

[CON 15] ANALYSIS OF LEAN MANAGEMENT IMPLEMENTATION IN CONSTRUCTION SECTOR

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ABSTRACT

This study presents the analysis of lean management implementation in construction sector. The construction industry in Malaysia currently shows decline in productivity. By applying lean concept in construction, it could assist the construction company to be able to facilitate delivery process. The objective of this research is to identify the obstacles to implement lean management in construction projects and which lean tools and techniques applicable in construction as well as to explore how five lean principles could improve the construction productivity. A qualitative method was used which involved in depth interview as the main instrument for the study. The finding is the main barrier to lean implementation is lack of knowledge about lean management. Lean principles, tools and techniques could improve the productivity of construction. The contribution of lean management in construction industry enables to provide non value added during the process, reduce costs and satisfy the customer. However, lean management in construction is still new in Malaysia and limited application in construction project. It is recommended that future study to establish the possibility of the adoption of the lean production concept and principles in the construction in Malaysia and determine the specific lean tools and techniques use in different construction project associate with benefit of implement lean.

Keywords: *lean management, lean construction, lean tools and techniques, five lean principle*

INTRODUCTION

The construction industry plays an important role in the growth of economy in Malaysia, which contributed about 2.5% of gross domestic product (GDP) in the year 2007. (Zakaria, 2006). According Malaysia Master Plan 2006-2015, this industry has been created more than 800,000 job opportunities. (Zakaria, 2006). Therefore, efforts to improve construction efficiency should be implemented from time to time in order to achieve cost-effectiveness and shorten construction time. Even some new and advanced technologies have been used in construction projects, but the productivity in this industry is still considered as low. However, until today construction industry is still facing numbers of problem that need to be resolved such as low productivity, inferior working conditions, insufficient quality and poor performance (Koskela, 1993).

Lean construction based on lean thinking has been introduced in this construction sector to overcome the construction problems. Lean construction project is very different compared to traditional construction project management. This is because lean approach maximize the performance based on customer's needs, set objective clearly

in the delivery process, concurrent design product and process and use production control for all the projects. (Ballard, 1998). The use of lean construction concept in the construction industry in Malaysia still considered new and novel approach (Lim, 2008). In fact, the application of lean in the construction industry is very much limited. Even in Malaysia, inadequate numbers of research done about the application of lean concept. It has shown that the usage of the lean concept still unpopular in the construction field. As a result, the purpose of the research is to identify the obstacles to implement lean management in construction projects and which lean tools and techniques that applicable in construction as well as to explore how five lean principles to improve the construction productivity.

STATEMENT OF THE PROBLEM

The Malaysian construction industry has been characterized as adverse and inefficient due to inconsistencies on policy, implementation guideline and practice among the players involved thus it need of structural and cultural reform (Kamar, 2012). According Sambasivan and Soon (2007), founded ten most problematic factors for delay cause and the effects in Malaysian construction industry. Which those problems are improper to planning, inadequate contractor experience, problems with subcontractors, shortage of material, poor site management, labour supply, insufficient finance from client for payments completed work, availability and failure of equipment, communication problem between of the parties, and error during the construction stage.

Many construction projects that using traditional methods are resulted to overrunning cost, not completed on time and not meet the specifications (CIDB, 2000). According to the National Audit Report (2009) showing that eleven construction projects are reported as over budgeted, not meet it requirements in the contract, incomplete, function inappropriate and not achieving the expected quality. However, nine of the construction projects resulted in delays, six are reported as not meeting specification and seven projects were having quality issues. For example, a public construction project for police housing and headquarter in Kedah Contingent was happened to face the problems such as delay, not meeting the specification in quality issues.

As a result, every construction project almost facing the same problems. It means that Malaysia has not learnt any lesson from their past experience. In Malaysia, the impact of these problems such as client or taxpayers is suffering from the effect of the late delivery in the construction projects.

