IMPLEMENTATION OF LEAN CONSTRUCTION PRINCIPLES TO IMPROVE PROJECT DELIVERY: (A CASE STUDY OF CONSAR LIMITED ACCRA BRANCH)

By

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MASTER OF SCIENCE IN PROJECT MANAGEMENT

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CERTIFICATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no materials previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or deploma at Kwame Nkrumah University of Science of Technology, Kumasi or any other educational institution, except where due acknowledge has been made is made in the thesis.

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ABSTRACT

Construction projects in Ghana for the past decades have not seen any improvement in transforming the industry with emerging global philosophies. However, lean construction principles have emerged in the industry to replace the traditional way of project delivery. In spite of problems associated with project delivery which in turn brought uncertainties of the environmental hazards, global economic climate, in addition to the projects been delayed with respect to zero margin contract bids and greenhouse gas emissions. Moreover, studies have alluded to the fact that projects take longer than expected, and the finished product not meeting client expectations with regards to quality. This research work is aimed at accessing the lean construction principles and practice toward improvement of project delivery at Consar limited. The methodology used in conducting this research work is a qualitative study. The data collected and use for this study is basically interviews, the researcher adopted the use of NVivo 11 software for analyzing the interviewed script. The research findings indicate that the Just in Time principles is fully in operational at Consar limited, regardless of some few challenges with regards to transportation. Further findings reveal that the 5S principles which concerns creating and maintaining well organized, clean, high effective and high-quality workplace is fully operational at Consar limited. The rest of the lean construction principles are partly operational. However, the major recommendation that ensures project objectives are successful is that project participants must endeavour to collaborate in the design process so as to minimized variations that emerged as a result of deficiencies in design process, which is coupled with schedule delay, budget escalating and above all not meeting customer expectations.

Keywords: Lean Construction Principles, Project delivery, Stakeholders, Just in Time, Transformation Flow Value.

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DEDICATION

I dedicate this research work, first of all to the GOD ALMIGHTY for his protection and guidance throughout the entire research work, not forgetting the encouragement exhibited by my wife and children.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Lean construction according to Young, et al. (2016) has originated from the production and manufacturing industry which emanate from lean principles as a project management methodology. Lean construction was considered a philosophy for managing construction projects and not a standalone contractual delivery system. Project are the temporary endeavor needed for the production systems to deliver the product in such a way as to maximizes value creation and minimizes waste production which is considered as lean principles. Lean project delivery and traditional project delivery differs from the goal it achieves and the relationship between phases with the participants for each phase of the project (Ballard and Howell, 2003). Professional organisations have defined Project delivery systems according to American society of civil engineers (2000), that describes how the participants are organised to interact, with the view to transforming the goals and objectives of the sponsor into finished facilities (Chen, 2011). Kenig (2011), also defined project delivery system as a process of assigning a contractual responsibility for the design and construction process. The American institute of architects also adopted the definition that a project delivery system is the process of selecting roles and responsibility in a project with the view to rewarding parties in the accomplishment of design, construction documentation and construction project management (CSI, 2011). Project delivery systems are made up of three forms namely design bid build, design build and construction management at risk. Lean construction according to Womack and Jones (2013) was developed as a philosophy on the concepts of lean manufacturing. The concepts were to

manage and improve the construction process to yield benefit to support the needs of the customer. Lean production is structured in a way that fit three fundamental goal and objectives which in turn stands to deliver the project by maximizing the value as well as minimizes waste accumulation (Koskela, 2000). Sayer and Williams (2007) also are of the opinion that lean organisations use less human effort to work, less material to build their products, less time to develop them, and less energy and chance to produce them. They are oriented toward customer demand, and develop high quality products in the most effective and economically possible. The features of lean construction principles included a mind set to deliver the process in a way that is structured to maximize performance and improving the needs of the sponsor at the project stage. The outcome of emergence of lean tools have successfully been applied to both simple and complex projects in the industry. Generally, organization of projects with lean concepts are manage easily, carried out safely, completed early, and cost less with better quality (Aziz and Hafez, 2013). Lean Construction Institute (2014) argues that there are approximately 57% of productive time spent on wasteful resources in the industry. According to Ansah, et al. (2016) the application of lean construction was aimed at reducing the wastes in workflow which the traditional methods were insufficient in eliminate them. Ayarkwa et al., (2012) and Ankomah et al. (2015) conducted studies within the Ghanaian construction industry respectively and suggested a low level of similarity and application of lean construction principles among professional within the industry. Consequently, Ayarkwa et al. (2011) also concluded that the Ghanaian construction industries understanding to lean concepts is ineffective, government policies inconsistent, poor project understanding, inadequate designs, lack of standard in their work

and lack of establish relationship among suppliers the challenges identified as Managerial, Technical and Teamwork issues.

