Productivity Comparisons, Are They Possible or Even Desirable?

Olander, S.
Construction Management, Lund University
(email: stefan.olander@bekon.lth.se)
Widen, K.
Construction Management, Lund University
(email: kristian.widen@bekon.lth.se)
Hansson, B.
Construction Management, Lund University
(email: bengt.hansson@bekon.lth.se)
Pemsel, S.
Construction Management, Lund University
(email: sofia.pemsel@bekon.lth.se)

Abstract

Increased productivity is of societal good and efforts to achieve this should be a relevant task for all businesses. However, the concept of productivity is not clear as to what is to be measured. This becomes a problem especially when statements are made that the development of productivity in the construction industry is not as good as other sectors of industry. It is not clear if this comparison is relevant or even possible to make. This study aims to address and discuss the problem surrounding productivity measurements and comparison of them and is based on literature reviews that address the problem of evaluating productivity, with special focus on construction productivity. The results show that there is no uniform measure for construction productivity that can be used. Different situation calls for different measures. There unique circumstances for various construction activities, such as housing, commercial, industrial, infrastructure etc, that makes comparison of productivity between them virtually impossible. If statements of productivity are made without the knowledge of what the measures really show or is based on, there is a risk that these lead to misleading conclusions. Every study of productivity needs to be critically scrutinised with a high degree of scepticism. Instead of trying to achieve one uniform measure of productivity a set of key performance indicators can be used instead in order to obtain more qualitative facts about the state of the construction industry.

Keywords: productivity, efficiency, incommensurability, construction

1. Introduction

Increased efficiency in various sectors of society is a prerequisite for growth; the construction sector is no exception. Buildings and infrastructures needs to be improved in order to achieve the ambitions of a more sustainable use of limited resources. Often this increased efficiency is described in terms of increased productivity. Statements concerning the development of productivity in the construction sector are often made in relation to other industrial sectors, where the conclusion often is that the construction sector is not as productive as other industrial sectors (e.g. Koskela and Vrijhoef 2001). However, most of the available data and statistics are of *macro economical type*, which means that the pictures given are rough and not very suitable for control and decision-making at company operational level.

Nevertheless, the information is useful for the industry as general background. But when it comes to measuring productivity and efficiency, the need of project level data is essential (Ingvaldsen et al. 2004). Different initiatives to improve the construction industries competitiveness have been introduced in a number of European countries, for example Constructing Excellence, the UK, PSI Bouw, Holland and BQR Best Practise, Sweden where all more or less base their existence on a notion that the productivity in construction has increased less than in other industrial sectors. Three Swedish governmental official reports (SOU 2000, 2002 and Statskontoret 2009) during the last ten years all base their evaluation based on this assumption. This debate is not new and not limited to the perception of Swedish governmental agencies. Already in the 1960s, Dacy (1965) questioned the statement that the productivity in the US construction sector was worse than other sectors. Davy based his arguments mainly by questioning the reliability and suitability of available statistics.

This study aims to address and discuss the problem surrounding productivity measurements and comparison of them and is based on literature reviews that address the problem of evaluating productivity, with special focus on construction productivity. The results show that there is no uniform measure for construction productivity that can be used. Different situation calls for different measures.

2. Is it possible to measure productivity in construction

In a perfect world, perfect productivity (Whiteside 2006) would be achieved during a 40 hour working week where all employees take their vacations as planned. All drawings are 100% correct and no delays occur in the project process. All work safely, everything fits and functions perfectly the first time, and the temperature is always 20 degrees Celsius. However, Whiteside (2006) points out that we are not living in a perfect world. In order to evaluate the level of productivity for the construction sector and compare this with other sectors there is a need for a common framework. For example, a simple way of measuring productivity of a building process is to measure the working time productivity (labour productivity). Based on the working time of the working force at the site and the produced floor area, one can calculate the gross area produced per. hour, which in some situations can be used to compare different project organizations‟ ability to compete (Ingvaldsen et al.

