Towards a global construction database using a simplified systems approach

Stephen Gruneberg[1]

Towards a global construction database

The need for a global construction database is recognised but little activity has so far taken place to co-ordinate the national data that is already widely available on the internet. Construction data is gathered and made publicly available in almost all countries of the world. However, there are significant differences in definitions, means of gathering and methods of presentation. Two case studies are used to identify common approaches and characteristics and use is made of a recent CIB study of a systems approach to analysing construction industries internationally. National differences in approach to defining and collecting construction data as well as real economic differences may mean that a single universal approach may not be appropriate. It may therefore be necessary to cluster national construction data sets according to various economic, social and political criteria to facilitate useful measures of construction industries to be made accessible and internationally comparable and capable of aggregation on a global scale. This could then begin to meet the needs of policy makers in the absence of any other detailed worldwide construction industry data.

Keywords: Global construction data, construction sector system approach, cluster analysis, national construction industries, global construction yearbook

1. Introduction

Construction is a universal economic activity. The output of the global construction industry is achieved at a worldwide cost in terms of materials, plant and labour and in terms of pollution. Construction data on these and other economic aspects is gathered and made publicly available in almost all countries of the world. The website at the University of Westminster (University of Westminster, 2012) contains links to the majority of these sources.

However, according to the World Bank, (2011), the lack of international comparability especially in capital goods was a source of weakness in making international comparisons in the 2005 round of the International Comparison Program (ICP). A second round was implemented in 2011. However, since the 2005 round a number of issues have been identified involving construction. These included problems in making international construction price comparisons and assessing the basis and level of comparison appropriate

[1] Reader, Department of Property and Construction, University of Westminster, 35 Marylebone Road, London NW1 5LS, s.gruneberg@westminster.ac.uk.

for construction. The ICP ask how quality and level-of-service differences among countries might be incorporated in such comparisons.

The concept of a global construction industry implies that it is at least conceivable to aggregate the national construction industries of all countries. This is essential if the global impact of construction is to be measured. Only measuring the economic activity of one country in isolation gives no indication of what may be occurring internationally with international implications and consequences. Without an international perspective it is not possible to devise policies to counter damage to the natural environment, inequalities of wealth, or encourage the spread of good practice and sustainable development for humankind.

In order to aggregate the output of all construction industries, it is necessary to identify the relevant data and bring it to a common measure or yardstick. However, practical difficulties emerge in the data. Moreover, even accessing the data is problematic. To demonstrate the some of the issues and begin the process of integrating the construction data of different national statistical systems two small case studies have been conducted to critique the data available on the internet.

In the case of national income accounts a universal system has been established and this system is used by the United Nations to enable comparisons of national income to be made. The national accounts of every country are given in US dollars and national currencies in current and constant prices. It is conceivable that something similar could be devised for national construction industry data. Such a system would be the eventual aim of this research. The result would be improved data sets on which to base global and national construction policies, international comparisons and sustainable development.

This introduction is followed by two brief case studies, which are used to identify distinctive features that can be found in national construction data sets. The two construction datasets used are South Africa and the PR of China. These are discussed with a view to finding commonalities and differences as well as difficulties in accessing the statistics. The subsequent section returns to an earlier report of the CIB to discuss some of the theoretical issues that arise in identifying the scope of construction data and combining construction industry information internationally. Two examples of construction industries in Australia and Canada, discussed in the CIB report, are used to illustrate further the scope of the construction issues that could be developed. In the final section proposals and strategies are suggested to begin the process of developing construction economic data sets in a meaningful way.

2. Case studies

2.1 South Africa

Of all the data available on the African continent South Africa possibly produces the most comprehensive and easily accessible set of construction statistics. Entering the StatsOnline web page of Statistics South Africa, one click enables access to the latest publication available, which at the time of writing was the Construction Industry 2011 report. Downloading the main publication opens 15 tables describing various construction indicators.

The tables appear similar to information derived from the accounts of construction firms found in company annual reports. The breakdown of the construction industry is based on the income and expenditure of firms according to the types of service they provide, ranging from site preparation, the construction of buildings and construction by specialist trade contractors to renting of construction or demolition equipment with operators, a breakdown of work similar in scope to that of the Standard Industrial Classification (SIC) codes used in NACE, an acronym, which stands for the Nomenclature statistique des activités économiques dans la Communauté européenne, namely: the classification of economic activities as defined in the European Community. For each type of service, the opening and closing values of inventories are given as well as net profit or loss, the value of fixed assets, and capital expenditure on new assets.

