Services, goods and business client productivity: Learning from construction

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This paper reviews research since the 1960s on productivity growth in the construction industry and how low growth rates, which it shares with business services, have been explained over the years. Effects of deficiencies in output quality measurement have been underestimated, and in retrospect it is clear that persistently low growth rates cannot be explained by productivity determinants that operate in the short or medium term. Better output measures would support studies of links between productivity and innovation. Industry interest in multi-criteria benchmarking of project performance suggests the development of additional measures for output quality, related to effects on client productivity.

1. Introduction

It has long ago been recognized that the issue of measuring quality change is not confined to the services sector, and that it also affects the measurement of output in construction (Griliches, 1992, 7). Construction as an industry is traditionally assigned either to the secondary sector along with manufacturing or to the tertiary sector. The development of the tertiary sector during recent decades and in particular the growth of importance of business services makes it worthwhile to study the proximity of construction to business services, although some of the output from construction firms (owner-occupied dwellings, repairs) is bought directly by households. Calculations based on the EU KLEMS data (Timmer et al., 2010, 59) indicate that the growth rate for labour productivity in construction is low and close to that for business services if compared with a range of twenty-six industries in the EU over the 1980-2005 period.

Furthermore, the difficulties of measurement of services productivity and the specific determinants of productivity growth in the services sector are nowadays more widely recognized (Djellal; Gallouj, 2008), and this is a strong reason for assessing what has been written on construction productivity in a services perspective.

This paper has two main objectives: (i) reviewing research since the 1960s on labour and multifactor productivity growth in the construction industry and how low growth rates, which it shares with business services, have been explained over the years, and (ii) to relate construction industry productivity issues to current thinking on productivity measurement for business services.
Thus the paper reviews the construction productivity literature since 1965, emphasizing contributions that are based explicitly on economic theory. The outcome of engineering analyses of resource use in Swedish case studies of various construction project types in a thirty-year retrospective is also included. It is argued that construction presents the paradox of an old industry that nevertheless has operated — and still does so — in ways that prefigure more recent business services, notably because of its complicated nexus of coproduction relationships and client willingness to pay for service process qualities.

This paper is structured so that it begins by reviewing the construction productivity debate before looking more closely at the relationship between the construction industry and business services as the term is usually understood. Next, the notion of client productivity in business services is explored and compared to what is known about construction client effects. In the following section, innovation aspects are considered and then illustrated by findings from a Swedish project on construction innovation. Finally, a number of conclusions are drawn — is there anything that those who study business services productivity could learn from construction?

2. The construction productivity debate

Already before productivity measurement was introduced, a number of relevant issues were identified during the early development of construction statistics in the US, when the primary concern was that of stabilizing employment in the industry. Thus Gill (1933) referred to several alternative data definitions: whether to include only construction awarded through contracts, whether to include alterations and repairs, and whether there should be a minimum contract sum for inclusion. Also, when discussing the measurement of construction costs, Gill (1933) noted problems associated with construction inputs: equipment used and equipment rental, and how to deal with “higher grade materials going into buildings”, i.e. the input quality measurement problem.

The debate on construction productivity has three main topics: the definition (delimitation) of ‘construction’, the measurement of productivity and the factors that explain productivity growth (Goodrum et al., 2002). Important distinctions are made between labour productivity, which has attracted more interest among researchers, and total factor (multifactor) productivity. The relation between productivity measures at various levels of aggregation has also been investigated, notably to explain why obvious increases in labour productivity and the construction project or site level fail to be reflected in industry level data.

The definition of the construction industry has consequences for the measurement of the outputs. While common usage among non-specialists tends to interpret ‘construction’ generously, including architectural and other related professional services and materials producers who sell their products to the construction industry, NACE and other international classifications do not consider them to be within the limits of the industry (Briscoe, 2006).

In the 1960s, when comparing productivity growth in the construction industry to other industries, US economists initiated the debate of how to explain the low growth
rates in construction. Among the ideas brought forward was that short or medium term shifts between types of construction projects and between sizes of projects could explain variations in construction productivity and that there were effects of the business cycle. However, in the long term, the apparently low rate of productivity growth emerged as linked primarily to problems of determining and measuring changes in output quality.

As noted already in the interwar period, heterogeneity of output is one of the major obstacles in deflation of construction. As a consequence of output heterogeneity in the construction industry, prices of inputs rather than outputs are used to estimate the value of construction. Pricing of inputs as an approach is obviously seen as worrisome; hence Kaplan (1959) suggested the use of intermediate outputs such as cubic yards of concrete foundation as a step towards direct measurement of heterogeneous outputs.

