Chia, Fah Choy and Skitmore, Martin and Runeson, Goran and Bridge, Adrian (2010) ***An assessment of construction labour productivity in Malaysia***. In: Full Paper Proceedings - CIB 2010 World Congress, 10-13 May 2010, The Lowry, Salford Quays.

An Assessment of Construction Labour Productivity in Malaysia

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Abstract

The construction industry is one of major strategic importance. Its level of productivity has a significant effect on national economic growth. The analysis of published census/biannual surveys of construction by the Department of Statistics of Malaysia shows that Malaysia managed to achieve construction labour productivity growth between 1996 and 2005 despite increases in cost per employee. The decrease in unit labour costs is attributed to the value added improvement per worker through the increase in capital intensity. The marginal decline in capital productivity is due to the gestation period and the overcapacity of the industry. The civil engineering sub-sector recorded the highest labour productivity and is the most labour competitive in terms of unit labour cost and added value per labour cost. The residential sub-sectors recorded greatest change in the productivity indicators between 1996 and 2005.

Keywords: productivity, construction sector, productivity-measurement, productivity-indicators, Malaysia

1. Introduction

Productivity is by far the most important determinant of the long-term health and prosperity of an economy (Baumohl, 2005). It is the engine of economic growth both for a country and for an individual organization (Hope and Hope, 1997). It is necessary to examine the situation at the industry level for causal factors for economic performance. If the causes of performance in enough industries is understood, it should then be possible to understand what causes a country's productivity to be what it is (Lewis, 2004). This is because the productivity of a country is the average productivity of all industries weighted according to size.

This paper examines the productivity performance of the construction industry in Malaysia in order to establish whether productivity change is the result of industrial composition, or a reflection of the productive capacity throughout the industry. This involves the consideration of the data available from various reports of Census/Survey of the Construction Industry published by the Department of Statistics Malaysia.

2. Productivity measurement

Productivity measures can be classified as single factor productivity measures or multi-factor productivity measures (OECD, 2001). Labour productivity and capital productivity are the two most common examples of single factor productivity measures. Labour productivity is the output per unit of labour input. Labour input is measured along two dimensions: the number of persons employed and the total number of hours worked by all persons employed. There is a possible third dimension that concerns labour quality (Goodbridge and Schreyer, 2007).

The two different measures of output are gross output and value added output. The gross output-based productivity measure provides a more complete picture of the production process by including intermediate inputs as a source of industry growth. It reflects a variety of influences including changes in efficiency, economies of scale, variations in capacity utilisation and measurement error as well as disembodied technological change (Schreyer, 2001). It is sensitive to substitution between factor inputs (including labour) and intermediate inputs, particularly through outsourcing. Outsourcing activities previously conducted in-house will cause the gross output per unit of labour input to increase even though the amount of labour used to produce the output may not have changed.

The inclusion of intra-industry flows of intermediate products would involve double counting on both the input and output side of an industry production function. The input measure would include both the intra-industry transactions and the inputs required to produce them, and output measures would include intra-industry transactions and the goods made from them. The double counting of output and intermediate inputs tends to obscure the extent of technological change or changes in efficiency taking place in the industry/sector as a whole (Schreyer, 2001).

The measurement of output poses problems in relation to changes of quality, particularly in the construction sector. Identifying and capturing changes in the quality of services is difficult in both concept and practice. Although some adjustments for quality are captured in the price data used to deflate current price estimates, the difficulties involved are such that the final measure of industry output may not have adequately captured all changes (Pink, 2007).

The value-added measure is more meaningful in the presence of outsourcing and is generally favoured for estimating labour productivity (Cobbold, 2003). Value added-based measures exclude intermediate inputs. The value-based measure which takes the role of output measure is gross output corrected for purchases of intermediate inputs (Schreyer, 2001). This is in effect a total measure of productivity, converted into a partial measure by deducting the value of raw materials, bought-out goods and services from both the numerator and the denominator to give a measure of value-addedness during the production process (Grimes, 2007). By excluding intermediate inputs, value-added based estimates of productivity growth deny the effect of attributing productivity improvements gained through the more efficient use of intermediate inputs to capital and labour.

