

ANALYSIS OF THE CHALLENGES IN THE PLANNING AND IMPLEMENTATION OF
LEAN CONSTRUCTION

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Master of Science

by

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Lean construction is one of the most conservative strategies that have been put in place to address the issue of resource misuse and wastage in construction projects. Lean construction in the U.S. has seen a slower adoption as compared to other similar economies across the world. In comparison to the U.K., France among other countries in the European Union, the U.S. has a much slower adoption rate. Recent studies have indicated that this is due to the presence of impediments which challenges the process of planning and implementation. This prompted the research into the specific challenges that lead to slowed adoption. The research process was conducted in two phases. First, a literature review of existing literature and then administration of questionnaires to selected professionals in the field of Lean construction to effectively rank the issues surrounding the topic.

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CHAPTER I

INTRODUCTION

General Area of Concern

The term Lean construction was first used in the year 1992 by architect Lauri Koskela. Koskela (2019) stated that Lean construction was a strategy in construction that focused on the improvement of the final output, efficiency of using resources, as well as the optimized use of manpower and resources through eliminating wastages and non-value tasks and activities while providing a service to the client. It is, therefore, a construction management system that seeks to eliminate inefficiencies in construction and provide quality to the client. The strategy of Lean construction not only eliminates inefficiencies, but it also ensures the provision of value to the client throughout the whole construction phase, from the start of the project to the handing over of the project. Over the past few years, the U.S. has seen a sudden spike in the application of Lean construction principles, with most emphasis put on commercial construction (Koskela et al., 2019). Even after three decades, the value of Lean construction has not been fully tapped. Throughout the U.S., construction corporations continue to face challenges that impede the implementation process of Lean construction.

The U.S. construction industry has seen various changes that have caused improvement in the way construction is made. One of the most common strategies of implementing efficient construction is through the use of Lean construction, a system of construction that is a combination of both practical development strategies and operational research. Lean construction combines traditional operational objectives of construction with modern strategies that optimize value, focused on the continuous improvement in all dimensions of the built

environment, including salvaging, maintenance, design, construction, and recycling of construction material at the end of the life of a building (Li et al., 2018). Since the advent of Lean construction, the implementation of methods and tools associated with Lean construction has been a challenge. The successes of the new system of construction are evident, but the process has not been easy. Implementing the procedures has been an uphill task. Among the impediments to the implementation process are cultural issues, leadership, training, but also in part, the implementation process of Lean construction principles and methods.

Research reports that the majority of implementation challenges are related to the misconceptualization of Lean construction tools, including methods and frameworks. In most of the case studies with failed Lean construction projects, Lean construction frameworks, and principles were not correctly applied in construction projects (Bajjou et al., 2017). The U.S. is one of the main countries with large investments in the Lean construction industry. It is often considered as a nation with advanced implementation and widespread knowledge of Lean construction. But in reality, how many of the proclaimed construction companies follow through with the set procedures and frameworks of Lean construction? The purpose of this paper is to outline the various challenges that come across in the implementation of Lean construction, as well as the provision of probable recommendations to counter these challenges.

Statement of the Problem

The U.S. construction industry has seen an increased demand for construction services. Rising populations, resulting from the high rate of births as well as immigration, have exponentially grown the demand and need for housing facilities, as well as commercial buildings for business. The technological revolution of the world, coupled with a need to address the climate implications of construction, has necessitated the innovation of new methods to ensure

construction and counter the growing demand as well as the need to address client requirements. The inclusion of all these factors has led to the invention of genius, environmentally friendly, and resource-efficient construction systems, such as Lean construction (Gupta et al, 2020). The approach to construction works in tandem with the client's requirements, environmental fulfilling as well as the optimization of scarce resources. The implementation of the methods, approaches, and strategies has, however, been marred by a myriad of challenges that threaten the achievement of quality, and environmental conservation, based on the implementation plans (Koskela et al., 2019). The process of Lean construction has unarguably been an underused system, despite its benefits to the construction industry. This study is therefore based on the challenges facing the planning and implementation of Lean construction, with an attempt at ranking the most prolific challenges and their respective solution, in a bid to encourage and reaffirm the role of Lean construction in shaping an environmentally friendly and effective system of construction.

Significance of the Study

The resolution of the challenges affecting the construction industry in the U.S. and, more specifically, within the Lean construction sector is based on the understanding of its significance. The process is defined as client-centered, and unlike traditional construction strategies, Lean constructions are more focused on consolidating and harmonizing the previously fragmented tasks and processes into one coherent system that smoothly works to enhance efficiency as well as quality in the delivery of the final product. The synchronization and enhanced coordination activities, as well as the inclusion of sustainability principles (Stevens, 2014). The 21st century has seen increased attention towards matters of stability and the judicious use of natural renewable construction material. Lean construction, therefore, as a method of construction,

effectively addresses sustainability issues. The use of Lean construction practices results in better outcomes for the construction companies as well as the client. According to research on Lean construction, the systems results in an approximately 25% higher quality for a third of the effort, resources, and time. This makes the application of Lean construction easier as a system of construction, which possesses the numerous benefits listed. The first step to ensuring the widespread application of Lean construction principles as well as implementation across the entire U.S. construction sector; is to understand and address the challenges which planners and implementers have to deal with in the Lean construction system (Liu et al., 2017). Addressing solutions to the challenges will make the procedures easier and more valuable to the consumers. The history of Lean systems of construction started in motor assembly plants, before finally being incorporated into construction systems. The systems have evolved from the early 1900s to the present systems, which ensure environmental conservation and increased value to the final user of the products. The research on the challenges that affect Lean construction is, therefore, important in the identification of the matching solutions, and which will ultimately lead to increased enjoyment of the benefits of Lean construction as a discipline.

Objectives

This research study is conducted as a conduit to identify the main issues about the planning and implementation of Lean construction as a discipline. The research process seeks to specifically identify and rank the impediments to the implementation of Lean construction.

The general objective of this research appears to ascertain the challenges to the implementation of Lean construction methods, processes, and strategies. The research requires both primary data and a systematic literature review to effectively understand the specific effects of the challenges to Lean construction. The research then experimentally and analytically

analyzes the tenets of Lean construction, with a key to understanding the befitting solutions to the mentioned challenges. There is a need to identify aspects of Lean construction, especially with the documented and experienced factors such as inadequate knowledge and poor frameworks (Tezel & Aziz, 2017). Projects usually face various challenges between kicking off and the handover of the final project. It is, therefore, prudent to include the principles of Lean construction to construction methods to determine the inherent benefits of a carefully coordinated Lean construction system. The specific objectives include those listed below:

1. Determining the challenges of implementing Lean construction from existing literature.
2. Conducting a comprehensive and systematic data collection process, including secondary and primary sources of data. Primary sources of data include the administration of closed-ended questionnaires to professionals in the field of Lean construction. Secondary data will be collected through systematic reviews of existing data.
3. To rank the challenges of planning and implementing Lean construction frameworks.
4. To provide recommendations on the management of the issues associated with planning and implementation of Lean construction.

Hypothesis

The hypothesis of the study is based on the study of previous literature on the subject matter. Past research generally agrees that challenges exist in the planning and implementation process of Lean construction. The theoretical hypotheses are therefore listed below.

- The challenges facing Lean construction methods in the 21st century do not affect the implementation of Lean construction methods on a large scale.

- The challenges facing Lean construction methods in the 21st century affect the implementation of Lean construction methods on a large scale.

Assumptions

This study will assume:

- The answers from respondents will be truthful and honest. Since the respondents are professionals in the construction industry with years of experience and the questions are not of any personal or sensitive nature, we can easily assume their answers will be honest and intended to have value.
- Several relations within processes and methods, as identified in the literature review section, are based on logical analysis of factors.
- Lean construction practicing organizations were used as units of analysis.