1.2 STATEMET OF THE PROBLEM

Construction projects in Ghana for the past decades have not seen any improvement in transforming the industry with emerging global philosophies. Lean concept and ideology are based on: what the customer wants, in no time, with absolutely nothing in stores. To achieve this concept, lean implementers follow sets of principles. Lean construction uses the lean concept application in their operation as a philosophical basis (Tommelein, 2014). In spite of the traditional project delivery method, owners and customers are dissatisfied with projects in a view that they take longer than planned, cost more than expected, and the finished product not meeting client expectations with regards to quality (Lichtig, 2006). According to AEC community Poor design and documentation quality have been identified as a major factor in reducing the overall performance and efficiency of construction projects. Consequently, they have directly caused many projects to run over budget, over time schedules, and to be plagued with rework, change orders (variations), and disputes. However, the construction industry according to Anerao and Deshmukh (2016) are also facing various problems as a result of the uncertainties of the environmental hazards, global economic climate, addition to the projects been delayed with respect to zero margin contract bids and greenhouse gas emissions. Cooke-Davies (2002), argue construction projects practicing traditional delivery are failing in practice and creating substantial losses for their organisations (PMI, 2015; PMI, 2016). According to McMahons (2013), current studies establishes that lean construction implementation failures ranges between 50% and 95%.

However, even though some degree of research has been conducted on lean construction but none of the researchers within the Ghanaian construction industry had not considered the accessing lean construction principles and practice toward improvement project delivery over the traditional method of delivery.

1.3 RESEARCH QUESTIONS

1. What are the lean construction principles currently been practice at Consar limited?
2. What are the possible challenges they face as a result of adopting to the lean construction principles?
3. How can Consar limited mitigate the challenges in the adoption of lean construction principles and practice?

1.4 AIM AND OBJECTIVES

In view for addressing the research question above, the aim of the current study was to access lean construction principles and practice toward improvement of project delivery at Consar limited.

Objectives to achieve the aim are:

1. To identify lean construction principles currently been practice at Consar limited?
2. To identify the challenges, they face in adopting the lean construction principles?
3. To identify ways of mitigating the challenges in adoption of lean construction principles and practice?

1.5 JUSTIFICATION OF STUDY

The implementation of the lean construction principles and practice in the Ghanaian construction industry has not been successful, therefore the need for this study. Various empirical studies have been conducted within Ghana and other countries but the implementation in Ghanaian industry has not seen any success. Therefore, current study is conducted to access lean construction principles and practice toward improvement of project delivery system at Consar limited. However, the objectives are to identify lean construction principles currently been practice at Consar limited. Again, to identify the challenges they face in adopting the lean construction principles. Finally, to identify ways of mitigating the challenges in adoption of lean construction principles and practice. This current study focuses on accessing lean construction principles and practice toward improvement of project delivery system at Consar limited. In the context of accessing lean principles and practices, any resources that do not add value to client's needs is eliminated from the process. Lean manufacturing is a widely use managerial approach highly recognised for developing the operational performance of a company (Shah and Ward, 2003). Organisations who support the implementation of lean principles approach hope to achieve efficiency in their ability to eliminate wasteful resources to achieve a competitive advantage (Deshmukh et al., 2010; Lopez-Fresno, 2014). However, the elimination of wasteful resources follows a systematic approach in identifying the work procedure from design to construction and also employees training to eliminate wasteful resource from the activity process. Other sources of wasteful activities should be eliminated by organisations readiness to overcome overproduction, faulty products, and unnecessary waiting, movement or transportation with excess inventory from the system of production (Demeter and Matyusz,

2011). The paper sought to assess lean construction principles and practice on improvement of organisational project delivery at Consar limited.

1.6 METHODOLOGY

This chapter deals with the methodology for the information collection where the findings, conclusion and recommendations are presented. The literature review, aims to provide better understanding of the lean principles and practice in both theoretical and practical aspect in the construction industry. Lean construction principles exhibit significant strategies in minimising resource use and strive achieve better efficient in the use of resources for the reduction of wasteful activities from the production (Pulaski, et al., 2003). The main aim of this research is to access lean construction principles and practice toward improvement of project delivery system at Consar limited. This research methods include data gathering, along with using semi-structured interviews with a randomly selected group of senior experts at Consar limited. However, the method adopted for this research work is the qualitative approach. A qualitative study is appropriate for achieving the goal of the research while explaining the phenomenon for relying on personal perception and experience in a given situation (Stake, 2010). As explain by Creswell (2003), a qualitative research approach is appropriate when a researcher seeks to understand relationships between variables. The interviews would be conducted and analysed to identify the challenges face in adopting the lean construction principles and identify ways of mitigating the challenges in adoption of lean construction principles and practice.

1.7 SCOPE OF THE STUDY

The overall subject and approach of this research is broad and therefore the content has to be limited due to time restrictions. This research work was conducted from Consar limited a construction company in Ghana. The data obtained for the proposed projects will be based on primary data. The lean principles and practice tools that are going to be evaluated and investigated are mainly limited to the principles and practice tools that are used frequently in literature and close related to the principles and practice tools formulated and used by Consar limited. The data used for this thesis will be obtained from information sources available at the main yard as well as Consar limited sites. The focus is on projects around Accra and limited mainly to commercial projects. The qualitative data could therefore be limited to selected groups at the main yard where management of construction would be interviewed under the study. The survey questionnaires will be based on worker perceptions and understanding of lean construction principles and practice in a life time projects administer by Consar limited and investigate constraints that hinders implementation to improve project delivery. The data is confined to a single company in Ghana, within the construction industry to be precise Consar limited. The data is aimed at giving a representation for the specific company within the construction industry in Ghana to be precise Consar limited and not necessarily directly applicable to other companies.

