AWARENESS OF LEAN MANAGEMENT IN CONSTRUCTION INDUSTRY

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AWARENESS OF LEAN MANAGEMENT IN CONSTRUCTION INDUSTRY

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SUPERVISOR'S DECLARATION

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledge. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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DEDICATION

This Degree dissertation is dedicated specially to my parents that give full supportive all the way during my study.

I would like to dedicate this thesis to my supervisor, Mr Azizan Bin Hj Azit who gives me lots of advice, guidance and suggestion throughout my study.

Moreover, this thesis also dedicated to all my friends who always give full support to me during my study.

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ABSTRACT

Nowadays, Malaysian construction industry is growing rapidly. Therefore, more systematic and innovative method has been introduced to the industry to enhance the management and performance of construction project. Lean in construction as discussed by previous researchers is introduced to the construction industry in order to enhance the performance of project and enlarge the contractor's profit by eliminating waste. According to the past researcher OGC (2007), stated that the purpose of lean in construction is to work on continuous improvement, waste elimination, value for money, high user focus, strong quality management of projects and improved communications. There are two objectives of conducting this research. The first objective of this research is to identify the level of awareness of Lean management among the contractors and finally the second objective is to determine the barriers of implementing the Lean management in Malaysian construction industry. The questionnaire was distributed to the construction industry in Melaka. The result was obtained by using SPSS software. Based on the result, it shows that most of the contractors in Melaka are aware on the implementation of Lean in construction industry.

ABSTRAK

Pada masa kini, industri pembinaan di Malaysia sedang berkembang dengan pesat. Oleh itu, kaedah yang lebih sistematik dan inovatif telah diperkenalkan kepada industri untuk meningkatkan pengurusan dan prestasi projek pembinaan. Pengurusan Lean dalam pembinaan seperti yang dibincangkan oleh penyelidik telah diperkenalkan kepada industri pembinaan dalam usaha untuk meningkatkan prestasi projek dan membesarkan keuntungan kontraktor dengan menghapuskan pembaziran. Menurut penyelidik lalu OGC (2007), menyatakan bahawa tujuan pengurusan Lean dalam pembinaan adalah untuk penambahbaikan yang berterusan, penghapusan pembaziran, nilai untuk wang, tumpuan pengguna yang tinggi, meningkatkan pengurusan kualiti dalam projek dan meningkatkan komunikasi. Terdapat dua objektif untuk menjalankan kajian ini. Objektif pertama kajian ini adalah untuk mengenal pasti tahap kesedaran pengurusan Lean di kalangan kontraktor dan objektif kedua adalah untuk menentukan halangan untuk melaksanakan pengurusan Lean dalam industri pembinaan Malaysia. Soal selidik telah diedarkan kepada industri pembinaan di Melaka. Hasilnya telah diperolehi dengan menggunakan perisian SPSS. Berdasarkan keputusan itu, ia menunjukkan bahawa kebanyakan kontraktor di Melaka sedar mengenai pelaksanaan Lean dalam industri pembinaan.

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

In today's competitive and developing environment, the construction industry has become one of the main contributions for the global economy development. As well as in Malaysia, the construction industries are an important role in generating wealth and improving the quality of life of Malaysians. Moreover, construction industry can give impact to the development and growth of other industries including financial services, professional services and manufacturing. Nowadays, the construction industry has been highlighted in the government economic planning as the key drivers in the development of the country. Therefore, the construction industry should keep up and improve their organizational performance to remain competitive in the economic development. In addition, this study describes regarding the Lean Management concept in order to minimize the generation of waste in the Malaysian's construction industry. Thus, this study will also reveal the awareness of the contractors towards the implementation of lean management in construction industry. The introductory chapters will provide the reader a description of the study's background, problem statements, research objectives, research questions, research framework, research hypothesis, scope of study, and significant of study.

1.1 RESEARCH BACKGROUND

Lean management was popular and traditionally been interrelated with the manufacturing industries. Recently, many industries such as services, financial, construction and health care industry have adopted the lean principles with the aim of improving their performance and customer satisfaction. Piercy and Rich (2009) has declared that Lean as a concept comprising a set of principles, practices, tool and techniques that would improve resource utilization, quality and delivery with respect to products and services if being implemented by following a systematic approach. Howell (2001) was defined the word "lean" as "Give customer what they want, deliver it instantly with no waste". In other word, lean is an activity of adding value for the customer, waste elimination, and continuous improvement from a standard of the activity. The successes of Lean implementation in manufacturing can be seen through Toyota. The reason is because Toyota Company had taken control of the market shares in the automobile production as the result of lean implementation.

Construction industry is unique and covers a variety ranging from the slow, certain, and simple project to quick, uncertain as well as complex project stated by Ballard and Howell (1998). Moreover, Koskela (1992) said that construction is unique in the sense of one kind of nature projects, site production and impermanent multi- organization. Recently, due to the global economic crisis and poor performance, construction projects are currently progressing slowly around the world. According to Lo et al., (2006), poor performance including time delays, cost overruns and quality defects are not unfamiliar in the construction projects. Beside of that, the poor management system in the construction project will direct and lead to many issues that would cause cost of project increases, late completion of project and low quality. These issues will finally reduce the profit of the contractor. Low and Chong (2001) have mentioned that the productivity levels within the construction industry have consistently lagged behind other sectors especially manufacturing industry. Therefore, some researchers have come out with the new initiative.

In Malaysia**,** the construction industry plays an important role in the development of the economic. Derrick (2011) stated that the Malaysian Construction industry represent an important aspect in the total Malaysian economy. The Malaysian construction industry is productive and generates wealth for the country by addressing social and economic needs through the provision of infrastructures and buildings that constantly contribute to the growth of the economy Hamid (2010). However, the construction industry is facing come chronic issues such as lack of quality, poor coordination, low productivity and high cost. Other than that, delay in delivering completed project also one of the main problems. The capability to finish on time is a global construction industry crisis especially in the developing country. In this competitive environment, the construction industry must compete through consistent productivity environment, more value added operations and improve the output quality.

In order to overcome the construction issues, lean construction based on lean thinking has been introduced in this construction industry. The beginning or introductions of the lean construction approach are in the early 1990's from the adoption of the lean manufacturing. According to Howell (1999), the new philosophies of lean construction that been implemented by Toyota in their manufacturing process, which now applied throughout the construction industry with the aim to smoothen the construction project and increase the contractor's profit by eliminating waste. Throughout the Lean concept, the waste elimination and value improvement in a construction project were defined. However, Ballard and Howell (2003) stated that this concept will compulsorily alter and change the traditional work practices, usually undertaken by the construction firms according to the needs and suitability in line with the objectives and principles begin in the lean construction concept itself. Other than that, the objectives of Lean Construction are at reducing waste and improving the productivity in achieving the client's requirements on the construction industry. The introduction of lean construction approach seems suited well with the current circumstances of Malaysian construction industry.

Construction management and technology are the two key drivers influencing the improvement and development within the construction industry based on Guo (2009). According to the Serpell and Alarcon (1998), there are an arising number of construction companies implementing actions to improve their projects performance by reducing all kinds of waste

during the construction process. Lean construction is one of the new management philosophies that have been considered in the construction industry. Originally, Lean construction has been adopted from the Lean Manufacturing or Lean Production. Gleeson and Towned (1993) stated that the goal of Lean construction is meeting customer needs while using less of everything, a term developed by the International Group for Lean Construction in United Kingdom. In addition, this management philosophy refers to the application of Lean production principles and practices in the design- construction processes to reduce waste and to maximize value mentioned by Howell and Ballard (1998).

On top of that, this study will deeper identify the level awareness of the construction industry toward the implementation of Lean. Basically, lean constructions are easier to manage, cost less, better quality, safer and completed sooner. The implementation of Lean will provide a positive effect to the performance of the construction industry. Other than that, this study also will be conducted in order to determine the barriers in Lean implementation.

1.2 PROBLEM STATEMENTS

Nowadays, in this innovative and developing world, all the industry should be more competitive in order to provide big advantages to the development of the country. One of the industries is construction industry that provides big impact to the profit and economic enhancement to the country. Generally, construction industry is unique and complex due to the involvement of many parties and consumption of varieties of resources. Nowadays, Malaysian construction industry facing big challenge and problems such as lack of productivity, lack of quality, adversarial relationship among team members, ineffective project communication, project delay and value about their output. In the last decade, Malaysian projects especially the magnificent monuments were not effective in cost and function mentioned by Pratt (2000). Some cases in the projects are project completion date was not attained, the budget was exceeded and quality not always achieves the expectation.

The issue that concerning the several of the industries such as manufacturing, services and construction are the non value added activities or known as waste that generate in the organization. According to Hay (1988), waste can be define as anything other than the absolute minimum resources of material, machines, and manpower required to add value to the product. There are many general categories of waste in the industry. According Poppendieck (2006), the seven wastes that are targeted by the Lean Manufacturing Philosophy are overproduction, inventory, over-processing, motion, waiting, defects and transportation. Waste is a problem that creates no value for the customer and cost to the organization. Karlsson and Ahlstrom (1996) stated that although most companies experience the seven types of production waste the most common source being that of inventory, their reason is that keeping parts and products in stock does not add value thus it should be eliminated.

Recently, the above issues as well as give huge impact and affect the performance of the construction industry. Baccarini (1999) stated that the differences between good and poor project performance was defined by the project team's meeting time, quality and cost objectives. According to Leong and Tilley (2008), poor performance of the construction industry was because of a gateway waste of using wrong, inappropriate or insufficient measures for performance appraisal. Essentially, Lean concept has been introduced into the construction industry to reduce the waste caused by unpredictable workflow. Therefore, with the concept of value enhancement and waste elimination in construction project able to develop a process of implementing activities in a project in systematic and effective behavior. Imtiaz and Ibrahim (2007) have recognized that Malaysian construction industry does improve their performance by implementation of Lean principles.

Beyond on that, the application of lean construction concept in Malaysian construction industry is still considered a new approach based on Lim (2008) study in Malaysia. Beside of that, Lean implementation within the construction firms throughout the country is very limited. In Malaysia, the usage of this concept is still unpopular within the construction firms even though there are many skilled academic professional in construction processes.

1.3 RESEARCH OBJECTIVES

This study is conducted with the objective guidelines and the objectives must be achieved in order to outstandingly complete the study. The objectives of this study are:

1. To identify the level of awareness of Lean management in construction industry.

2. To determine the barriers of Lean implementation in construction industry.

1.4 RESEARCH QUESTIONS

The study intends to find answer to the following questions:

1. Why there is different level of awareness in implementation of Lean among the contractors?

2. What are the barriers in implementing Lean management in construction industry?

1.5 SCOPE OF STUDY

The aim of this study is finding the level of awareness in lean management among contractors in Malaysian construction industry. Lean management is a broad topic and it was not possible to analyze all the concept of lean due to limitation in time and resources. Therefore, the study is focus on several principles of lean thinking. Beside this study also identify the barriers of Lean implementation in construction industry. This scope of this study is all the Grade 7 construction industry in Melaka, Malaysia. There are about 126 Grade 7 construction companies exist in Melaka that are registered under Construction Industry Development Board Malaysia (CIDB). Contractors in construction industries in Melaka will be the respondent as a representative for the company in answering the questions. The detail to gain the data will be discussed in methodology.

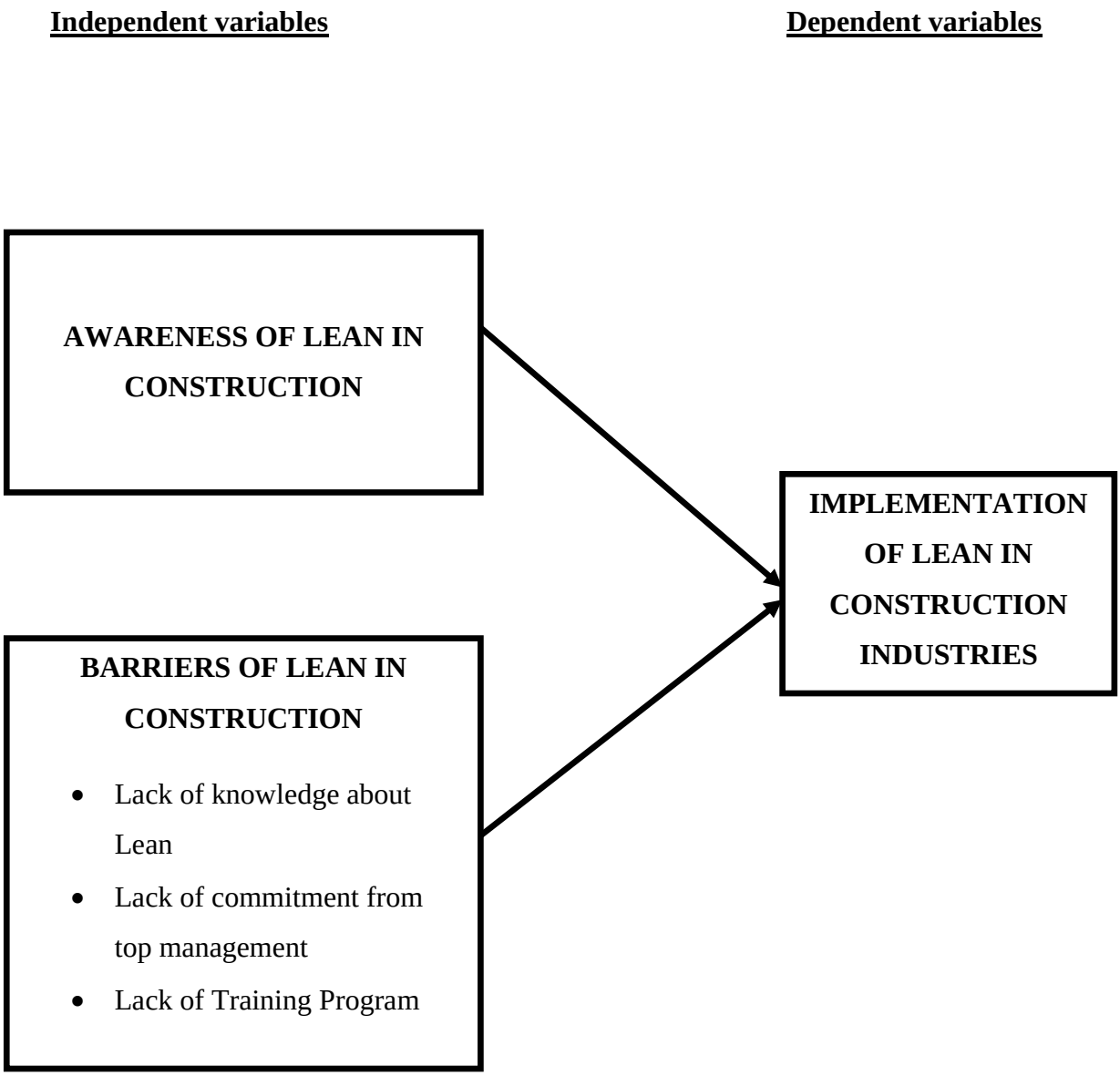
1.6 SIGNIFICANT OF STUDY

The study of lean management can give advantages to all organizations especially construction industry in this country. Nowadays, the construction companies focus to increase their productivity, performance and enhance their efficiency in achieving the client's requirements and needs by adopting a positive approach which is Lean construction. Beside of that, this study would benefit the researcher with a deep understanding regarding the development of Lean construction.