Limitations

The limitations of this particular study describe the characteristics of study design and other uncontrolled parameters that impact and influence the outcomes and interpretation of the study. They include aspects of practice, constraints to validity, reliability as well as the generalizability of study outcomes. The possible limitations of this study include the following. During the period of this study, the world has been ravaged by the pandemic, which has limited close interaction with others, as well as making travel difficult. The effect on the study is that limited traveling and interaction eliminates interviewing and researcher involvement as a means of data collection. The government has issued strict directions against congregating and being in close contact with other people (Gupta et al, 2020). To this effect, it is impossible to use interviewing, one of the most important tools of data collection in this study. Other methods of data collection have, however, been proposed to counter the limitation. The study will use the

administration of interactive questionnaires to the selected sample representatives. The questionnaires will, however, be semi-structured to allow for two-way communication between the researcher and respondents. There might also occur differences in the information reported from the respondents. Standardization and analysis will however handle these cases of data duplication among other issues.

Ethical Considerations

Ethical consideration in research, and particularly in social research, is a vital requirement. The consideration of a strong code of ethics by researchers is key in the protection of participants, their organizations, gaining their trust and confidence as well as promoting research integrity and quality.

Through promoting a strong relationship between the researcher and participants, using a strong code of ethics, the researcher will be assured of quality responses as well as openness and integrity (Fiesler, 2019). This research intends to use a strong framework of ethics to allow integrity and openness in the processes of research formulation, data collection, and analysis, as well as results dissemination.

The entire research will be conducted in a way that ensures the confidentiality of information collected, as well as the participants' integrity. Participants will be fully briefed about the expectations, as well as the aims and objectives of this study, including the significance of researching to the Lean construction sector. Consent from the participants will first be obtained, and notification made that participation will be voluntary, that any participant can opt-out of the research process at any particular time.

Definition of Terms

Lean Tools are used connotatively to refer to the various structures and tools that have been developed and adopted to assist in the application of the methods and strategies of Lean construction.

Lean Techniques refer to the practices that have been developed to assist in the application of Lean construction strategies. They are used as subsets of Lean tools.

Lean Practicing Corporations refers to all the companies within the U.S. that practice Lean construction in most of their construction projects.

Lean Construction Institute (LCI) is a membership-based organization whose mission is to transform a broken design and construction industry through Lean thinking, tools, and techniques.

CHAPTER II

REVIEW OF LITERATURE

Introduction and Origins of Lean Construction

The concept of Lean thinking is borrowed from the success of Toyota motors. The concept was first used by the company in the manufacture of cars, making it successful and hence it's spread and adoption in other sectors, including construction. The organization used it as a means to ensure environmental responsibility by recycling all materials in the making of other cars, thereby eliminating all waste (Jones & Womack, 2016). Though Lean thinking, as a concept lacks a universally agreed definition, scholars have agreed that Lean thinking is a strategy used in the reduction of project time, elimination of unnecessary wastes as well as costs used in operations, in this case, construction, thereby improving employees' performance, and client satisfaction, among other environmental and social benefits. The philosophy of Lean construction rejects all forms of waste and also focuses on minimizing defects in construction works. Beyond just minimizing the costs and time used in projects, Lean thinking strategies offer value to the final client through optimized quality, quantity, and timely delivery at a lower cost. According to Maginnis et al. (2017), the organization is, therefore, continuously involved in activities that add more value to their activities and eliminate those with no value.

The origin of the concept of Lean thinking was out of necessity. During the world war, Japan, which owns Toyota car manufacturing companies, was resource-strapped. They did not have enough material to supply cars and make new ones, due to the effects of the second world war. The economy was broken down, and the citizens of Japan had nothing much to hold onto. The devastating effects of the war meant that the consumption rates for the cars dropped. Fewer people had the resources to buy new cars, and therefore most of the products from Toyota had to

be left laid out in scarp yards. The company was, therefore, unable to continue with the mass production of cars, leading it to scale-down on its operations. This also made it impossible for the company to acquire new technologies to be used in car manufacture. This need and issue prompted the managers of Toyota to devise new ways of production. From that point on, they no longer involved themselves in mass production; rather, they now began producing only what was needed without having to engage in non-value-adding technologies, which were now considered as waste. The struggle and endeavor to maintain the company afloat despite the crisis made to the birth of Lean thinking, a system that now only produced what is required, eliminating the additional losses in terms of costs, labor, and time, and also being able to provide better value to customers (Jones & Womack, 2016). The company identified time and resource wastage on overproduction, waiting times as well as in making defective items as the main issue, leading to wastage. By adopting more clinical means of production, which reduced waste.

Barriers to Implementing Lean Construction

Lean construction is a form of design formulation approach in a manufacturing setting. Its objective is to decrease the time the work is done while considering the effort used during manufacturing and shrinking waste, such as transportation. The approach provides useful and productive plans that are directly obtained from the team of manufacturing. This concept makes the project to be entirely completed on time. Even though this approach is so effective and simultaneously productive, it faces significant barriers in its implementation.

The Lean idea dated back to the early 20th century and was introduced into the automotive assembly industry by Henry Ford, which transformed vehicle production. In the mid-20th century, production administration principles were designed by Engineer Ohno. He focused on waste elimination by converting it into value and developing a more productive team (Ruan,

Zuofa & Yang, 2016). Lean construction has shown its success to some production companies but has also proved not to be productive to other construction companies; this is due to some difficulties it faces in its implementation. The current execution form mainly focuses on eradicating waste from the industrial and working panorama and eradicating disadvantageous relationships, sharpening collaboration, and teamwork. The fundamental adjustment of project administration has been ignored; which mainly involves infotech, planning, last planner system, etc. This makes the implemented approach face barriers, such as financial and management issues.

Administration issues are doubtlessly the most sensitive challenges. Successful execution of Lean construction or any leading-edge ideas requires backing from the top management. Administrators have to prepare enough time and resources to create a practical strategy and handle adjustments that emerge from the execution process. Research performed reveals that the absence of administration leadership and responsibility is a significant difficulty in successfully executing Lean Construction (Pate & Vasatkar, 2018). Lack of leadership and commitment mainly affects central administration compared to the top management. Top administrators can spot a precise value of the concept, which is having an increased production, reducing production duration, and eliminating accidents during the production process. Middle-level administrators don't have a clear benefit of Lean construction. Also, their experience and training are not adequate to have different thinking (Lean Thinking); this makes implementation a difficult task.

The organizational architecture also can be a barrier to the implementation of Lean Construction. For the Lean construction approach to work, there is a need to adopt the Lean organization structure, tailor-made to emphasize value using fewer resources to develop a

valuable product than a traditional organization structure. The organizational style adopted can either stymie or boost performance, depending on the relationship's effectiveness between the management and the workers (Albalkhy & Sweis, 2020).

The minimal involvement of the employees makes the implementation of the Lean concept challenging. Most producing organizations only focus on the final value of what they manufacture, not caring about the employees. An organization can achieve value if all stakeholders are involved, the community, the clients, suppliers, the investors, and the employees. If the employees are not considered, they will not achieve its vision, mission, and principles. Employees only work towards the organization's goals if they are motivated to do so. Motivation is not only done by increasing an employee's wage but also other factors are considered, for instance, proper working environment, health insurance, transportation from home to work, etc.

Delayed decision-making also affects the Lean approach. One primary doctrine of Lean construction is eliminating delays, which adds up to over ninety percent of the total production time, and decision making is included in the production process. The time at which the organization will finish the task doesn't only depend on the labor pool but the boardroom. Currently, administrators are not punished for not authoring resolutions but are hammered for formulating decisions with errors. It makes managers often tend to stay on the safe side, which is not deciding to avoid the repercussions of making decisions that can either be right or wrong; this makes the Lean construction approach ineffective. Indecision is an illness that can crush an organization's desire to achieve (Kim & Hochstatter, 2016).

