INDONESIAN CONTRACTORS' READINESS TOWARDS LEAN CONSTRUCTION

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ABSTRACT

This paper discusses development of an assessment model and its implementation to measure the readiness of Indonesian contractors towards lean construction and to identify which parts of lean construction principles and techniques the Indonesian contractors still lack and need improvements and promotion. The model measures contractors' readiness by observing how the contractors perform their business practices at project level and rating the practices to lean construction principles. Six major building construction projects, conducted by three big well-known contractors, were assessed as case studies. The results of the case studies conclude convergent findings since those contractors have almost similar business processes at their project levels. The case studies also revealed that big Indonesian contractors have already implemented macro lean construction principles, i.e., the policy to have continuous improvement and to promote transparency. Meanwhile, on micro principles of lean construction, i.e., reduction of cycle time and reduction of variability, the Indonesian big contractors still lack of awareness and ability to implement the principles and techniques. It is also found that Indonesian big contractors still lack the capability to plan good work flow for reducing the cycle time of their construction operations.

KEY WORDS

Assessment model, contractor, lean construction, readiness.

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INTRODUCTION

As a concept, lean construction is still considered as a new paradigm among Indonesian construction practitioners as well as academia. Introduction of lean construction concepts to the Indonesian construction industry becomes a strategic, challenging, and painful effort as a prophet seeks believers. Although some lean construction principles and techniques are already adopted and implemented by construction practitioners in their day-to-day activities, understanding of lean construction as an integrated concept is still not yet sufficient. Therefore, a socialization of lean construction concept, principles, and techniques becomes a big agenda for research and education in Indonesia.

A research agenda, which was developed based on a so called 'a roadmap towards lean construction in Indonesia', was developed by academia and looked forward to practitioners' comments, validations, and participations on its implementation (Abduh et al. 2005). One of the important assumptions made on the development of the agenda is the capacity of parties involved in Indonesian construction industry, especially contractors which are the most important actors at the production line of construction projects. In the meantime, Indonesian contractors face problem of inefficiencies in their business processes. Alwi et al. (2002) stated that inefficiencies found in Indonesian contractor's operations were mostly in the forms of delays of schedule, repairs on finishing works, damaged materials on site, waiting for equipment repair and to arrive, and equipment frequently breaks down. Identified factors causing such wastes were lots of design changes, lack of trades' skill, slow in making decision, poor coordination among project participants, poor planning and control, delays on delivery of materials to site, and inappropriate construction methods.

Realizing the importance role of contractors in adopting and implementing the lean construction concept, an assessment model is needed to measure the readiness of contractors towards lean construction for validating the research agenda. Furthermore, the model should also be developed to gain a clear picture on which parts of lean construction principles and techniques the Indonesian contractors still lack of and need improvement and promotion (Abduh et al. 2005).

DEVELOPMENT OF THE ASSESSMENT MODEL

An assessment model to measure the readiness of Indonesian contractors was developed based on lean construction principles that were previously introduced by Koskela (1992), dos Santos (1999), Ballard (2000), and Bernardes and Formoso (2002). Thirty six measurement indicators of the lean construction principles were identified and analyzed to be further grouped into appropriate classifications. Finally, the assessment model consists of 4 major lean construction principles, 12 minor lean construction principles, and 31 measurement indicators as depicted in Table 1. As shown on the table, major lean principles include reducing cycle time, reducing variability, increasing transparency, and continuous improvement. The first two principles, i.e., reducing cycle time and reducing variability, are considered as micro lean principles since they highly relate to the operations and project level processes, and the other two principles, i.e., increasing transparency and continuous improvement can be considered as macro ones since they mostly relate to project and corporate level management.

The assessment model was intended to measure contractors' readiness by observing how the contractors perform their business practices at project level and rating the practices to the identified lean construction measurement indicators. Moreover, the assessment model was transformed into an interview-guideline questionnaire by breaking down each measurement

indicator into several representative questions. Qualitative rating scales, i.e., good, fair, and poor, were used to assess the contractor's practices suitability towards lean construction principles based the questions. The qualitative value for each answer to the question was then transformed into a quantitative numerical scale, i.e., 3 for good, 2 for fair, and 1 for poor.

Instead of using average method to describe the readiness of a contractor for each measurement indicator, the assessment model utilizes percentage using ratio between the sum of numerical values with the sum of maximum possible values of the representative questions. Additive mathematical formulas were used to describe the readiness of contractors towards minor and major lean construction principles. Moreover, weight assessments were introduced in the model to determine the importance of indicators, minor principles, and major principles. The questionnaire for weight assessment uses rating method with numerical scales of 1 to 5 which represents increasing degree of importance.