2004), but, in this case, a consistent definition of direct labour needs to exist (Whiteside 2006), otherwise the misinterpretation can be made that a contactor that uses more direct labour hours is less productive. In reality the opposite may be true if indirect labour hours have been accounted for as direct. Whiteside (2006) argues that the only time productivity as a measure can be constant and thus act as a comparative measure is in highly automated and robotised assembly lines. Thus, there are good grounds to doubt statements concerning productivity in different sectors and the comparisons between them. Such "short-cut interpretations" can be explained by the lack of satisfactory statistics for the construction sector. The result is a sector with very limited true information for studying and understanding own performance and prepare for the future (Ingvaldsen et al. 2004). Calculations and measurements of productivity are always uncertain. To measure both added value and labour input is hard and when changes in productivity is calculated by dividing these with each other there is bound to exist an interval of uncertainty.

Incommensurability is the scientific term of describing the problem of „no common measure", i.e. the impossibility of comparing two factors expressed in different units and scales (Stanford Encyclopedia of Philisophy 2009).

"It has been said that successive and competing theories within the same domain 'speaks different languages'. They cannot strictly be compared to each other nor translated into each other. The languages of different theories are the linguistic counterparts of different worlds we may inhabit. We can pass from one world or one language to another by a gestalt-switch, but not by any process of understanding." (Hacking, 2007)

Kuhn stated that the scientific history has proven the failure of competing paradigms to acknowledge the views of each other and, thus never be able to develop serious inter-disciplinary studies. The different paradigm does not evolve cumulatively towards a common goal, with firm rules, methods and standards, but rather away from anomalies within the reigning paradigm. Incommensurability between two theories means that the same term is used as reference, but with different meaning and content. This is evident when discussing productivity measurement and comparisons. The term productivity is often used differently in different contexts and, thus, creates incommensurable viewpoints for describing the phenomenon. How academics and practitioners interpret something (e.g. productivity) is depended by the theories that are used, and when theories are changed so is the explanation of a certain phenomenon. Duhem (1954) stated that it is necessary to both understand the theories as well as how they are implemented. It is important to define the context of a studied phenomenon in order to understand the specifics and relate to the whole. When it comes to comparisons concerning productivity and innovation it is common to compare the motor vehicle sector with the construction sector, where the result often falls to the advantage of the motor vehicle sector. However, is this a fair comparison? The value created is often the base when comparing different sectors, a key factor is then how values for different sectors are defined. Winch (2003) argue that because international standards define sectors differently the comparison between them basically has no value. For example when defining the value created in the construction sector the whole value chain (design, manufacturing, distributing and maintenance) are included, but for the motor vehicle sector only design and manufacturing are included. By excluding the maintenance, which by its very nature have a low productivity and innovation rate since its purpose is to reinstate

the existing. Winch (2003) states that this sheds construction in an unfavourable light while it flatters other industries. Thus, the way something is measured affects how the results can be interpreted, with apparent risk of misinterpretation in the best case and in a worst case scenario constitutes the base for potentially harmful developments.

Productivity is generally defined as the relation between the value of produced goods and services (output) and the cost of used resources (input). For example, in a road project the output could be described by the amount of produced road in meters divided by used resources. However, a problem arise, Talvitie and Sikow (1992) states that one meter of constructed road in difficult terrain cannot be compared to one meter of road constructed under more favourable conditions. There is no way of determining which of the two road projects that is most productive because they cannot be compared on equal terms. Talvitie and Sikow (1992) suggest a solution to the problem by introducing an advanced logarithm function where different parameters are weighed together. Despite of the fact that the calculations becomes intricate and difficult to grasp the value of the results are limited when trying to compare productivity with other kinds of projects, and even more so when trying to compare companies and industrial sectors with each other i.e. productivity is hard to measure. However, there is still a need for indicators of how efficiency and productivity are developing. As Lord Kelvin stated "if you cannot measure it, you cannot change it".

3. Measuring the value creating effects of change and innovation

Change is a complex issue, especially in fragmented and project-based industries, such as construction, where success often is depending on the actions of more than one organisation. Change can on one hand be easy to understand, but often involve issues that are not obvious (Bergh and Fairbank 2002). Different types of change need different units of measure; most types are covered by human resource measures, process measures and operational measures, i.e. the notion of one uniform productivity measure is perhaps a utopian concept. For evaluating operational excellence Taskinen and Smeds (1999) proposed some different variables that can be used for measures:

1. Human resources measures:

    a. Effectiveness: competencies and skills, education, operational expertise, customer awareness, and process awareness.

    b. Efficiency: input/output measurements on human productivity, quality, and flexibility.