Lack of involving suppliers and consumers in production affects the Lean concept. Presently, customers are progressively demanding goods and services of low cost, high quality,

short delivery duration, and dependability. An increase in demand from customers and competition from other companies insinuates that the production cost will increase. Presently, organizations that do not regularly engage their supplier and customers in the production process tend to have a higher production cost since the customer expectations are high while the suppliers are also high. If an organization does not engage its suppliers and clients, they will have to endure gigantic prices from their suppliers; they are also not given better discounts. Other costs, such as the supplier's transportation of products, will have to be paid by the company, which could be easily omitted if they had engaged their suppliers. Competition leads to an increase in product quality to attain quality; additional cost has to be incurred (Wu et al, 2019). Clients should be engaged and informed about the product's increased quality; A company can do this through advertising; if the clients do not know the cost of production, they will continue demanding products at a lower price.

Successful application of innovative programs such as Lean construction call for sufficient funding. To increase productivity, a company has to use proper machines and equipment, employ modern technology, have a professional team, reward team members, train, and develop. A company can even source Lean specialists to advise the team players (including the company's manager/ employer). Research conducted reveals that financial constraints are brought about by project corruption in the company, inflation, unsteady markets for production, low project financing, etc. Lack of finances insinuates that workers will not be motivated since their wages also will be wanting. The organization will not source proper equipment. There will be no engaging Lean gurus meaning that employers will not train their staff about Lean construction. Low financing goes against Lean Construction, as it does not support the main principles of the approach.

Many organizations in different countries are affected by the same difficulties, whether in advanced or undeveloped nations. Subcontracting is a barrier that challenges the successful application of Lean into an organization. Subcontracting prevents the principle of the team working to cooperate and work together. People who work under a subcontract tend to have different concerns but with one goal: to finish the task given. It is vital to develop an effective communication strategy between the employees and the team that has been subcontracted. Poor communication will lead to more wastes and the unproductivity of the team players.

Training concerns are also a challenging factor in the implementation of Lean construction. Presently, there are attempts to promote realization, administering guidance and insight associated with Lean construction by universities, analysts, and institutes such as the Lean Construction Institute. However, these institutes serve few states. Although there is a surge in Lean know-how, training concerns emerge challenging because of the adoption of old production syllabus, lack of professional expertise, and difficulty grasping the aspect (Sarhan et al, 2019). Training and development of staff to accept Lean construction are both tricky because they require time. Usually, the organizations recruit different personnel and have to let go of some employees, possibly due to old age. If the recruits do not know about Lean construction, it will be challenging to implement the concept.

The manufacturing industry encounters many governmental issues despite its meaningful economic contribution. Specific barriers to implementing Lean construction arise due to the government's attitude towards the manufacturing industry. Policies enacted by the government may alter the pricing of different commodities. Also, lack of infrastructure increases production cost, challenging the implementation of Lean construction since production resources

will have to be sourced at a high price, against the Leans principle of obtaining value from cheaply sourced resources (Gupta, Ahmadi & Kumar, 2020).

Human-related concerns are also a significant barrier towards implementing Lean construction, for example; Resistance to adopt the new culture from the employees. Lean construction is all about an individual's behavior towards Lean principles by eliminating costs and reducing wastage, such as idling. Behavioral changes have to be met by every individual included in the workforce. If there is no change in behavior, the implementation of Lean construction will be challenging. To acquire a shift in action in every team player is difficult if there is nothing to motivate a person. Poor leadership is also a human-related concern that affects the implementation of Lean Construction. Poor leadership affects the whole organization since all decisions are made from the top. Productivity and employee motivation largely depend on the leader's rules, and if the decisions made are mostly wrong, the organization will not implement Lean Construction effectively. Poor leadership also brings about leadership conflict, which mainly affects the organization and Lean construction concept.

From the challenges explained above, it is essential to realize that employee management brings about many challenges to implementing the Lean concept, followed by asset management and standardization. Therefore, people-related concerns are components of Lean implementation (Jadhav et al, 2014). To fully implement the idea, the organization should ensure that its employees from the top-bottom level are adequately cared for and motivated. Organizations can efficiently resolve resource challenges and pressure from customers if they engage them in the production process. Lean construction is a useful concept that can increase productivity while ensuring that value is enhanced if correctly implemented.

The Advent of Lean Thinking in Construction

According to the Lean Construction Institute (LCI), Lean construction is a technique that is aimed at managing production systems to minimize material, time, and effort wastage to produce the best value possible. This definition captures the aspect of Lean construction in the sense of the manufacturing processes; however, in our case, it applies the production management principles on the dynamics of construction. Some aspects of Lean as a concept of the manufacturing process trace its origins to Henry Ford. He designed his assembly line in groups of methods that applied the steps and sequence and use of special-purpose machines like conveyor belts to produce cars with a maximum value. In 1930 just after World War II, Kiichiro Toyoda and engineer Ohno tweaked some Ford model processes to invent the Toyota Production System (Gao & Low, 2016). This production system employed the same flow-based management system principles but applied self-monitoring machines that could make many parts of the car in small volumes and were integrated. Each section was aware of the previous step and the current need for material. The Lean process in Toyota produced high-quality cars at a low cost and within a short period.

Lean construction accepts the Toyota production criteria as a standard of reducing wastage; however, the construction industry believes that the methods and design that goes into construction is different from the manufacturing process. The concepts used in construction to ensure production management, are project management and mass production. These concepts aim to optimize the project operations step by step, assuming the customer, has already selected value in the design. Lean construction is then established by breaking down the project into tasks such as design and construction. The activities are put in a rational sequence, approximating the

resources and time necessary for the job's effective execution. Each of the laid-out tasks is assigned to a foreman whose responsibility is to monitor each activity against the timetable and budget estimation. Emuze and Saurin (2016) predicate that project reports are a vital component in Lean construction to check activities along the critical path that are delayed. This will ensure that measures are instigated to reduce cost, and the duration of the lagging action or the sequence of work is changed altogether. Thus, the essence of Lean construction is to understand how the various activities in production depend on each other; it supports teamwork and redesigning along the supply chain.

In an attempt to gain a competitive advantage over rival organizations, non-automotive companies have taken up the challenge of Lean thinking as a tool to craft competitive thinking strategies. Construction companies are one of the most prolific up takers of the Lean thinking philosophy, which they use to ensure better outcomes in their construction projects. In the construction context, Lean thinking is applied in a system that designs a construction process to ensure the judicious use of construction material, employee efforts, time, and finances, to provide the optimum possible value (Forbes, 2016). The concept was also defined as a continuous value addition process that eliminates wastes to meet and exceed client directions and expectations while continuously pursuing perfection in project execution. Forbes (2016) most recently defined the process of Lean construction as the elimination of wastage from the construction process, using Lean principles first advanced by Toyota Corporation. By minimizing activities and expenditures that do not add value to the organization and or project, a project gains maximum value for that particular activity or project.

Lean construction, as a principle, has five basic principles that are critical in obtaining operational acceptance and market excellence. Womack and Jones (2016) first identified the

principles in 1996 when Lean construction was in its early stages. The identified principles included identification of customer needs, understanding the value stream for a project, achieving an efficient flow of work processes, achieving customer expectations at the right time, and striving for continuous improvement. These drivers have been identified as specific drivers for organizational excellence and continuous growth and improvement in conservational construction practices.

Due to the difference in designs and purposes, however, not all the principles are applicable to all construction projects across the board (Dixit et al, 2017). The adoption of these frameworks and principles is based on a needs assessment on a case to case basis. To enhance a good understanding of Lean construction, a discussion of the principles is crucial. Below are the 5 Lean principles as defined by Womack and Jones (2016).

1. Value Identification

From the perspective of Lean construction, value is examined from the customer's point of view. It is, therefore, defined by the needs and expectations of a client within a project. Project value should be easy to understand, possible to achieve, and should be a function of the net processes that lead to the achievement of objectives at the right cost and time. The provision of value to the final client should be the final objective of the project; all the processes within should, therefore, be aimed at providing the final objective. Lean construction is, therefore, a system that explores the addition of value at all stages of the project. To add adequate value to the project, a construction company should prepare to undertake all specifications, tasks, and activities, which lead to optimized value provision in a way that the client is prepared to pay for it (Womack & Jones, 2016). The client requires an end product that satisfies its purpose and also

offers value for investment. Through Lean construction methods, therefore, organizations undertaking projects can easily manage the requirements of the client.