This study will be significant to the Malaysian construction industry to improve the performance of the organizational practices. Research done had recognized that one of the factors that affect the performance of the construction industry is due to the seven deadly wastes in the process. Lean construction is a new construction management approach in Malaysia and majority of the construction professional don't have adequate perception of Lean Concept. This concept will be a recommendation and awareness to the construction industry to improve their performance by using modern organizational method which is Lean Approach.

Other than that, this research is focus on the identification of the probable barriers which might occur in implementation the Lean construction by the construction industry. Moreover, it is obvious that finding the barriers of implementing lean construction is a major causes that play a significant role in the first step to assist and enhancing the efficiency of performing this Lean construction approach. This study is led to show the major barriers and also the components which influence the most critical barriers of lean implementation, "lack of understanding the concept of lean construction" and "lack of commitment and leadership from top management" to bring up future possibilities to enhance in these areas.

1.7 THEORETICAL FRAMEWORK



1.8 OPERATIONAL DEFINITION

1.8.1 Lean

Lean is an activity of adding value for the customer, waste elimination, and continuous improvement from a standard of the activity.

1.8.2 Lean Management

Lean management is an approach to running an organization that supports the concept of continuous improvement, a long-term approach to work that systematically seeks to achieve small, incremental changes in processes in order to improve efficiency and quality.

1.8.3 Project

Project is a temporary endeavor undertaken to create a unique product, services or result (PMI, 2008).

1.8.4 Project Performance

Project performance is a manifestation of meeting the project budget and schedule, achieving operational efficiency, and conducting high quality work (Subaramaniam et al, 2007).

1.9 CONCLUSION

In summary, this research is to find out the level of awareness among the contractors in Malaysia construction industry and major barriers that might appear in the implementation of Lean construction. There are two research objectives and questions were developed to better understand this topic. From the chapters, these research questions are investigated and come out as conclusion and recommendation.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents a literature review of the study. This chapter will discuss in more details about the opinion and view of the past literature from many others researcher that do past study which is more or less similar with this study. Inside this chapter will briefly goes through and discusses about the lean management in construction industry. Besides that, this study wants to identify the level of awareness of lean management among the contractors in construction. Nowadays, the lean approach has become very important and useful tools according to their purpose and implementation. An organization especially construction related company can improve the quality of their services, reduce the cost and can enabling to make a continuous improvement with lean approach.

2.1 THE ORIGIN OF LEAN

To understand the concept of lean management, this chapter gives a short explanation about the development of the Lean Production approach from Toyota Motor Corporation that invents the concept of Toyota Production system. According to Emiliani (2006), Toyota Motor Corporation has contributed at developing a critical management system that may leaders of organizations, companies and manufacturing want to imitate. Abdullah (2003) statements stated that Shigeo Shingo and Taiichi Ohno devised a new disciplined which known today as Toyota Production system or Lean manufacturing. Toyota Production System or lean is the management system coined by John Krafcik in the late of 1980 in order to differentiate between Toyota Production System and the mass production that was dominating in the most western countries (Krafcik 1988).

In 1910, Ford and his right-hand-man, Charles E. Sorensen, fashioned the first comprehensive manufacturing strategy (R. C. Thomas, 2005). All the element of manufacturing system were assembled into an efficient manufacturing system to produce the Model T.Ford that was considered to be the first one use lean manufacturing to improve production. After that, Toyota Motor Company began to incorporate Ford production and other techniques into Toyota Production System. Liker (2004) stated that Toyota Production system was developed between 1945 and 1970, and is still growing today all over the world. They successfully implement the lean manufacturing concept in Toyota. Liker and Franz (2011) mentioned that the last decades have witnessed many manufactories and organizations that have been inspired by Toyota Production system.

2.2 DEFINITION OF LEAN

Lean can provide many advantageous and benefit to increase the productivity and performance of an organization. The fundamental of Lean is waste reduction and almost certainly the most focused principle in lean organizations (Chen, et al., 2010; Hines, et al., 2004; Karlsson & Alhlstrom, 1996; Shingo, 1981). Moreover, Lean also can become a continuous improvement tools for the company. Karlsson and Ahlstrom (1996) mentioned that the second

fundamental principle of Lean production is continuous improvement, following the principle of elimination of waste. In the process of continuous improvement, there are focuses on two ways which are eliminate waste in order to decrease the cost, second, to enhance products and processes in order to improve the customer satisfaction (Chen, et al., 2010). In simple word, the definition of lean is an approach to maximize customer value while minimizing wastes that occur in a company.

There are lots of of definition for lean based on the various perspectives. For the last decades, various lean management approaches have received much attention and concern to improve the productivity of the industry. These approaches have been successful in improving the productivity of manufacturing company. Womack et al. (1990) describing lean main objective as increasing efficiency through minimizing costly non value adding activities while retaining customer perceived value. According to Womack and Jones (2003), all types of non value adding activities are waste, must be consistently and thoroughly eliminated.

Jeffery Liker's (1996) view lean as a philosophy that when implemented reduces the time from customer order to delivery by eliminating all sources of waste in the production flow. Elimination of waste in a systematic ways will reduce the cost of operating in organization and fulfills the customer's desire for maximum value. Hines and Taylor (2000) mentioned that lean as reducing waste at all levels and also concerned about changing corporate culture. According to Womack and Jones (1996) describe that lean is a way of thinking and the whole systems approach that creates a culture in which everyone in the organization continuously improve operations.

According to Taylor (2009), Lean approach in a general way that can be outlined as a management method employed to minimize operational waste, a system of operation employed to deliver value added products and services to the customer. Next, lean is a practice of producing goods Just In Time for customer orders to lower the inventory holding cost. In addition, lean is a company's journey to eliminate the cost of operational waste from selling prices. Generally, based on the definition from Anderson, Eriksson, and Tortstensson (2006) is a

systematic approach to identify and eliminate elements of a process that do not add value to the final outcome of the process.

In addition, Lean can give big impact to the competitiveness of the organizations. There are differences in application of lean management in one industry with others. Hanna (2007) stated that the difference of lean operational system comes from how it alters the way a company learns through changes in problem solving, coordination and standardization. Lean can be a strategic approach that can be used to resolve severe organizational problems uniting several change initiatives that are running currently in a business (Atkinson, 2004).

Some perspectives from people interpret that lean is all about to reduce the amount of staff and resources. However, lean approach is not about cutting tasks and resources in the first place, it is about focusing people's efforts on creative tasks by speeding up the operation through the progressive elimination of waste. Based on Bonaccorsi, Carmignani and Zammori (2011), the aspiration of an easier, functional and rewarding workplace should be the main form of motivation for the fulfillment of Lean objectives. So that the staff will feel appreciate with what they are working at.

2.3 SEVERAL FORMS OF WASTE

Waste is defined as any activity that consumes resources but create no value for customer (Womack et.al, 1990). Taiichi Ohno had stated a list with respect to the TPS which are the seven wastes and also been called as deadly wastes. Womack and Jones (2003) refined them and tried to draw some rigid outlines. According to Bon and Rahman (2009), the seven wastes that are targeted by the lean manufacturing Philosophy are overproduction, inventory, over-processing, motion, waiting, defects, and transportation.

On the other hand, Womack and Jones (2003) added an eighth type of waste defining it as manufacturing products that do not meet customer demand or expectations. Besides of that, other previous authors also added an eighth waste named "waste of unused human talent", terming an inappropriate management practice under utilizing human work force with unaligned

tasks according to their level of qualification. In this study focus is on traditional types of waste which are the seven wastes. The table following below is the short explanation on the eight classes of wastes stated by Terry and Smith (2011).

Table 2.1: Short explanation on the eight classes of wastes stated by Terry and Smith (2011)

WASTES	EXPLANATION
OVERPRODUCTION	Producing products or services which customer do not require at that moment (ahead of demand). Producing product that is more than needed. Generating waste through overstaffing, transportation cost and long storage period. Producing items beyond specification. Examples, larger than necessary excavations, orders placed for same materials with different suppliers and can be physical or information that is produced.
INVENTORY	Too much stock which is not requires for production or by the customer. Liker (2004) proposed that inventory also give problem such as production imbalance, late deliveries from suppliers, defects, equipment downtime and long setup times. Poor stock management and too much material compromising workplace.
OVER-PROCESSING	Using more expensive valuable resource than is needed for the task or making a product and service better than a customer needs or produced to standard beyond specification. Adding features that are not value added to the customers need does not improve a products or process (Wader, 2005).
MOTION	Motion is an unnecessary movement by employees, product or equipment more than required to perform the processes. This waste envelops ergonomics of production and leads to lower productivity and product quality.

WAITING	Failure to deliver products when needed downstream, employees waiting for resources, the queue for their products or services that are not yet delivered to the customer. The waste may arise from the staff difficulties in doing their work because of lack of training, lack of information or lack of regularization. Beside of that, time wasted directly due to queuing or delayed information provision, waiting for approval.
DEFECTS	Failure to conform to specification or customer needs that prevent the customer from accepting the product produced. According to Wader (2005), organization will loses money when products in manufactured, assembles or serviced twice, while the customer will only pay once for the goods or service. Inspecting and fixing defects can affects direct costs and entails additional tasks. Example, wrong information on drawings.
TRANSPORTATION	This waste involves the unnecessary movement of material or goods. Materials and people are moved from process to process that are separated by distance and require time. So, they are requiring forklifts, conveyors or other moving devices. All of this movement adds no value to a process (wader, 2005).
SKILLS MISUSE	Skills misuse can effect in losing time and ideas, skills improvements and learning opportunities. This is because the employees learning from one site not being used well on another, people working one or two levels down from their true capability. Other than that, mismanaged health and safety.

2.4 NATURE OF CONSTRUCTION INDUSTRY

Construction industry is an important sector of national economy that involves in process of preparation of land and development, modification and renovation of buildings, structures and other real property. Nowadays, in this developing area, the existence of construction companies is very emerging and rising in each country in this world, as well as Malaysia. Construction is a big, dynamic and complicated industry that have significant role in country's economy (Behm, 2008). According to Australian Bureau of Statistic (2010), they defined construction industry as businesses that have high engagement with constructions of residential and non-residential buildings, engineering structure and related commerce services. The responsible of construction companies is in doing all construction works. Construction works includes maintenance and repair of buildings or other types of engineering project, renovation process and also alteration process (Behm, 2008).

In Malaysia, there are several associations that have been established to handle and monitor all construction companies which are Construction Industry Development Board Malaysia (CIDB), Pusat Khidmat Kontraktor (PKK) and Persatuan Kontraktor Melayu Malaysia (PKMM) and others. According to PKMM (2008), the responsibility all of these association is to create and develop contractor community that creative, innovative and have competitive strategy in developing construction industry in Malaysia. Beside of that, construction and manufacturing differ significantly based on its physical features and the result of the end product. For example, in manufacturing, finished goods generally can be moved in whole to retailers or end consumers while construction on the other hand deals with larger unit that cannot be transported as freely or stored by retailers or end consumers. Therefore, when compared to manufacturing, construction is viewed to be fundamentally different in nature. There are three others factor that differentiate construction industry from manufacturing which are on-site production, one of a kind projects and complexity (Koskela, 2002).

2.5 CONCEPT OF LEAN IN CONSTRUCTION

Construction industry becoming much more complex and therefore a new initiative should be developed to solve and overcome the chronic problem and difficulties of the construction projects. Lean construction (LC) was introduced as a new management approach in construction industry. Lean construction defined by The Lean Construction Institute (LCI) as "a production management based approach to project delivery a new way to design and build capital facilities". The differences between the current practices and lean construction is that lean construction is based on production management principles, and it has better results in complex, uncertain, and quick projects.