Information is also given on the source of profits for each type of service or specialism. These sources include sales, services (construction work), rental and leasing activities, interest payments and profit from the sale or leasing of assets. A further breakdown of expenditure is also given in terms of purchases, payments to subcontractors, salaries and wages, depreciation, rental of plant and machinery, vehicle running costs, and repair and maintenance. Another table describes the value of fixed assets owned by each type of service firm from site preparation to demolition contractor. Details of current and non-current assets and liabilities are also given for each type of service firm.

The picture that emerges from the data on the South African construction industry is similar to what would be provided by individual firms from their own profit and loss accounts and balance sheets. The result is a vision of the performance of the industry in terms of its financial viability and productivity. This data set of the South African construction industry could be used as the basis for benchmarking data and estimating the aggregate performance of firms in a particular construction industry for international comparison purposes.

2.2 PR of China

Chinese data sets are available from the National Bureau of Statistics of China, (2013). Although more recent annual data up to and including 2011 appears to be available, the most recent year for which data is freely accessible, at the time of writing, is 2003. Chapter 14 of the China Statistical Yearbook is concerned with construction data, broken down into

32 subheadings, including 'main economic indicators' of construction enterprises, total construction output value by region, construction value added, pre- and post-tax profits of construction enterprises, labour productivity, number of construction enterprises by registration and status, number of staff and workers in construction enterprises, number and power of machinery and equipment owned, assets, liabilities and creditors of construction enterprises, total income of construction enterprises, construction quality of construction enterprises and state owned construction.

The emphasis on enterprises and state owned construction reflects the concerns of policy makers in the PR of China. In 1993 of the total of 20,998 construction enterprises only 505 (or 1.9 per cent) of construction enterprises were not state owned or owned by collectives. By 2002 the total number of enterprises had risen to 47,820 of which 27,107 (or 44 per cent) were foreign funded, or funded in Macao, Hong Kong or Taiwan. Thus not only had the number of enterprises more than doubled in the decade up to 2002 but the composition of those enterprises had shifted significantly away from direct public sector control. The figures for China also show that in the same period the average number of employees per enterprise was 405 people in 1993 and 470 in 2002.

These figures can be compared to the UK figures for the same year. In 2002 there were 166,181 contractors in the UK employing a total of 989,900 or only 6 employees per firm on average. In both countries, these figures may be read with caution, since UK firms tend to use a high proportion of casual labour not recorded as employees. Nevertheless, the contrast is striking. Also striking is the rapid increase in productivity in the PR of China between 1997 to 2002. According to Table 14.7 in the China Statistical Yearbook, in these six years productivity rose from 12,089 Yuan per person in 1997 to 19,316 Yuan in 2002, an increase of 37 per cent.

3. The Construction Sector System Approach

In 2004 the CIB published a report entitled, The Construction Sector System Approach: an international framework, edited by Carassus, (2004). This report contained a number of papers on the construction industries of Australia, Canada, Denmark, France, Germany, Lithuania, Portugal, Sweden and the UK on the theme of setting out an international framework to study the construction sector. Taking the report as a whole, several common themes emerge and it appears useful to use the report as the starting point of further study and research. The main theme was, of course, the sector system approach as it applied to the construction sector of each country considered.

Carassus (2004) argued that the construction industry had moved from large scale production to providing the services of the built environment. However, it can be argued that on a sector-wide basis the two concepts of production and services are intertwined and indistinguishable, even if firms may specialise in different aspects of the production of the built environment, including facilities management. Without physical buildings and infrastructure there would be no built environment and nothing to service and no built

services to provide. Production may be more circuitous and complex than in the past, due to increasing levels of specialisation caused by technological developments and layers of ownership and complex financial arrangements, such as the public private finance initiative, (PFI), and public and private partnerships, (PPP), which were prominent in the 1990s and early 2000s before the financial crisis of 2007. Nevertheless it is important to recognise that the physical built stock requires tending and new additions to the stock and demolition of redundant or obsolete buildings do take place.