Table 1: Major and Minor Principles and Measurement Indicators (Roza 2006)

Major Principles	Minor Principles	Measurement Indicators
Reduce cycle time	Planning production process	Planning hierarchization
		Detailed planning hierarchization
		Material and equipment resources planning
		Productivity planning
	Synchronizing and smoothing the flows	Batch size and task volume analysis
		Delay time and waiting time analysis
		Constraint analysis
		Non-value adding activities
Reduce variability	Control activity	Control mechanism
		Tools of control
	Measuring, finding and eliminating the root cause of problems	Progress work reports
		Non conformity product
		Customer complaint
	Analysis and quantitative evaluation of processes	Material and equipment resources analysis
		Productivity analysis
		Cycle time of activity analysis
		Evaluation of production process
Increase transparency	Making the process directly observable	Lay out production
		Security and health safety
	Rendering invisible attributes visible through measurements	Performance indicators development
		Shared of measurement output which used performance indicator
	Use of visual devices	Shared information activity
		Visual devices to shared information
	Shared decision making	Decision making mechanism
		People who has responsible to make decision
Continuous improvement	Using standards as hypothesis of best practice	Using standard operation procedure
		Evaluation of standard operation procedure
	Measuring and monitoring improvements	Measuring and monitoring improvements mechanism
		Evaluation of improvement activity
	Giving responsibility for improvement to all employees	Mechanism of giving responsibility for improvement
		Role of all employees in improvement program

To ease the analysis of the assessment results, Roza (2006) developed a relationship map to describe relationship between measurement indicators and to show level of readiness for each measurement indicator. This relationship map vertically shows lean construction principles and horizontally shows stages of project life cycle. The lean construction principles, vertically, consist of major principles, minor principles, and measurement indicators. While, horizontally, the stages include bidding, planning, and production processes. Arrows on the map imply associations between indicators, and the level of readiness of each measurement indicator is depicted by different colours.

CASE STUDIES AND IMPLEMENTATION OF THE ASSESSMENT

Six major building construction projects were observed as case studies which were conducted to test the assessment model and, as well as, to assess the readiness of Indonesian contractors. The projects were located in Jakarta and performed by three big well-known and ISO-9000 certificated contractors; each contractor performed two projects. The cases vary in their building types, i.e., office, apartment, trading mall; contract values vary from US$ 2.7 Millions to US$ 29.7 Millions; project durations vary from 195 days to 510 days. Six project managers were interviewed and also become respondents of the weight assessments.

Interviews to the project managers were conducted based on the developed questionnaire and focused on whether the contractors performed the activities asked by questions and whether the contractors had standard operating procedures (SOP) related to those activities. The observations and cross-checks, by collecting related information, only made by assessors to the availability of SOP but not to the implementation of the SOP in the field yet, evermore to the quality of contractors' performance. Judgement by assessor is still a big part of the assessment and makes the results of assessment considered not totally objective.

In the meantime, weight assessment done by respondents collected project managers' opinions on the importance of measurement indicators, minor lean construction principles, and major lean construction principles. In this weight assessment, awareness and understanding of lean construction terminologies, and contractors' habit are very important to prevent biased answers.

INDONESIAN CONTRACTORS' READINESS

The results of the case studies, based on the assessment model, are shown in Table 2. This table depicts level of readiness and weighted readiness of Indonesian contractors towards lean construction.

Table 2: Indonesian Contractors' Readiness Towards Lean Construction (Roza 2006)

Major Principles	Weights	Level of Readiness	Weighted Readiness
Reducing Cycle Time	0.24	68%	16%
Reducing Variability	0.23	77%	18%
Increasing Transparency	0.21	89%	19%
Continuous Improvement	0.32	91%	29%
	1.00		**82%**

Table 2 shows that level of readiness of Indonesian contractors towards major lean construction principles varies even though the overall the percentage of readiness of Indonesian contractor towards lean construction is considered high, i.e., 82%. The highest level of readiness is the level of readiness of Indonesian contractors towards the continuous improvement principle, i.e., 91%. Respondents also put highest weight, i.e., 0.32, on the importance of this principle. It means that Indonesian contractors had already been aware of, had implemented, and thought the importance of this principle more than others. This is very solid and obvious finding since the continuous improvement principle had been introduced along with TQM concept long before the lean construction was introduced to Indonesia and evidently those big contractors are already ISO-9000 certificated.