Thus the problems of measuring the real output from the construction industry have been an obstacle to estimating its productivity. Dacy in his pioneering article (1965) mentioned that there had been little interest in studying the real output, productivity and price trends; he went on to identify factors that increase construction productivity. Already here, we find listed shifts in construction product mix, geographical distribution (different design and building codes in different US states), increase in construction firm size in contract construction, introduction of new techniques, decline in average age of construction workers and increase in capital per worker are all included in his 1965 list. Stokes (1981) basically confirmed Dacy’s reasons for low rates of productivity growth in the construction industry. However, Stokes (1981) was additionally able to estimate that these factors explained only 25 per cent of the change in productivity growth, and that capital per worker was the major contributor to growth.

Also in the 1980s, research appeared to show that errors in the measurement of real output did not understate productivity growth as much as it had been believed; when Allen (1985) investigated the same productivity factors and found that the capital-labour ratio and wrong deflators explained more than half of the low growth in construction industry productivity.

Furthermore, technological advances in design and construction, the fragmented structure of the industry and the fragmentation of the construction process due to separation of design and construction were identified by Ganesan (1984) as important factors that influence construction industry productivity.

It is unusual to find construction productivity studies that rely on data from the establishment (firm) level; Albriktsen and Førsund (1990) did so and found that there were large variations between Norwegian builders. Many of the more recent investigations into construction labour productivity have concentrated on the construction project level, sometimes gathering data at task level on construction sites. Studying construction sites, it is possible to find productivity increases clearly associated with higher inputs of real capital. Improvements in equipment technology seem to have contributed to long term improvements in labour productivity (Goodrum and Haas, 2002; 2004). Nevertheless, data aggregated to the industry level show consistently lower values for productivity growth. Thus construction practitioners who are actively involved in the construction process are often surprised by national statistics on the industry level, since they think that improvement of productivity is within their own span of control and that external conditions are less important (Rojas and Ar- amvareekul, 2003). On the other hand, there is at least one investigation (Allmon et
al., 2000) that suggests that construction management practices have had only a minor influence on labour productivity, whereas depressed real wages over two decades, implying that the gap between construction and manufacturing wages had been reduced successively, and technological improvements emerged as major factors of growth.

The evolution of the EU KLEMS database has influenced thinking on construction productivity in later years, beginning with Crawford and Vogl (2006) in their useful overview when they discuss the contribution of total factor productivity to labour productivity growth in construction. Recently, Abdel-Wahab and Vogl (2011) have analysed construction industry data in the EU KLEMS database, however without being able to add to or modify the set of explanatory factors identified by earlier research on construction productivity.

In retrospect, it seems that low growth rates, persisting over decades, should not be explained by productivity determinants that operate only in the short or medium term. Many such determinants have been proposed since the 1960s, but the general impression of previous research is that effects of deficiencies in output quality measurement have been underestimated.

It should be noted that construction productivity data derived from KLEMS have to be used with caution. The growth in the UK of self-employment in construction and of workers employed in firms not registered for VAT has led to the withdrawal of construction productivity data from government statistics (Daffin et al., 2001). Currently, no industry-level measures of productivity are published for the U.S. construction industry. Statistics Denmark publishes labour productivity data for construction, broken down into subbranches of Construction of new buildings, Repair and maintenance of buildings and Civil engineering; however, as discussed by Buch and Odgaard (2010, 10) the development between 1966 and 2009 of civil engineering productivity in particular appears to be erratic in behaviour and hardly a reliable basis for analysis.