2. Value Stream Mapping

Every single project has a deliverable which requires value, and a client who expects to receive value for investment. A construction project has both value-adding and value-consuming tasks. Value-consuming tasks use resources such as time and finances, while value-adding tasks add the value of the project facilitating its completion and success. Recent studies have established that non-value-adding processes within a project usually take up about 25% of all resources and, therefore, leading to lesser value in terms of time and costs, as well as materials (Young et al., 2016). Therefore, to efficiently conduct a project, by maximizing the value-adding products, project personnel need to focus on elements of Lean construction, which promote the reduction of non-value adding processes and replace them with activities and tasks that only add value to a project. There is also a need to identify all activities leading to the value stream, a series of activities that add value to a project. The value stream comprises all activities that are used to design, provide, and produce the project. They, however, must be value-adding activities. In Lean construction, the value stream ranges from the concept stage up to the last stage of handing over. Identification of the value stream involves establishing how and when decisions are made on how to build value for the project. The outline of all activities and tasks is important in deciding what to do and what not to do to optimize labor, resources, and finances put into a project (Young et al., 2016). Careful management of the stream results in a more predictable and manageable project management and value addition process.

3. Flows

These explain a smooth flow across boundaries for resources and knowledge, among other factors in a construction project. Lean construction strategies advocate for the streamlined flow of information, ideas, and resources to optimize all activities. The interconnection between tasks, activities, and processes is integral for the easier management of the construction projects as well as the ensuring of an enabling environment for adding value to projects. There are, however, some occasions that could counter the smooth flow of activities. These include accidents, poor communication, approval cycles, and executive meetings, among other things (Womack & Jones, 2016). The challenges must be managed and minimized if the project is to enjoy optimum benefits. With this concept in mind, Lean thinking in construction projects is used as a tool to add value to processes by removing risky activities from the process and engaging in development activities, which limit risk on the scope, budget, or schedule.

4. Pull

According to Young et al. (2016), the principle of Lean construction is based on the fact that a contractor/ construction project manager is able to provide the service or required final product on schedule or at the earliest possible time. Lean thinking in construction therefore allows for the definition of the user's needs, as well as the time schedules within which a project is expected to be complete. In cases where Lean construction is used, a contractor or the project manager can apply Lean construction strategies to ensure the optimized use of labor, finances, and other forms of power to ensure completion of the project on time and in the required state of quality. An understanding of the project cycles and streams enables the person in charge to make arrangements for suppliers to make timely deliveries and labor to be maximally involved, thereby ensuring completion of a project on time.

5. Perfection

One of the most important aspects of Lean thinking is that of perfection. Being a client-centered approach, it is expected that the customer expectations are the top priority. In the example of a construction project, a customer expects that the final product is perfect in terms of integrity, use of materials, among other things. It is, therefore, prudent that the contractor or person in charge of the building uses strategies that ensure the perfection of the final product (Young et al., 2016). Lean construction strategies achieve this objective. Through continuous development, an organization is able to build on human capital and ensure the optimization of resources as well as the emphasis on customer needs, as the final objective.

Additional Themes in Lean Construction

- When defining the value of design, the customer's perspective must be taken into account.
- Ideas that are considered to yield a higher performance are used in the construction project.
- A metric is established to measure the performance of activities throughout the process to ensure the construction project's efficient management.
- Specialty is given priority in problem-solving with brief analysis and resolving of hitches that might appear within the tasks assigned.
- Focusing on the complete process, rather than the individual tasks and activities of the project is also important. Even though monitoring is done to the individual activities on the project checklist, progress and evaluation must be made across the whole project. Through building a continuous and strong framework for the management of the project (Young et al., 2016), a wholesome focus is developed on the process. This will ensure that the whole project moves together and that all activities are completed on schedule and, therefore, do not delay the achievement of project outcomes.

Challenges Experienced in the Implementation of Lean Construction

Various research projects have been carried out in the field of Lean construction. Most specific research has been done to identify the main issues and challenges that are contracting and implementing organizations go through in implementing methods and strategies of Lean construction. Using a systematic review of literature, the following factors were found to be the top challenges associated with Lean construction in the U.S.

Lean construction is a new and effective way of managing construction projects. However, construction organizations should consider partnering and collaborating with other consultants in the construction industry to ensure a pool of knowledge and skills that result from Leaning projects. There needs to be comprehensive education on the Lean principles and theories across the board to address myths and concerns attached to the practice to bring many players on board. The various governments should do extensive research on Lean construction to set policies and regulations that do not hinder the progress of the method.

- **Governmental Issues**

As much as citizens may want to involve themselves in aspects of the more efficient Lean construction, and the economic growth and prosperity that comes with construction, governments are at the forefront in downgrading those efforts by having strict policies that discourage Lean construction (Wijerathne, 2019). Research reports that challenges like inconsistent policies and instability of prices all affect the planning and implementation processes for Lean construction.

Implementation of Lean construction principles has been met with significant opposition in some nations through construction policies and regulations. Lean construction as a concept may be misconstrued as rushing the construction process, which poses a concern for the health

and safety of the constructed structures. When governments show little or no support to the construction industries, they leave them exposed to setbacks caused by inflation, corruption and excess duties applied to construction materials.

- **Organizational and Management Issues**

Lean construction requires a great deal of teamwork to ensure the different activities align. This needs a change of culture in work execution. Factors like a low personnel turnover and lack of effort aligning due to strict procedures will negatively impact the whole process. To accomplish Lean construction, all the personnel must be willing to work together and accept responsibility when mistakes occur. The supervisors also must be willing to offer leadership. The alignment of separate processes requires the collaboration of parties working on different tasks to ensure a standard final structure.

The top management in any organization has to ensure successful planning and implementation of projects. The success of Lean construction projects, therefore, dwells on the commitment of the leadership to develop and implement effective strategies to provide the required resources and offer support in the achievement of set objectives. Some challenges in the planning and management of Lean construction have, however, been identified in management. In some cases, issues such as poor project definition, inadequate resources, and delayed delivery of materials led to the failure of Lean construction projects. These managerial issues, therefore, hinder the implementation of Lean construction. Further studies point out to the fact that inadequate time for innovation, as long as extended periods of implementation make the implementation of Lean construction tedious. Other managerial issues associated with Lean construction include a lack of clear definition for objectives. This is a managerial role, in which

project management is supposed to make clear schedules and ensure the provision of materials on time, for the smooth flow of all activities.

- **Financial Issues**

The implementation of conservative and innovative strategies such as Lean construction requires huge sums of money to input. Unlike normal construction projects, Lean construction projects require an adequate financial base to pay employees, hire Lean construction specialists and consultants to guide the project (Wijerathne, 2019). In cases where finances are short, the planning and implementation of Lean construction projects. Issues related to finances are among the most common issues in Lean construction. Issues such as poor wages for professionals, inadequate budgets, among other issues, affect the planning and implementation of the projects.

To implement the designs and align the processes in Lean construction requires adequate funds. The idea of cutting down on time and wastage requires activities to run concurrently; this translates to employing more supervisors than you would when events happen consequently. It will also mean many machines and construction tools working simultaneously (Marhani et al, 2018). Enough resources must be at the contractor's disposal to hire specialists to monitor the tasks and fund any sudden change of process that might occur during the project. Worker training is also necessary for areas where the people are not conscious of equipment or execution of specific tasks.

- **Technical Issues**

Technical issues concerning the implementation and planning processes for Lean construction processes play an important role. Factors such as flexibility, simplicity, and reliability all have a direct impact on the implementation or end product of Lean construction (Wijerathne, 2019). Design-related challenges such as inaccurate and incomplete designs have an impact on the final product. The said factors may cause a product to be of low quality, or not to the expectation of the client. In this case, a person will not get value for their money. If not addressed, the whole issues and challenges concerning technicalities of a project could affect its holistic and effective implementation.