According to Koskela (2000), Lean construction conceives a construction project as a temporary production system dedicated to three goals of delivering the project, maximizing value and minimizing waste. In addition, OGC (2007) stated that the purpose of lean construction is to work on continuous improvement, waste elimination, value for money, high user focus, strong quality management of projects and improved communications. Hook and Stehn, (2008) mentioned that lean construction research has traditionally focused on a top-approach to improve construction projects. Theoretical and empirical evidence show that error proofing and continuous improvement is statistically connected to worker motivation, and that workers follow standardized routines if they are visual and clear to workers (Hook and stehn, 2008). They confirmed further that workers do not take own responsibility to obtain standardization in work and maintenance of equipment and tools.

The past researcher Eriksson (2010) conducted a study on how to improve the understanding of how different aspects of lean thinking can be implemented in a construction project and how they effect on their performance. There are six core elements of lean construction which are waste reduction, process focus in production planning and control, end customer focus, continuous improvements, and system perspective. The Figure below shows the house of lean production adapted from the works of Hook and Stehn (2008).

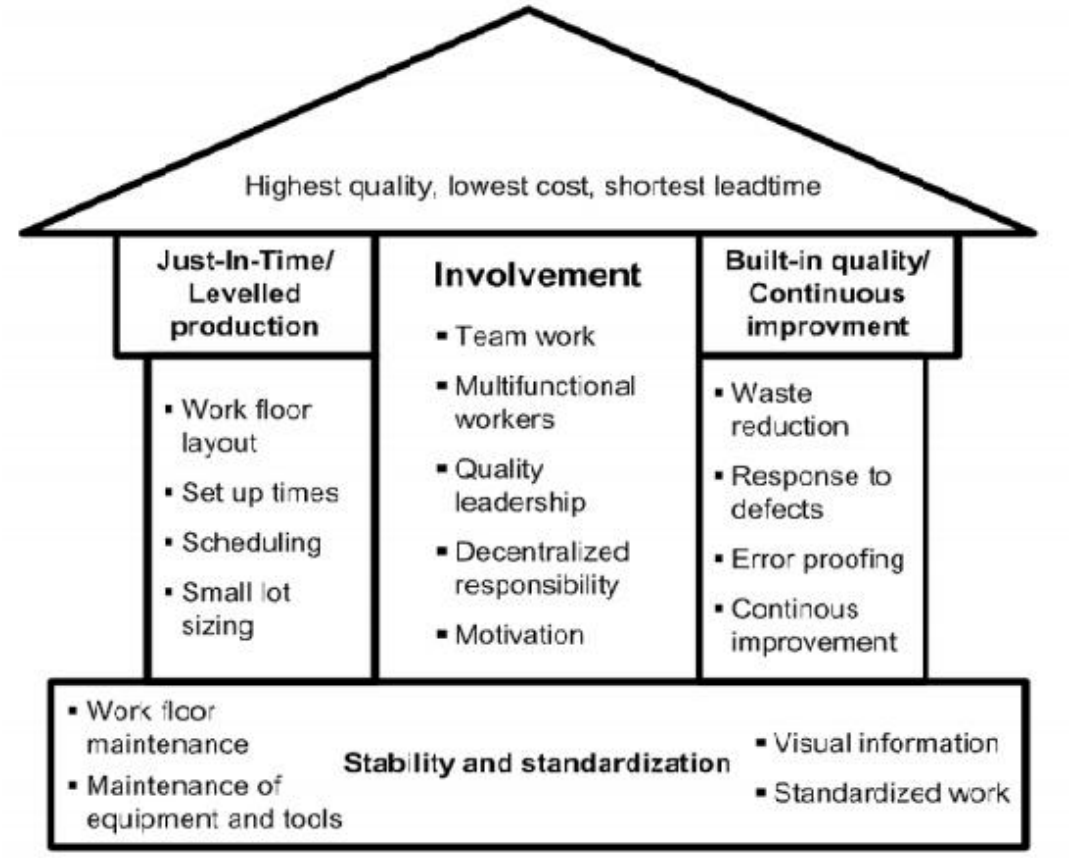


Figure 2.1: The House of Lean Production in the context of the Literature Review of Lean Culture in Industrialized Factory Production. (Source: Hook and Stehn,2008)

2.6 DEFINITION OF LEAN CONSTRUCTION

From the past literature, many definitions of Lean construction have been revealed representing positive evolution of lean methodology as well as its diversity. The definitions stated below would best illustrate the methodology and application of Lean construction.

Table 2.2: Definition of Lean in construction

Individuals/ Organizations	Definition of lean in construction
Koskela et all. 2002	Lean Construction it basically a "way to design production systems to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value. Advantages of the new production philosophy in terms of productivity, quality, and indicators were solid enough in practice in order to enhance the rapid diffusion of the new principles
Lukowski (2010)	Lean construction is the practical application of lean manufacturing principles, or lean thinking, to the building environment
Yahya and Mohamad (2011)	Lean construction is about managing and improving the construction process to profitability deliver what the customer needs by eliminating waste in the construction flow by using the right principle, resources and measure to deliver things right first time
Lean Construction Institute (2012)	Lean construction is a production management based approach to project delivery - a new way to design and build capital facilities. Lean production management has caused a revolution in manufacturing design, supply and assembly. LC extends from the objectives of a lean production system - maximize value and minimize waste - to specific techniques and applies them in a new project delivery process.
Lim (2008)	Lean is about achieving a balanced use of people, materials and resources. This allows companies to reduce costs, eliminate waste and deliver projects on time and it is not about trimming everything to the bone and squeezing more out of what is left.
Green and May (2005)	Lean construction and Lean production are "variously understood as a set of technique, a discourse, a socio- technical paradigm" or even a "cultural community".
Bertelson (2004)	Lean construction is a big scale of adaption from the Japanese manufacturing principles and the concept is implemented to the construction process.

2.7 LEAN CONSTRUCTION PRINCIPLES

According to Koskela (2000), the lean principle is attributed to the manufacturing industry and was introduced to construction. Koskela (2000) suggested that construction production should be seen as a combination of conversion and flow processes for waste removal. On the other hand, Womack and Jones (1996) discovered there were five principles of lean construction. In addition, Lim (2008), Bashir et al. (2011) and Lean Enterprise institute (2009) have the same point of view with Womack and Jones , however Lean Enterprise Institue used different keywords. Beside of that, Salem and Zimmer (2005) recommended the five lean principles that applicable in the construction industry are customer focus, culture/people, workplaces standardization, waste elimination and continuous improvement. Table below shows the Lean Principles in Construction.

Table 2.3: Lean principles in construction

AUTHORS	LEAN CONSTRUCTION PRINCIPLES
Womack and Jones (1996), Lim (2008), Bashir et al. (2011)	1. Specify 2. value 3. Identify the value stream 4. Flow 5. Pull 6. Pursue perfection
Lean Enterprise Institute (2009)	1. Identify value 2. Map the value stream 3. Create flow 4. Establish pull 5. Seek perfection
Salem and Zimmer (2005)	1. Customer focus 2. Culture/people 3. Workplaces standardization 4. Waste elimination 5. Continuous improvement/built-in quality

2.8 KEY CONCEPT OF LEAN CONSTRUCTION

There are many significant when implementing Lean Construction in construction projects such as can reduce the construction cost by using precise material and fewer waste at the construction. There were many of key concepts of Lean Construction that can be implemented by the stakeholder. Table below shows key concept of Lean Construction.

Table 2.4: Key concept of Lean in construction

KEY CONCEPT	ESSENTIAL FACTORS	AUTHORS
Just In Time (JIT)	Three methods linked with JIT: optimize inventories according to backward requests (Japanese: Kanban), construction leveling and decreasing the number of setup activities. Related to the waste concept. Continuous improvement of procedures, equipment and processes in order to eliminate waste.	Salem et al (2006) Koskela (1992)
Total Quality Management (TQM))	Total Quality Management (TQM) As an integrated management thinking and actions encouraged an organization-wide focus on quality. An organization's functions made continuous effort on improving the quality of goods and services. Effective organizations needed an accurate understanding of customers' expectation.	Small et al (2011) George and Jones (2008) Summers (2005)
Business Process Reengineering (BPR)	Improvement through rapid and substantial gains in organizational performance by starting from scratch in designing or redesigning the foundation business development. Business process involved any activity that was	Small et al. (2011) George and Jones

	fundamental for fast delivery of goods and services to customers, or that promotes high quality and low cost.	(2008)
Concurrent Engineering (CE)	Deal primarily with product design base, incorporating the constraints of subsequent phases into the conceptual phase and tightening of change control towards the end of the design process	Koskela (1992)
Last Planner System (LPS)	To achieve lean goals of reducing waste, increasing productivity and decreasing unpredictability mainly throughout a social process, by trying to make planning mutual attempt and by increasing the reliability of commitments of team members In construction, LPS was a method that forms workflow and deal with project variability.	Salem et al (2005)
Team work	Teamwork was complementary skills groups of people with who were committed to a common purpose and hold themselves mutually accountable for its achievement, in which they develop a different identity and work together in a co-ordinate and mutually supportive way	Excellence (2004)
Value Based Management (VBM)	Value based management approach in which indicate that product value for the customers is considered product value while value for the workers and project participants was termed process value	Bertelsen (2004)

2.9 AWARENESS OF LEAN CONSTRUCTION

According to Woudhuysen and Abley (2004), increasing and improving overall construction productivity and performance has been identified as a major issue influencing international construction. Based on the discussions by Jorgensen and Emmitt (2008), it was discovered that the exposure given towards the application of lean construction concepts is lacking when compared to that of lean manufacturing. This situation has subsequently generated sparse critical discourse regarding the implementation process of lean construction in the industry.

This deficiency has caused the parties involved in the construction industry to be less exposed to the actual needs and requirements in realizing the lean construction concept. In addition to this, awareness programmes towards the implementation of lean construction concepts are only actively done in developed countries such as the United Kingdom, USA, Singapore and others as they have specific institutions established to give consultations on the matter. Examples of such institutions are the Constructing Excellence in the UK and the Lean Construction Institute based in USA. Without the existence of programmes that focus on the importance of lean construction, the parties involved in the construction industry are unable to clearly identify or as certain the necessary requirement.

2.10 BARRIER IN IMPLEMENTATION OF LEAN IN CONSTRUCTION

According to Lean construction Institutes (2012), the research emphasized that the purpose of lean is to maximize value and minimize wastage using a specific techniques and implement them in the new project delivery. On behalf of that, it is obvious that finding the barriers of implementing lean construction play a critical role in the first step to facilitate and enhancing the efficiency of performing this new approach. There are several types of barriers such as in terms of managerial, technical, human attitudes, the process of Lean Construction, educational, government, and financials are among the important barriers in Lean Construction.

Abdullah et al. (2009) and Mossman (2009) stated that lack of commitment from top management of a company was one of the main barriers in implementing LC. This barrier due to the top management not gives their support in the organization. Bashir et al (2011) stated that to manager should provide sufficient time and resources to develop an effective plan, and changes from the implementation process. As mentioned earlier by Kim and Park (2006), it was found that many construction projects are facing lack of support from the top management. Therefore, it will lead to the disruption and ineffectiveness on the delivery and coordination system. Without continuous supports from the top management, the stakeholders involved in the construction industry may face numerous difficulties in adopting Lean construction concept. Besides, the top management of a construction company should overcome this breakdown in communication so that it will not contribute to low productivity and quality of the projects.

Other than that, the next barrier has been highlighted by previous researcher which is lack of buildable designs under technical aspects (Alinaitwe, 2009). Design and planning are determine as major attributes of the process of Lean Construction. Furthermore, Tindiwensi (2006) establish that most of architectural designs were lacked of constructability elements due to the limited knowledge about construction practices and the separation of design from construction contributed to a breakdown of the production process during construction. This will give impact in the implementation of Lean Construction especially to the worker's productivity.

According to Bertelsen (2003), the systems within a construction project are immensely complex. Therefore, there are difficulties in understanding the concept of lean construction. Although there are many effort o provide awareness and guidelines to LC by researchers, academics, practitioners and professional bodies in the UK and some other countries, it seems that educational barriers could pose a great threat to the sustainable implementation of LC (Bashir et al., 2010). Beside of that, inadequate exposure to the requirements for LC implementation was also regarded as barriers (Abdullah et al., 2009 and Alinaitwe, 2009) in LC implementation.

Olatunji (2008) mentioned that inflation due to unsafe markets condition for construction, additional construction cost and poor salaries of professionals were the barriers for financial aspects. The successful implementation of LC requires adequate funding to provide

relevant tools and equipment, sufficient professional wages, incentives and reward systems; investment in training and development programmes, and perhaps employing a lean specialist to provide guidance to both employers and employees during the initial implementation (Bashir et al., 2010). Lack of incentives or reward systems in a construction project also led to the barriers in LC wide implementation (Alinaitwe,2009).

Applying Lean thinking principles into the construction industry requires support from all the stakeholders. According to Kim and Park (2006), the attitude of the stakeholders concerned in a construction project towards the LC concept was a sensitive factor that in actual fact influenced the success of implementing LC concept. Furthermore, Howell (1999) added that human attitude is one of the main aspects that slowed down the execution of LC in the industry, especially during the physical implementation phase.

