

# **THEME PAPER: IMPROVEMENT OF THE PRODUCTIVITY OF THE CONSTRUCTION INDUSTRY**

## **1. EXECUTIVE SUMMARY**

A productive and competitive building and construction industry is of critical importance to promoting the economic growth of Hong Kong. This paper explores the three main facets of construction productivity: (I) The status quo of the construction productivity and the contribution of the construction industry to Hong Kong's GDP, with a discussion on the different ways of estimating productivity performance as well as the causes of low productivity. (II) Measures to improve the productivity of the construction industry in light of the report by the Construction Industry Review Committee (CIRC). (III) Future development with suggestions of what remains to be done by the Construction Industry Council (CIC) to implement the 109 recommendations made by CIRC, and how these can be achieved.

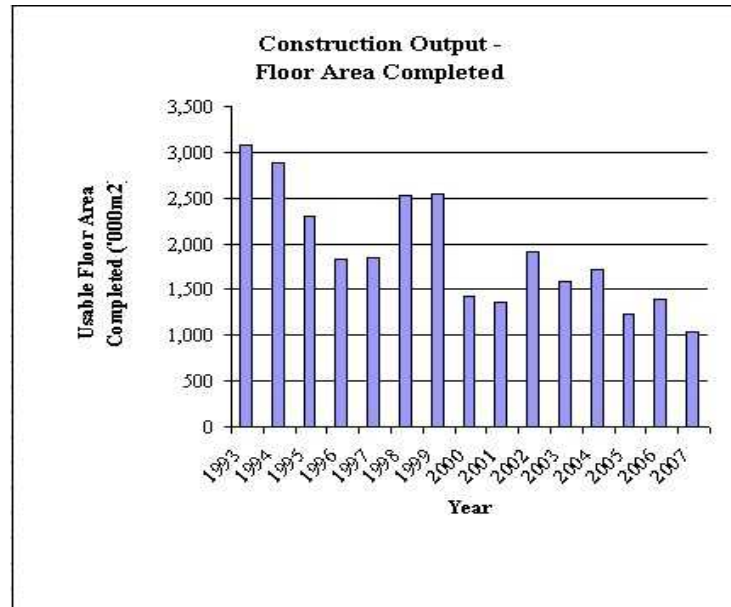
The objective of the paper is to depict the general situation in construction productivity in Hong Kong by exploring reasons of low productivity and proposing practicable measures for improvements. It is imperative to improve construction productivity for creating and sustaining a built environment that is conducive to fostering economic growth and raising quality of life.

## **2. STATUS QUO OF CONSTRUCTION PRODUCTIVITY**

### *Construction Productivity*

The construction industry is of critical importance to the growth and success of the Hong Kong economy (Leung et al, 2004). Due to the large size of the construction industry, productivity changes within it have significant direct effects on the overall productivity and economic well-being of the territory. Stoeckel and Quirke (1992) estimated that a 10% lift in productivity in construction would boost GDP by 2.5%. In 2006, Hong Kong's nominal Gross Domestic Product (GDP) was HK\$ 1,476 billion, of which HK\$ 39 billion or 2.6% was spent on construction activities. Meanwhile, it accounted for 32.9% of Gross Domestic Fixed Capital Formation (GDFCF). About 8% of the total workforce was employed by the construction industry in that year.

Measuring productivity can be straightforward in concept, taking consideration of input and output—Manpower, Management, Materials, Money and Machines (Olomolaiye, 1998). It can be expressed as:  $\text{Productivity} = \text{Output} / \text{Input}$ . In a previous AsiaConstruct Report (2003), construction productivity (production) was estimated in terms of floor areas completed. In spite of fluctuations, there has been a tendency of decrease in productivity over the years, especially after financial crisis in 1997.



Source: Census & Statistic Department, Hong Kong

However, the productivity indicator can also be estimated in many other ways and/or in different units, such as square meter per man-day, or square meter or million dollars of construction per person. The practical measures of productivity include labour productivity, labour efficiency and plant productivity. So far, there has been no consistency in measurement of productivity by the industry or academia.

According to a study commissioned by the *Hong Kong Construction* in 1999, there has also been a slight year-on-year decrease, as a long-term average, in the growth of the total factor productivity of the local construction industry since 1972 (CIRC, 2001). The local construction industry is fragmented with an adversarial culture. There are a small number of large local contractors while most local construction companies are small in size (HKTDC, 2001). Local construction activities are also regarded as 3-Ds: dangerous, dirty and demanding. In 2007, 18.9% of all industrial injuries were from construction activities, of which 76% were fatal (Census and Statistics Department, 2008). Additionally, labour-intensity, an under-developed subcontracting sector, lack of buildable designs, and inadequate automation are all the myriad of factors that exercise adverse influence over construction productivity.