An advantage of the value added productivity measure is its ease of aggregation across industries and the conceptual link between industry-level and aggregate productivity growth. Value added is derived directly from national accounts data and is available earlier than gross output and for a longer time series.

At the aggregate (or national) level, gross output-based and value-added based measures are close, only differing to the extent that intermediate inputs are sourced from imports. In proportional terms, this tends to be low. At the industry or sectorial level, however, intermediate usage tends to be a much higher proportion of gross output. This results in a greater variation between the two measures (Cobbold, 2003).

While productivity refers to the physical relationship between inputs and outputs, generally, this is not the way it is being measured, especially over longer periods of time. Output and the composition of input mix change over time. It is difficult to establish a rate of conversion between labour and capital in order to compare them on equal terms. The solution has been to use the price of outputs and inputs and establish the rate of change. This method works well where the value of outputs can be measured independently from the value of inputs. However, there is no obvious way of measuring the output independently of the input in the construction industry. Hence, in the construction industry, productivity increases when times are good and profit is high, and decreases when times are bad and profit is low. In the long run, there are very small changes (Runeson, 2000). In addition, costs are influenced by the level of prices in a nation’s economy, the industry’s efficiency and the difficulties in its operating environment as perceived by the entrepreneurs. These change with time. A high output may simply be a measure of the level of inefficiency or an indication of high prices in general (Ofori, 1990).

On the other hand, off-site production of formerly on-site activities, process changes - where capital is substituted for labour and which represents a substantial source of the reduction in labour required on-site – is not considered as productivity improvement in the building industry. They are classified as manufacturing industries because of the peculiarities of Standard Industrial Classification (SIC) (Runeson, 2000).

3. .Productivity indicators

Malaysia Productivity Corporation (2008) defines productivity indicators as follows:

(a) *Labour cost competitiveness* – competitiveness in terms of labour cost indicates the comparability of the industry in producing products or services at the lowest possible labour cost. There are three competitiveness ratios, which include *added value per labour cost*, *labour cost per employee* and *unit labour cost*.

   i. *Added value per labour cost* (Added Value/Labour Cost) indicates how competitive the activity is in terms of labour cost. A low ratio indicates high labour cost which does not match with the creation of added value.

   ii. *Labour cost per employee* (Labour cost/Number of Employee) measures the average remuneration per employee. A high ratio means high returns to individual workers and vice-versa.

   iii. *Unit labour cost* (Labour Cost/Total Output) indicates the relationship of labour cost to total output. A high ratio indicates high labour cost.

(b) *Labour productivity* – can be used as one of the ways of gauging the productivity performance of the industry. The commonly used indicator is *added value per employee* and *total output per employee*.

   i. *Added value per employee* (Added Value/Number of Employees) reflects the amount of wealth created by the company relative to its number of employees. A high ratio indicates the favourable effects of the labour factor in the wealth creation process.

   ii. *Total output per employee* (Total output/Number of Employees) measures the size of output generated by the enterprise.

(c) *Capital productivity* (Added Value/Fixed Assets) – indicates the degree of utilisation of tangible fixed assets. A high ratio indicates the efficiency of asset utilisation.

(d) *Capital intensity* (Fixed assets/Number of Employees) –the ratio measuring the amount of fixed assets allocated to each employee. This ratio is used to measure whether an industry is relatively capital-intensive or labour-intensive. A high ratio indicates high capital intensity and low ratios mean dependence on labour-intensive methods.

(e) *Added value content* (Added value x 100/Total Output) – this ratio can be used to gauge the degree of utilisation of bought-in materials and services and changes in the price differentials between products and purchases. A high ratio indicates efficient usage of purchase or favourable price differentials. A low ratio means high cost of bought-in materials and services, poor products quality and low price competition.