In addition, the lengthy implementation period of LC process was regarded as the barriers in implementing LC. Based on Kim and Park (2006), it was discovered that the implementation of LC in construction projects had resulted in too many meetings and information needed for discussions. This will cause the long implementation period of lean concept in construction processes. The Lean construction concept is still relatively new approach and the understanding towards this concept is quite limited even among the professional involved. If unmanaged well, this situation will become obstacle towards the implementation of lean concept in construction. The table below shows that the summarized of barriers to Lean construction concept.

Table 2.5: Summarized of barriers to Lean construction concept

AUTHORS	BARRIERS TO LEAN CONSTRUCTION
Castka et al., (2004); Cua et al., (2001); Conte and Gransberg (2001)	• Lack of organizational culture supporting teamwork • Lack of capability of a team to maintain alignment with other teams • Inadequate knowledge and skills

	• Inability to measure performance of the team and to gauge the team's progress • Individual needs and personal differences of team members • Lack of group culture, shared vision and shared consensus.
Haupt and Whiteman (2004)	• Lack of understanding of needs of customers • Lack of management leadership • Poor communication • Inadequate teamwork • Lack of continuous improvement
Fawcett and Cooper (2001)	• Fragmented nature of the industry • Cyclic nature of the industry • Diversity in organizational sizes and structures • Ambiguous nature of inputs and outputs • Lack of agreed methodology
Mathews et al., (2000); Ballard and Howard (1998); Mader (2003)	• Inadequate resources • Inadequate planning
Anumba et al., (2002); Koskela and Huovila (1997)	• Lack of knowledge on how to implement • Lack of management support • Reward systems based on individual goals • Barriers to concurrent engineering • Lack of client and supplier involvement

2.11 SUMMARY

This chapter had review literature cover all the objectives of research such as level awareness and barrier in implementation of Lean in construction industry. Beside of that, the research topic also defining the Lean production concept, Lean construction concept, the techniques of Lean and also the barriers of implementing Lean in construction. Thus, Lean management provides huge advantages to the construction industry.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter provides information of the methodology involved and being utilized in collecting data for the study. Beside of that, the roles of data and the type of data collected are also being discussed in this chapter. This entire topic will have researcher identify the appropriate method to get the relevant data needed to answer the problem statement, research question and relation between independent and dependent variables. Other than that, this chapter will also discuss in details about the steps taken to conduct the research on the implementation of lean management. In order to find and analysis the data needed, the instrument that will be use to collect the data includes survey and questionnaire. Basically, this chapter consists of several parts which include information about research design, population and sampling, data collection method, and data analysis. This research must be focus on the awareness of lean management in construction industries in Malaysia.

3.1 RESEARCH DESIGN

This research is being designed according to the sequences of steps. At the early stage, the research problem was identifying, where most of the researcher found that the no value activities and waste in construction industry. Then, the research title was developing in this stage. After that, the research objective and research questions were being identify and develop. Next step is to identify the resources for this study, written materials such as literature review, previous journal and data which are applicable for this research. The literature review was done in order to help the researcher identify the variables that related with the research topic.

Data classification is made on the basis of attributes of the data and they are two types of data classification which are qualitative and quantitative. Quantitative research is difference from the qualitative research. Qualitative relates to data that is descriptive in nature and does not involve number and statistics. Meanwhile, quantitative is the data which is numerical and has a lot to do with numbers and figures. There are many methods that can be use to collect primary data for the research. According to Syuhaida (2009), the methods are questionnaire, interview, focus group interview, observation, case study and many more.

In this research, the data collection will be based on the quantitative method which is survey questionnaire. Cavana, R.Y. et al., (2001) proposed that quantitative methods provide information which is easy to be analyzed statistically and is fairly reliable, for example in experiments, questionnaires and psychometric tests. Quantitative method will be use to collect the primary data needed while review of literature from past studies will be use as the source for secondary data related to this study. Cavana et al. (2001) stated that quantitative research is a survey design that places heavily emphasis on using formal standardized question and predetermine response options in questionnaires or surveys administered to large number of respondents.

The quantitative study have two designs of questionnaires whether descriptive (subject usually measure once) or experimental (subject measured before and after a treatment). Mugenda (2003) mentioned that descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals. This research is to study the awareness of lean management in construction industries. The importance of this study is to identify the barriers in lean management of the construction industry.

In this study, data are being collected from the Grade 7 construction industry in Melaka, Malaysia through the medium of questionnaires. Contractors of construction industries in Melaka will be the respondent as a representative for the company in answering the questions. The questionnaires will be hand in direct or online. The last stage will be the discussion and conclusion to the overall of this study. Below flow chart shows the flow of the research design in figure 3.2:

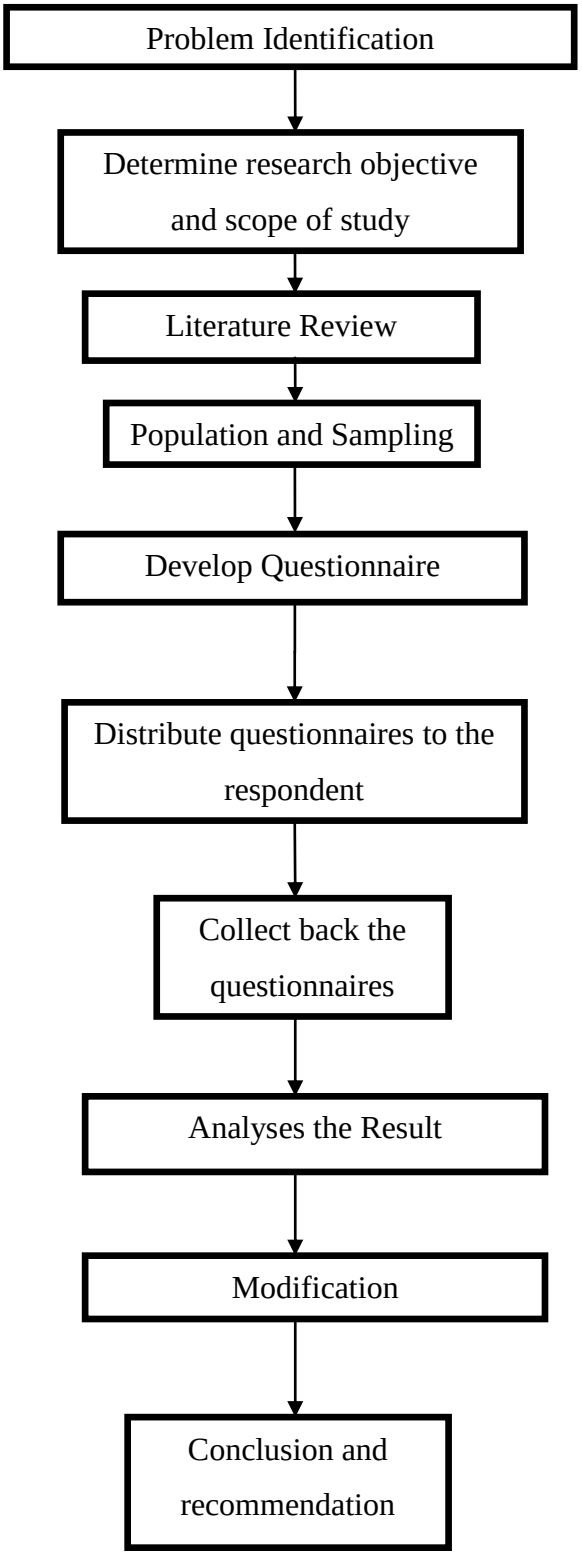


Figure 3.1: Research methodology process

3.2 POPULATION AND SAMPLING

The population for this study is the construction companies that operate in area of Melaka, Malaysia. To be more specific, the Grade 7 construction company has been chosen to be the scope of this study. There are about 126 Grade 7 construction companies exist in Melaka that are registered under Construction Industry Development Board Malaysia (CIDB). The respondents in this study are all contractors of Malaysia which is in Melaka states. The contractors will be the respondent as a representative for the company in answering the questions. Generally, this study will discuss about the awareness of lean management in construction industry.

The total population for this research is 126 respondents from Grade 7 construction companies in Melaka and according to Morgan table below, the sample of respondent for this research are 97 so that can enough to get the research valid and reliable. This research uses non-probability convenience sampling to obtain the required information. By this selection, it will provide more information for a given sample size and all the same time provides some might on the usage Lean management among contractors in construction industry.

Table 3.1: Table for determining sample size

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Source: Krejcie and Morgan, 1970

3.3 DATA COLLECTION METHOD

There are lots of methods that will be used in collecting the data in the research, such as survey questionnaire, interview and observation. However, this research chooses the instrument survey questionnaire as a method to collect the data in this research. In this study, the method is to get information of the awareness of lean management in construction industries in Melaka, Malaysia. The questionnaires were distributed to the sample population in Grade 7 construction companies in Melaka. This survey questionnaire is designed to answer and achieve the objective. According to (Leung, 2001), the design decision are depend on the purpose of the study, the nature of problem and the alternative appropriate for its investigation. Additionally, the notes from journals, researches and articles will be used as reference for the survey questionnaire.

3.3.1 Primary Data

Survey questionnaires technique will be used to collect the primary data. The questionnaires in this research are divided into two types which are paper pencil questionnaire and the web based questionnaires will be provided to respondents of the selected company by personal administrated, post or email. Milne (1999) mentioned that questionnaires is very popular tools that is being used in most research because questionnaires survey is more objective compare to the other types of survey such as interview. Survey questionnaire is much more convenient in time efficient and the data needed can be obtained faster. The questionnaire is easier to be analyzed rather than interview because interview questions are tending to be more towards open ended questions. Questionnaires is a closed ended questions to ensure the respondent make quick decision and help me as a researcher in coding the information for analysis the collected data.

3.3.2 Secondary Data

Saunders et al. (2007) describe secondary data research as "data used for a research project that were originally collected for some other purpose". Secondary data also will be used to obtain data for this research. Secondary data can be obtain from the literature review such as journals, magazines, reference books, published articles, websites and handouts of published modules. Furthermore, secondary data can act as a supplement, compare work or as a guideline to the research when conducting the study.

3.4 DEVELOPMENT OF MEASUREMENT: DESIGN OF QUESTIONNAIRE

Overall, the questionnaire consists of three main parts which are part A, part B and part C. Part A is the questions which focus on respondents demographic that are in nominal scale. The demographic criteria are consists of respondents background which is about the respondents' age, education level, experience in construction and etc. This is very crucial part because we must to know the detail about respondent to make the researcher easy to analyze and measure the data that gathered from respondent. Then, part B will contain about the objective one which to study about level awareness of Lean management among the contractors. Lastly, part C which is this part will obtain the objective two which the barrier of Lean management in construction industry. All the questionnaire of this research indicator based on the Likert scale. Usually, this Likert scale have the indicator 1 to 5.

Section A: Demographic Information

This question is related to the personal information of the respondents to identify about the personal detail of the respondent. It measures the demographic and background of the respondent. According to Balan and Peter (2010), among the questions that must be asked is, such as age, gender, employment, work experience, academics and more. In this demographic section are include name of organization, respondent's experience in the company and the position of the respondent.

Part B: Level awareness in Lean management of construction industry.

This part is more focus on the knowledge of respondent about Lean management. This questions is to know whether contractors are aware on the implementation of Lean in construction industry. The statements are in relation to Lean management in construction such as the benefit of Lean, management, effectiveness and other that related with Lean.

Part C: Barrier in implementation of Lean management

This part of questions will determine regarding the objectives of this study related with the barriers in implementation of Lean management in construction. The questionnaire for this objective is self-administered which take from the literature review and based on the past review from others study.

3.5 DATA ANALYSIS

After the questionnaires have been collect, the data will be analyze by using Statistic Package for Social Sciences (SPSS). SPSS is a computer program which is widely used to calculate and determine the information from the answer of the respondents in the questionnaire survey. Statistical techniques consist of two parts such as descriptive statistics and inferential statistics. Data will be analyzed by using descriptive statistic. Each question in the questionnaire is labeled for easier identification and then key in into the SPSS for the statistical technique. This software has specific data analysis procedure that will be used to analyze the entire results of this study. All of the data will be analyzed using this software and the analyzing process are divided into three groups which are section A, section B, and Section C. This software will produce results in table or graphs that indicate the results for each section separately.

3.5.1 Descriptive Analysis

Descriptive statistics provide a useful summary of security returns when performing empirical analysis and analysis, as they provide a historical account of behavior again. Descriptive statistics is a method that used by researchers to compile and make interpretations of the raw data (Malim and Birch, 1997). Among the techniques used to describe the descriptive statistics is the frequency, percentages, means and standard deviation. An analysis of descriptive statistic will be conducted on the individual demographic variables such as age, gender and race.

3.5.2 Likert Scale

Originally developed by Rensis Likert (1932), this type of rating is the most widely used attitude scaling technique. Likert rating scales are used in various settings, including clinical, educational, administrative, and organizational contexts. The reasons for its popularity including relatively easy to construct, yields reliable scores and flexibility in its ability to measure many types of affective characteristics. Table 3.2 shows the likert scale declared by Vagias, Wade M. (2006) and this scale had been used in this research.

Table 3.2: likert scale

1	**2**	**3**	**4**	**5**
Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
1	**2**	**3**	**4**	
Not at a barrier	Somewhat of a barrier	Moderate barrier	Extreme barrier	

Source: Vagias, Wade M. (2006)

3.5.3 MEAN ANALYSIS

Meanwhile for section B and C, in order to analyze the results that are obtain from the targeted respondents from the Likert scale of the questionnaire, the formula of getting average or mean will be use. All of the answer need to be sum up and divided with the numbers of questions. The formula to find average which is also known as mean is as follow:

Mean = Sum of all the observed values ÷ number of observations

OR

$$\mu = \frac{\sum x}{n}$$

μ = the mean value of x

n = the number of observations in the data set

Σ x **=** the sum of all observed values

According to Mohd Najib Abdul Ghafar (2003), he proposed range and mean analysis to interpret overall analysis of questionnaires.