1.8 STRUCTURE OF REPORT

This research work was structured and organized into five chapters as follows: The first chapter presents an introduction to the topic. Consequently, it clarifies the study's background and rationale. A background about the context of study is presented. The

research aim and objectives are defined clearly. This chapter also summarises the significance of this study and its expected contributions to the construction industry. Consequently, it defines the scope of the study and delimitations. The chapter two of this research work is intended to provide a review of the relevant literature on the lean principles and practices in the industries. However, the chapter will begin with a detailed overview of lean manufacturing and situate it to lean construction. This domain includes the various definitions of lean principles with other managerial concepts. Previous studies are provided to understand how these practices are used in the manufacturing firms. Furthermore, the study is intended to focus on the construction industry and how lean principles and practice are implemented to improve project delivery. Chapter three outlines the research methodology that will be adopted in the current study. To answer the research objectives, a qualitative research design approach would be used. In addition, discussion of the research approaches would be qualitative research and attached with the justification of the desires for opting to qualitative method. However, comparison of the different data collection methods is provided with shedding the light on the survey-based research methodology, which is adopted to analyse the collected primary data. The results will be discussed and the potential impact on the company concluded. The literature review and the practical findings are analysed and discussed in Chapter four and the answer for the research questions and recommendations are presented in chapter five. The conclusion of the research and recommendations for implementation will be incorporated in this chapter. In summary, the value proposition to the company is revealed and direction is provided for future studies. The bibliography is presented and it is followed by Appendix.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The literature review is conducted to examine critically the relevant literature on the implementation of lean construction principles and practice to improve on the traditional practices of project delivery at Consar limited. Numerous studies have been conducted and published in the domain of literature that suggest that the application of traditional construction project delivery system lack behind when it comes to staying within budget, timely and on schedule completion of projects (Ghassemi and Becerik-Gerber, 2011). In view of the global settings, project delivery system adopted for the execution of construction building projects are (1) design bid build (2) design build (3) design build operate and (4) construction management at risk. However, these forms of project delivery systems come with different interaction among project stakeholders within the industry (Kensek, 2014). However, there are some similarities which can be compared to principles of lean together with that of total quality management, just in time and six sigma with the same approach in mind. Another area is that they can also exhibit the same output of good quality deliveries (Pakdil and Leonard, 2015). These principles metamorphosed in the traditional way of labour and work flows to the flow that achieves value generation. Ansah et al. (2016), alluded to the fact that the main aim of lean construction is to reduce waste generation in the traditional method.

2.2 TRADITIONAL PROJECT DELIVERY

According to Forbes and Ahmed (2011) recognize the significant of a project with the view to working against schedule and budget to achieving a specific result. Consequently, these results are achieved by stakeholders administering the construction process within various organisations that collaborate to ensure project objectives are addressed. However, these stakeholders are namely the Project sponsor, Design team, Main contractors, Project team, Suppliers, etc. The project management institute in one of its seminars defined project delivery system by Moore Dale as the structure of the relationship of the parties, the roles and responsibilities of the parties, and the general sequence of activities required to deliver the project. Several models and process are adopted in the designing and constructing the facilities. This delivery system establishes four standard delivery methods namely: Design bid build, Design build, Construction management at risk and integrated project delivery. However, there is a brief summary of how these delivery system factor in the services provided by various stakeholders. Furthermore, PDS (Rubin and Thomas-Mobley, 2013) contains four sub-system or component which comprises the selection strategy, relationship type, pricing structure and form of agreement.

2.2.1 DESIGN BID BUILD

According to Porter (2016) the design bid build form of contracts is executed by the design team from a specific firm in which the project is established. The design team perform the design process, construction details and specification and put them together for bidders to bid. Consequently, the successful contractor is awarded the contract based on submitting the lowest bid price which is further dependents on his bid being responsive. This type of

project delivery system is mostly considered in the construction industry while it is deemed to be the traditional delivery method globally. According to Forbes and Ahmed (2011) the design bid build as many shortcomings which are protracted process to do programming, design, bidding and bid award before the construction commences. These shortcomings oftentimes delay the extended project duration which in turn result in budget overrun as the time extends. When this happens litigation and disputes set in the delivery process because of dissonance between the expectations of the parties to the contract which include the owner/sponsor, designer and contractors. According to Forbes and Ahmed (2011) the underlisted advantages and disadvantages where cited:

Advantages

(1) The design team maintain neutral for the interests of the sponsor
(2) Successful bidders are fairly treated to advance the sponsors decision capability.
(3) It enables the sponsor to develop competitive project cost.
(4) Projects deliverables normally establish acceptable quality measures.