2. Process measures:

    a. Effectiveness: strategy alignment (links between operational performance and strategic competitive factors), and profitability.

b. Efficiency: operational input/output measurements such as productivity, volume, lead-time, flexibility, amount of work-in process, quality.

3. Technology measures:

    a. Effectiveness: selection of strategically right technologies and tools (process technology and IT).

    b. Efficiency: productivity of technology, cost/benefit measurements.

Project-based industries have a different setting than traditional manufacturing industries and change need to be measured at three different levels, industry, company and project levels (Brusoni et al. 1998). There have been different efforts to measure change in construction, these have had different scope and subsequently different approaches. In the UK, Key Performance Indicators (KPIs) is used both to compare single construction business performance with the construction industry as a whole (Constructing Excellence 2006). Other initiatives for, example Considerate Constructors Scheme, UK and BQR Best Practise, Sweden measures the performance on a project level so that projects can be compared with each other. It is also possible to see overall changes in industry performance over time when comparing project scores between different over a period of time. However, at the end of the of the day initiatives of change and innovation is undertaken with the purpose of increasing the value creating capacity of that organisation.

All organisations create value from leveraging their intangible assets (e.g. human capital, information systems, processes, customer relationships, innovation capabilities and culture). An organisations (in the case of construction this is often a project organisation) intangible assets may represent more than 75% of its value (Kaplan and Norton 2004). So, the performance of these assets needs to be monitored and evaluated. It is important to consider how an organisations performance is measured and how it can be communicated to a wider market, i.e. how it can be understood and interpreted by the potential stakeholders (Kagioglou et al. 2001). Measuring the impact of performance from a solely financial perspective may not be sufficient (Landin and Nilsson 2001), and can encourage companies to achieve short term financial results at the expense of long-term objectives. Torbett et al. (2001) showed that design performance measurement (DPM) in construction most focus on cost issues, overlooking design quality, flair, project management and client satisfaction. Financial measures are lagging indicators that fail to capture much of the value created or destroyed by managers (Kaplan and Norton 1996). However, it is incorrect to believe that financial measures are unnecessary (Kaplan and Norton 1992). A well designed financial control system can enhance rather than inhibit an organisation‟s total quality management program.

In traditional manufacturing organisations most intangible assets lie within the border of the company while in construction they lie within the borders of the project. This means that many different organisations will have an effect on whether value is created or not. The construction project is an interdependent organisation that ought to work towards the same goal but tends to create conflicts concerning responsibility and power instead (Loosemore, 1999), thus limiting the possibility of

creating value. To add to the complexity many stakeholders define and understand value differently. It is important to ensure that none of these values, created or asked for, are lost in the process. A number of different methods and tools have been identified that aim to aid in various ways. None though, aim to take a holistic perspective of the project process and none are used to any larger extent (Pemsel et al. 2009).

The balanced scorecard (Kaplan and Norton 1996) aims to provide a comprehensive framework to translate an organisations vision into strategy. Kaplan and Norton (1996) argue that it is essential to identify the key performance indicators and the key performance drivers to adequately assess an organisations fulfilment of its vision and strategy. Benchmarking procedures are a technique that companies can use to compare their performance against competitors „best practice" (Kaplan and Norton 1992). Benchmarking and performance assessment attempts in construction are bound to face certain difficulties such as incomplete or non-existent data (Mohamed 1996). Mohamed distinguish between three types of benchmarking:

- Project benchmarking, where the construction organisation assesses the performance of projects in which it is involved.

- Internal benchmarking, where the construction organisation aims towards identifying improvement areas within its structure through comparison with others.

- External benchmarking, where the construction sector as a whole attempts to increase its efficiency by making tools and techniques developed and successfully used by other industries, applicable to construction.