4. Methodology

The productivity indicators were computed from the data obtained from the three industry surveys and two industry censuses by The Department of Statistics, Malaysia (DOSM). DOSM conducts a Construction Industry Survey every two years and Census of Construction Industry every five years. The surveys/censuses cover 25 industries from the Construction Sector (based on the Malaysia Standard Industrial Classification, 2000). The respondents are the establishments primarily engaged in construction activities, with a value of construction work RM500,000 and above. The surveys collect information pertaining to growth, composition and distribution of output, value added, employment and other variables of the sector (Department of Statistics Malaysia, 2009). All the values from the surveys/censuses are deflated to 2000 prices using the Implicit Price Deflators for construction obtained from the National Accounts (DOS, 2006, 2009).

The construction sector comprises two categories namely, general construction and special trade. General construction comprises three sub-sectors which are residential construction, non-residential construction and civil engineering construction. The second category concerns special trade, which involves activities such as metal work, electrical, plumbing, sewerage and sanitary, refrigeration and air-conditioning, painting, carpentry, tiling and flooring, and glass (Malaysia Productivity Corporation, 2008).

5. Results

The added value per employee of the construction sector has increased between 1998 and 2004 and decreased between 2004 and 2007 (Figure 1). The sub-sectorial comparison shows that labour productivity is falling in the civil engineering sub-sector from 2000 onwards after recovered from a setback in 1998. It also lost its most competitive position to the special trade sub-sector in 2005. The special trade sub-sector was growing between 1996 until 2002; but subsequently falling between 2002 and 2007. The residential sector rose between 1996 and 2004 and surpassed the non-residential sector in 2002. Although there is an overall improvement in the performance of the non-residential sub-sector between 1996 and 2005, its progress is uneven.

The total output per employee follows the trend of the value-added per employee, i.e. it rises between 1998 and 2004 and falls between 2004 and 2007. There is a net expansion in total output per employee in 2007 compared with 1996. However the value added per employee is in contraction. Despite the increase in labour cost per employee, the unit labour cost declined from .22 in 1996 to .21 in 2007; however, the added value per labour cost did not improve. The capital intensity increased, but the capital productivity did not catch up. The added value content of contracts is 29.81 in 2007, compared with 38.51 in 1997.