Mean Score	Level
1.00-2.33	Poor
2.34-3.66	Moderate
3.67-5.00	Good

3.6 CONCLUSION

The purpose behind this section was to portray the research methodology of this study, explain and clarify the sample selection, depict the technique utilized as a part of designing the instrument and collecting the data, and provide an explanation of the statistical procedures used to analyses the data. The awareness of Lean management in construction industry is target of this research. Thus, the SPSS is a quantitative analysis and suitable for survey questionnaire which is using to do data analysis as well as measuring the results. Moreover, literature review and survey questionnaire are the instruments that referred in gathering information and helping in data collection.

CHAPTER 4

DATA ANALYSIS

4.1 INTRODUTION

This chapter present the data collected and focuses on analyzing the survey data gathered from the respondents through the online and by hand survey questionnaire. The results and feedback from the conducted survey was interpreted by using Statistical Package for Social Sciences (SPSS). Demographic analysis, Descriptive analysis, Reliability analysis, Normality analysis and Correlation were carried out in this data analysis chapter. This analysis serves the attempt to identify the awareness of Lean Management among contractors. The questionnaire comprises of three parts which is part A, B and C. The demographic and personal details of the respondents were cover in part A. Part B focuses on level of awareness in Lean Management. Part C focuses on the barriers of Lean Management in construction industry. The feedback from the data collected for each question asked will be analyzed in details and presented in table or figure in the following sections.

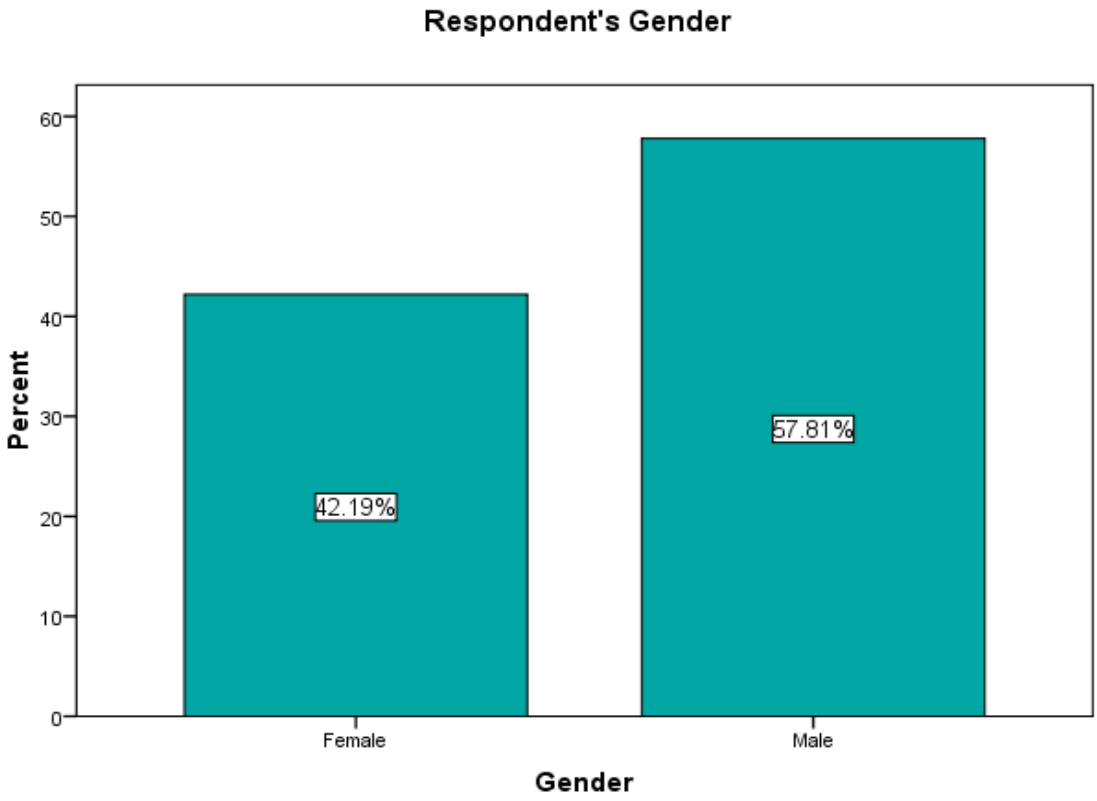
4.2 DEMOGRAPHIC ANALYSIS

Demographic is the first part of the questionnaire that identifies the background profile of respondent. In this questionnaire survey, the target respondents are among the contractors that are working in construction industry. The mean, mode and frequency of respondent's background profile were determined in this demographic analysis section. In this research, there are 64 respondents answer the questionnaire.

Table 4.1: Demographic

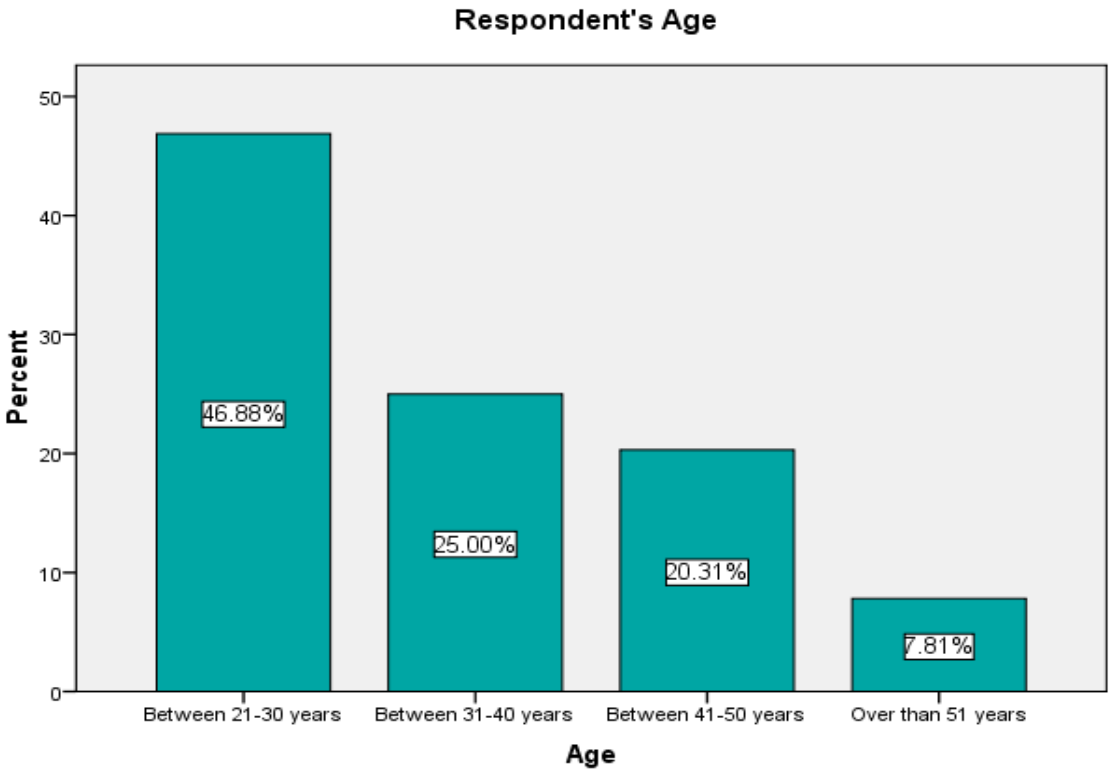
Variables	Characteristics	Frequency	Percentage (%)
Gender	Female	27	42.2
	Male	37	57.8
Age	Between 21-30 years	30	46.9
	Between 31-40 years	16	25.0
	Between 41-50 years	13	20.3
	Over than 51 years	5	7.8
Race	Malay	52	81.2
	Chinese	11	17.2
	others	1	1.6
Educational Qualification	Certificate	7	10.9
	Diploma	9	14.1
	Bachelor Degree	39	60.9
	Master Degree	8	12.5
	PhD	1	1.6
Working Experiences	Less than 1 year	4	6.2
	Between 1-3 years	31	48.4
	Between 4-6 years	12	18.8
	More than 6 years	17	26.6
Total		64	100

Table 4.1 above shows the demographic analysis of the survey questionnaire for 64 respondents in construction industry. There are five variables that include in the demographic which are gender, age, race, educational qualification, and working experiences of the respondent. A clear picture of the result can be seen through bar chart in figure 4.1, figure 4.2, figure 4.3, figure 4.4, and figure 4.5.



Figures 4.1: Respondent Gender

Figures 4.1 show the percentage of gender between Female and Male of the 64 respondent who participate in this survey. According to the pie chart above, the frequency of male respondent is higher than female respondent where the value is 57.81% and 42.19% respectively. There are 37 of respondents were male and 27 of respondent were female.



Figures 4.2: Respondent's Age

Based on the bar chart above, the age range is from 21 – 30 years, 31 – 40 years, 41 – 50 years, and over than 51 years. Among the age range, the most dominant are those who their age 211 – 30 years. Meanwhile, the least number of respondent is 5 who his/her age over than 51 years.

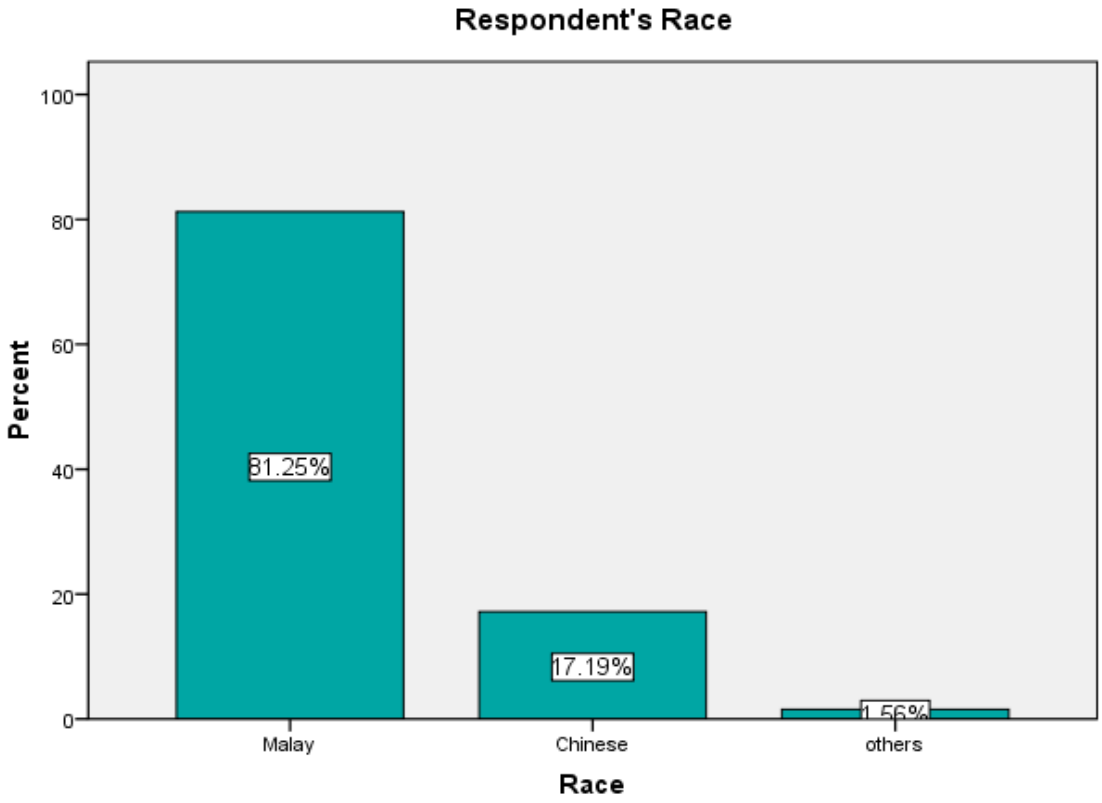
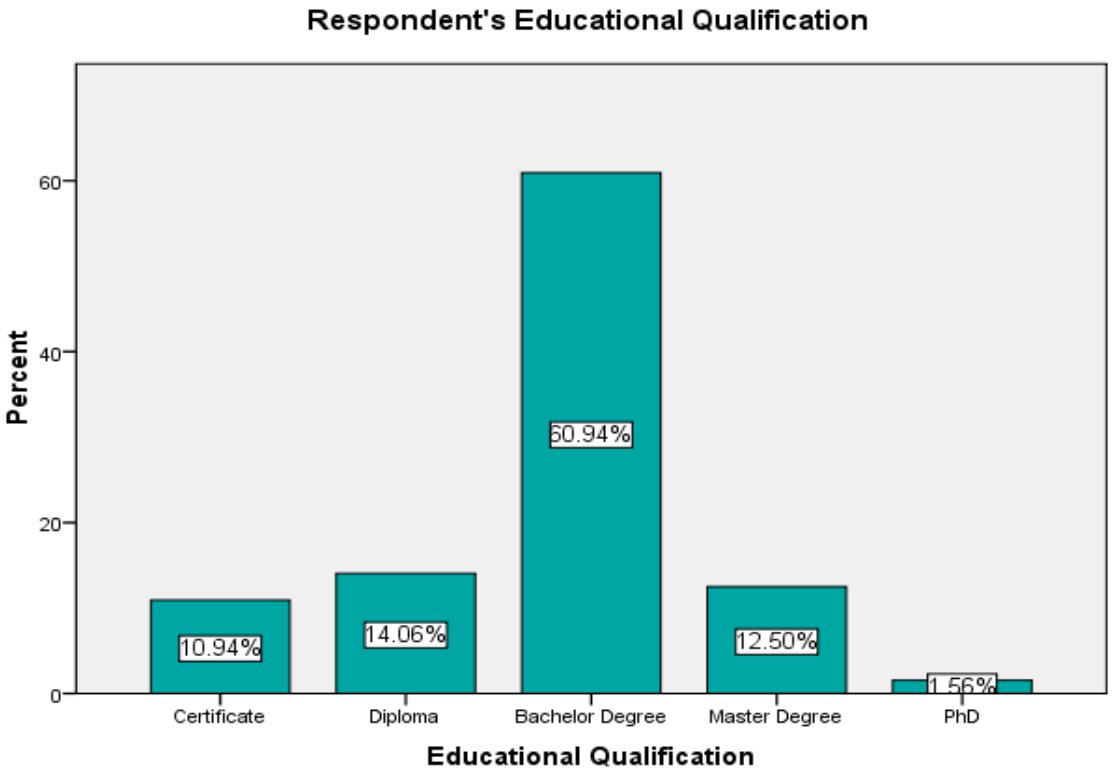


Figure 4.3: Respondent's Race

The bar chart above shows about the race of respondent that participated in this survey. In this research consists of Malay, Chinese and others. The highest number of respondent is among the Malay which is 52 (81.25%). Then there are 11 respondents among the Chinese and 1 is others. The total number of them will be resulted in 64 respondents' altogether.