Disadvantages

(1) Errors developed from the design team may escalate the cost of project as well as delay it operation.
(2) The quality issues would be undermined as the cost escalate the risk burden of the contractor.
(3) The contractor's advice on the cost effectiveness of the project is limited.
(4) Dispute may arise as pressure mount on the design and construction team.

2.2.2 DESIGN BUILD PROJECTS

The delivery system has an arrangement between the designer and the construction professional either from the same organisation or through a joint venture. However, the design team can form a joint venture with the construction firm to offer service to the owner or sponsor. This form of contract is organized with a single construction firm early in the preconstruction stage which takes the project from conceptual design through the construction process to its completion. This system can also be referred to as turkey (Darwish, 2017). According to Forbes and Ahmed (2011) design build projects expedite delivery through concurrent design and construction activities. This ensures that preliminary design as well as cost and schedule proposals for the overall project are carried out by one entity. In other DB projects, the owner may review proposals from various organisations where legally binding agreements are entered into with a single organisation that provides the most appropriate proposal. Furthermore, once the proposal is accepted by the owner the successful firm is then given access to the site to commence construction process as soon as the legally agreement is established. However, the design build has the potential of providing better quality, especially with regards to the following factors that are considered as a subsets to quality: (a) Communication is simplified and accelerated, as the owner has one point of contract (b) the adversarial nature of the three way relationship in design bid build project is avoided (c) Conflicts over the intent of the specifications and their deployment are resolved internally (d) the accelerated completion of design build projects lends itself to greater owner satisfaction (e) Cost growth is minimized for the owner. The following are the advantages (Forbes and Ahmed 2011):

(1) The design build project deliverables are completed at the fast pace.

(2) Design and construction project are accomplished by sole entity.

(3) Project participants' deals with conflict without the involvement of the sponsor.

Disadvantages:

(a) The construction firm may adopt ways of cutting cost on the project as a way to improve savings.

(b) The sponsors' interference is limited with this type of projects.

(c) Reduction in quality may compromised as a result of increasing profit margin of the builder.

(d) The sponsors' interest is undermined because design team is accountable to the contractor.

2.2.3 CONSTRUCTION MANAGEMENT AT RISK

According to Porter (2016) construction management at risk is basically involves preconstruction service where the sponsor employs the service of selecting a contractor even before the design process is completed. However, before the delivery the construction manager and the designer are concurrently nominated earlier at the beginning level of the contract. Furthermore, the construction manager provides an advice to review alternative mind set use in production, cost and other similar recommendations. There is a reduced uncertainty by having the construction manager Forbes and Ahmed (2011) involved in the management of the design phase of the project, in a way that will involve the selection of sub or specialty contractors to assume the risk of successful completion. Furthermore, the construction management at risk works under a maximum guaranteed price which requires that the project contains cost and bear the overrun cost. The construction manager bears the

risk of pricing and directly contracting with the respective contractors. Moreover, the contract type of the construction manager is not as amenable to quality initiatives as for the design bid build and deign build contracts. Therefore, immediately after the guaranteed maximum price is established the construction manager can begin to allow for overlap of the design and construction phase to expedite action to accelerate the schedule activities. However, as soon as the construction start the general manager assumes his duty as the general consultant. The risk associated with the contract are bone by the construction manager for any cost exceeding the guaranteed maximum price (Porter, 2016). Forbes and Ahmed proposed some advantages to this method of delivery:

(1) Establishment of the preliminary cost of the project enables cost effectiveness for the sponsor.

(2) The construction management at risk is accountable for the management of production process with connections over subcontractors.

(3) The sponsors risk can be eliminated with the involvement of the construction management at risk in a complicated project.

Disadvantages:

(1) The supervision of the construction project by the construction management is an additional cost.

(2) Conflict of interest is paramount when one firm act in the position of manager and contractor is responsible for the administration of the contract.

2.2.4 INTEGRATED PROJECT DELIVERY

Integrated project delivery according to Porter (2016) put emphasis on promoting collaboration among the key project participants namely the sponsor, Architecture, Engineers and lead Contractor of the construction industry. Porter also defined integrated delivery of project as multi-party form of agreement signed by all of these participants. However, these agreements provide a shared financial incentive, collaborative decision making, lean construction principles and provision to prevent litigation. He recognized that similar conditions persist with contractors working under integrated project delivery and management of construction at risk. Contractors have a high level participation in the design process under the integrated project delivery than the construction management at risk. The integrated delivery of project success include commitment to collaboration of all the projects participant. Participants in integrated project delivery require flexibility in adapting to new and evolving discipline. Any member of the integrated team can make comment on any aspect of the design while the participant in the design team collaborate to ensure that a collective effort to decide to amend and resolve matter in the design phase. Some case studies alluded to the fact that integrated delivery project have met as well as exceeded sponsor's objectives including favorable budge, schedule and safety outcomes (Porter, 2016).

2.3 THE JOURNEY OF LEAN PRINCIPLES

Lean manufacturing concepts according to Amal and Umarali (2017) was originally developed by Toyota in Japan. They proposed that the manufacturing strategy was to minimize or eliminate the non-value added activities in the production and operation system.