- **Human Attitudinal Issues**

According to research, human attitude is one of the issues affecting the planning and implementation of Lean construction projects. Some of the human attitudinal issues include lack of cooperation from employees, poor understanding of project objectives and client's needs, as well as misconceptions regarding Lean construction and its implementation (Hochstatter, 2013). These, including lack of commitment, lack of teamwork as well as the fear of unfamiliar practices, have led to the inadequate completion of projects relating to Lean construction.

- **Educational Issues**

Over the past few decades, significant efforts have been made to raise awareness, share knowledge, and provide guidance about Lean construction to project leaders, academics, and researchers. This has been necessitated by the huge knowledge gap in the field of Lean construction.

The Lean construction technique requires an in-depth understanding of principals and tools in its execution. It has been established through research by Howell and Ballard (1998) that

some contractors do not fully understand the theories used in Lean construction or lack the necessary tools and workforce to execute the tasks effectively, so they end up implementing it in selected parts. The other issue relating to training is the misinterpretation of the Lean construction principles, making the people execute the various tasks not to be in tandem since the processes depend on each other. The training bodies, like the Lean Construction Institute (LCI), that are supposed to give direction and knowledge in this field operate in few nations across the globe. This proves to be a challenge, especially considering that practices in the construction industry evolve each day, as do customers' design needs.

Addressing the Challenges of Lean Construction

The application of Lean construction practice is marred by several challenges, as described previously. These include unfavorable government policies, inadequate knowledge, attitudinal challenges, poor management, and financial challenges. Various research has been done regarding the potential solutions to this issue. This will ensure that organizations and clients get to effectively enjoy the benefits of Lean construction. In an attempt to explain the potential solutions to challenges facing Lean construction, Suresh (2012) identified the solutions as the creation of a Lean awareness program, education, and staff training on elements of Lean construction as well as government policies. There is, therefore, a need to address the potential solutions to challenges facing Lean construction.

CHAPTER III

METHODOLOGY

Research Design

The study design incorporates the meta-analysis of existing literature as well as the collection of primary data to bolster the findings of the systematic literature review. The findings were also used in the authentication of the hypothesis statement. Within the primary data collection, a total of 50 semi-structured questionnaires were administered to professionals in the industry of Lean construction. Ten out of the 50 questionnaires were returned. The questionnaires contained questions related to the results of the literature review.

The materials used in the review were chosen from a random list with the following criteria.

1. The article/ journal must be related to the discipline of Lean construction.
2. The article must be peer-reviewed.

The validity and reliability of data were also reviewed to ensure that recent, reliable, and valid data is used in the study. The challenges identified from the literature review were used in the structuring of a questionnaire administered. Additionally, the administration of questionnaires to selected persons from the study population was done through the internet, which aims to collect first-hand information from specialists regarding the difficulties that they have to bear within the implementation of the principles of Lean construction. The study utilized both secondary and primary data, as described in previous sections of the methods sections. The first step was a systematic review of existing literature, which provides an insight into the expected challenges as described in historical data. The collected information was then

condensed into emailed surveys through a semi-structured survey, which addressed the current problems as well as their proliferation within the Lean construction sector in the U.S.

Study Population

The study population targeted professionals in the field of Lean construction, as well as other workers in the Lean construction value chain. The population to be represented is spread out all over the U.S. and is limited to all persons including clients, masons, planners, project managers, and other workers, with the main criteria being a worker or employee in a Lean construction site or an organization that is directly involved in Lean construction within the U.S. Within the population, a sample of 10 individuals was randomly selected from the population. The sample was then selected through a random stratified mechanism, aiming to ensure non-bias in terms of race, gender, and other criteria. Additionally, the sample selected is from a pool of people whose experience ranges from 1 to over 15 years in the Lean construction industry. The sample was chosen non-discriminatively and administered via emailed questionnaires. The current health situation, with the Covid-19 Pandemic, would not allow for face to face interviewing; therefore, semi-structured emailed surveys were posted to the selected individuals in the sample and filled surveys were to be returned through the same platform for analysis.

Data Collection Methods

For this particular study, two types of data were collected, that is secondary data and primary data. The first type of data collected was secondary data. This was done chronologically in that a systematic review of existing literature is done first, and then its findings were used in the structuring of the survey questions. The systematic review process involved the selection of peer-reviewed articles from authoritative journals which address historical challenges within the

past ten years in the field of Lean construction. The criterion for the selection of the required materials is listed below.

The first step of the exclusion and inclusion criteria is the choice of articles is a read over of the abstracts of the materials and get the general idea and relativity to the thesis. Other exclusion and inclusion criteria include peer review, reported outcomes, participants, date, and exposure of interest. After satisfying the exclusion/inclusion criteria, ten (10) articles were selected.

The exclusion/inclusion criteria are described in the table below:

Table 1: The Exclusion/Inclusion Criteria

Criterion	Description of exclusion and inclusion
Date	All the articles to be reviewed must be less than ten years old from the date of publication. This criterion excludes all articles done before 2009.
Exposure of Interest	The participants in the specific study must be professionals in Lean construction
Peer review	All research papers to be used must be peer-reviewed.
Reported Outcomes	The outcomes of the specific studies should, among other criteria, address elements of Lean construction.
Participants	The inclusion criteria for all participants within the studies is that they must have any sort of experience in the field of Lean construction.

The second type of data to be collected was the primary data. Primary data refers to firsthand responses to direct, structured, semi-structured, or unstructured questions. In this study, data will be collected using semi-structured questionnaires. The semi-structured questionnaires are usually the best tools in the collection of information regarding Lean construction and the challenges within the sector. Semi-structured questionnaires are used for their ability to ensure two-way communication. An example is where the researcher already has some information regarding the topic but also requires an input of opinion from the respondent. The questions in this survey majorly dealt with the ranking of the opinion of identified challenges, using an individual's experience in the field of Lean construction. A sample of the survey is attached below.

Questionnaire

The design process of a questionnaire plays a pivotal role in achieving a good response rate, as well as objective answers.

The questionnaire for this study has four sections, all of which was extract crucial information with relation to Lean construction from the respondents.

Section A: This request is for information on the profile of the respondent. Due to anonymity, the respondents would only be requested to offer information regarding their job titles, working experience in Lean construction, as well as the average value and nature of projects on Lean construction that they undertake.

Section B: Focuses on the impacts of specific methods and strategies that are used in Lean construction.

Section C: Identifies challenges faced in the Lean construction sector, as well as the issues that make these challenges unresolved. It also identifies the impacts of the challenges on project wellness, with particular regard to customer satisfaction and risk on project continuity.

Section D: Ranks the challenges described in section C above as per the order of significance in Lean construction.

The complete questionnaire is attached below:

Section A: Profile of Respondent/ Organizations

1. How many years of experience do you have in the construction industry?

1- 2 years

3-5 years

6-10 years

11-15 years

Over 15 years

2. For how long have you been involved in Lean construction.

1- 2 years

3-5 years

6-10 years

11-15 years

Over 15 years

3. Which of the following titles describes your position in the company?

Project manager

Site supervisor

- Health and safety manager
 - Foreman
4. What sizes of projects does your organization deal with?
- Less than \$ 5 million
 - \$ 0.5 -1 million
 - \$ 1-2 million
 - \$2-5 million
 - More than \$5 million

Section B: Specific Impacts of Lean Construction

Please use the scale below to indicate how good Lean construction is by crossing out your choice in achieving the following objectives of Lean construction. **The rating scale means:**

1-Very Ineffective 2-Ineffective 3-Neutral 4-Effective 5-Very Effective

- | | | | | | |
|---|---|---|---|---|---|
| a) Worker involvement | 1 | 2 | 3 | 4 | 5 |
| b) Pre task analysis | 1 | 2 | 3 | 4 | 5 |
| c) Open communication between stakeholder | 1 | 2 | 3 | 4 | 5 |
| d) Collaborative planning process | 1 | 2 | 3 | 4 | 5 |
| e) Resource Optimization | 1 | 2 | 3 | 4 | 5 |
| f) Increased worker accountability | 1 | 2 | 3 | 4 | 5 |
| g) Increased predictability and reliability | 1 | 2 | 3 | 4 | 5 |
| h) Increased client satisfaction | 1 | 2 | 3 | 4 | 5 |

Section C: Challenges in Planning and Implementation of Lean Construction

Please indicate using the scale below, how often you encounter the following challenges of Lean construction within your organization and the projects you undertake.