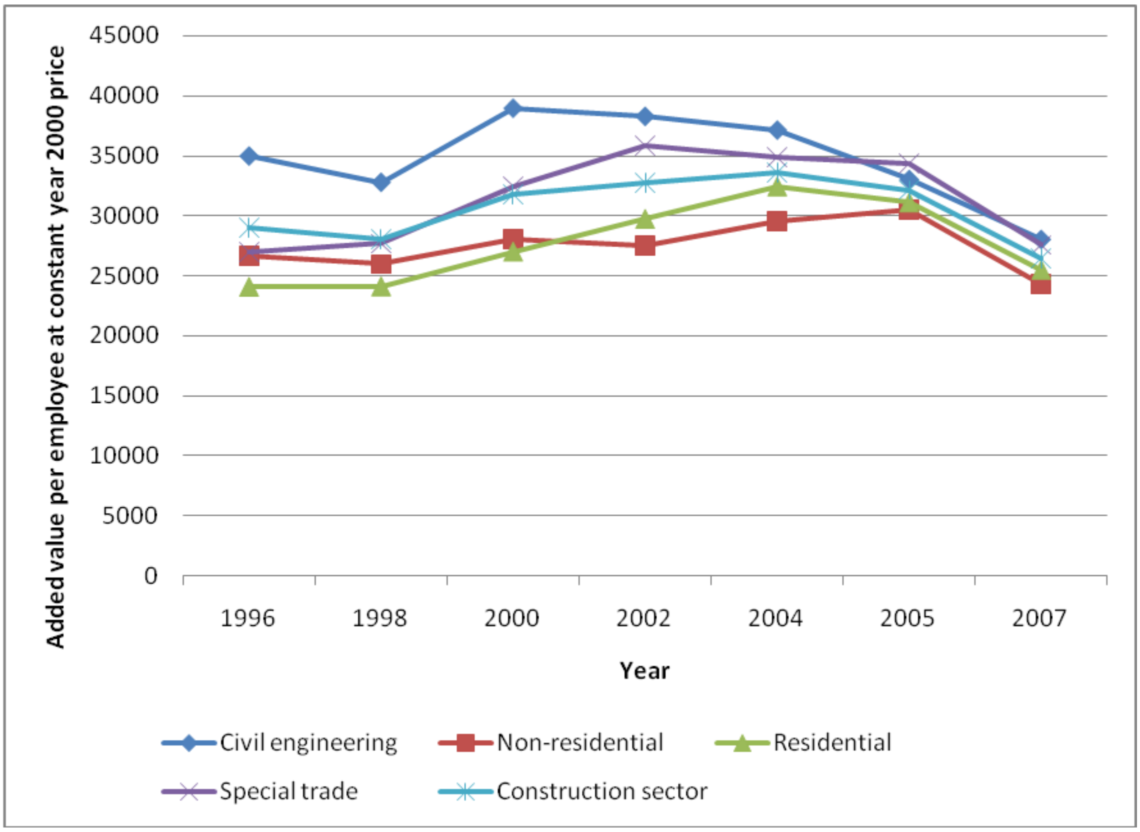

Figure 1: Value added per employee of Malaysian construction sectors (1996-2007)

Table 1: Productivity indicators of the Malaysian Construction Sector 1996-2007 at 2000 constant price

Productivity Indicators	*1996*	*1998*	*2000*	*2002*	*2004*	*2005*	*2007*
Added value per employee	*29055*	*28033*	*31820*	*32741*	*33628*	*32177*	*26444*
Total output per employee	*75439*	*72606*	*86947*	*92607*	*97823*	*91400*	*88712*
Added value per labour cost	*1.72*	*1.60*	*1.67*	*1.62*	*1.69*	*1.75*	*1.40*
Labour cost per employee	*16923*	*17467*	*19020*	*20191*	*19842*	*18408*	*18932*
Unit labour cost	*0.224*	*0.241*	*0.219*	*0.218*	*0.203*	*0.201*	*0.213*
Capital productivity	*2.65*	*2.18*	*2.18*	*2.40*	*2.38*	*2.54*	*2.16*
Capital intensity	*10976*	*12852*	*14585*	*13638*	*14155*	*12681*	*12266*
Added value content	*38.51*	*38.61*	*36.60*	*35.35*	*34.38*	*35.21*	*29.81*

The comparison of productivity indicators shows that the differences among the four sub-sectors, with the exception of value added content, are statistically significant based on the ANOVA test (Table 2). Follow-up tests were conducted to evaluate pairwise differences among the means. As Levene's test for all the productivity indicators (except the last indicator - unit labour cost) are not significant, equal variances were assumed among the four subsectors and Turkey test was selected for the post hoc comparisons. The Levene's test of the unit labour cost is significant, therefore equal variances were not assumed, Game-Howell was used for *post hoc* comparisons (Morgan *et al*, 2004).

Table 2: Mean and One-way ANOVA F Test Statistic (F Ratio) of productivity indicators of construction sub-sectors, 1996-2007 in 2000 price

Productivity Indicators	*Civil engineering works*	*Non-Residential works*	*Residential works*	*Special trades works*	*F*	*Sig.*
Added value per employee	*34747*	*27501*	*27711*	*31410*	*7.32*	*0.001*
Total output per employee	*97632*	*77041*	*78104*	*91873*	*5.97*	*0.003*
Added value per labour cost	*1.76*	*1.57*	*1.52*	*1.63*	*5.80*	*0.010*
Labour cost per employee	*19700*	*17551*	*18170*	*19300*	*3.07*	*0.047*
Unit labour cost	*0.20*	*0.23*	*0.24*	*0.21*	*580*	*0.004*
Capital productivity	*2.01*	*2.88*	*2.97*	*2.10*	*20.24*	*0.000*
Capital intensity	*17424*	*9680*	*9358*	*15182*	*28.32*	*0.000*
Added value content	*35.66*	*35.88*	*35.96*	*34.30*	*0.43*	*0.734*