Benchmarking the delivery and performance of construction services can extend from the analysis of a specific process to cover a general social vision that looks to use metrics as milestones for general quality of life issues (Holt and Graves 2001). Josephson et al. (2006) identified nine factors relevant to performance assessment for a construction project, which all can be structured using the four perspectives of the balanced scorecard; however, special attention needs to be addressed to the factor of learning and development. Landin and Nilsson (2001) emphasise the point that when evaluating construction companies and projects the perspective of innovation and learning is not used to its full potential. A company"s ability to innovate, improve and learn ties directly to the company"s value (Kaplan and Norton 1992).

Value is a concept that has many definitions. Value can be regarded as subjective in nature and the context of the individual´s experiences and current situation (Thomson et al., 2003). Value can also be regarded as the relation between subjective and economic parameters (Andersson et al., 2006). In other words the concept of value may be interpreted differently in different contexts. From an evaluation perspective value is one part and therefore it is important to clarify the values and underlying assumptions behind the goals in the evaluation of a process (Preiser and Vischer, 2005).

A process can be seen as a set of inter-related resources and activities which transform inputs to outputs. It can also be explained as something ongoing that leads to a change or development, or the

process refers to how the collaboration should be managed to create value (Sebastian, 2007). Bergman and Klefsjö (2003) who looked at manufacturing industry define a process as a "network of activities that are repeated in time, whose objective is to create value to external or internal customers". Within the definition of process is a notion of value, but it includes the dimension of collaboration and customer, i.e. the core business of an organisation.

The construction sector"s core business is undertaking projects generating new or refurbished facilities (Kagioglou et al. 2001). When a project is finished the project organisation is dissolved and new constellations are formed. The construction sector struggles to see how benchmarking of performance can be used effectively in a project based setting where products, processes and teams change regularly (Garnett and Pickrell 2000). Thus, there is a relevant need for effective assessment and benchmarking tools during the construction project life cycle and for knowledge transfer between projects. Cost, time and quality are the traditional indicators of success or failure of a construction project. However they do not, in isolation, provide a balanced view of project performance (Kagioglou et al. 2001) and there is a lack of consensus as to what performance criteria should be measured beyond traditional time, cost and quality measures (Dainty et al. 2003).

4. Conclusions

There are unique circumstances for various construction activities, such as housing, commercial, industrial, infrastructure that makes comparison of productivity between them virtually impossible. If statements of productivity are made without the knowledge of what the measures really show or is based on, there is a risk that these lead to misleading conclusions. Every study of productivity needs to be critically scrutinised with a high degree of scepticism. Instead of trying to achieve one uniform measure of productivity a set of key performance indicators may be used instead in order to obtain more qualitative facts about the state of the construction industry. Uncertain measurements of productivity need to be replaced with the measurement of well defined indicators that, when analysed together, can give insights about value creating factors as well as increased efficiency and productivity. Within the construction sector various actors, practitioners and academics alike, implement their views of how well, or bad, the sector is functioning. In order to avoid incommensurability when discussing the development of the construction sector methods needs to be developed that can handle conflict concerning different expectations as a result of insufficient communication and inconsistent definitions of the context. There is, according to Duhem (1954), a difference between practical facts (the observed and real) and theoretical facts (the symbolic and ideal). A common view within the construction sector that combines theory with practise is needed in order to create meaning and stability when developing indicators for efficiency and productivity.

References

Andersson T Bergman I Björk O and Ericsson L-G (2006) *Value Management – skapa värde i projekt, program och projektportföljer,* SIS Förlag, Stockholm, Sweden.

Bergh D D and Fairbank J F (2002) Measuring and Testing Change in Strategic Management Research, *Strategic Management Journal,* **23**: 359-366.

Bergman B and Klefsjö B (2003) *Quality from Customer Needs to Customer Satisfaction,* Studentlitteratur, Lund, Sweden.

Brusoni S Prencipe A and Salter A (1998) Mapping and Measuring Innovation in Project-based Firms, *Working Paper CoPS Publication No46,* May 1998.

Constructing Excellence (2006) UK Construction Industry – Key Performance Indicators, *Constructing Excellence,* London, UK.

Dainty A R J Cheng M-I and Moore D R (2003) Redefining performance measures for construction project managers: An empirical evaluation, *Construction Management and Economics,* **21**: 209-218.