LITERATURE REVIEW

Lean management

Lean management plays an important role in improving the performance of businesses in the USA since 1970s. It involves reducing costs, improving quality, reducing lead-times, develop new products and services, increasing market share and human resources (Emiliani, 2006). Lean management was developed from Toyota Production Systems by Ota Ono, Shigeo Shingo and others. It is a long term approach to run an organization and to work as systematically in order to achieve small change in improving quality and productivity. Lean management referred to as lean production practices. It considers

that the use of resources is a waste of anything other than creating value for the end customer and thus a target for elimination (Begam, Swamynathan, & Sekkizhar, 2013). Besides that, lean management does not identify activity with value, but it is focused on the principle that it is possible to produce less motion, so that costs and waste are reduced and people work more satisfying. Hence, there are five lean principles that should be used by organizations to improve their operations and it should focus on improvement continuously (Loughrin, 2010). Womack and Jones define the five principles of lean, which are accepted by major importance to the successful implementation and they are determined in the following.

a) Specify the value

The first principle is specifying the value from the customer's point of view. The challenge faced by manufacturing company is based on understanding customer needs, leading to comply with the specified value of lean principles to develop a portfolio (Melton, 2005).

b) Identify the value stream

The second principle is to determine the value stream, which means that according to the customer's point of view, rather than according to departmental needs of the organization from raw materials to the final customer process (Melton, 2005).

c) Elimination the waste

The third principle is to eliminate the waste. Elimination of waste is a process to eliminate waste or add value to the production of a product or service, which can provide customer with one of the best product or service. Waste can be eliminated through the implementation of lean and various lean tools, but the focus should not be on the identification and removal of waste (McBride, 2003).

d) Establish pull

The fourth principle focusing on the demands of customers in order for elimination of excess production. Customers may "pull" the product from manufacturer as required, usually for weeks rather than months. As a result, the product does not need to be produced in the early stages and inventory of raw material because it generates an expensive inventory that needs to be managed and saves money for both the producers and the customers (Crawford, 2016).

e) Seek perfection

The fifth principle concerns the improvement of quality through the production of products that the customer needs at a reasonable price and without waste. (Womack J. J., 1990). The cyclical improvement should be carried out continuously and without end (Melton, 2005).

Lean construction

Lean construction has defined by the Construction Industry Institute (CII) as "the continuous process by eliminating waste, meeting or exceeding all owner requirements, focusing on the entire value stream, and pursuing perfection in applied in constructed project" (CII Lean Principles in Construction Project Team, 2016). According to Abdullah et al. (2009), lean construction is a concept that needs to link with the construction industry and the purpose is to increase the sector's productivity level by eliminating activities and actions that create waste in the construction process. The

concept also highlighted on the reduction of waste, increase of value to the clients, and continuous improvement. As a result, lean construction concepts and techniques has been successfully implemented in the construction industry by using effective lean construction tools such as the Last Planner System (Antillon, (2010).

According to Koskela and Howell (2002) stated the theory of the traditional construction project management practice is obsolete and it should be revised. They pointed the traditional methods occurred problem such as have not achieved the goal as set and do not perform in a satisfactory way. Therefore, it is important to search for non-traditional methods and new management thinking in the construction industry to achieve the maximum value with minimum waste, time, and cost.

Table 1
Differences between the traditional approach and the lean approach (adapted from Ballard (2000) & Sicat (2012))

Traditional Construction Approach	Activity	Lean Construction Approach
Monitoring the performance on schedule and cost. After detecting negative variances take corrective actions immediately.	Control	Ensure the reliable workflow by measuring and improving the system performance.
The effort of management focus on maximizing each activity separately. Therefore will reduce overall performance.	Performance	The main objective is to maximize the value with minimum waste at the project level to ensure reliable workflow.
Value consider as low cost. The client has to define all his requirements in the beginning of the project, regardless the change in the new technologies and market.	Value	Construction project managed by creating value in the process where the customer satisfaction is created and developed over the course of the project.
Push-driven schedules are used to release information and material.	Work techniques	Pull-driven schedules control the information and material flow.
No applied	Collaboration	By developing new commercial contracts to suppliers able to show continuing support to suppliers which gave the suppliers incentives for reliable work flow and for participating in the overall product improvement.
No applied	Transparency	All the stakeholders of the project are increasing transparency in order to allow people to make decisions for reducing the need of central management.
Do not have so much on continuous improvement.	Continuous Improvement	LC considers continuous improvement in the process and workflow.

