983); RUSSELL (1981).

72. STINCHCOMBE (1959).

73. WINCH (2003b).



fundamental unit of construction, defining *ad hoc* whatever supply of services, finance, information and products are possible or necessary<sup>74</sup>. These critiques have led to growing criticism of the basis of construction statistics, the Standard Industrial Classification<sup>75</sup>. Substantive differences in the ways construction and manufacturing are recorded make for lack of comparability; automotive engineering includes design and manufacture, its most efficient components, but not the less efficient distribution and maintenance. Construction, on the other hand, includes maintenance (about 50% of value added) but excludes design, which is the primary locus of construction innovation. It is the combined effect of these differences, putting construction in an unfavourable light with respect to automotive engineering, which fuels backwardness rhetoric about construction.

## 13. Conclusion

I have tried to show how construction has come to be seen as a modern industrial activity, partly through the development of building science, partly through the demands of wartime and post-war reconstruction, partly through the development of a new discipline of construction economics and partly through the enthusiasms of modernist architects and engineers. Despite political and technical failures of building under this banner, the industrial paradigm is alive and well. It continues to underpin academic work in construction management and economics, and government initiatives to improve construction behaviours.

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74. WINCH (2006); GROAK (1994).

75. BRISCOE (2006); WINCH (2003a); RUDDOCK (2000); CANNON (1994).

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