3. Comparing productivity in construction and in business services

Industry comparisons of productivity growth according to the EU KLEMS database for the 1980-2005 period reveal a varied picture. Table 1 lists industries with labour productivity (LP) and multi-factor productivity (MFP) growth rates similar to construction, according to Timmer et al. (2010). Contributions of information and communications technology (ICT) capital (K) to aggregate labour productivity have also been included. In principle, similarities between construction and other industries ought to be due to common problems of measurement or to common underlying productivity factors. The definition of Business Services follows NACE rev. 1.1, where it included 71-74, (=Renting of machinery and equipment; Computer and related activities; Research and development; Other business activities).
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<tr>
<th>Productivity definition, region and time period</th>
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<td>LP (gross VA/h) EU 1995-2005</td>
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<td>Food and Beverages</td>
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<td>Difference in contributions to aggregate LP EU 1980-95 vs 1995-2005</td>
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<td>Difference in contributions of ICT K to aggregate LP EU vs USA 1995-2005</td>
<td>Retail Trade</td>
<td>Wholesale Trade</td>
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<td>Difference in contributions of non-ICT K to aggregate LP EU 1980-95 vs 1995-2005</td>
<td>Hotels and Rest.</td>
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<td>Contributions of non-ICT K to aggregate LP EU 1995-2005</td>
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<td>MFP EU 1980-2005</td>
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<td>Other services</td>
<td>Automotive trade</td>
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<td>Difference in MFP contribution to LP EU 1995-2005 vs 1980-95</td>
<td>Transport</td>
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<td>Difference in MFP contribution to LP EU vs USA 1995-2005</td>
<td>Post and telecom</td>
<td>Utilities</td>
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Table 1: KLEMS data for construction, compared to other industries (derived from Timmer et al., 2010)

It is essential to note that in NACE rev. 2, the industry classifications within the service sector have been restructured thoroughly. As for ‘Construction’, although the move from NACE rev. 1.1 to rev. 2 implied only minor change, there is thus a variety of delimitations of Business Services. The widest definition is that of business-to-business services as opposed to consumer services. However, it is obvious that the same service providing firms in a given industry might provide both firms and households with their services, as with legal services.

The pattern that emerges from Table 1 is varied. It is actually easier to understand why a number of industries fail to appear as adjacent to construction rather than to summarize what the ‘neighbours’ in the table have in common. Nevertheless, in the case of labour productivity growth, there is a relationship to Business Services. Evidently, construction remains far from most types of manufacturing, as productivity data for eight industries never appear in the proximity of construction: Electrical equipment, Rubber and plastics, Wood products, Non-metallic mineral, Transport...
equipment, Other Machinery, Textiles and Footwear, Other Manufacturing. Note that important suppliers of inputs to construction are found in this list.

The industry pattern related to contributions from deepening of ICT capital to aggregate labour productivity reveals Construction to be close to Retail Trade, Wholesale Trade and other logistics dominated industries. During the 1995-2005 period, the industry with the greatest contribution of this nature was Business Services in both the EU and the US, and Construction did not lag far behind. Contributions from deepening of non-ICT capital to aggregate labour productivity have been important for Construction in this more recent period, particularly in the EU, whereas non-ICT capital deepening had played a greater role for Business Services in the earlier period, 1980-95. Also, there was a strong effect for Construction as to the contribution to aggregate labour productivity from changes in labour composition, at least in the EU during the 1995-2005 period.

A possible explanation for Construction appearing close to Agriculture and Mining is land as a production factor. Fresh results from a cross-sectional study of housing productivity in US metropolitan areas by Albouy and Ehrlich (2011) do not exclude the possibility of low productivity growth caused by successive moving of new construction to worse sites. Land is almost a non-renewable resource subject to depletion, as property development in a given area tends to begin by exploiting the best sites available, those with the most favourable location, access to amenities, as well as the best geotechnical characteristics. There is thus an analogy with declining yield in the mining industry, and as shown by Topp et al. (2008) for productivity in the Australian mining industry, once depletion effects have been removed, productivity growth is evident.

Higher specialization, standardization, consolidation of business processes and a shift to higher value-adding services have been invoked as causes of both higher employment and higher productivity in business services (Sako, 2006). These are examples of generic factors that have escaped most authors on construction productivity, probably because of limited interest in the level of the individual firm in the industry.

Nevertheless, the similarities between business services and construction are sufficient to make it worth considering more in detail at least one stream of the business services literature, the one that raises the issue of links between provider and client productivities.

4. Business services client productivity

Productivity measurement for most services is complicated because of quality change. The underlying heterogeneity of transactions and interaction with users leads to difficulties in standardizing service output (Griliches, 1992, 7); there is little detail on the performance characteristics of professionals, and even less on the characteristics and training levels that matter for performance. It is not just interaction with users, consumers may be considered to supply an input when a service takes place (Sherwood, 1994). Various types of business services depend to various de-
grees on client inputs, and it is to be expected that professional services exhibit a high degree of dependence.