Lean tools and techniques

There are several lean tools and techniques that can be used in the construction industry to improve performance and create efficient construction processes such as in the pre-

construction, construction and maintenance phases of a project. The following are the several lean tools and techniques that are available to implement by the construction sector.

a) Last Planner System (LPS)

LPS is a collaborative approach to manage complex and uncertain projects-based production that able to identify the problems and resolved the source by increase the work flows with no delays (Mossman, 2012). The LPS practices in construction involved both design and design process, managing tender process, and construction production with integrated project delivery (Mossman, 2012).

b) Five S's (5S)

The five S's include sort, straighten, standardize, shine, and sustain. By using 5s lean tools in construction allow for a transparent at the job site which materials flow between warehouses and the related jobs in site.

c) Visual management

Visualization plays an important role in the construction process where it is to avoid ambiguity information. It can help a site worker has created awareness of action plans and identify the work flow (Salem, Solomon, & Genaidy, 2006). The technique able to show the availability of materials, changes in the layout and the locations of other resources, status work completion of the previous activities and equipment. There are various visualization forms that can be used in construction projects such notice boards, electric wiring, safety signs, mobile signs, project milestones and PPC charts (Salem, Solomon, & Genaidy, 2006).

Obstacles to lean implementation

a) Fragmentation & subcontracting

In both competitions, fragmentation and subcontracting are the barrier in the construction industry to stimulate the workers on the project to learn together and cooperate and (Mossman, 2009). The workers in the project with the same objective to achieve successfully complete the related project, but they have different circumstances and priorities. (Abdullah, 2010). Therefore, it is crucial to have communication effectively between all parties such as in partnering and integrated team-working route. Thus, during the process of implementing the LC concepts, poor communication will bring negative impact to the effectiveness of project delivery and coordination system.

b) Lack of adequate lean awareness/ understanding

According Abdullah et al. (2009) suggests that in order to be able to clearly understand the concept of LC it is crucial to have a comprehensive of understanding about lean manufacturing concepts at first .Besides that, many studies have reported the lack of exposure on the need to adopt LC and hard in understanding concepts to be significant barriers for implementation of lean in construction. (Johansen & Porter, 2003)

c) Financial issues

The tactics for successful implementation of lean in Construction requires adequate capital to provide relevant lean tools and equipment, sufficient professional wages, incentives and reward systems; investment in training and development programmes and provide guidance to both employers and employees by employing a lean champion during the initial implementation (Bashir et al., 2010).

RESEARCH METHODOLOGY

A qualitative data collection method used in this research was comprised of primary data and secondary data. According to Brikci (2007), qualitative method can help the researcher interpret and have a better understanding of the reality in a given situation. This research began by studying and gathering some information about the background of construction in Malaysia. A construction company was chosen for in-depth interview. This company was selected based on the experience of construction project in Kedah. The researcher prepared the data collection by first contacting the company to be researched, explained the objective of the study and recorded the key information. A semi-structured interview question and guide was developed based on the review of literature where it was done prior to the case study. The interview was done in the form of one-by-one discussion where the time taken approximately two hours. The interview process was recorded and transcribed.

The respondent involved is the civil engineering in the company where he has been working about six years for the company and hold a Bachelor of civil engineering from the University of Tenaga Nasional. He also an active member of the Institute of Engineer Malaysia (IEM). He has more than eight years of experience in the field of civil and structural design, project planning and is project coordination. He was questioned based upon his practical experiences. The research questions were developed and listed down as below. Those questions are performed in structure based on the research from significant literature within the lean in the service sector.

FINDINGS AND DISCUSSION

Company background

Company A was located in Kedah, Malaysia and it was established in September 2010. The main activity of the company is property development and construction houses which purpose to build harmonious living spaces through thoughtful design that enough family bonding yet creates a lifestyle that promo healthy living to family and community. The construction project involved apartment, storey shop offices, storey terrace houses and condominium.