	1-Never	2-Sometimes	3-Often	4-Frequent	5-Always
1. High implementation costs	1	2	3	4	5
2. Incompliance with set instructions for methods	1	2	3	4	5
3. Inadequate Lean knowledge	1	2	3	4	5
4. Leadership issues	1	2	3	4	5
5. Inadequate government support	1	2	3	4	5
6. Inadequate resources	1	2	3	4	5
7. Inadequate incentives	1	2	3	4	5
8. Ineffective organizational structure	1	2	3	4	5
9. Complexity of projects	1	2	3	4	5
10. Ambiguity of client needs	1	2	3	4	5

Section D: Impacts of the Challenges in the Planning and Implementation of Lean Construction

From your experience and professional acumen on Lean construction, rank the problems listed in part C above, regarding the significance and how the challenge affects Lean construction. Use a scale of 1 to 10, with 10 being the most significant challenge, and 1 being the least. (*You can use any number more than once*)

1. High implementation costs _____
2. Incompliance with set instructions for methods _____
3. Inadequate Lean knowledge _____

4. Leadership issues _____
5. Inadequate government support _____
6. Inadequate resources _____
7. Inadequate incentives _____
8. Ineffective organizational structure _____
9. Complexity of projects _____
10. Ambiguity of client needs _____
11. Other (specify) _____

End of Questionnaire

Thank you for your generous input in this research. All information will be treated with utmost confidentiality for research purposes only.

If you would like to receive the research findings and implications on the business of Lean construction, please attach your contact information herein.

Name of Company:

Contact Address:

Email:

Phone Number:

Data Analysis

The data analysis for the project was to be carried out in two distinct phases. The first phase involves the analysis of articles in the systematic review. The second phase involves the analysis of data collected from the questionnaires.

The systematic review process is a comprehensive process from data collection to the analysis of texts. Through the collection process, inclusion and exclusion criteria are used to identify the best articles that can be used in the research process. The selected text was analyzed using descriptive analysis, which describes the outcomes of past studies, as described by Munn et al. (2018). The review outlined the main challenges in Lean construction and was validated by the returned questionnaires. This led to a conclusive argument concerning the top challenges faced by Lean construction planners and implementers in the U.S.

Analysis of questionnaire responses employed the use of statistical methods to extract, rank, and determine the significance of any mentioned challenges. All data obtained from the returned questionnaires were analyzed using the statistical software advanced excel. The software ran the data for regressions and calculated an analysis of the outcomes and standardization of data, which led to a ranking of challenges based on the aggregate themes that were revealed through this analysis.

CHAPTER IV

FINDINGS AND ANALYSIS

The results of the project have been categorized into two stages. The first stage involved a review of the literature to find out and identify the historical data about challenges of Lean construction. A review of 10 texts was systematically done, after the inclusion and exclusion process. The result of the exercise is shown below in table 2.

Table 2: Summary of Challenges of Lean Construction from Literature Review

Reference	Industry	Challenges Identified
Li et al, 2017	Lean construction	Unclear client expectations
Wijerathne et al, 2019	Lean construction	Inadequate government support
Forbes & Ahmed, 2010	Lean construction	Complex projects
Bijou et al, 2017	Lean construction	Inadequate employee incentives
Suresh et al, 2012	Lean construction	Ineffective organizational structures
Stevens, 2014	Lean construction	Incompetent employees
Liu & Shi, 2017	Lean construction	Knowledge gap

Jones et al, 2016	Lean construction	Cost constraints in implementation
Hochstatter, 2013	Lean construction	Poor leadership
Fiesler et al, 2019	Lean construction	Inadequate resources

From the results table above, it can be deduced that several studies have been done to ascertain the challenges facing Lean construction. An inclusion study was done to identify the sources that outline the challenges of Lean construction. From the table above, the main challenges have been identified. The literature review revealed the main challenges identified in the texts and later presented them as a part of a questionnaire to collect information about current trends, impacts and ranking of the main challenges in planning and implementing Lean construction projects. The main issues highlighted include inadequate funding from the clients and unclear instructions, which made implementation of Lean principles on construction projects difficult. The other challenges faced include constrained budgets and inadequate human resources to handle the complex but helpful topic of Lean construction.

The identified challenges were then used in the second phase of data collection, which involved the administration of 10 questionnaires to professionals in the field of Lean construction. The results of the questionnaires are presented in the second phase below.

The second phase, which involved the administration of the questionnaire yielded results based on the sections within the questionnaires. The sections covered information about the organizations, experience of respondents, the ranking of challenges, as well as the impact and

identification of the particular intensities of the challenges in the modern era of Lean construction. The results are presented below:



Figure 1: Organizational Experience in Lean Construction

The 10 organizations that were represented by the respondents have been classified based on experience in Lean construction. All the organizations have been fitted on a scale between 1 to 15 years of experience in Lean construction. As shown in Figure 1, four organizations have more than 15 years of experience in the Lean construction industry. Three companies have had between 11 to 15 years of experience in the U.S. in the application and practice of Lean construction strategies. Additionally, only one company possesses experience of 1 to 2 years, 3 to 5 years, and 6 to 10 years respectively. This demographic of the sample shows that most of the organizations are well established in Lean construction, having completed

several years in the practice. All of the organizations that were surveyed have the necessary experience and therefore fit the requirements of the study project. This includes the organization with experience of only 1 to 2 years, as they can provide the Lean method of fresh eyes and see things from a new perspective. Experience is key in providing the required responses and answers to research questions. This project is therefore based on the premise that respondents possess adequate knowledge of the challenges faced in the planning and implementation of Lean construction strategies.