With PFI and PPP there appeared to be greater emphasis on the life cycle of buildings and not just the production of the physical built assets. Carassus focused on a sector system approach, bringing the following issues together: the aim of construction activity, the shaping of its characteristics, grouping of construction activities, profit formation in the construction sector, fragmentation of the construction production process, the operational configurations of players and institutional regulations affecting the building process. (Carassus 2004, p8). According to Carassus, there is a distinction between construction industry analysis and construction sector systems analysis. Analysing the construction industry focuses on building buildings and infrastructures whereas a construction sector systems approach focuses on producing and managing the services provided by the built environment throughout the life of the built assets.

Although clearly an important distinction, the measurement of construction activity entails the former approach, restricted to those activities that build new or repair and maintain the existing stock of building. How that stock is managed, while clearly important, is beyond the scope of the study of global construction data at this stage. This may be contentious as Carassus (2004) rejects the principle that the main aim of construction is "to produce and manage necessary structures for people's living and working environment," (p10). Instead he says the main focus is "to produce and manage the services" of the built environment throughout their life.

Carassus (2004) defines the construction economic sector system as the organised complex of commercial and non-commercial relationships between productive and institutional actors producing and managing services of built structures throughout their life cycle. This definition includes the producers, consumers and regulators and the rules and regulations governing their activities. However, the focus of the following analysis of construction remains construction production activities and the materials and other resources used in the process.

Two country analyses, Australia and Canada, included in the CIB report, demonstrate the extent of construction activity that could be incorporated into discussions on global construction data. For example, de Valence (2004) points out that in Australia, the output data of the construction industry is divided into three distinct industry sectors, namely residential, non-residential and engineering construction. According to de Valence, in the 1990s, there was a shift in the housing market from separate houses to medium and high density developments especially in parts of Sydney and Melbourne. This indicated that shifts in the types of building may have had a significant impact on the interpretation of the data. The division of engineering construction data also reflects conditions in Australia, where a relatively small population inhabits a large area of land. In the Australian data set

the engineering construction sector is divided into six major components. These are road and bridge construction, electrical generation, transmission, water and sewerage, processing plants including oil and gas pipelines, and other types including railways, harbours and pipelines.

De Valence points out that there are no national built environment standards in Australia and planning is under the control of state governments. However, the majority of development decisions are made not at the state level but at the local level. Because each state has its own legislation regarding planning, development and environmental protection, construction market data needs to be considered on a state by state basis.

In Australian data size of firms by employment can be measured in size categories of less than 5, 5 to 19 and 20 and over. These size classifications are not compatible with the size classification used in the UK. The specialist trades are broken down into five broad categories, namely, site preparation, building structures, installation trades, building completion and other construction.

De Valence also discusses a broad definition of construction, which includes on-site services (trade services), client services (engineering, technical, etc.) building and construction project firms, materials and product suppliers, and machinery and equipment suppliers. By including materials and equipment suppliers, the size of the construction sector almost doubles in income, (from $58.6bn, to $110.4bn in the year 1996 to 1997) and employment, (from 484,100 to 682,000 employees in 1995 to 1996), according to de Valence (2004 p.31).

The value of repair and maintenance (R&M) is divided between residential and non-residential work on existing stock. In terms of residential R&M official statistics in Australia only record data on alterations and additions to houses for work valued at over AUD$10,000. According to de Valence, in 2002-2003 this work was valued at $4.6bn. To estimate spending on residential renovations, he suggests including a large proportion of the $8.3bn hardware sales to produce a total of more than $13bn per annum.

As the Australian Bureau of Statistics does not record R&M in the non-residential sector, de Valence suggests the equivalent can be estimated from a report produced by Arthur Anderson (1999) for the Facility Management Association of Australia. According to that report the total turnover of the Australian facility management industry was estimated to be more than $35bn, though de Valence points out that this could be a large underestimate. In any case, this estimate was not necessarily totally related to R&M. De Valence suggests that a final adjustment of both non-residential expenditure on facilities management and R&M would be approximately at least $15 billion.