Table 3: Test of homogeneity of variance of productivity indicators

Productivity Indicators	*Levene Statistic*	*df1*	*df2*	*Sig.*
Added value per employee	*1.888*	*3*	*24*	*.159*
Total output per employee	*1.338*	*3*	*24*	*.286*
Capital productivity	*.562*	*3*	*24*	*.645*
Capital Intensity	*1.901*	*3*	*24*	*.156*
Added value per labour cost	*.166*	*3*	*24*	*.919*
Wages per employee	*1.507*	*3*	*24*	*.238*
Unit labour cost	*3.968*	*3*	*24*	*.020*

The results of the selected statistically significant pairwise comparison are shown in Table 4. The civil engineering sub-sector is higher than the non-residential sub-sector and residential sub-sector for both of the labour productivity indicators, i.e. added value per employee and total output per employee. The civil engineering and special trade sub-sectors have a higher capital intensity than the residential or non-residential sub-sectors. However the residential or non-residential sub-sectors recorded higher capital productivity than the civil engineering and special trades sub-sector. The labour competitiveness indicators show that the civil engineering sub-sector has a lower unit labour cost than the residential sub-sector and higher added value per labour cost than the non-residential and residential sub-sectors.

The residential sub-sector shows the highest improvement in total output per employee (54 percent) and added value per employee (29 percent) between the construction industry censuses of 1996 and

2005. This sector also records a 33 percent increase in capital intensity, 24 percent reduction in unit labour cost and 17 percent increase in the labour cost per employee. The added value per labour cost has improved by 10 percent.

Table 4: Selected results of multiple comparisons of productivity indicators

Dependent Variable	*(I) Types of works*	*(J) Types of works*	*Mean Difference (I-J)*	*Std. Error*	*Sig.*
Added value per employee	*Civil engineering works*	*Non-Residential works*	*7245.57**	*1798.58*	*.003*
Added value per employee	*Civil engineering works*	*Residential works*	*7035.86**	*1798.58*	*.003*
Total output per employee	*Civil engineering works*	*Non-Residential works*	*20591.43**	*5905.72*	*.010*
Total output per employee	*Civil engineering works*	*Residential works*	*19528.71**	*5905.72*	*.015*
Capital productivity	*Civil engineering works*	*Non-Residential works*	*-.87**	*.16*	*.000*
Capital productivity	*Civil engineering works*	*Residential works*	*-.96**	*.16*	*.000*
Capital productivity	*Non-Residential works*	*Special trades works*	*.78**	*.16*	*.000*
Capital productivity	*Residential works*	*Special trades works*	*.87**	*.16*	*.000*
Capital Intensity	*Civil engineering works*	*Non-Residential works*	*7743.86**	*1069.53*	*.000*
Capital Intensity	*Civil engineering works*	*Residential works*	*8065.57**	*1069.53*	*.000*
Capital Intensity	*Non-Residential works*	*Special trades works*	*-5502.00**	*1069.53*	*.000*
Capital Intensity	*Residential works*	*Special trades works*	*-5823.71**	*1069.53*	*.000*
Added value per labour cost	*Civil engineering works*	*Non-Residential works*	*.20**	*.07*	*.038*
Added value per labour cost	*Civil engineering works*	*Residential works*	*.24**	*.07*	*.009*
Unit labour cost	*Civil engineering works*	*Non-Residential works*	*-.03#*	*.01*	*.005*

* The mean difference is significant at the .05 level using Turkey HSD test.

The mean difference is significant at the .05 level using Games-Howell test.