However, Amal and Umarali emphasis that the term lean was used by Womack and his colleagues to denote a system that uses less in terms of all inputs, to create outputs similar to those of the traditional mass production system while offering increased choices for the final consumer. The lean thinking provides a way to do more and more with less and less of human effort, less equipment, less time, and less space while coming closer and closer to providing customers with exactly what they want. According to Tommelein (2014) Lean refers to the pursuit of an ideal that is to: (1) do what the customer wants, (2) in no time, and (3) with nothing in stores. Tommelein reiterated that in order to achieve these ideal, lean thinkers follow a set of principles to attain that ideal, and in turn a set of methods and tools to apply those principles. Lean construction adopts the lean thinking mindset, therefore he alluded to the fact that lean is philosophy. Leadership commitment and the constant improvement of the lean construction principles are what is required to sustain the lean implementation. Tommelein (2014) stress the need for continuous improvement by following the steps of PLAN-DO-CHECK-ACT in order to becoming learning organization. The application of lean principles when properly carried out, will bring improvement in the area of cost overrun, schedule delay, quality and safety are achieved at the project level. Lean manufacturing according to Amal and Umarali (2017) is an integrated system composed of highly inter related element and wide variety of management practices, including just in time (JIT), quality system, work teams, cellular manufacturing as well as the various tools and techniques to implement lean principles to an industry such as: Total Productive Maintenance (TPM), Total Quality Management (TQM). Failure Mode and Effective Analysis (FMEA), 5S, Quality Function Deployment (QFD) Kaizen, Kanban, Value Stream Mapping (VSM) etc. (Umarali, 2017)

2.3.2 CONCEPT OF LEAN CONSTRUCTION PRINCIPLES

Lean construction according to Aziz and Hafez (2013) is a way to design production system to minimize waste of materials, time and effort in order to generate the maximum possible amount of value. However, the most important determinants of construction are supposed to be workflow reliability and labour flow, but lean construction has changed the traditional view of the project as transformation, and embraces the concept of flow and value generation. Some techniques proposed by Aziz and Hafez (2013) is the use of concurrent engineering which seek to describe as parallel execution of various tasks by multidisciplinary teams with the goal of obtaining most favorable products concerning functionality, quality, and productivity. The important planning parameters for scheduling concurrent activities are lead time, quantity, and risk under ambiguity. It focuses on team efforts; communication and information sharing are the keys for discovering new ideas while partnering with subcontractors and suppliers to have a good mind to the changes regarding concurrent engineering. Lean success is depending on the involvement of all participants in the early stages of the design. Aziz and Hafez (2013) also proposed the following to be implemented on project site: (1) Select suppliers who are willing to adopt lean project delivery; (2) Structure the project organisation to allow money to move in pursuit of the best project-level returns; (3) Define and align project scope, budget, and schedule; (4) Explore adaptation and development of methods; (5) Make design decision, with explicit alternatives against stated criteria; (6) Build quality and safety into projects; (7) Implement JIT and multi-organisational processes after site demand; (8) Use evaluations and planning on process that transform materials; (9) Use computer modeling to integrate product and process design; (10) Use 5s workshops: a tool for work place organisation and

promoting teamwork (S1) Sort through items, keep what is needed and dispose of what is not; (S2) Straighten: organize and label everything; (S3) Shine: clean; which can also expose abnormal and pre-failure conditions; (S4) Standardize: develop rules to maintain the first three S's; and (S5) Sustain: manage to maintain a stabilized work-place and initiate continuous improvement when needed and (11) Apply value Stream Mapping to make visible all the steps in process. Forbes and Ahmed (2011) cited Ford in lean business norms cisca included the following principles:

(1) The area within which the project is executed must at all times be clean.

(2) Leaders of project decisions are made that will advance the beneficiaries of the projects.

(3) Advancement of construction activities must be enhanced routinely.

(4) Industries must assist distributors by producing high valve product at a reduced price.

(5) Continuous supervision of management of construction is key in order to understand the work by field visit and not be comfortable in their offices.

(1) (6). Employees must be allowed to advance in learning in order to better their job performance.

The application of lean principles results in better utilization of resources especially labour and material. It also results in better construction quality in completed facilities, greater owner/client satisfaction, higher level of safety, and ultimately greater profitability for clients, builders, and design professionals. Lean construction uses production management techniques to make significant improvements particularly on complex, uncertain and quick projects (Forbes and Ahmed, 2011).

2.3.2.2 VALUE STREAM MAPPING

According to Layeequddin and Khatoon (2017) value stream mapping (VSM) is a tool for depicting the flow of material in a manufacturing process. VSM is a mapping strategy to improve material and information flow by coordinating the activities performed by manufacturers, suppliers and distributors to deliver products to the customers. However, Layeequddin and Khatoon defined the value stream mapping as a collection of all actions value-added and non-value added that are required to bring a product or a group of similar products from the raw material to the customer. The value stream mapping according to Carvalho et al. (2019) is designed over the years to manage and follow spot ways and identify and remove waste. Carvalho meant that in order to design the material flow through the operations, considering the whole supply chain, with the information of cycle time, downtime, and inventories and other key operations. Furthermore, there are some benefit associated to VSM which are as follows: (1) It allow a wide view of flow which assist in the identification of waste; (2) It identify the relationship between material and information flow; (3) It provide simple standardization as a way to treat procedures; (4) It makes decision more visible; (5) It allows possible changes and improvement in previous discussion; (6) It forms the basis of an action plan. The best possible way to manage the value stream involves the understanding, measuring and improving the flow of materials and information with the interactions of all tasks to ensure that cost, services and quality products are as competitive as possible (Dal Forno et al., 2014).