#### *Enhancing Construction Productivity*

Improving productivity is a major concern of the construction industry on facilitating the effective and efficient conversion of resources into marketable products, and consequently improving business profitability. It can also help to minimize or optimize project durations and improve construction site process efficiency.

In April 2000, the Chief Executive of the Hong Kong Special Administrative Region formed the Construction Industry Review Committee (CIRC) to review the current state of the industry and recommend improvement measures. The Committee has proposed a large number of improvement measures aiming for better performance of the industry, including construction productivity. There were also recommendations on certain areas which, if carried out, would improve the existing tendering process and procurement logistics.

In April 2007, the then Environment, Transport and Works Bureau (now re-organized as the Development Bureau), in conjunction with the newly established Construction Industry Council (CIC), released the progress report, with their comments, on the follow-up actions taken to implement the CIRC recommendations. A full picture of the up-to-date progress of implementation actions and time frame can be browsed at the CIC website ([www.hkcic.org](http://www.hkcic.org)).

### **3. MEASURES TO IMPROVE THE PRODUCTIVITY OF THE CONSTRUCTION INDUSTRY:**

#### *Observance of the Law - Improved Security of Payment to Contractors and Subcontractors*

Good cash flow management is essential to the success of contractors and subcontractors. The prospects of prompt payment for completed work offer a strong incentive to contractors and subcontractors to deliver quality service, as well as establishing the fair market. However, the locally "pay-when-paid" and "pay-if-paid" arrangements are common in the local industry. There is much room for improvement in the area of security of payment to contractors and subcontractors.

The following good practices over project payment were promoted widely in the industry (CIRC, 2001):

- (a) Project requirements should be clearly defined to reduce payment uncertainty;
- (b) Adequate rules for measurement and valuation should be agreed and observed;
- (c) Pre-pricing of variations, wherever practicable;
- (d) Payments to contractors and subcontractors should be made within the periods stated in the contracts;
- (e) Retention should be released at the times specified in the contract;
- (f) The use of bonds or parent company guarantees should be considered to release retention monies to subcontractors where work is completed well before the completion of the main works;
- (g) Main contractors should only deduct discount when their contracts permit it;
- (h) Final account preparation should proceed throughout the contract period and not be left until completion. In any case, it should be completed promptly upon the completion of the contract;
- (i) Settlement of the final account and payment of monies due should be made within the period given in the contract;
- (j) Subcontractors' work schedule and co-ordination obligations should be set having regard to a clear overall programme for the project; and
- (k) Obligations regarding the protection of work should be reasonable.

CIRC has been monitoring the progress of implementation. To enhance the security of payment to subcontractors and workers, the Housing Authority (HA) also introduced new contractual requirements for building contracts in May 2006 and extended such requirements to demolition contracts in September 2006. The requirements include engaging designated labour relations personnel, paying wages through auto pay and employer's direct payment to workers in proven cases of default. Imposition of on-demand bonds will be applied to all HA new works contracts to address cases where main contractors are in liquidation or under petitions for winding up. Although some discussion has been in place for legislation of payment security as being practiced in other countries (such as Australia, New Zealand, Singapore and the UK), it remains to be seen whether the local industry would adopt such a move (Lam and Wong, 2007).

Aiming at streamlining the procurement practice, the ETWB promulgated a set of guidelines on the selection of procurement route for public works projects in October 2004. For public housing projects, HA has awarded a contract for piloting on "Modified Guaranteed Maximum Price Contracting" for completion by 2009.

#### *Improving Relationship between Contractors and Subcontractors*

The subcontracting segment of the industry needs recognition and development in order to be attractive to the next generation of construction workers. The development of sub-contractors is crucial to worker development and welfare, as well as productivity and quality standards for the future. The CIC can play an active role in the development of their subcontractors. Meanwhile, contractors could assist in raising the performance standards of their subcontractors through the following measures (CIC, 2007):

- (a) Incorporating quality considerations in selecting subcontractors;
- (b) Nurturing stable partnerships with subcontractors of a good standing through feedback and review in the pre-contract and post-contract stages;
- (c) Enhancing the transparency of the subcontracting process by means of written contracts with each subcontractor, clearly setting out the mutual obligations and responsibilities;
- (d) Fostering fair dealings with subcontractors; and
- (e) Improving security of payment to subcontractors.