Figures 4.4: Respondent's educational qualification

The Figure 4.4 illustrates the educational qualification of the respondents. The educational qualification in this survey consists of five choices which are Certificate, Diploma, Bachelor Degree, Master Degree and PhD. However, based on the respondent feedback, they are all either graduated as degree holder or diploma holder. Moreover, the frequency of Degree holder is higher than PhD where the total respondent for Degree holder is 39 respondents while PhD holder is only 1 respondent.

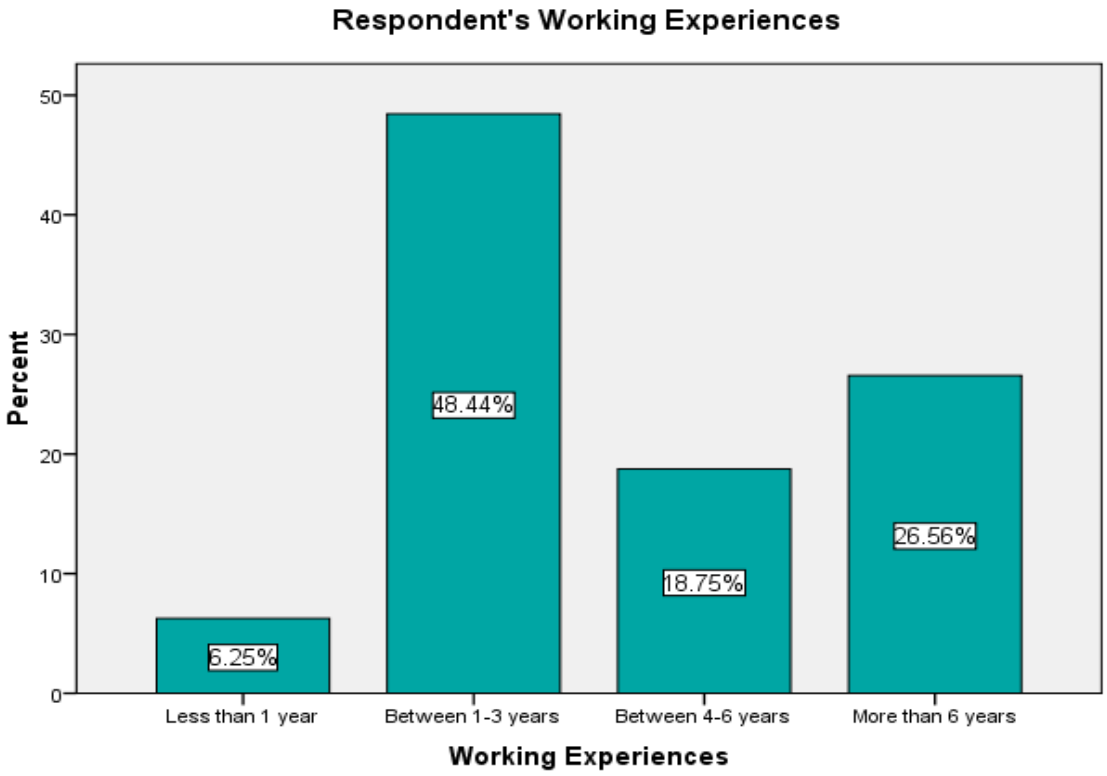


Figure 4.5: Respondent's working experiences

Figure above illustrate about the working experiences of the respondents. The most of the contractor in this survey have 1-3 years of experience in construction industry. There are 48.44% of them that is 31 contractors, followed by above 6 years which is 17 respondents (26.56%). Next, there are 12 contractors which is 18.75% have 4-6 years of experiences. Then, the remaining 6.25% that is 4 contractors have less than 1 years of experience in construction industry. Experience is important element for the contractors in order to achieve a successful project that on time and on budget.

4.3 RELIABILITY ANALYSIS

In this research, reliability analysis of the questionnaire is recognized by testing for both stability and consistency. The importance of reliability test is to measure whether the questions are reliable or not. Cronbach's alpha is most commonly used to perform the reliability test (Craigh and Janes, 2003). According to Nunally (1967), value of Cronbach's alpha above 0.5 is considered as an acceptable level of reliability coefficient.

Table 4.2: General Guidelines for Interpreting Reliability Coefficients

Reliability coefficient value	Interpretation
.90 and up	excellent
.80 - .89	good
.70 - .79	adequate
below .70	may have limited applicability

Source: U.S. Department of Labor, Employment and Training Administration, 1999

4.3.1 Reliability of level awareness of Lean management in construction industry (pilot test)

A pilot test is a technique that is used to test and analysis the questionnaire before conducting the research. Generally, pilot test was conducted to test the reliability and validity of the result to ensure the questionnaires can achieves the research objectives. Initial test of data collection was conducted to find and remove errors in the questionnaire before the real questionnaire distributed to the respondents.

Table 4.3: Reliability analysis of Pilot test

Variables	N of Items	Value of Cronbach's Alpha
Level of Lean awareness	**11**	**0.875**

Table 4.3 shows the Cronbach's alpha for the level awareness of Lean management in construction industry. 10 respondents were selected to participate in the pilot test to test the reliability.. Based on the above table of reliability statistics for the variable, the coefficient value of Cronbach's Alpha is more than 0.50 so it consider as acceptable. For the table above, level awareness of Lean management shows the value of Cronbach's Alpha which is 0.875. This value is too close to 1, which indicates that the data is reliable and these questionnaires are valid. In addition, there is no need to delete any item to get better coefficient value of Cronbach's Alpha as is done by an independent variable previously. So, this research can be proceed to real collection data and distributed to the population sample.

4.3.2 Reliability of barriers of Lean management in construction industry (pilot test)

Table 4.4: Reliability analysis of Pilot test

Variables	N of Items	Value of Cronbach's Alpha
Barriers of Lean management	**10**	**0.826**

Table 4.4 shows the Cronbach's Alpha for the barriers of Lean management in construction industry. Then, 10 respondents were selected to participate in the pilot test to test the reliability. Based on the above table of reliability statistics for the variable, the coefficient value of Cronbach's Alpha are more than 0.50 so it consider as acceptable. For the table above, barriers of Lean management in construction industry shows the value of Cronbach's Alpha which is 0.826. This value is too close to 1, which indicates that the data is reliable and these questionnaires are valid. In addition, there is no need to delete any item to get better coefficient value of Cronbach's Alpha as is done by an independent variable previously. So, this research can be proceed to real collection data and distributed to the population sample.

4.3.3 Reliability of level awareness of Lean management in construction industry (Real test)

Table 4.5: Reliability analysis of Real test

Variables	N of Items	Value of Cronbach's Alpha
Level of Lean awareness	**11**	**0.936**

Table 4.4 shows the reliability for the level awareness of Lean management in construction industry. 64 set of questionnaire data had been use to test the reliability to know whether the questionnaire is reliable or not. Level awareness of Lean management in construction industry shows the Cronbach's Alpha which is 0.936 and the value is too close to one. The value of Cronbach's Alpha is more than 0.5, it is consider as acceptable level.

4.3.4 Reliability of barriers of Lean management in construction industry (Real test)

Table 4.6: Reliability analysis of Real test

Variables	N of Items	Value of Cronbach's Alpha
Barriers of Lean management	**10**	**0.947**

Based on the above table, the value of Cronbach's Alpha for the level of awareness has the highest value which is 0.947. From the table 4.5, we can conclude that all the variables are reliable since all of them have Cronbach's Alpha value exceed 0.5. Nunnaly (1978) agreed that value of Cronbach's alpha above 0.5 is considered as an acceptable level of reliability coefficient.

4.4 DESCRIPTIVE STATISTIC

Descriptive statistic will be describe the basic features of the data and provide summaries about the sample in a study. This will involve the description of data in term of measurement for example minimum, maximum, mean and standard deviation of the selected data. For my research, descriptive statistics were used to provide result for the objective number one and objective number two. For this research, the result of descriptive analysis is generated by using SPSS.

Mean analysis will be used in this study for the measurement of the level awareness of Lean among the contractors and the barriers of Lean in construction industry. From this analysis, the objectives in this study have been analyzed successfully. The analysis will involve all the respondents that answer the questionnaire. There are overall 64 respondent have answered the survey questionnaire. The mean for overall questionnaire will be discussed in the next section below. According to Mohd Najib Abdul Ghafar (2003), he proposed range and mean analysis to interpret overall analysis of questionnaires.

Table 4.7: Interpretation of mean value range

Mean Score	Level
1.00-2.33	Poor
2.34-3.66	Moderate
3.67-5.00	Good

Source: Mohd Najib Abdul Ghafar (2003)

4.4.1 Mean of the level awareness of Lean in construction industry

Table 4.8: The level of awareness of Lean among contractors

	N	Mean	Std Deviation	Rank
Aware on the important of quality in a construction project	64	4.20	.94583	1
Familiar on the term Lean	64	3.94	.68718	2
Aware on various short courses to support Lean implementation	64	3.48	.95937	9
Aware on government enforcement of using Lean	64	3.39	1.03306	11
Knows various types Lean techniques	64	3.42	1.15201	10
Lean allows greater productivity of the projects	64	3.77	.90400	5
Lean's ability to provide higher quality construction project	64	3.72	.95067	7
Lean objectives is reducing waste	64	3.80	.91165	4
Lean's ability to provide great customer satisfaction	64	3.84	.85855	3
Lean reduce the overall project cost	64	3.66	1.01134	8
Lean is a continuous improvement	64	3.77	.93846	6
Average Mean	**3.73**			

Source: Adjusted from SPSS

Table 4.9: The Likert scale to test level of awareness

1	Not at all aware
2	Slightly aware
3	Somewhat aware
4	Moderately aware
5	Extremely aware

Source: Vagias, Wade M. (2006)

The table 4.8 above illustrates about the data analyze by using the descriptive statistic for the section B questionnaire. This section will answer the objective number one for this research. The data shown above is explaining regarding the level awareness of Lean management among contractors in construction industries in Melaka. There are 11 statements that have been analyzed in the above table. The Level awareness questions that are listed have been rate using the likert scale technique as shown in table 4.9 above. The likert scale for this section B questions include not at all aware, slightly aware, somewhat aware, moderate aware, and extreme aware. The results will be analyzed by using the mean analysis technique.

From the table 4.8, the highest mean of variables is aware on the important of quality in construction industry. The highest mean is 4.14. Based on the mean, most of the contractors seemed to be aware on the important of quality in construction industry. The second highest mean value of mean score is 3.94 for the questions of the familiar on the term Lean. This means that the contractors also agree that they are familiar on the term Lean. The third highest mean scores are for questions Lean's ability to provide great customer satisfaction with 3.80 mean scores. The respondent knows about Lean's ability to provide great customer satisfaction in a project.

However, from the above table also illustrate that most of the contractors not totally aware on the government enforcement of using Lean. The result of this question shows the lowest mean score which is 3.39 that explain they are not totally aware on the government enforcement of using Lean. The other variable in the question is regarding the awareness on various short courses to support Lean implementation which the mean score is 3.48. From the result, we can see that contractors are not totally aware on the various short courses to support Lean implementation. Next, the data above describe that most of the contractors does not totally knows about the various types of Lean technique that can be used in construction with mean scores of 3.42.

The average mean for overall section B questionnaire regarding the level awareness of Lean among contractors had been calculated. The result of the average mean is 3.73. Based on the table 4.6, the average mean of 3.73 is considered as good and strong. This can be concluding that most of the contractors in construction are aware on the Lean management in construction industry. This result is supported by M.L. Ahmad Jeni and Z.A Akasah (2003), majority of the contractors in Malaysia is aware of implementation of Lean Construction Concept but the implementation is still at early stage.