2.3.2.3 THE LAST PLANER SYSTEM

According to Cwik and Roslon (2017) who cited lean construction institute defined the last planner system as a system for project production planning and control, aimed at creating a workflow that achieves reliable execution of project. Furthermore, Aziz and Hafez, (2013) cited Mossman who defined the last planner as a system for collaboratively managing the network of relationship and conversations required for programme coordination, production planning and project delivery, by promoting conversations between trade foreman and site management at appropriate levels of detail before issue become critical. According to Aziz and Hafez (2013) the most effective ways to increase efficiency of construction industry is to improve planning and control process. Planning defines the criteria and creates strategies required to reach project objectives, while controlling makes sure that each event will occur following the planned sequence. However, the last planner is one of best lean principles which has been demonstrated to be a very useful tool for the management of construction process, and continuous monitoring of the planning efficiency, to assist in developing foresight, smoothing workflow variations, and reducing or removing uncertainties plaguing construction processes (Aziz and Hafez, 2013). Furthermore, they reiterated that the last planner consists of work flow control and production unit control. Work flow control is accomplished primarily through the look-ahead process, while the production unit control is accomplished primarily through weekly work planning. The last planner is based on two main objectives which are to make better assignments to direct workers through continuous learning and corrective action and to cause the work to flow across production units in the best achievable sequence and rate. The integrated components of the last planner are: the master plan, phase planning, look-ahead planning, weekly work planning, Percentage of

Promises Completed on time or Percent of Planned Completed (PPC). However, it is assumed that when a project team improves its planning it reduces variation, and thus can become more productive by matching its production resources more closely to the demand for them, so reducing waste. Furthermore, companies utilizing the LPS have been able to maintain project on time and at budget, as well as having a stress-free production planning and control process. Another area of interest was when Aziz and Hafez (2013) cited Fernandez work reported benefits attributed to LPS implementation were: (1) smooth work flow, (2) predictable work plans, (3) reduced cost, (4) reduced time of project delivery, (5) improved productivity, and (6) greater collaboration with field personnel and subcontractors. The last planner also has four element which are: (1) Programming Workshop: Collaboratively creating and agreeing production sequence (and compressing it if required); (2) Make-Ready: Making tasks ready so that they can be done when we want to do them; (3) Production Planning: Collaboratively agreeing production tasks for the next day or week; and (4) Continual Improvement: Learning about and improving the project, planning and production processes. However, Cwik and Roslon (2017) gave eight (8) reasons for adopting the last planner which was mentioned Mossman in his paper entitled last planner: 5+1 crucial and collaborative conversations for predictable design and construction delivery which are as follows: (1) to deliver the projects more safely; (2) to create a more predictable production programme; (3) to reduce project durations; (4) to better manage costs; (5) to reduce stress on the project management staff; (6) to help to improve the overall production process; (7) to help to make projects a reliable customer for just-in-time deliveries; (8) it works in a way that traditional critical path method do not.

2.3.2.4 THE 5S SYSTEM

The 5S according to Flilip and Marascu-Klein (2015) is the method to improve efficiencies and enhance the management performance. The 5S is the methodology of creating and maintaining well organized, clean, high effective and high-quality workplace. Its result is the effective organisation of the workplace, reduction of work environment, elimination of losses connected with failures and breaks, improvement of the quality and safety of work. The meaning of the 5S represent Flilip and Marascu-Klein (2015) who cited Michalska the concept of good maintenance which are written in a five short form words in Japan. It has the following significance: (1) Sort – decide and separate or remove the unnecessary thins by the necessary tools; (2) Set in order – putting in an logical order each item most often used in properly place and storage out those in a well-established location; (3) Shine – perform and maintaining a deep cleaning, eliminate sources of dirt and simplify cleaning process, quality can be obtained only in clean working environments; (4) Standardize – established rules and storage areas by making simple visual rules along with training of maintain standards to reduce search time and avoid mistakes; (5) Sustain – all activities should be monitored, evaluated and continuously improved in order to respect and maintain the results achieved through the implementation of 5S method.