#### *Human Resources*

With labour being a major influential factor in the construction productivity, the level of productivity is directly related to the "driving, induced and restraining forces acting upon workers" (Maloney, 1983). If innovative technology in the construction industry is to be adopted, construction labour force should be able to catch up through readily acquiring the necessary skills. More effective utilization of a large pool of narrow-skilled and core multi skilled workforces can result in higher productivity on some projects (Olomolaiye, 1998).

In Hong Kong, the Construction Workers Registration Authority was established in 2004 to administer the implementation of the Construction Workers Registration Ordinance. It is a mandatory construction workers registration system which is expected to substantially benefit the construction industry. All the construction craftsmen working on the site are required to register, and there are different layers of trade test achievements, such as

- (a) Trade test for Construction Craftsmen;
- (b) Trade test for Electrical and Mechanical Workers;
- (c) Intermediate trade test for semi-skilled construction craftsmen;
- (d) Intermediate Trade test for Semi-skilled electrical and Mechanical Workers;
- (e) Certification for workers on Gondola and Builder's Lift Operation;
- (f) Certification for Construction Crane Operation;
- (g) Certification for Load shifting Machine Operation.

In Singapore, multi-skilling of workers was introduced by the government, as part of its programme to improve the productivity of the construction industry and reduce its reliance on foreign workers (BCA and MOM, 2003). Under the new rules, workers would need to have full skill certifications in two related trades to qualify for the lower levy payable by employers of certified skilled workers. It is suggested that Hong Kong Construction Workers Registration Authority (CWRA) should consider adopting similar rules so as to minimize workers' ineffective activities and increase their productivity.

In the meantime in Hong Kong, training on assembly type skills should be stepped up, since these will be needed as the level of prefabrication goes up, whilst basic craft skills such as plastering and tiling should still be improved to ensure quality works. Skill enhancing courses and foremen training should be introduced as part of continuous training.

#### *Increase in the Volume of Construction*

Figure 1 above shows there has been a significant decrease in construction output after the Asian financial crisis in 1997, estimated in terms of floor areas completed. The volume of construction in Hong Kong, and hence the business opportunities, have remained very limited, although there is a strong potential for Hong Kong firms to go into new business in the Mainland market. By combining expertise in accounting, financing and legal services with construction expertise, the construction sector can provide a comprehensive service package to Hong Kong developers undertaking property development in the Mainland. Efforts have been made by the Works Bureau and the Hong Kong Trade Development Council in promoting the export of Hong Kong's construction services to the Mainland market and elsewhere.

#### *Improvement in the Efficiency of Work Execution on Construction Sites*

There should be wider use of prefabrication and other buildability measures. Prefabrication coupled with the use of standardized and modular components will contribute to improved buildability and associated efficiency gains. The Housing Authority (HA) has adopted prefabrication since the mid-1980s. Precast concrete facades are now a mandatory requirement for all standard public housing blocks. A variety of other prefabricated building components such as precast concrete structural elements and panel wall partitions have also been tried out. Whilst the HA's experience has confirmed the benefits of prefabrication, it also demonstrates that prefabrication requires a sufficiently large scale of operation to be cost-effective.

The Buildings Department (BD) issued a Joint Practice Note in February 2002 to promote the use of non-structural prefabricated external walls through exemptions from gross floor area and/or site coverage calculations, followed by a code of practice on the design, construction and quality control of precast concrete construction in November 2003. More recently, the ETWB has launched a database on its website to promote the wider use of standardized components and practices (CIRC, 2007).

Buildability is a term more often heard in Singapore than in Hong Kong. As design and construction still remain predominantly separate functions, developers' drive and designers' attention to buildable designs will have significant impact on site construction methods and their efficiency. The Building & Construction Authority in Singapore has publicised the concept of "buildability", which focuses on the 3S Principles of Buildable Design in their assessment scheme. These principles are: (i) standardization – repetition of grids, sizes of components and connection details; (ii) simplicity – use of uncomplicated building construction systems and installation details; and (iii) single integrated elements – those that combine related components together into a single element that may be prefabricated in the factory (BCA, 2005). Being inspired by the Singapore approach, a research team at the Hong Kong Polytechnic University has worked on a Buildability Assessment Model to enable benchmarking of the buildable designs in Hong Kong (Lam et al, 2006).