Therefore it is also reasonable to assume that the productivity of professional services is related to the productivity of whatever these services are intended to support as intermediate inputs, although this insight is hard to translate into data collection. Hitherto, the concept of client productivity has mainly been used in the context of management consulting services. For management consulting, Nachum (1999) has proposed that client input should be measured as labour resources that the client has used in the relationship with the consulting firm. One problem she noted is that the time that top management spends on a particular project is usually not accounted for. As for output measures, she proposed a combination of price (=turnover of the professional service firm) and improvement of the client firm’s competitive position, due to the services received. Here there is the obvious difficulty of identifying the effect of these services (Sherwood, 1994). Similar to construction outputs, there is a time dimension in that the effects do not emerge instantly and should ideally be measured over a period of time. Nachum suggested measuring change in market shares for the firm’s five largest clients, two years after the completion of a project. Unfortunately, for her subsequent analysis of data, she was forced to omit the measures of input and output from the clients because these were unable to provide that information. The internal organization of the client firm adds a further complication when analysing management consulting services. Client input to professional services production is delivered by both those employees (frontline) who enter into direct contact with provider staff and employees with support functions in the background (Martin et al., 2001).

Relying on Danish input/output data, Drejer (2002) explored the possibility to estimate the effect of business services inputs on production in a range of industries, where Construction was included in the category of supplier-dominated manufacturing. She used a production function with capital, labour and business services. Baker (2007) has exploited input-output data for studying productivity effects in client industries of business services as intermediate inputs. Unlike outsourcing of support services from manufacturing firms (Sako, 2006), the widespread practice of subcontracting in construction usually implies flows of services within the construction industry itself, although the long-term trend of increased use in construction of prefabricated components as intermediate inputs delivered by the manufacturing sector may influence productivity growth. There is also a growing reliance among construction contractors on architectural and engineering services bought in the marketplace.

From an empirical viewpoint, what is lacking is access to customer data that sometimes are available for comparatively standardized consumer services. In principle, surveys of client satisfaction with business services should be possible to analyse along the lines of when data from customer satisfaction surveys are used for Malmquist productivity indices (Fixler; Zieschang, 1992; Färe et al., 2006). It is probable that client satisfaction with business process service qualities is strongly related to effects on client productivity, and this could be linked into the more general idea of multi-criteria frameworks for measuring service performance (Djellal; Gallouj, 2008, 53seqq.), an example of which has been developed by Becker et al. (2010).

Turning again to the construction industry, there is not only the complication of the customer participating in the production process of construction, e.g. when approving technical and schedule changes at site meetings. Hidden under the contractual ter-
minology of traditional design-bid-build versus design-build projects (Ling et al., 2004) is a three-party relationship of (i) construction clients, (ii) providers of architectural and engineering services and (iii) construction contractors. In design-bid-build projects, clients buy professional services in order to specify their detailed requirements as a basis for competitive procurement of construction work. Under the design-build regime, it is the construction firm that buys at least the detailed design from architectural and engineering firms, although at an early stage of the project, the client will often have bought some professional services before signing the construction contract. These are obviously not just simple cases of customer coproduction; the presence of three co-producers as well as role shifts along the time axis of construction projects is a further challenge for productivity analysis.

5. Innovation in construction and in business services

How strong is the link between productivity growth and innovation for construction? As mentioned, traditional statistical classifications do not include the construction industry among business services, although productivity related data reveal a number of similar features that were possible to recognize in Table 1. When it comes to innovation, a comparison based on data from European Innobarometer 2002 and 2004 surveys together with successive UK Innovation Surveys shows even more clearly that the construction industry shares many characteristics with the wider services sector (Bröchner, 2010a, 745-749). However, the observation that official innovation statistics have reported low levels of innovation in construction and that productivity statistics have been disappointing does not necessarily imply a strong logical connection.

Construction innovation may suffer more than innovation in other industries from the liabilities of immobility and unanticipated demand (Reichstein et al., 2005). Researchers wishing to defend the construction industry against its detractors, imagined or real, have followed at least one of two lines of argumentation. The first line of defense consists of emphasizing how narrow the NACE delimitation of the industry is in comparison with how the construction sector is understood among practitioners, much as Briscoe (2006) has argued for a wider definition to be used for construction productivity data. Arguments for a more generous definition of construction have been brought forward by Winch (2003) and several other authors, including Asikainen and Squicciarini (2009) who proposed stretching the construction sector definition and restated Finnish data on innovation activities in various industries. The alternative line of argumentation is to estimate innovatory activities in construction for the whole range of product, process, marketing and organizational innovation, according to the broadened definition of innovation in the current version of the OECD Oslo Manual, which reflects the need for a better understanding of innovation in the services sector (Bröchner, 2010b).