2.3.2.5 THE JUST IN TIME PRINCIPLES

The just in time (JIT) inventory system is a management strategy that aligns raw material orders in the suppliers directly with production schedules. JIT delivery in construction, is an inventory management approach designed to eliminate waste by receiving goods only as they are needed in the production processes. While JIT delivery is most often correlated with

combating the issue of inventory waste, it is also perfectly applicable to the elimination of D.O.W.N.T.I.M.E and all of the eight (8) waste of lean construction. They are: Defects Overproduction, Waiting, Non-utilized Talent/Resources, Transportation, Inventory Excess, Motion Excess and Extra Processing. Companies use this inventory strategy to increase efficiency and decrease waste by receiving goods only as they need them for the production process, which reduces inventory costs. This method requires producers to forecast demand accurately (Banton, 2019). Banton however, proposed some advantages of just in time system:

(1) Lower inventory holding costs – with inventory purchased or produced at short notice there is no need to have unsold inventory taking up valuable warehouse space.
(2) Improved cash flow – without the need to store large volumes of inventory at all times, capital expenditure in reduced, and cash can be invested elsewhere.
(3) Less dead stock – because inventory levels rely on customer demand, there is less risk of unwanted stock left sitting in your warehouse.

Disadvantages:

(1) Problems with order fulfillment – if a customer orders a product and you don't yet have it in stock, you run the risk of not being able to fulfill order in a timely fashion.
(2) Little room for error – doing JIT right means having accurate demand forecasts and insights to customers' buying habits at all times. Any miscalculation could have a significant negative impact on business operations.
(3) Price shocks – with a Just in Time system, you don't have the luxury of waiting around for the best prices on goods. When prices go up, profit margins go down.

2.3.2.6 KANBAN SYSTEM

Kanban according to Ahmad el al. (2018) is process that seeks to focus on visualizing the flow and minimizing work in progress to reduce the idle time in the process within the construction industry. Furthermore, Mayilsamy and Pawan Kumar, (2014) Kanban is a system which is signaled for demand of specific product, with a specific quantity and delivered to a specific process. Kanban is a card that attaches to an inventory number of the ordered item until it is installed. However, Rajat et al. (2015) reiterated that Kanban system is set up to focus on waste reduction in all informs overproduction, unnecessary motion, defects over processing and waiting. They further proposed some principles of Kanban system: (1) Visualize work; (2) Limit work in progress; (3) focus on flow; (4) Continuous improvement. Kanban system according to Rajat et al. (2015) uses cards to establish signals for the need to move material within or outside supplier to the production facility which contains details of product and other relevant information. Mayilsamy and Pawan Kumar propose some benefit with regards to using Kanban they are as follows: (1) It reduces manual card handling and order entry activities; (2) It clarifies communication with suppliers; (3) It enables real time visibility of demand signals; (4) It speeds analysis of supplier performance; (5) It allows efficient analysis and adjustment of Kanban quantities and (6) It is simple as compared to the traditional Kanban system, where signals are transferred faster.

2.5 LEAN PROJECT DELIVERY

According to AEC community there has been deficiencies in the design and construction processes that are evidenced by cost overruns, project delays, and quality and performance

shortfalls in the finished construction. Poor design and documentation quality have been identified as a major factor in reducing the overall performance and efficiency of construction projects. Consequently, they have directly caused many projects to run over budget, over time schedules, and to be plagued with rework, change orders (variations), and disputes. Various case studies have identified design and documentation deficiency as the major contributor for construction contract variations (Forbes and Ahmed, 2011). Projects have long been understood in terms of phases, eg predesign, design, procurement and installation. Some of the key differences between phases and the participants in each phase. The term project delivery system is traditionally used for a project's contractual structure, eg prime contract. The lean community understand delivery in term of the work process from a building's concept to commissioning. According to small, et al. (2017) who cited Koskela introduced the TFV – theory of production, which complements the three views of production: Transformation (T), flow (F) and value (V). The development and incorporation of lean principles in construction is generally tied to Koskela's pioneering work on the development of the TFV theory of production of overcome the failure of traditional project delivery methods to achieve time, cost and quality objectives. In this approach, T refers to the Transformation of materials into a completed facility, F refers to the flow of the material through the construction process and V refers to value generation and creation, which comes primarily through the elimination of loss and waste in the process. Lean project delivery (LPD) systems are structured, controlled and improved in the pursuit of the TFV – theory, illustrated in figure 2.1

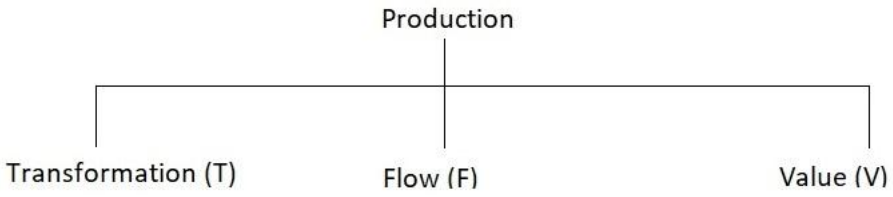

Figure 2.1: TFV - Theory

(Source: Forbes and Ahmed, 2011)

2.6 CHALLENGES IN ADOPTING LEAN CONSTRUCTION PRINCIPLES

According to Bashir, et al. (2015) the challenges facing the implementation of lean construction principles, even though its application has yielded a lot of benefit across various organisations. A total of eleven challenges were identified across the organization which include (1) resistance to cultural change; (2) complexity; (3) lack of cooperation; (4) lack of long term forecast and investment; (5) lack of lean knowledge; (6) cost of implementation; (7) long implementation time; (8) change in attitude and thinking; (9) misconceptions about lean; (10) lack of management support; and (11) high expectations from the management. Bashir, et al., (2015) also proposed in their work that there exist significant barriers to the successful implementation of lean construction as stated below: (1) Lack of adequate lean awareness and understanding; (2) Lack of top management commitment; (3) Cultural and human attitudinal issues.