4.4.2 Mean of the barriers of Lean in construction industry

Table 4.10: The barriers of Lean in construction industry

	N	Mean	Std. Deviation	Rank
Lack of knowledge about Lean in Construction	64	2.92	1.07	5
Lack of organizational culture and support from top management	64	3.19	0.92	1
Difficulties in understanding the concept of Lean	64	2.81	1.08	7
Implementation of Lean is too Expensive	64	2.73	0.90	9
Absence of long term Planning	64	3.08	0.88	3
Lack of continuous Improvement	64	3.06	0.92	4
Lack of resources and inadequate teamwork	64	3.11	0.94	2
Lack of training on how to implement Lean	64	2.86	0.99	7
Wait and see attitudes among the workers and resistance to implement Lean	64	2.90	0.98	6
Lack of client and supplier involvement	64	2.81	1.02	8
Average Mean	**2.95**			

Source: Adjusted from SPSS

Table 4.11: The Likert scale to test the barriers of Lean in construction industry

1	Not at a barrier
2	Somewhat of a barrier
3	Moderate barrier
4	Extreme barrier

Source: Vagias, Wade M. (2006)

The table 4.10 above shows about the data analyze by using the descriptive statistic for the section C questionnaire. Sections C consists of 10 statements and have been interpret in the above table 4.10. This section will answer the objective number two for this research. The data shown above is explaining regarding the barriers of Lean management among contractors in construction industries in Melaka. The questions of barrier in Lean management that are listed have been rate using the likert scale technique as shown in table 4.11 above. The likert scales for these section C questions include not a barrier, somewhat barrier, moderate barrier, and extreme barrier. The results will be analyzed by using the mean analysis technique.

From the table 4.10, the data illustrates that most of the contractors agree that the most significant barrier to implement the Lean management in construction industry is lack of organizational culture and support from top management with the highest mean of 3.19. Next, the second highest mean is barrier of lack of resources and inadequate teamwork (3.11). The contractors agree that lack of resources and inadequate teamwork is the barrier to implement new technique in an organization especially Lean management. The next barrier with mean 3.08 is absence of long term planning. As revealed in Table 4.9, it appears clearly that implementation of Lean is too expensive was not considered by the respondents as a main barrier that threat the implementation of Lean with the most lower ranking of mean (2.73).

Based on the findings of the analysis as shown in table 4.10, it was discovered that the entire 64 respondent had managed to identify the barrier of Lean implementation in construction industry. The average mean had been calculated and the result is 2.95 which consider as in moderate level. Therefore, the result shows that the respondents of this study are seemly knowledgeable regarding the barriers faced to implement Lean. The barriers that had been listed may not be the most critical barriers for Lean management. However, from the above table was shown that the first rank barrier is lack of organizational culture and support from top management. This result was supported by Miranda Filho et al. (2006), the supposed root cause of the difficulties in implementing lean practices in construction firms is lack of understanding by top managers of construction. Kim and Park (2006) stated that top management support is necessary to emphasize lean implementation on a construction project as professionals involved in the construction sector may face many difficulties in adapting the lean concept without top management support.

4.5 NORMALITY TEST

Normality test was carried out to test whether the data is normally distributed or not. There are several techniques that can be used in the normality test which are Kolmogorov-Smirnov and Shapiro-Wilk test, Quantile- Quantile test (Q-Q test), and Skewness-Kurtosis test. For this research, Q-Q test is used to measure the normality test.

The Q-Q plot is to conclude the outcome whether the data comprised in this study is normally distribution. Thus, Q-Q plot were utilized to demonstrate whether the data is normally distribution or not. Dots in Q-Q plot of normally distribution data must fall approximately on the line and not in a curves or S-shape. This because of the fact that the general principles of Q-Q plot where normally distribution dots supposed to be approximately and the dots supposed to be the straight line and not forming in any pattern or being in the form of S-Shape.

4.5.1 The Q-Q Plot of level awareness of Lean in construction industry.

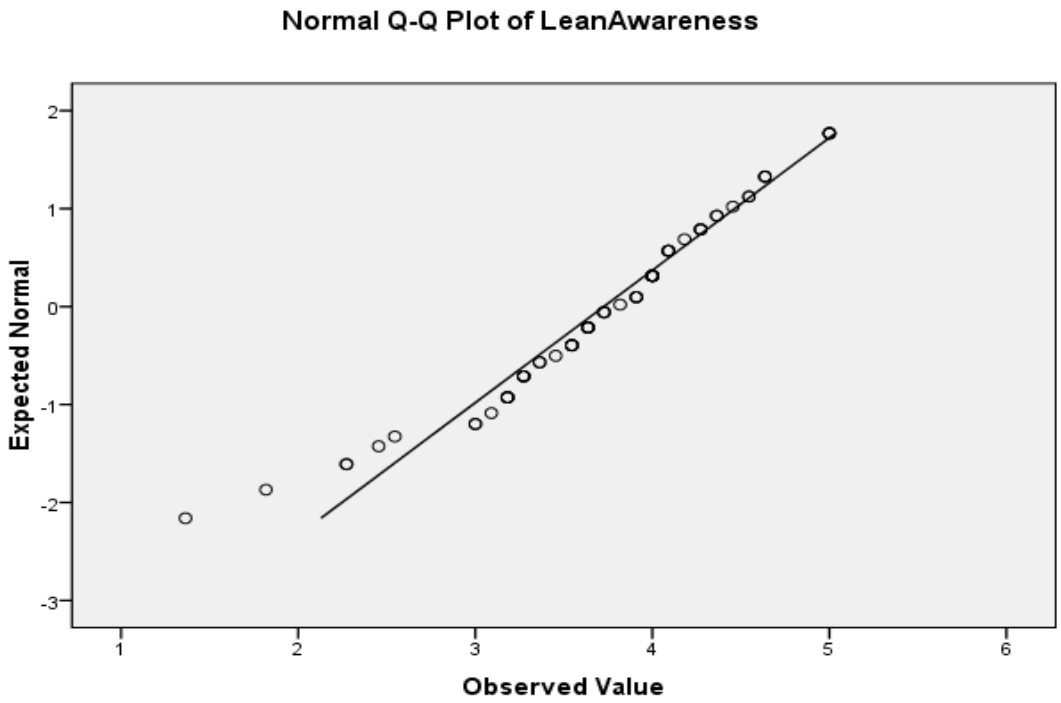


Figure 4.6: The Q-Q Plot of level awareness of Lean in construction industry

Figure 4.6 shows the normality analysis for the level awareness of Lean in construction industry. The data appears as dots in the Q-Q plot above shows that the data is normally distribution. These because of the fact that dots in the Q-Q plot are in the region of the straight line and not forming in any pattern or being in the form of S-shape.

4.5.2 The Q-Q Plot of the barriers of Lean in construction industry.

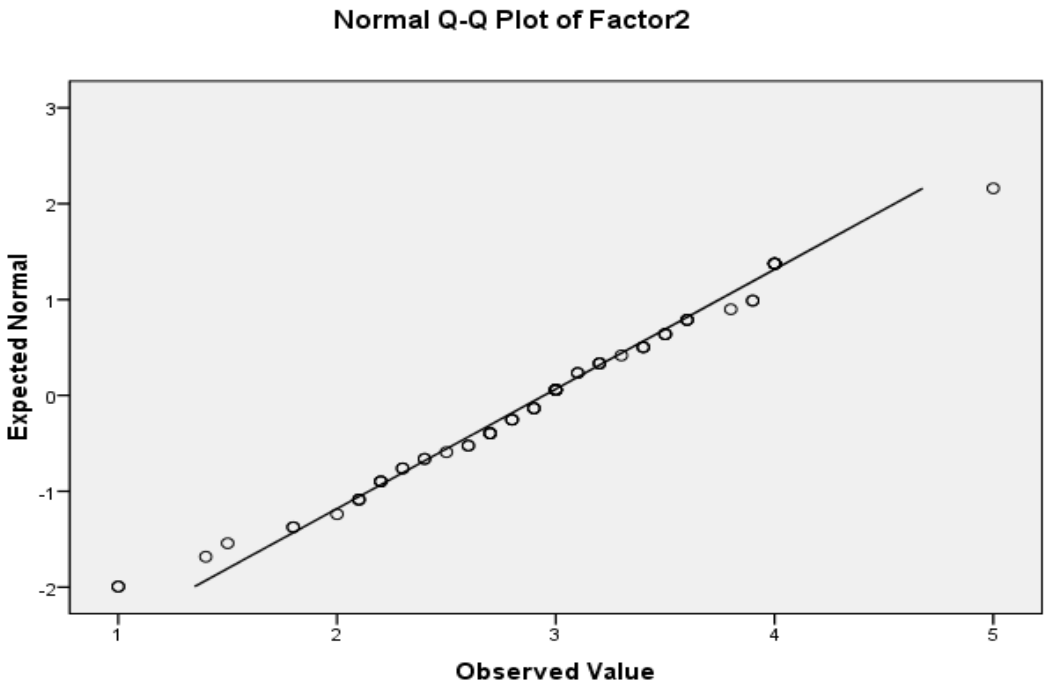


Figure 4.7: The Q-Q Plot of the barriers of Lean in construction industry

Figure 4.7 shows the normality analysis for the barriers of Lean in construction industry. The data appears as dots in the Q-Q plot above shows that the data is normally distribution. These because of the fact that dots in the Q-Q plot are in the region of the straight line and not forming in any pattern or being in the form of S-shape.

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CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In this chapter provide conclusions for the research and the overall research is a set of questionnaire that can be used to answer research questions stated in chapter 1. Next, the objective of this chapter is to conclude all the findings derived from the study. This chapter also shows the limitations that occur while doing this research. At the end of this chapter, there some recommendation for the future research of Lean management in construction industry so that further improvement can be done.

5.2 MAIN FINDING

In this study, there are 64 respondents that participate in answering the questionnaire. Most of them have 1-3 years experiences in construction and have highest education level in degree. Generally this research is trying to examine the awareness of lean management among contractors in the construction industry in Melaka. There are 2 objectives that have been achieved which are to identify the level of awareness of Lean management and to determine the barriers of Lean management in construction industry.

5.2.1 Objective 1: To identify the level of awareness of Lean management among contractors in construction industry.

Firstly, we discuss the result obtained for the first objective by analyzing the level awareness of Lean management among the contractors. There are 64 respondents who participated in this survey. The respondents are aware on the important of quality for construction industry and they also agree that they are familiar on the Lean term. Besides of that, the respondents know about Lean's ability to provide great customer satisfaction in a project.

Based on the analysis, the overall mean score for level awareness of Lean in construction industry among the contractors was 3.73. We can conclude that majority of the contractors are aware on the Lean implementation in construction industry. M.L. Ahmad Jeni and Z.A Akasah (2003) stated that majority of the contractors in Malaysia is aware of implementation of Lean Construction Concept but the implementation is still at early stage.

5.2.2 Objective 2: To determine the barriers of Lean management in construction industry.

Secondly, we discuss the result obtained for the second objective by analyzing the barriers of Lean management in construction industry. From 64 respondents, the three most critical barriers in Lean management were lack of organizational culture and support from top management (3.19), lack of resources and inadequate teamwork (3.11), and absence of long term planning (3.08).

From data analysis, majority of the respondents among contractors agree that the most significant barrier to implement the Lean management in construction industry is lack of organizational culture and support from top management with the highest mean of 3.19. According Abdullah et al. (2009), and Alinaitwe (2009) have identified lack of top management leadership and commitment as a main barrier to the implementation of Lean in construction industry. Without the support from top management in construction sector, the professionals involved may face the difficulties in adapting the Lean construction concept.

5.3 LIMITATIONS

There are several limitations that occur when completing this research. Limitations always become the main barriers to ensure the research is running smoothly and every researcher could have faced the limitations. For this research, the questionnaire was distributed by hand to the company and by Mail. First, the limitations of the literature as reference in completing this research give difficulties for researcher. Although the articles and journals are available, not all of them can be used. There is not many are relevant to the scope of this research with solicited literature.

The Next limitation is lack of support from the respondents and company. 100 of questionnaire had been distributed to the company, but only 64 questionnaires were collected back. Some of the company refused to participate in answering the survey questionnaire and they are not welcoming us to conduct the survey. Other than that, the respondents are not interested to respond to the questionnaire that had been distributed to them especially those who receive the questionnaire via email. Not only that, some of the company's email address is invalid and unable to send to them. Some of companies need us to take back the questionnaire that had been distributed to them by hand on the other days, but, after I came back to their company was close. There is also a challenge when finding the company building, the company is hard to find because the address not given proper poultry and some of the company moved to a new building.

5.4 RECOMMENDATION

Meanwhile, it is recommended for this research should be added with other techniques of collecting the data. The researcher should not depend on just one technique such as questionnaire, but also added another method such as interview. The respondent will provide more information and details when using the interview method. The Next recommendation is, the future researcher can investigate in more details regarding the Lean implementation in Malaysian construction industry.

Other than that, it stated before, the main barrier of implementing Lean in construction is lack of organizational culture and support from top management and lack of resources and inadequate teamwork. Therefore, the appropriate party must take action so that the barrier can be avoided and Lean can be implemented in Malaysian construction sector.

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APPENDIX A
QUESTIONNAIRE

FACULTY OF INDUSTRY MANAGEMENT

University Malaysia Pahang

Questionnaire on awareness of Lean management in construction industry

Dear Respondents, this questionnaire are to collect data for the fulfilment of the final year project under
Bachelor Degree of Project Management course in University Malaysia Pahang.