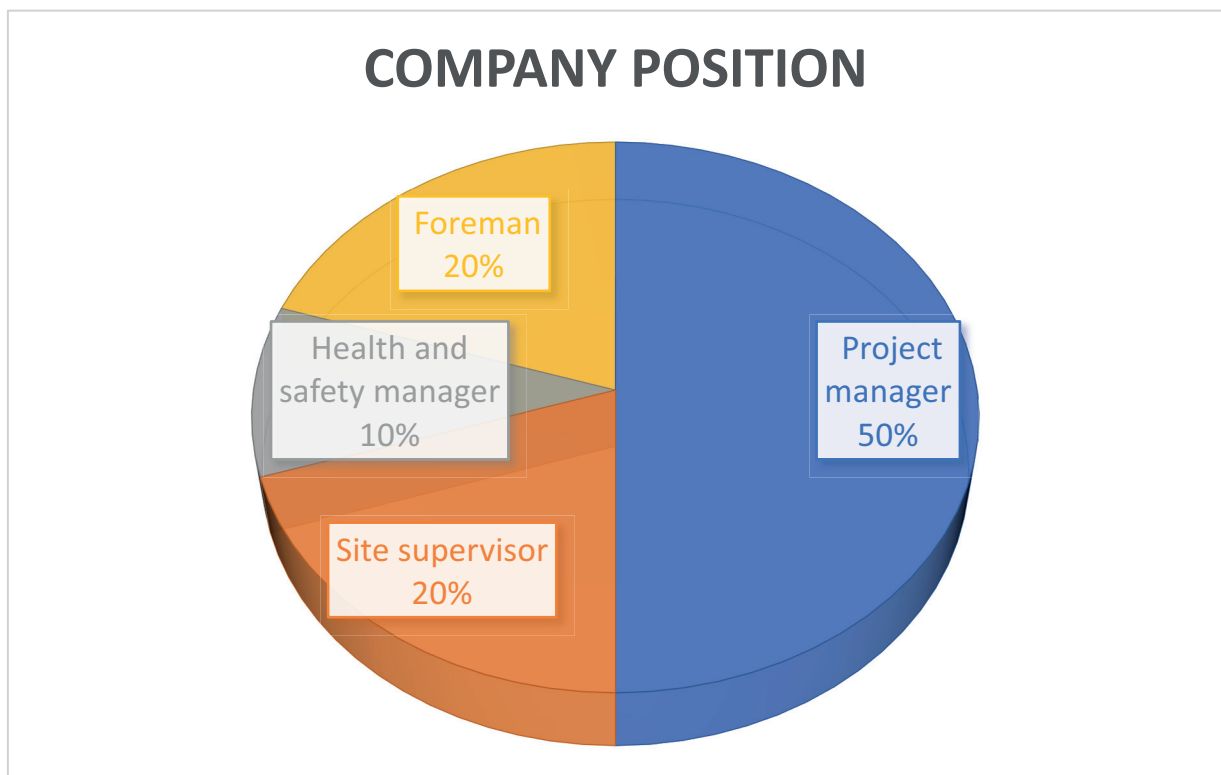


Figure 2: Job Positions of Respondents

The job positions of the respondents are also important questions that need to be collected from the study. This is because a job position communicates the experience that a person has in conducting Lean construction. As shown in Figure 2, the job positions in the

questionnaire have been classified into four major categories; site supervisor, project managers, health and safety managers and foremen. The four classes have been administered to the respondents and expected to be filled in the questionnaire. From the ten administered and received questionnaires, five of the respondents are project managers, two of the respondents are site supervisors and the other two are foremen. The last respondent is a health and safety manager in the organization represented. The respondents are all drawn from different organizations. Their diversity and variation in opinion, due to their differing perspectives, is key in advancing this research project. The ten respondents are actively involved in the planning and implementation of projects. Considering that the organizations have considerable experience with Lean construction, the respondents have direct involvement and experience in the field of Lean construction. Their individual job experiences are an important aspect of determining the challenges of Lean construction. Employees in different roles within the construction industry can provide their own unique experience with the challenges they have faced and gauge the impacts and intensity of these challenges on Lean construction, both as a process and a practice. This not only works in determining challenges but being actively involved in the planning and implementation process also provides a person the opportunity to gain a better understanding of Lean construction as a whole.

Impacts of Lean Construction

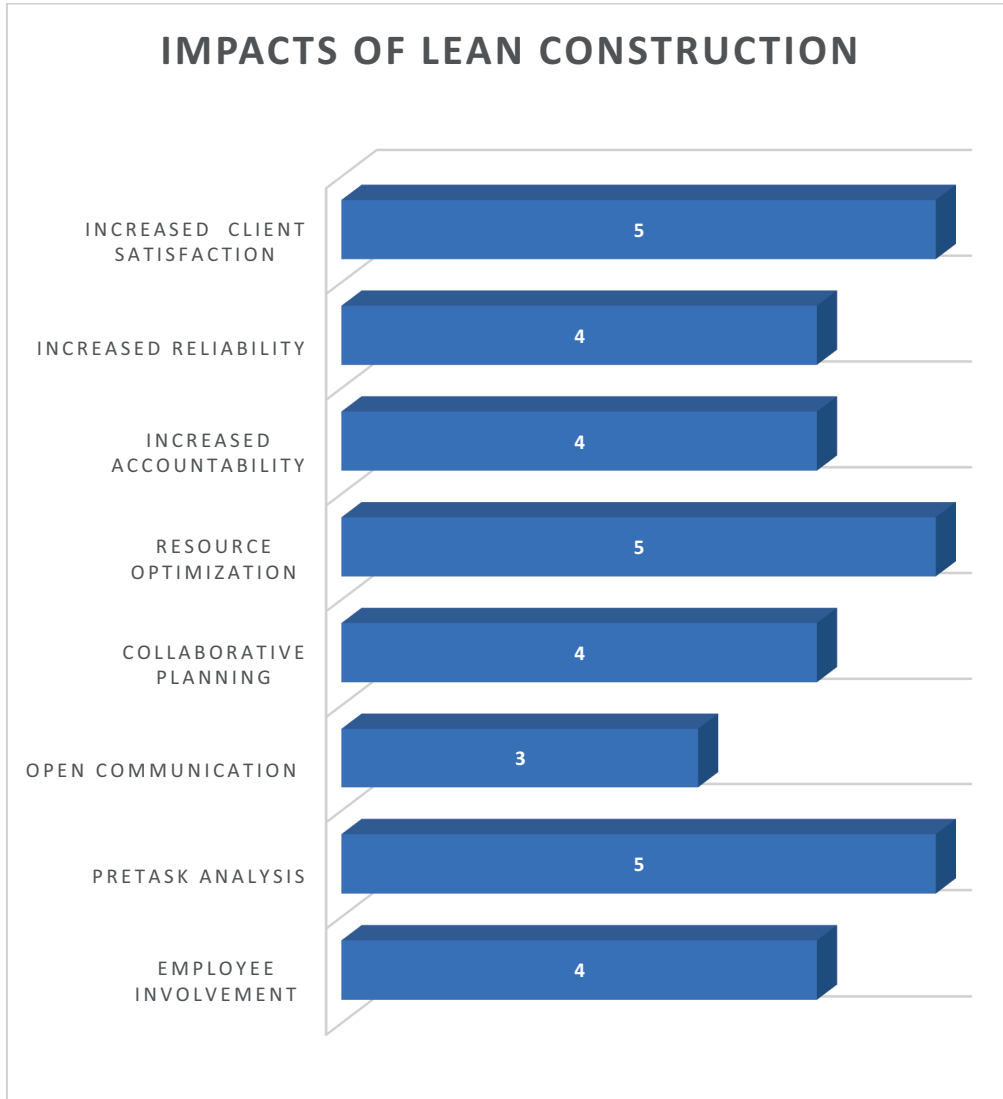


Figure 3: Impacts of Lean Construction

1-Very Ineffective 2-Ineffective 3-Neutral 4-Effective 5-Very Effective

The impact of Lean construction is an important element of this study. The involvement of the respondents is needed in the identification of the challenges as well as a ranking of the significance of those challenges. Figure 3 shows the ten respondents identified the scale to which Lean practices impacted various sections of the planning and implementation process in the

construction industry. The tasks have been ranked on a five-point scale, with five being very effective and a rank one being the lowest or highly ineffective.

Increased Client Satisfaction

The ranking metric ranked the impact an average of 5 from all respondents. This means that the respondents viewed Lean construction as very effective, a scale of 5 in the ranking. This means that most employees in Lean construction have witnessed that the method of construction, improves client satisfaction. The method described in the literature review section of this report has important advantages and elements, which in totality contribute to the success of the project. Through Lean construction, a client can achieve value from a project. The main objective of any project, and especially in construction is that the client gets value for their investment. Value is only achieved if all elements such a schedule, quality, quantity, and budget are adhered to. This leads to client satisfaction. Through a prudential use of natural and human resources, work can be completed in time without any pressure on budgets or needing further inputs. This also ensures that a client can expect the final product to be of high quality without having to add too much money. Lean construction as a discipline achieves this. It allows for the achievement of construction objectives, culminating in a high-quality product with optimized inputs. It allows for the optimized use of labor and other resources, all aimed at achieving consumer satisfaction.

Increasing Reliability and Accountability

Lean construction also increases accountability and reliability. The planning and implementation process usually follow a careful process which allows for the accountable use of resources. The planning process effectively limits the misuse of resources, leading to increased employee accountability. The accountable nature of Lean construction ensures reliability for the project. From the respondent's ratings, Lean construction is effective in increasing reliability

and accountability in projects. The effectiveness rating means that the experienced respondents, with years in the construction industry, have experienced improved accountability and reliability in projects after using Lean construction principles.