Similarly, Manseau (2004) estimates the Canadian construction sector as measured by the output of contractors at between 10 and 12 per cent of GDP. The estimate is necessary because appropriate data for related sectors is not available. General and specialist contractors comprised 5.2% in 2002 (Statistics Canada, 2003). Manseau acknowledged that the size of services in construction, including design, engineering and technical services was very difficult to assess.

Data for construction in Canada include building permits, housing starts, completions and vacancy rates, flows and stocks of fixed non-residential capital, wage rates and various price indices. It also includes construction capital expenditure giving a breakdown of as many as 56 building types. However, many of the building types are distinct from those in use in the UK official construction statistics, those some terms overlap with the UK typology. For example, under commercial building construction the Canadian data includes laboratories, freight terminals, grain elevators, automotive dealerships, motels, convention centres, fast food outlets, plazas, bunkhouses, dormitories, camps and broadcasting and communication buildings.

Manseau points out that the share of each major type of construction output was relatively stable in the 1990s. For example, the residential building sector was around 33% of total construction, the non-residential building was 20% and the engineering sector accounted for the rest at 47%. In describing the size distribution of firms in Canada, Manseau reports that in 2000, the sector comprised approximately 215,000 contractors employing 896,000 people, with a third of firms being sole person firms and with 95.6 % of all firms receiving a revenue of less than US$1.4M in 2003. According to Manseau, the turnover of only 0.3% of contractors exceeded US$14m but the combined output of these largest firms represented over 23 per cent of total construction output in Canada.

From the data it would appear that repair and maintenance is a lower percentage of construction output in Canada than it is in Europe, according to Manseau (2004), who argues that as much as CAN$50bn is spent each year on replacement rather than repairs to existing stock.

4. Discussion

Whatever assessment of the size of the Canadian construction industry is made from existing data, Carassus (2004) draws the conclusion that using a systems approach to assessing the size of the construction sector in any country increases its size significantly and hence gives more weight to its importance to the economy. This also takes into account the shift in economies towards the tertiary sector, emphasising the service aspects of construction as well as the physical production of buildings and structures.

Carassus refers to four existing classifications used by Boyer (1996) to identify the main institutional contexts of markets and goes on to add a fifth. The first type of market environment is an ‘anglo-saxon’ model that relies on liberal market values, relatively little regulation, private finance and relatively poor conditions of employment. These characteristics were typified by the UK, Canada and Australia. The second model, he termed the ‘social-democrat’ model which can be described in terms of tripartite agreements between the state, employers and the unions. Examples of social democratic construction systems included Denmark and Sweden.

Similar to the social democratic system, the third model called 'corporatist' also relies on a system in which the state, employers and unions, called "social partners" negotiate to protect shared social values, including worker protection. This described the system in Germany. The fourth system is defined as 'public'. In this system the role of government is emphasised, as it is seen as the co-ordinator of the economy and finance. Examples of public systems include France and Portugal. Carassus' fifth model, which he refers to as 'transitional' applied to those countries, whose construction sectors were shifting from a soviet style planned economy to a market driven system. Typical of this category of construction industry was Lithuania.

Describing a number of types of business environment, Carassus' approach of classifying the countries in his report used cluster analysis, a method of grouping countries by similar economic characteristics. Jackson and Deeg (2008) view clusters as similar combinations or institutional configurations of economic variables in different countries. In the case of construction this could include the stage of development, the technology and materials used and the output mix of buildings and structures.

Amable (2003) carried out a cluster analysis of a greater number of countries than those in the Carassus study, using various indicators outside construction, including competition, labour markets, corporate governance, social policies and education systems. This produced more general types of capitalism, namely: market-based, social-democratic, continental European, Mediterranean, and Asian. Though still Euro-centric, these descriptions may well be appropriate for an approach to global analysis of construction industries. However, while clusters may emerge in terms of Amable's geo-economic, geo-social and geo-political analysis, they may be too general to apply to data on the construction industry. The focus on aspects of the construction industry and measures of construction output remain the ultimate focus of this research.

5. Concluding remarks

Cross border differences in construction industries may well imply that no one universal measure or system of measuring can be adopted to make all construction industries meaningfully comparable or capable of being aggregated. It may well be necessary to divide national construction industries into sub-groups in a manner first suggested by Turin (1973). Elkhalifa and Shaddad, (2010), describe Turin's classification of national construction industries in terms of international modern, national modern, national conventional, and traditional. Each classification has a distinct and predominant use of materials, ranging from modern methods using technological developments to using locally sourced materials applying simple techniques, depending on building types and civil engineering requirements.