The objectives of this questionnaire are:

i. To identify the level of awareness of Lean management in construction industries in Melaka

ii. To determine the barriers of Lean management in construction industry

All data will be kept confidential and used anonymously for research purpose only. Your cooperation in answering this questionnaire will be much appreciated.

Thank you.

SECTION A: DEMOGRAPHIC PROFILE

This section seeks general information about you .We would like you to provide some general information about your profile. Please note that the data is collected for the purpose of the analysis and will be strictly confidential. Please fill in your answer in the blank field and tick the box best describing about you.

1. Gender

   ☐ Female ☐ Male

2. Which category best describe your age?

   ☐ Less than 20 ☐ Between 21-30 years

   ☐ Between 31 – 40 years ☐ Between 41 – 50

   ☐ Over than 51 years

3. Race

   ☐ Malay ☐ Chinese

   ☐ India Other, please specify_____

4. Your highest educational qualification is

   ☐ Certificate ☐ Diploma

   ☐ Bachelor Degree ☐ Master Degree

   ☐ PhD Other, please specify_____

5. How many years you have been involved in your organizations?

   ☐ Less than 1 year ☐ Between 1 – 3 years

   ☐ Between 4 – 6 years ☐ More than 6 years

SECTION B: THE LEVEL AWARENESS OF IMPLEMENTATION OF LEAN AMONG CONTRACTORS.

(Bahagian B: Tahap kesedaran pelaksanaan Lean di kalangan kontraktor)

This section seeks information about the lean implementation of your company. Tick the box which describes your answer regarding the questions. For your responses, please use the scale below:

1= Not at all aware (Tidak sedar sama sekali)

2= Slightly aware (Sedikit sedar)

3= Somewhat aware (Agak sedar)

4= Moderately aware (Sederhana sedar)

5= Extremely aware (Amat sedar)

	Statement	Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
1	Aware on the important of quality in a construction project *(Sedar tentang kepentingan kualiti dalam projek pembinaan)*	1	2	3	4	5
2	Familiar on the term Lean *(Biasa dengan istilah Lean)*	1	2	3	4	5
3	Aware on various short courses to support Lean implementation *(Sedar tentang pelbagai kursus pendek untuk menyokong pelaksanaan Lean)*	1	2	3	4	5
4	Aware on government enforcement of using Lean *(Sedar tentang penguatkuasaan kerajaan terhadap penggunaan Lean)*	1	2	3	4	5

	Statement	Not at all aware	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
5	Knows various types Lean techniques *(Tahu tentang pelbagai jenis teknik dalam Lean)*	1	2	3	4	5
6	Lean allows greater productivity of the projects (*Lean memberikan peningkatan produktiviti terhadap sesebuah projek)*	1	2	3	4	5
7	Lean's ability to provide higher quality construction project (*Lean berkebolehan untuk menghasilkan projek pembinaan yang berkualiti tinggi)*	1	2	3	4	5
8	Lean objectives is reducing waste (Objektif Lean untuk mengurangkan pembaziran)	1	2	3	4	5
9	Lean's ability to provide great customer satisfaction *(Lean berkebolehan untuk memberikan tahap kepuasan yang tinggi kepada pelanggan)*	1	2	3	4	5
10	Lean reduce the overall project cost (*Lean dapat mengurangkan keseluruhan kos pelaksanaan projek*)	1	2	3	4	5
11	Lean is a continuous improvement (Lean adalah satu penambahbaikan yang berterusan)	1	2	3	4	5

SECTION C: THE BARRIERS OF LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY

(Bahagian C: Halangan terhadap pelaksanaan Lean dalam industri pembinaan)

This section seeks information about the barriers of Lean implementation in construction industry. Tick the box which describes your answer regarding the questions. For your responses, please use the scale below:

1= Not a barrier *(bukan halangan)*

2= Somewhat of a barrier (*Sebahagian daripada halangan*)

3= Moderate barrier (*Halangan yang sederhana)*

4= Extreme barrier (*Halangan yang melampau*)

	Statements	Not a barrier	Somewhat of a barrier	Moderate barrier	Extreme Barrier
1	Lack of knowledge about Lean in Construction (*Kekurangan pengetahuan tentang Lean dalam pembinaan)*	1	2	3	4
2	Lack of organizational culture and support from top management (*Kekurangan budaya berorganisasi dan sokongan daripada pihak pengurusan tertinggi*)	1	2	3	4
3	Difficulties in understanding the concept of Lean (*Kesukaran dalam memahami konsep Lean*)	1	2	3	4

	Statements	Not a barrier	Somewhat of a barrier	Moderate barrier	Extreme Barrier
4	Implementation of Lean is too expensive *(Pelaksanaan Lean terlalu mahal*)	1	2	3	4
5	Absence of long term planning (*Tiada perancangan jangka panjang)*	1	2	3	4
6	Lack of continuous improvement (*Kekurangan penambahbaikan yang berterusan*)	1	2	3	4
7	Lack of resources and inadequate teamwork (*Kekurangan sumber dan kerja berpasukan yang tidak mencukupi)*	1	2	3	4
9	Lack of training on how to implement Lean (*Kekurangan latihan untuk melaksanakan Lean)*	1	2	3	4
10	Wait and see attitudes among the workers and resistance to implement Lean (*Sikap tunggu dan lihat di kalangan pekerja dan rintangan untuk melaksakan Lean)*	1	2	3	4
11	Lack of client and supplier involvement (*Kekurangan penglibatan daripada pelanggan dan pembekal)*	1	2	3	4

APPENDIX B

Gantt chart for Final Year Project 1

Task	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14
Choose project title														
Meeting supervisor														
Discuss research title and objective														
Find related journal and article														
Chapter 1: Introduction														
Chapter 2: Literature Review														
Chapter 3: Methodology														
Prepare draft questionnaire														
Completing proposal report														
Submission of proposal report														
Preparation for presentation														
PSM I Presentation														

Gantt chart for Final Year Project 2

NO	RESEARCH ACTIVITY	MONTH					
		JUL	AUG	SEPT	OCT	NOV	DIS
1	Correction						
2	Distribute the questionnaires						
3	Collecting the questionnaires from the respondent						
4	Conduct data analysis						
5	Start the Chapter 4 and 5						
6	Add on information of data analysis						
7	Submitting draft of the full report						
8	Correcting and editing of full report						
9	Submitting full report of FYP 2						
10	Preparing slide and oral presentation						
11	Presenting the FYP 1						

APPENDIX C

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	27	42.2	42.2	42.2
	Male	37	57.8	57.8	100.0
	Total	64	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Between 21-30 years	30	46.9	46.9	46.9
	Between 31-40 years	16	25.0	25.0	71.9
	Between 41-50 years	13	20.3	20.3	92.2
	Over than 51 years	5	7.8	7.8	100.0
	Total	64	100.0	100.0	

Race

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Malay	52	81.2	81.2	81.2
	Chinese	11	17.2	17.2	98.4
	others	1	1.6	1.6	100.0
	Total	64	100.0	100.0	

Educational Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate	7	10.9	10.9	10.9
	Diploma	9	14.1	14.1	25.0
	Bachelor Degree	39	60.9	60.9	85.9
	Master Degree	8	12.5	12.5	98.4
	PhD	1	1.6	1.6	100.0
	Total	64	100.0	100.0	

Working Experiences

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	4	6.2	6.2	6.2
	Between 1-3 years	31	48.4	48.4	54.7
	Between 4-6 years	12	18.8	18.8	73.4
	More than 6 years	17	26.6	26.6	100.0
	Total	64	100.0	100.0	

Reliability Statistics of Real Test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.936	.937	11

Reliability Statistics of Real Test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.947	.947	10

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Aware on the important of quality in a construction project	64	1.00	5.00	4.2031	.94583
Familiar on the term Lean	64	2.00	5.00	3.9375	.68718
Aware on various short courses to support Lean implementation	64	1.00	5.00	3.4844	.95937
Aware on government enforcement of using Lean	64	1.00	5.00	3.3906	1.03306
Knows various types Lean techniques	64	1.00	5.00	3.4219	1.15201
Lean allows greater productivity of the projects	64	1.00	5.00	3.7656	.90400
Lean's ability to provide higher quality construction project	64	1.00	5.00	3.7188	.95067
Lean objectives is reducing waste	64	1.00	5.00	3.7969	.91165

Lean's ability to provide great customer satisfaction	64	2.00	5.00	3.8438	.85855
Lean reduce the overall project cost	64	1.00	5.00	3.6562	1.01134
Lean is a continuous improvement	64	1.00	5.00	3.7656	.93846
Valid N (listwise)	64				

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Lack of knowledge about Lean in Construction	64	1.00	5.00	2.9219	1.07356
Lack of organizational culture and support from top management	64	1.00	5.00	3.1875	.92367
Difficulties in understanding the concept of Lean	64	1.00	5.00	2.8125	1.08196
Implementation of Lean is too expensive	64	1.00	5.00	2.7344	.89518
Absence of long term planning	64	1.00	5.00	3.0781	.87839
Lack of continuous improvement	64	1.00	5.00	3.0625	.92367
Lack of resources and inadequate teamwork	64	1.00	5.00	3.1094	.94478
Lack of training on how to implement Lean	64	1.00	5.00	2.8594	.98990

Wait and see attitudes among the workers and resistance to implement Lean	64	1.00	5.00	2.8906	.97780
Lack of client and supplier involvement	64	1.00	5.00	2.8125	1.02159
Valid N (listwise)	64				

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LeanAwareness	.091	64	.200*	.955	64	.022

a. Lilliefors Significance Correction

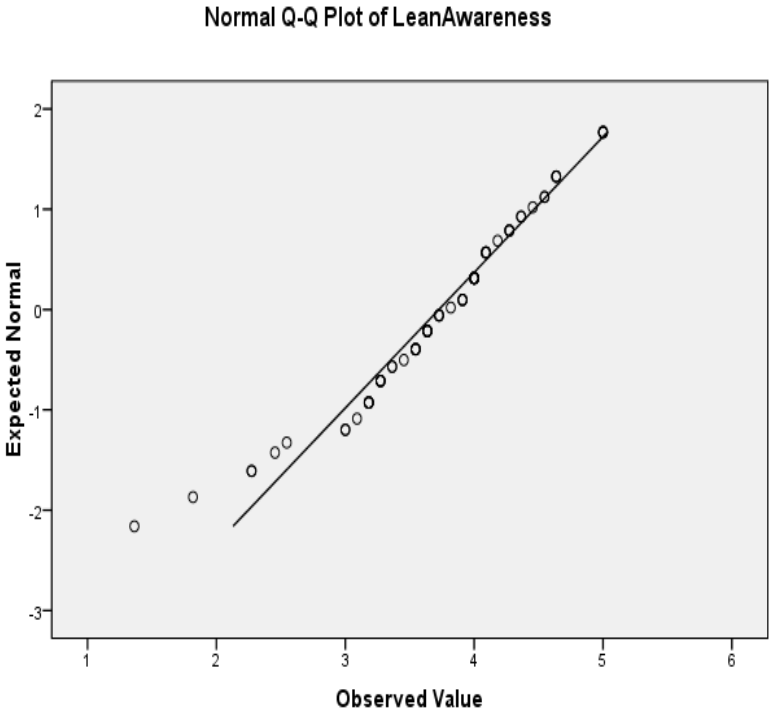
*. This is a lower bound of the true significance.

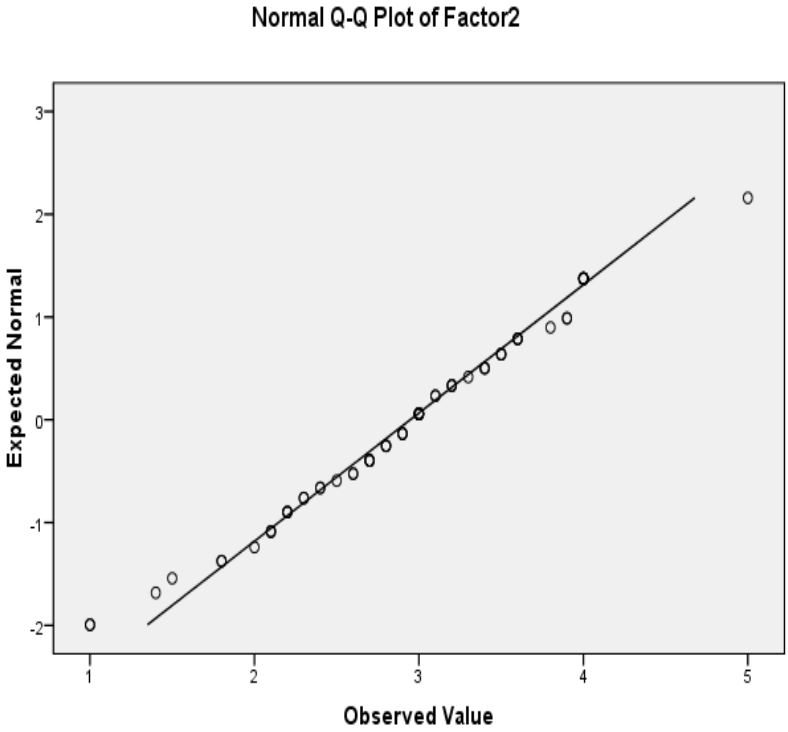
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Barriers	.079	64	.200*	.978	64	.299

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.


Normal Q-Q Plot of LeanAwareness
Expected Normal
Observed Value
2
1
0
-1
-2
-3
1
2
3
4
5
6


Normal Q-Q Plot of Factor2
Expected Normal
Observed Value
3
2
1
0
-1
-2
1
2
3
4
5