The effects of investment by firms in intangible assets have attracted more attention recently, as better measurement can be expected to reveal stronger links between innovatory activity and higher levels of construction productivity (Ruddock; Ruddock, 2009). UK data (Haskel et al., 2011) now indicate that for 1997-2007, the level of construction intangible investment was about twice that of tangible investment. Admittedly, and precisely because of the investment nature of research and develop-
ment activities, it is not obvious whether a refined method for measuring construction inputs due to intangible investment will always be associated with higher rates of productivity growth, at least not in the short term.

Innovations in construction seldom have the nature of a technological step-change; this raises the possibility that the signals that construction firms perceive in the market direct their innovatory activities into output qualities that are increasingly difficult to measure, relying on conventional methods of data collection for government statistics. This shift in output qualities is only what we should expect, now that there is a more frequent practice of public procurement with non-price contract award criteria such as “quality” and “sustainability” (Waara; Bröchner, 2007), also taking “relational capabilities” for construction partnering projects (Kadefors et al., 2007) into account. Public clients have thus developed scales and weights for qualities that are not recognized in industry statistics. Case studies within the Swedish Bygginnovationen project reinforce the impression that there is a trend away from the easily measured output features.

6. The Swedish Bygginnovationen project

How construction innovation can raise construction productivity has been an initial question for the Swedish Bygginnovationen project¹. During the first phase of the project (2009-2010), a series of thirty-year retrospective case studies of output qualities and resource use in bridge projects and other selected types of construction projects have been carried out in order to increase the understanding of the relation between technological progress and resource use in construction.

To describe the engineering analysis in the bridge case studies, some engineering detail is necessary and also gives an opportunity to grasp the mix of goods and services that is involved. Data from a number of beam bridge projects were retrieved from interviews and design drawings, comparing old and new bridges of the same type. Interviews were held with the original contractor site managers to retrieve information on the project organization, production methods used, unit times for operations such as placement of reinforcement, formwork, pouring of concrete, and man-hours spent in the project. Geometrical data, bills of quantities and estimates of engineering hours spent in each project came from drawings and other documents held in project archives among the firms behind the original engineering design.

In this way, data were collected for a 1974-2007 sample of concrete beam bridges and one type of steel beam bridge with a concrete deck. The historical comparison reveals that the more recent bridges have consistently more reinforcement per sq.m. of useful surface area. Throughout the sample, the concrete cover is thicker for the newer bridges. Otherwise, there appears no significant difference over the years in terms of useful bridge surface area produced per hour – or in unit times for various tasks. A closer look at labour time consumption for concrete related operations

¹ “The Construction Innovation”, www.bygginnovationen.se, supported by VINNOVA, the Swedish Governmental Agency for Innovation Systems, and an industry consortium.
(formwork, reinforcement, and pouring) shows that placing of reinforcement bars in relation to useful bridge surface area takes clearly more time now than thirty years ago.

For the pair of steel bridges analysed, there was no obvious increase in the ratio of useful bridge surface area to man-hours spent. The general impression made by the case data is that of long-term stability in on-site labour productivity. In terms of usable bridge surface area per hour of professional services input (=structural design), productivity is twice as high, given that the number of drawings per hour of structural design has been about doubled. Comparing an old and a new concrete bridge of similar type, it was found that prefabrication of formwork and the use of concrete pumps had reduced the number of hours for formwork and pouring, while hours for reinforcement had increased. The introduction of advanced ICT support over the years had not led to any significant increase in structural engineering labour productivity could be identified, and if productivity is measured as the useful bridge surface area per structural design hour it remained about the same, while the number of drawings clearly increased per unit of useful area for the newer bridge.

The increase of concrete and reinforcement was further investigated by estimating 34 concrete box beam bridges designed and built between 1969 and 2006. It emerged that bridges built after 1987 compared to similar types of bridges from earlier years had consumed about 50 per cent more concrete and reinforcement per useful bridge area unit. Higher regulatory demand on reinforcement quantities and thicker concrete cover is a possible explanation for the lack of labour productivity growth as it is measured traditionally. Thus the method of partial coefficients for design in ultimate and serviceability limit state was introduced in the Swedish bridge norms in 1988. Six years later, concrete structures began to be classified according to their expected service life, relying on the expected corrosion initiation time, depending on the emergence of scientific models of how chloride penetrates concrete covers.

These observations highlight the need for analysing the little-explored consequences of performance-based engineering for construction productivity. If design decisions are based increasingly on long-term considerations, with methods of life cycle cost analysis are applied to the selection of strategies for improving durability of exposed concrete structures, short-term productivity measures are unlikely to indicate growth.