The obstacles during lean implementation

From the perspective of the respondent, he stated that main of obstacles is the lack of knowledge about lean management. This could be due to he lack of the exposure on the importance of adopting lean construction in Malaysia and they assume the lean concept is difficult to understand. Moreover, financial issues deemed as obstacles to lean implementation. Regarding to the respondent, he stated their company still considered as small, inadequate capital to provide relevant tools and equipment, reward system, investment in training and to development programmes and provide guidance during initial implementation to both employers and employees. Besides that, the culture and human attitudinal issues also one of the obstacles in implementation lean management in construction. The employers and employee resistance to change traditions and behaviour. For an example, they have some old worker are lack of their ability to work using new approach. The workers also fear of taking risks and wrong attitudes to change.

The use of five lean principles to improve the construction productivity

From the interview, researcher realized that the company does not implement lean management in their organization. However, the researcher uses the existing information from the interviewer and analyses it based upon the five lean principles and it was categorized into the following.

a) Specify the value

The respondent has been analysed processes, conducted customer surveys and used audit to determine customer need and wants. They add value to the luxury condominium construction project, which located in Kedah by providing affordable price, high quality, high building with sky facilities in the rooftop and strategy location which nearly Hospital Sultanah Bahiyah and Airport. In order to measure the value adding to the project, they used Information for Competitive Advantages (IFCA) software's construction management system allow monitoring of project budget, select and award contracts, manages contractor's performance, monitor construction schedules, control cash flow and quality. Moreover, they used AutoCAD which this tool help contractors and subcontractors improve construction planning, produce results faster such showing the building in 3D visualization.

b) Identify the value stream

After a construction plan produced based on the design agreed. The respondent start to managing flow of people, materials and equipment by using process map flow in order to increase awareness of action plans on site. Before starting construction work on site, the contractor will give a briefing to the worker, in order to ensure their own responsibility in order to avoid bottlenecks and lead time.

c) Elimination the wastes

The construction project still facing delays workflow problem due to poor weather such as rain, lack of commitment between workers and poor project planning. Besides that, it also faced difficult to get authorities' compliance for water and electricity from the government because it takes few months for approval. They solved the problem by revising the planning, hold weekly meeting and organize a family day for the workers and contractors in order to facilitate the relationship between each other as well as improve the working productivity.

d) Establish pull

The construction project using pull approach. The company sold the condominium property before builds it. So, the contractor will order the material and resource into the process once needed to satisfy project requirements. For example, the correct amount of concrete, bricks, sand pipe would be delivered directly to a designated area within a building section. This approach allows contractors to reduce cost of carrying and storing good, overproduction and reduce stock cost.

e) Seek perfection

Due to the company still small, they do not have an improvement team, but they work based on guideline stated on quality of project control. They control the quality of construction project based on the contractor and worker inspection and the feedback from customer. Besides that, they have use IFCA to control the quality.

Lean tools and techniques that applicable in construction

As the company does not implement lean in construction projects, so there are some lean tools and techniques are suggested to be used in their construction project. One of lean tools is last planner system that enable to create an improvement in project, predictability, productivity, safety, speed of delivery and feeling wellbeing among workers. It also enables to identify the issues and solve it before the problem come on-site and improve the workflow of and complete the project on time. For an example, last planner system increases the conversations between trade foremen and site-management at appropriate levels of detail and before the issues become serious. Besides that, a lean tool for 5s is suggested to be implemented in construction site because it can transform a site into a clean, safe productive place in which people can work with pride. For example, all the concrete, brick, hand tools, hammers, measuring and drill presses follow 5s step which located in right place enable to eliminate waiting time if they needed to find the needed materials. Lastly, visual management was suggested, it can help workers to avoid any unclear information during in the construction process. For example, the location of concrete, brick and stone showing in the site communication centre for all the workers to know the actual material located in order reduce the waiting time.

CONCLUSION

Construction industry currently facing strong competitive which customers' requirements are very rigorous due to the rapid changes in the technology and the environment. In order to meet this global trend and to deliver gradually sophisticated product sometimes the traditional construction project management methods which surrounded by time, cost and quality might not be sufficient. Thus, by implementing lean management in construction will benefit to the company, especially the respondent agreed that the lean concept enables to improve the productivity, reduce non-value adding and waste, and complete on time as well as able to increase sustainable competitive advantage. Data collected from company A during interview emphasis the five lean principles used in the company which specifies the value, identify the value stream, elimination of wastes, establish pull and seek perfection.