Dacy D C (1965) Productivity and Price Trends in Construction Science Since 1947, *The Review of Economics and Statistics,* **47**: 406-411.

Duhem P (1954) *The aim and structure of physical theory,* Princeton University Press, Princeton, NJ.

Garnett N and Pickrell S (2000) Benchmarking for construction: theory and practice, *Construction Management and Economics,* **18**: 55-63.

Hacking I (2007) *Representing and intervening – introductory topics in the philosophy of natural science,* Cambridge University Press, Cambridge, NY.

Holt R and Graves A (2001) Benchmarking UK government procurement performance in construction projects, *Measuring Business Excellence,* **5**: 13-21.

Ingvaldsen T Lakka A Nielsen A and Bertelsen N H (2004) *Productivity studies in Nordic building and construction industry,* Project report 377 BYGGFORSK, Norwegian Building Research Institute.

Josephson P-E Lindström J and Frödell M (2006)Challenges when developing tools for measuring construction excellence: a Swedish case, *Proceedings from Construction in the XXI century: Local and global challenges Joint 2006 CIB W065/W055/W086 Symposium,* 18-20 October 2006, Rome, Italy.

Kagioglou M Cooper R and Aouad G (2001) Performance management in construction: a conceptual framework, *Construction Management and Economics,* **19**: 85-95.

Kaplan R S and Norton D P (1992) The balanced scorecard – measures that drive performance, *Harvard Business Review,* **70**: 71-80.

Kaplan R S and Norton D P (1996) *The balanced scorecard,* Harvard Business School Press, Boston, MA.

Kaplan R S and Norton D P (2004) The strategy map: a guide to aligning intangible assets, *Strategy and Leadership,* **32**: 10-17.

Koskela L and Vrijhoef R (2001) Is the current theory of construction a hindrance to innovation, *Building Research and Information,* **29**: 197-207.

Landin A and Nilsson C-H (2001) Do quality systems really make a difference, *Building Research and Information,* **29**: 12-20.

Loosemore M (1999) Responsibility, power and construction conflict, *Construction Management and Economics,* **17**: 699-709.

Mohamed S (1996) Benchmarking and improving construction productivity, *Benchmarking: An International Journal,* **3**: 50-58.

Pemsel S Widén K Svetoft I and Hansson B (2009) Managing end user requirements in construction projects, *Proceedings from the 5th Nordic Conference on Construction Economics and Organisation,* 10-12 June, Reykjavik, Iceland

Preiser W F E and Vischer J (Eds) (2005) *Assessing Building Performance,* Elsevier, Oxford.

Sebastian R (Ed) (2007) *Managing Collaborative Design,* Eburon, Delft.

SOU (2000) *Från byggsekt till byggsektor,* Byggkostnadsdelegationen, SOU 2000:44, Regeringskansliet, Stockholm

SOU (2002) *Skärpning gubbar,* Byggkommissionen, SOU 2002:115, Regeringskansliet, Stockholm.

Stanford Encyclopedia of Philisophy (2009) http://plato.stanford.edu/entries/ incommensurability.

Statskontoret (2009) *Sega gubbar,* Statskontoret 2009:6, Stockholm

Talvitie A P and Sikow C (1992) Analysis of productivity in highway construction using alternative average cost definitions, *Transport Research,* **26B**: 461-478.

Taskinen T and Smeds R (1999) Measuring change project management in manufacturing, *International Journal of Operations and Production Management,* **19**: 1168-1197.

Thomson D S Austin S A Devine-Wright H and Mills G R (2003) Managing value and quality in design, *Building Research and Information,* **31**: 334-345.

Torbett R Salter A J Gann D M and Hobday M. (2001) Design Performance Measurement in the Construction Sector: A Pilot Study. *Electronic Working Paper Series.* Brighton, SPRU

Whiteside J D (2006) Construction Productivity, *AACE International Transactions,* 2006: ES81-88.

Winch G (2003) How innovative is construction? Comparing aggregated data on construction innovation and other sectors – a case of apples and pears, *Construction* Management and Economics, **21**: 651-654.