Summing up, the investigated cases suggest that broadly similar patterns of resource use have remained stable over the period. Change is evident, however, in output qualities that are difficult to measure in traditional ways. Public and private sector customers have shown greater demand for low life-cycle costs and better long-term characteristics of constructed facilities. Also, there is greater awareness of risks associated with projects and of service process qualities in the delivery of construction projects. Issues of environmental sustainability have gained in importance.

In the Bygginnovationen system which is proposed for routine assessment of the productivity potential of construction innovation projects, there is a user-oriented measure of capacity (useful length/area/volume) as the primary output measure; this can be modified with a ‘future capacity for flexibility’ coefficient and further coefficients for site-specific factors. There is a set of secondary output measures defined as discounted future reductions in energy consumption, of other operations and maintenance resources, of disruptions in user activities, of client risks and of negative external effects; discounted future values of user comfort and architectural qualities.
are also included. For most of these measures, simple scales have been devised to support comparisons with standard levels of performance. Since the construction industry (NACE 41-43) includes both new construction and repairs, and also the whole range from housing to heavy civil engineering, the intention has been to create a single set of measures that could be applied to proposed innovation projects of all types and not only to those that relate to new construction.

7. Concluding remarks

What then can the study of business service client productivity learn from construction, an older industry, with a longer history of productivity debate? It is obvious that productivity measurement for the construction shares many problems related to heterogeneity of outputs and inputs as well as the measurement of output and input qualities. The material presence of goods in construction processes is more obvious and differentiates them from professional services, but the immobility of production and product, also giving rise to consequences for the environment, must be remembered.

Construction productivity researchers have been able to identify plausible short or medium term mechanisms that contribute to the dynamics of productivity growth, which can be compared with e.g. the study by Maroto and Rubalcaba (2008) of the business cycle effects on services productivity. However, the persistently low or even negative rate of productivity growth reported for the construction industry might primarily be due to measurement errors. Industry productivity studies have made further progress based on the EU KLEMS database with its advantage of a more detailed accounting for inputs (labour composition, ICT capital). This allows researchers to link productivity closer to incremental and immaterial innovation often associated with the services sector and also with the construction industry (Bröchner, 2010b). At the industry level, there remain the data difficulties of dealing with output heterogeneity and output quality change.

Another challenge is that of identifying the increase in customer productivity that is due to services bought. Taking an example from construction, the phenomenon that design and technologies affect the indoor climate of offices and the connection between climate and office worker productivity is increasingly recognized (Johansson, 2009). One possibility is to bring data from customer satisfaction surveys into the analysis of how provider and client productivity growth are related. Since the publication in 1998 of Rethinking Construction, a UK government report, and inspired by survey practices that had evolved for the US automotive industry, schemes for benchmarking performance in construction projects have gained widespread popularity (Costa et al., 2006; Rankin et al., 2008). These client-oriented schemes, often promoted by public sector clients, can be said to imply new output quality measures for the project level, while reflecting elements taken from customer satisfaction surveys and the project success literature. The degree of contractor success in adhering to a given project schedule is a key performance indicator that is typical of such schemes. Introduction of the Just-in-Time principle is an example of how a supplier might exhibit lower productivity and the customer firm a higher productivity. Time precision, probably like cost precision and quality precision, is a service process
quality that has not analysed in the context of construction productivity, although it is likely that there is an implicit price for such qualities.

Data from multi-criteria performance surveys could be used more widely to catch aspects of output quality change, in conjunction with traditionally collected figures, provided that performance indicators are defined in a way that is consistent with traditional statistics and permits aggregation to higher levels. The absence of international classifications and conventions is a disadvantage as it presents an obstacle to comparisons between industries and between countries.

A framework that is able to analyse co-production with clients is clearly useful for the study of business service productivity. One challenge that can hardly be unique to construction is how to analyse interdependent productivities when there is co-production with the involvement of more than two firms.

Since long ago, construction has been characterized by a mix of pure services and pure goods productive activities, and in that sense it has not been a laggard industry but rather prefigured what is currently the situation for advanced manufacturing firms. This is especially so when manufacturers deliver project-based complex products closely adapted to customer requirements and integrated with service elements. Recognizing this integration is crucial: for the development of government productivity and innovation policies, the construction industry tends to suffer if there is a clear divide between goods and services initiatives. Hence the plea by Rubalcaba et al. (2010) for considering the commonalities of production, across what is traditionally divided into manufacturing and services, is pertinent.

References


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