The research objectives have been achieved by identifying the obstacles of implementation lean management in the construction project from the perspective of the respondent, the analysing the implementation of five lean principles and applicable lean tools and techniques in construction site was suggested. However, the limitation of the study is limited company implements lean in construction project due to Malaysia still new in this area. Therefore, future study should establish the possibility of the adoption of lean production concept and principles in the construction in Malaysia and determine the specific lean tools and techniques in different construction project associate with benefit.

REFERENCES

Abdullah, M. R. (2010). Causes of Delay in MARA Management Procurement Construction. *Journal of Surveying, Construction*, 123–138.

- Antillon, E. I. ((2010). A Research Synthesis on Tthe Interface between Lean Construction and Safety Management. *Master of Civil Engineering*. University of Colorado.
- Ballard, G. a. (1998). What Kind of Production is Construction? *Proc.*
- Begam, M. S., Swamynathan, R., & Sekkizhar, J. (2013). Cyrrrent Trends on Lean Management. *International Journal of Lean Thinking*.
- Chesworth, B. L. (2014, June). *Lean – Challenges of Implementing Lean Construction*. Retrieved from Academia: http://www.academia.edu/12434112/LEAN_CONSTRUCTION_WITH_OR_WITHOUT_LEAN_CHALLENGES_OF_IMPLEMENTING_LEAN_CONSTRUCTION
- CIDB. (2000). *Manual for Assessment of Industrialized Buidling System*. Kuala Lumpur: CIDB.
- CII *Lean Principles in Construction Project Team*. (2016). Retrieved from Construction Industry Institute: https://www.construction-institute.org/scriptcontent/more/191_1_more.cfm.
- Crawford, M. (2016). *5 Lean Principles Every Engineer Should Know*. Retrieved from The American Society of Mechanical Engineers: <https://www.asme.org/engineering-topics/articles/manufacturing-design/5-lean-principles-every-should-know>.
- El-Namrouty, K. A., & Abu Shaaba, M. S. (2013). Seven Wastes Elimination Targeted by Lean Manufacturing Case Study Gaza Strip Manufacturing Firms. *International Journal of Economics, Finance and Management Sciences* , 68-80.
- Emiliani, M. (2006). Origins of Lean Management in America: The Role of Connecticut Businesses . *Journal of Management History*, 167-184.
- Eriksson, P. E. (2010). Improving Construction Supply Chain Collaboration and Performance: A Lean Construction Pilot Project. *15*(5), 394-403.
- Kamar, K. A. (2012, August 29). *Construction Industry in Malaysia: Issues and Challenges*. Retrieved from Blog: <http://ibsresearch.blogspot.my/2012/08/construction-industry-in-malaysia.html>
- Koskela, L., & Howell, G. (2002). The Underlying Theory of Project Management is Obsolete. *Proceedings of PMI research conference*.
- Loughrin, M. (2010). *The Four Elements of Lean Leadership*. Retrieved from Supply Chain Digest: http://www.scdigest.com/assets/Experts/Loughrin_10-04-26.php.
- McBride, D. (2003, August 29). *The 7 Wastes in Manufacturing*. Retrieved from EMS Consulting Group: <http://www.emsstrategies.com/dm090203article2.html>.

- Melton, T. (2005). The Benefits of Lean Manufacturing: What Lean Thinking has to Offer the Process Industries. *Chemical Engineering Research and Design*, 83(6), 662-673.
- Mossman, A. (2012). *Last Planner – Collaborative Short-Term Production Planning*.
- O. Salem, M., Solomon, J., Genaidy, A., & I. Minkarah, M. (2006). Lean Construction: From Theory to Implementation. *Journal of Management in Engineering* © ASCE / October.
- Ohno, T. (1988). *The Toyota Production System: Beyond Large-Scale Production*. Productivity Press.
- Womack, J. J. (1990). *The Machine that Changed The World*. New York: Rawson Associates.
- Zarabizan Zakaria, S. I. (2006). *Buildability and Maintainability in Final Account Closing: The Greatest Challenge for Construction Industry*. Retrieved from Academia:
http://www.academia.edu/8990110/Buildability_and_Maintainability_in_Final_Account_Closing_The_Greatest_Challenge_for_Construction_Industry.