The improvement is mainly due to the initiative to increase the use of the Industrial Building System (IBS) that utilises techniques, products, components, or building systems which involve prefabricated components and on-site installation (CIDB, 2005). The Construction Industry Development Board Malaysia formulated the *IBS Strategic Plan 1999* which subsequently redesigned its strategies and formulated the *IBS Roadmap 2003-2010* (CIDB, 2009). Examples of the measures taken are:

encouraging the use of alternative construction materials and technology under the IBS and designs based on the modular coordination concept in housing construction; using IBS components in the construction of affordable homes and in Government building projects and enforcing the use of modular coordination concept through Uniformed Building By Laws by the local authorities, increasing usage of IBS components in Government building projects from 30 percent to 50 percent commencing 2005 and giving accelerated capital allowance for capital expenditure on moulds to manufacture IBS components (Economic Planning Unit, 2006; Ministry of Finance, 2004, 2005). The initiative requires higher capital investment, which is reflected in the 33 percent rise in capital intensity. IBS reduces labour requirement and there is a reduction of 24 percent in the unit labour costs despite the rise of 17 percent in labour cost per employee. These changes managed to raise the added value per labour cost by 10 percent. The initiative also resulted in a 16 percent decline in value content because of a lesser dependence on in-situ processes. The modernisation of the sector through the purchase of new equipment requires a gestation period before new investments can be realised and therefore the capital productivity has contracted by 2.8 percent.

The censuses indicate there is a decline in the share of civil engineering subsector contribution to the gross output of the construction sector. Its share of the construction sector was 40.9 percent in 1996 and was reduced to 34.9 percent in 2007. Construction in the civil engineering sub-sector remained strong during 1997 underpinned by infrastructure developments. The first phase of the Kuala Lumpur International Airport is at the final stage of completion. Work on the Light Rail Transit Phase 2 is in progress for Commonwealth Games in September 1998. Several road projects are at various stages of implementation. These include the Second Link to Singapore, the Middle Ring Road II in Kuala Lumpur, the upgrading of Kuala Lumpur-Karak Highway and Simpang Pulai-Loji-Gua Musang-Kuala Brang Highway (MOF, 1997). Due to completion of major infrastructure projects such as the Kuala Lumpur International Airport and the Commonwealth Sport Complex construction activities in the civil engineering sector have slowed down significantly in 1998 (MOF, 1998). In addition, the Government had to defer the implementation of several large projects because of 1997/1998 East Asian Financial Crisis. Given the volatile nature of the international environment as well as the need to extract the economy from recession, the Government implements the National Economic Recovery Plan (NERP) to revive the economy. The Government stepped up its expenditure by RM7 billion in July 1998 which was focussed on selected projects with strong linkages to ensure maximum stimulus to economic growth, minimal leakage in terms of imports and short gestation periods as well as those with the capacity to enhance the efficiency of the economy (BNM, 1999). Subsequently, the civil engineering sub-sector has recovered because of a higher budgetary allocation for public infrastructure. Among the major on-going projects are the construction of the East-Coast Expressway, Kapar-Sabak Bernam and Klang-Banting Road, Tanjung Kidurong-Berkam Coastal Road in Sabah, Rawang-Ipoh double tracking project, the new Johor-Singapore Bridge as well as the Stormwater Management and Road Tunnelling (SMART) project in Kuala Lumpur (MOF, 1999, 2000, 2001, 2002, 2003).

The completion of several large infrastructure projects and the accelerated completion of the Eight Malaysia Plan projects, coupled with a lower number of new contracts awarded by the Government have contributed to a slower activity in civil engineering work in 2004 (MOF, 2004). Activities in the civil engineering sub-sector tapered off during 2005, partly due to the reduction in the number and value of infrastructure contracts awarded (MOF, 2005).

Table 5: Percentage change in productivity indicators of Malaysian construction sub-sectors between Construction Industry Censuses 1996 and 2005 (at 2000 constant price)

Productivity Indicators	*Civil engineering*	*Non-residential*	*Residential*	*Special trade*
Added value per employee	*-5.59*	*14.39*	*28.89*	*27.28*
Total output per employee	*3.74*	*20.10*	*54.09*	*30.41*
Added value per labour cost	*-3.81*	*1.55*	*9.83*	*8.95*
Labour cost per employee	*-1.85*	*12.64*	*17.36*	*16.82*
Unit labour cost	*-5.38*	*-6.21*	*-23.84*	*-10.42*
Capital productivity	*-7.20*	*8.47*	*-2.77*	*-20.08*
Capital intensity	*1.74*	*5.46*	*32.57*	*59.26*
Added value content	*-8.99*	*-4.75*	*-16.35*	*-2.40*