#### *Information Technology*

The construction industry is information-intensive. To maximize the benefits of IT and to achieve significant productivity gain through improved information flow across processes and disciplines, the industry should give priority to setting common standards and developing a common data infrastructure for seamless electronic communication among stakeholders. A number of initiatives have been undertaken by the Hong Kong Government which with an objective of the development of a common platform for electronic communication in the industry. Such initiatives include the ongoing consultancy study on the alignment of planning, lands and works data; the consultancy study on CAD standard for drawings for works projects; and the feasibility study commissioned by the Buildings Department on the development of an electronic system for building plan submission and document management. The conversion scheme to digitalize the building plans kept by the Buildings Department is already in use.

Whilst setting priority areas for software development were completed, more follow-up actions include: (a) Raising information technology literacy of the construction industry. Some measures have been pioneered by the Government, but yet to be rolled out by CIC for the private sector to adopt; (b) Wider adoption of IT including the feasibility study of electronic checking of building plans, and a common platform for electronic communications within the local construction (CIC, 2007).

#### *Improving Construction Management*

Past studies found that poor management was responsible for over half of the time wasted on a job site (Business Round Table, 1983). Good management is required for profitability and success. Scientific management covers responsibility for employing, training and equipping workers for construction project in order to achieve optimum productivity through proper plans, control and coordination of resources (Olomolaiye, 1998).

Hong Kong construction industry should aim to make the high standards of Japanese construction management commonplace. Japan has done comprehensive research and set the good example for other countries. For example, more building sites in Hong Kong have adopted the "5S" approach in tidying up site environment for improving work efficiency. This workplace management concept originated in Japan and represents 'organization', 'neatness', 'cleanliness', 'standardization' and 'discipline'. A tidy and ordered work environment can significantly contribute to high efficiency and productivity (OSHC, 2008)

#### *Construction Automation Initiative*

Construction in developed countries is leaning towards full or semi-automation in the construction process, although much of it is still in the developmental stage. This could be a long term objective to implement more automated processes as and when the technology is available and affordable. As our contractors get more sophisticated and as more design and build contracts are anticipated, the scope for automation is likely to increase. In the meanwhile efforts to promote mechanization, especially at the subcontractor's level should continue (BCA, 2005).

The use of IT has found its ways into building automation in a number of ways. Recently, seamless co-ordination of temporary works and plant/worker operation can be achieved through the application of virtual prototyping, which has hitherto been used in aircraft manufacturing. The use of Building Information Modelling (BIM) has also automated design activities such as sun-shade analysis, structural behaviour simulation, as well as clash detection. This suite of techniques can also be extended to beneficial use at the facilities management stage.

#### **4. FUTURE DEVELOPMENT**

All the measures have been formulated and implemented to promote an efficient, innovative and productive industry. Various measures and suggestions have been proposed to achieve better performance. The improvements in productivity and efficiency are expected to enhance our global competitiveness, providing us with a more promising outlook of business opportunities.

Through the joint effort of Government and the industry, substantial progress has been achieved on the remaining 109 CIRC recommendations, of which some are related to productivity improvements:

- (a) Process re-engineering to achieve better integration;
- (b) Facilitating regulators;
- (c) Achieving Clear accountability within parties;
- (d) Nurturing a Professional Workforce;
- (e) Export potential of the construction industry;
- (f) Achieving Value in Construction Procurement;
- (g) Wider use of standardization in component design and processes;
- (h) Wider use of prefabrication;
- (i) Wider application of information technology (IT) in project implementation, and
- (j) Investment in construction-related R&D.

Further measures on productivity improvement include: more integrated supply chains with longer term relationship that would encourage learning and continuous improvement; partnering between clients and the industry; adoption of best value principles that balance quality and cost, and procurement practices that incorporates consideration of life-cycle costing. The public sector should take a lead in: (i) the use of 'Alternative Dispute Resolution' to minimize legal disputes; (ii) the mandatory registration of sub-contractors to enhance site supervision; and (iii) the development of a productivity research strategy. Last but not least, there could be closer links between universities and the industry on research (CIB, 2005).

#### **5. CONCLUSION**

Construction productivity is of critical importance to the growth and success of the Hong Kong's economy. The productivity issue has therefore to be considered and addressed from all angles. For the purpose of improving productivity, it is necessary to renovate the industry structure as well as improve construction management at industry, corporate and project levels.

The paper has described the states quo of the construction productivity, measures to improve it, and future development. The successful implementation of the productivity measures will improve the industry's competitiveness significantly, enabling it to look beyond the borders of Hong Kong to find new business opportunities. Additionally, with the opening of the Mainland market and the need for extensive infrastructural development there, Hong Kong has strong potential to develop into an infrastructure service integrator for the Mainland market. To capture these opportunities and to compete successfully, the construction industry must move swiftly forward with its reform programme (CIRC, 2001).

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