The second highest level of readiness was towards the increasing transparency principle, i.e., 89%. This major principle includes minor principles such as making the process directly observable, rendering invisible attributes visible through measurements, use of visual devices, and shared decision making. Even though this principle was categorized as the second highest level of readiness, the weight assessment revealed that this principle was categorized to have slightly the lowest importance, i.e., 0.21, but almost as importance as two other major principles, i.e., 0.23 and 0.24. This finding also holds because as of the case studies were conducted, Indonesian government has been very aggressively promoting the transparency in all aspects of business, as a virtue of the Indonesian reform movement in 1998, as they also had issued the Construction Services Act No. 18 in 1999 for regulating the Indonesian construction industry. It seems that the wind of change has already affected practitioners of Indonesian construction industry to be more transparent in doing their business processes.

Meanwhile, the readiness of Indonesian contractors towards the reducing variability and the reducing cycle time principles were considered moderate, i.e., 77% and 68% respectively. Those principles included activities that should be performed by contractors in their operations and project level, such as planning production process, synchronizing and smoothing the flows, control activity, measuring, finding and eliminating the root cause of problems, and analysis and quantitative evaluation of processes. It seems that terminologies, concepts and techniques related to these principles were relatively less known and irregularly or even not yet adopted and implemented in Indonesian contractors' day-to-day businesses. This is true since the assessment model does not yet accommodate verification of the results with in the field implementation and contractors' performance. Therefore, the level of readiness towards these two principles would be anticipated lower.

More analysis was conducted to each measurement indicator. It was found that there were 9 indicators considered to have relatively low percentage, as depicted in Figure 1. The indicator of synchronizing and smoothing the flows gained the lowest percentage, i.e., 58%, while the indicator of analysis and quantitative evaluation of processes gained the second lowest percentage, i.e., 69%. Figure 1 also shows that the lowest percentage indicators relate very well with the ability of engineering division of the contractors to set up good flow of activities in the planning process. It means that the Indonesian contractors still lack of awareness and ability in planning the project activities regardless the techniques they were using. This weakness would accumulate and affect the production process, especially in evaluating and controlling the activities.

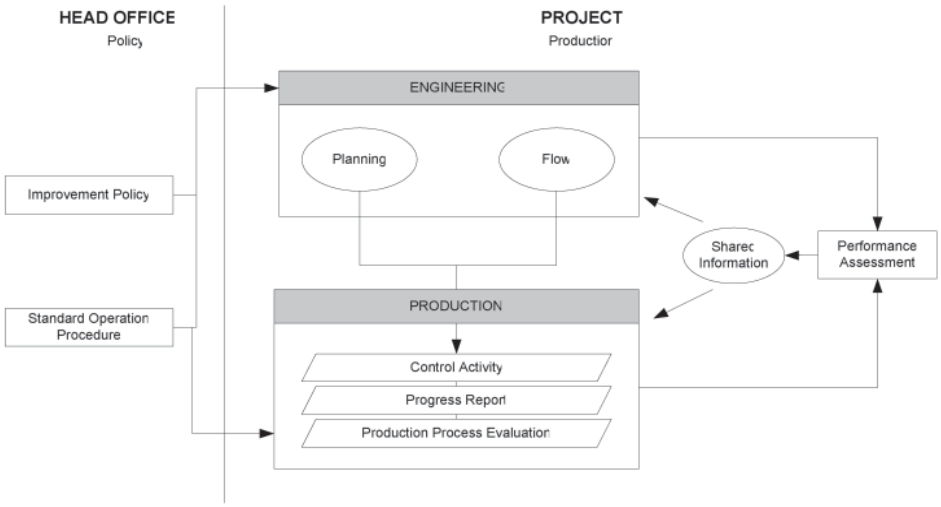

Figure 1: Relationship between Relatively Low Percentages of Readiness Indicators (Roza 2006)

Deeper analysis by comparing projects and contractors revealed that there are no significant variations between projects and between contractors for each measurement indicator. It means that the case studies could conclude convergent findings since those contractors have almost similar business processes at their project levels.

CONCLUSIONS

The six case studies to measure the readiness of Indonesian contractors towards lean construction revealed that Indonesian big contractors already implemented macro lean construction principles, i.e. the policy to have continuous improvement and to increase transparency. Meanwhile, on micro principles of lean construction, i.e. reduction of cycle time and reduction of variability, the Indonesian big contractors still lack of awareness and ability to implement the principles and techniques. It is also found from the case studies that contractors lack of the capability to plan good work flow of their construction operations.

Since the developed assessment model does not yet accommodate verification of the results with in the field implementation and contractors' performance, the level of readiness towards lean construction could be anticipated lower. The factors causing lower level of readiness of Indonesian big contractors could not be clearly identified by the assessment model, but several factors could be guessed based on the characteristics of measurement indicators and general weaknesses of the Indonesian contractors as identified by Alwi et al. (2002). Further agenda, for academia and especially contractors, along with other efforts to make lean construction in Indonesia a reality should focus more on the promotion and development of techniques related to planning production process and work flow.

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