Figure 2: Distribution of construction output (1996-2007)

The civil engineering sub-sector picked up in 2006 with the production of infrastructure projects under the Ninth Malaysia Plan (9MP) and ongoing projects such as Kuala Lumpur-Putrajaya Expressway, Senai-Desaru Expressway, Duta-Ulu Kelang Expressway as well as upgrading works at the Kota Kinabalu International Airport (KKIA). Among the 9MP projects, totalling RM15 billion announced by the Government in July 2006 (MOF, 2006). The construction sector is strengthened further with the implementation of major transport-related projects, such as the Second Penang Bridge, Penang Monorail, Ipoh-Padang Besar Double Tracking Rail project and extension of Ampang and Kelana Jaya Light Rail Transit lines. Efforts to develop Southern Johor as one of the world's largest integrated petroleum logistics hubs and the ongoing NCER will further add impetus to the growth of this sector (MOF, 2007).

Finally, Bivariate correlation test shows that capital and output of industrial composition are statistically significant associated with the labour productivity (table 6). The directions of correlation were positive, which means capital deepening or rise in output tend to have higher labour productivity. Using Cohen's (1988) guidelines, the effect size is 'larger than typical' to' much larger than typical' for capital (*r*=.54) and 'typical' to 'larger than typical' for output (*r*=.39) (Cohen, 1988).

Table 6: Pearson correlation of elements of industrial composition and construction labour productivity (N=28)

Elements of Industrial composition	*Value-added per employee*		*Output per employee*	
	Pearson Correlation	*Sig.*	*Pearson Correlation*	*Sig*
Output	*.390**	*.040*	*.410**	*.030*
Input	*.356*	*.040*	*.453**	*.016*
Number of employee	*-.028*	*-.888*	*-.081*	*.683*
Wages	*.206*	*.294*	*.192*	*.328*
Capital	*.540***	*.003*	*.460**	*.014*

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

6. Conclusions

Labour productivity reflects more than just the efficiency of the productivity of workers. The output is influenced by many factors that are outside the workers' influence – including the nature and amount of capital equipment that is available, the introduction of new technologies and management practices.

The labour productivity of the Malaysian construction sector peaked in 2004 over the period between the years 1996 and 2007. The civil engineering subsector kept its highest levels of labour productivity among the four sub-sectors; however, it also has had a downwards trend from the year 2000 onwards. The special trade subsector was catching up as the next highest labour productivity sub-sector and surpassed the civil engineering subsector in 2005.

The unit labour cost of the civil engineering sub-sector is the most competitive despite it having the most expensive labour cost per employee among the four sub-sectors. While civil engineering is the most mechanised subsector and it has the highest capital intensity, it also recorded the lowest capital productivity.

Between the construction census of 1996 and 2005, the residential sub-sector recorded the highest growth in labour productivity, both in value added per employee and total output per employee. In order to improve productivity, the residential sub-sector has focused on various strategies - such as reducing in-situ processes and increasing the use of the Industrialised Building System (IBS). The changes require acquisition of new machines and equipment for new projects. These are reflected in the dramatic increase in capital intensity. However such investment requires a gestation period before the results are seen in the capital productivity. Hence, there is a marginal decline in capital productivity.

Construction productivity has a long history of being difficult to estimate because of the variety of projects and techniques in different parts of the world, even within the same region. The sectorial performance comparisons and analyses indicate that increases in the intensity with which labour uses capital are necessary for sustainable productivity growth. The study also identifies a need to deal with the issue of capacity utilisation that impinges the capital productivity growth. Finally, Malaysia is a small, open and trade dependent nation. The sustainable growth of the construction industry perhaps requires not only the ability to increase productivity but also meeting the challenge of the 'new construction industry' envisaged by Runeson and de Valence as a result of globalisation of the construction market and technological progress in communication technology (Runeson and Valence, 2009).

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