Resource Optimization

Lean construction as a practice and procedure has been rated as very effective (5) in ensuring resource optimization. Resource optimization refers to the practice of increased efficiency even with limited resources. The wise use of resources to accomplish project milestones enables a project to be completed within the budget and on schedule. It is one of the elements and principles of Lean construction which works in contributing to other impacts. Prudential resource use contributes to value, increased reliability, accountability, and therefore client satisfaction.

Collaborative Planning and Pre-Task Analysis

To achieve effectiveness and accountability, planning in a construction project is paramount. Lean construction as a practice promotes planning together as a group. Therefore, one of the impacts on construction is that Lean construction strategies encourage and promote collaborative planning. Collaborative planning refers to the process through which all the stakeholders in a project work together to achieve milestones by planning. Pre-task analysis on the other hand allows for collaborative planning. Through working together, stakeholders can achieve efficiencies, reliability, and accountability thereby providing client satisfaction. The two tasks were rated as very effective by the respondents and alluded that the principles of Lean construction effectively led to increased pre-tasks planning. This leads to a reduction in errors and an increased appreciation of the role that collaborative planning plays in ensuring value at the end of a construction project.

Encouraging Open Communication

Lean construction was given an average rating of neutral in ensuring open communication. The process of Lean construction is based on the premise of constant communication and consultation. Effectively communicating teams lead to efficiency in the planning and implementation of Lean construction principles. Effective communication as one of the principles enables the achievement of the other principles, which collectively increase the value of a project, thereby achieving resource optimization, a key contributor to value for the client. It is possible that the respondents view open communication as part of their basic business principles and not solely a Lean contribution.

Challenges in Lean Construction



Figure 4: Challenges of Lean Construction

1-Never 2-Sometimes 3-Often 4-Frequent 5-Always

The primary objective of this study was to determine and rank the challenges of Lean construction. The preceding sections of these reports were all done in preparation to address the challenges of Lean construction as a discipline and a practice. Most of the challenges identified through the literature study were ranked as either *frequent* or *always* present within Lean construction projects. A few others were *sometimes* and *often* found in Lean construction project. As described earlier, all the project personnel surveyed are professionals, highly

experienced in Lean construction. They therefore could comfortably suggest and authoritatively name challenges that they meet within their work environments. The ranking system was based on a five-point scale with the emphasis being placed on the frequency of occurrence of the challenges in Lean construction projects. From the information collected, the challenges with the highest frequency include inadequate knowledge and inflated costs of practicing Lean construction projects. Knowledge regarding Lean construction is not widely spread in the world of construction. The main challenge that implementers and planners of Lean construction meet is inadequate knowledge in Lean construction principles in a competitive world. Most construction industries and companies shy off from trying out Lean construction principles, especially due to inadequate knowledge and high costs involved. The high costs involved are however a reflection and compensation of the advantages to be involved. Out of the 10 respondents that use Lean construction within their organizations, all of them alluded to the fact that knowledge on Lean construction was hard to find and also not well distributed in construction training institutes. This has led to a relapse and difficulty in implementing the practices of Lean construction.

Other challenges in the planning and implementation of Lean construction include ineffective implementation structures, unclear client needs as well as incompliance from workers and unclear leadership. Lean construction being a conservatory mode of construction needs to be checked and it should be ensured that all activities are conducted procedurally and within the stipulated range of activities and principles in Lean construction. Other challenges identified and ranked within the study include inadequate government support, low incentives for employees, and complexity of projects. These are not major challenges and are unilaterally agreed to be low ranking issues in the planning and implementation of Lean construction projects. An understanding of the frequency with which the challenges occur is key in deciding the major

recommendation that can be taken to address the challenges of Lean construction as described in the project objectives.

Ranking the Challenges of Lean Construction

Table 3: Ranking of the Challenges of Lean Construction

Items	Rank
High Implementation Costs	1
Inadequate Lean Knowledge	2
Ineffective Organizational Structure	3
Leadership Issues	4
Ambiguity of Client Needs	5
Incompliance with Set Instruction for Methods	6
Complexity of Projects	7
Inadequate Resources	8
Inadequate Incentives	9
Lack of Government Support	10

The challenges of practicing Lean construction can be ranked according to the order of importance. From the study, respondents were asked to first identify the challenges of Lean construction, describe the impact of the construction practice on the industry as a whole and then rank the challenges according to the order of importance and how they impact the construction

industry. From the results of the study, the most significant issue according to the respondents was high costs. The costs of hiring knowledgeable individuals with the necessary experience to drive Lean construction are usually higher as compared to other construction projects.

Lean construction projects need to have clear guidelines on how to effectively guide the planning process as well as implementation. A clear plan results in a successful implementation. Successful projects need the expertise to lay down plans with total regard to Lean construction. The plans will therefore be replicated in implementation, resulting in good outcomes full of value to the client. The other most important challenges are incompliance with set instructions, poor leadership and inadequate knowledge. All these challenges emanate from a lack of technical know-how of conducting Lean construction within the human resources within the project. While the challenges cut across different ranks of the organization. The common fact is that they all affect the human resources department. In the case that adequate knowledge is provided, all the issues in the leadership and implementation factions of Lean construction will be solved. In the case of this project, HR knowledge in management and dissemination of information about Lean construction principles and practice. The other segment of the project describes challenges that rank low in importance and are therefore rarely occurring. Challenges such as government support and incentives rank low on the index. This is explainable using the fact that current governments are now adopting environmentally friendly strategies in construction. Governments and private entities are now continually addressing the need to have environmentally friendly and conservative practices in all sectors. Lean construction addresses the environmental concerns of construction, reason why government support is increasing in the case of Lean construction.

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

Conclusion

Lean construction as a discipline is key in environmentally conservative and sustainable construction. With increasing populations and urbanization, professionals in the construction sector are looking for the best ways to continue constructing residences for the people. In most cases, the strategies used in construction are inconsiderate of the environment and require large amounts of inputs, which mostly result in wastage of labor, materials, or time. The advent of Lean construction, however, solved these issues. Lean construction, therefore, effectively addresses sustainability issues. The use of Lean construction practices results in better outcomes for the construction companies as well as the client. According to research on Lean construction, the systems results in an approximately 25% higher quality for a third of the effort, resources, and time. This makes the application of Lean construction easier as a system of construction, which possesses the numerous benefits listed. The first step to ensuring the widespread application of Lean construction principles, as well as implementation across the entire U.S. construction sector, is to understand and address the challenges which planners and implementers face in the Lean construction system. These challenges can sometimes cause delays in progress and lead to high costs. There is also a difficulty in the technical knowledge and know-how regarding the implementation procedures.

Perhaps the most interesting finding of this study is that the participants ranked high costs as the most significant perceived challenge, as Lean methods are proven to significantly reduce costs. This could possibly be related to the second highest ranked challenge of lack of knowledge. The perception of needing to hire a team of experts is actually the opposite of what

Lean intends. Lean makes the employees the experts. There seems to be a common theme of the inability to adapt lean methods in the construction industry and highlight the need for some basic reforms to address this.

Recommendations

This study has revealed the challenges discussed are rooted in the same basic causes and there are relatively simple ways to overcome these issues. Lean has mostly been taught solely from a manufacturing point of view and due to the differing needs of the construction industry, it has suffered from a lack of specification.

Where manufacturing is more streamlined and well versed in Lean methodology, the construction industry, with its complexity of contractors, subcontractors, and supply chain differences, it requires an adaption of Lean principles to meet its specific needs. While this has been done so far on an individual company basis, it should become the norm.

My recommendations to overcome the challenges identified are:

1. Lean construction-specific curriculum should be standardized and delivered in all universities for those who study the field. As these individuals enter the industry in leadership roles, this expertise will lead to increased adoption.
2. Incorporation of consistent Lean construction training as standard operating procedure across the industry will strengthen this adoption. It will empower all incoming employees from the ground up to become experts in Lean as intended.
3. Finally, there is a need for standardized practices with oversight by, and certification from, a governing institution much like OSHA. This could lead to the ability for preferential government contract awards and tax incentives for those who adhere to these standards.

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