Of course many countries have been omitted from this brief survey. The purpose of which is to show the possibilities of undertaking far more international comparisons and investigations to begin the process of aggregating and comparing data sets, a process begun by the 2004 CIB report edited by Carassus (2004). It therefore follows that a yearbook

based on a development of an annual update of the approach used by Carassus (or if not annual, then bi-annual) would be an extremely useful document, if carried out on an global scale. Such a project could be the output of the CIB Global Construction Data Task Group.

The issues identified include the distribution of building and civil engineering between residential, non-residential and civil engineering, the distribution of orders between corporate, non-corporate and public sector, construction as a share in value added, construction employment as a proportion of total employment, the distribution of new build and work on exiting stock in both building and civil engineering, the value of the net addition to the built stock in both absolute output terms and as a proportion of the value of the built environment stock, and the value of the built environment stock as a percentage of GDP, the distribution of firms in the construction sector by numbers employed by firm and by specialism and region. Other aspects of the construction production process include materials, international trade, and construction professionals.

Taken together these indicators form one definition of a construction sector system approach. Carassus (2004) sees these as enabling analysis of four aspects of construction: namely, statistical analysis, strategic planning of firms, sustainable development and construction innovation. On a global scale, this work would also be useful for national government construction policies, international organisations such as the United Nations, the World Bank, regional development banks and many other users. Its importance cannot be over-stated.

References

1. Amable B (2003) *The diversity of modern capitalism*, Oxford, Oxford University Press

2. Arthur Andersen (1999) *Facility Management in Australia: A Market Overview*, Melbourne, Facility Management Association of Australia

3. Carassus J (2004) *The Construction Sector System Approach: an international framework*, Rotterdam, CIB

4. de Valence G (2004) 'Meso-economics analysis of the Australian building and construction industry,' in Carassus J (ed.) *The Construction Sector System Approach: an international framework,* Rotterdam, CIB

5. Elkhalifa A and Shaddad MY (2010) 'The Construction and Building Materials Industries in Sudan' in Proceedings of the W107 - Special Track, 18th CIB World Building Congress, Salford

6. Jackson G and Deeg R (2008) 'Comparing capitalisms: understanding institutional diversity and its implications for international business' in the *Journal of International Business Studies*, Vol. 39, 540–561

7. Manseau A (2004) The Construction Industry Cluster in Canada still Blurry and Difficult to Assess,' in Carassus, J (ed.) *The Construction Sector System Approach: an international framework*, Rotterdam, CIB

8. National Bureau of Statistics of the PR of China (2013) *China Statistical Yearbook 2003*, http://www.stats.gov.cn/english/statisticaldata/yearlydata/yarbook2003_e.pdf (accessed 13th Jan 2013)

9. Ruddock L and Wharton A (2004) 'The UK Construction System at the Beginning of the Twenty-First Century,' in Carassus, J., (ed.), *The Construction Sector System Approach: an international framework*, Rotterdam, CIB

10. Statistics Canada (2003) *CANSIM Table 379-0019, Gross Domestic Product at basic prices* CANSIM, Statistics Canada

11. Statistics South Africa (2012) *P5002 Construction industry*, 2011 (Preliminary), Pretoria, StatisticsOnline http://www.statssa.gov.za/publications/P5002/P50022011.pdf (accessed 13th January 2013)

12. Turin D A (1973) *The Construction Industry: Its Economic Significance and Its Role In Development* (2nd ed.) London, University College Environmental Research Group

13. University of Westminster (2012) *Construction Statistics*, Project Support Centre, London, University of Westminster http://site.westminster.ac.uk/psc/online-resources/construction-statistics/ (accessed 13th January 2013)

14. World Bank (2011) *Construction Surveys*, International Comparison Program 2011, World Bank http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/ICPEXT/0,,contentMDK:20735971~pagePK:60002244~piPK:62002388~theSitePK:270065~isCURL:Y,00.html (accessed 10th Jan 2013)