2.6.1 MANAGEMENT ISSUES

According to Abdullah et al. (2009) success of lean practice lies in their commitment to develop and implement an effective plan and adequately provide the required resources and support to manage changes arising from the implementation. In their study they identified

poor project definition, inadequate resources and delay in materials delivery were some of the managerial issues hindering the successful implementation of lean construction. However, the identified challenges are lack of poor communication, lack of clearly defined plans, lack of client, subcontractor and supplier involvement, lack of transparency, inaccurate preplanning, delay in decision making, unsuitable organisational structure, weak administration and poor procurement strategies, among others.

2.6.2 FINANCIAL ISSUES

According to Bashir, et al. (2015) strategies for the implementing and innovating lean construction need enough funds to motivate the workers by providing relevant materials and equipment as well as employ lean construction specialist to guide both employers and employee in the concept implementation process. However, Olatunji (2009) identified poor professional wages, corruption, lack of incentives and motivation and poor risk aversion to be common challenges.

2.7 MEASURES TO MITIGATE LEAN CONSTRUCTION IMPLEMENTATION

According to Bashir et al. (2015) they proposed thirteen (13) different strategies that could be used to address the challenges of lean construction implementation. However, these challenges have been established as: (1) Simplification of lean language; (2) Total belief by site team and supply chain; (3) Lean education; (4) Get clients to insist on lean application; (5) Legislative requirement; (6) Publication of results (7) Reduce fear among workers; (8) Management involvement and support; (9) Persistence; (10) Robust planning (11)

Enlightenment on benefits of lean and need for change; (12) Gradual step by step implementation and (13) Workers involvement and empowerment.

2.7.1 ENLIGHTENMENT ON BENEFITS OF LEAN CONSTRUCTION PRINCIPLES AND THE NEED FOR CHANGE

Bashir et al. 2015 was of the view that organisations should endeavor to engage their staff in enlightenment meetings, workshops and other events on the benefits of lean construction principles implementation. They further suggested that workers should be enlightened on the need for change from the traditional practice and should be made to understand the difference between lean and non-lean practice. The employees should be informed about how they can comply with the demands of lean practices. This could address the challenges of misconceptions about lean and lack of cooperation from employees.

2.7.2 SIMPLIFICATION OF LANGUAGE OF LEAN CONSTRUCTION

According to Bashir et al. (2015) they are of the view that the terminologies adopted from lean manufacturing should as much as possible be minimized to prevent confusion in the employees' mind. However, simplification of the language of lean was suggested by Bashir work that organisation should use terms that are simple to understand which can be easily apply by the employees at all levels. The established that all instructions, directives and terms should be made easy to understand in order to achieve compliance and successful execution of the assigned tasks.

2.7.3 TOTAL BELIEF BY SITE TEAM AND SUPPLY CHAIN

The organisation should ensure that the site team and the supply chain have confidence in the new approach. However, they should be made to belief in it and mentally accept it and have full conviction that it is progressive change. This strategy ensures addressing the challenges in changing working culture and lack of cooperation from employees (Bashir et al., 2015).

2.7.4 EDUCATION

According Bashir et al. (2015) every organisation seeking to improve on the lean construction principles must endeavour to engage their staff in a continuous learning process to acquire all the necessary knowledge and skill required to achieve a smooth and full implementation. They also belief that these could involve organizing a workshop or a training session with lean consultants as the workforce must be adequately trained to fully and successfully accomplish task using the new tools and approach. These approaches could address the misconception about lack of lean knowledge, complexity of lean principles and lack of cooperation from employees.

2.7.5 PUBLICATION OF RESULTS

According Bashir in their study emphases that the benefits of lean construction practice should be communicated to the employees at all levels and even engage in publication in the newspapers building magazines and journals. They can also use TV programmes and other audio – visual aids to communicate the result and benefits of the adaptation of lean

principles for all and sundries to see and appreciate the need to implement the lean construction principles in all organisations (Bashir et al., 2015).

2.7.6 REDUCE THE FEAR/RESERVATIONS

Bashir et al. (2015) proposed that organisations should ensure that fear built in the staff due to misconceptions and misunderstanding of lean construction principles and practice is cleared from their minds which will enable the employees clear away any reservations from their minds. However, in order to clear those reservations from their minds Bashir proposed to call it business improvement rather than lean construction with workers viewing it as an innovative continuous improvement strategy rather than an entirely new method of doing business.

2.7.7 TOP MANAGEMENT IMVOLVEMENT AND SUPPORT

According Bashir they are of the view that management must be fully involved in the implementation of the lean principles in order to ascertain how the implementation can yield results. Management must engage themselves in continuous improvement activities required to support and strengthen the staff by way of addressing the challenges of lack of long term forecast and investment, high expectations from management, lack of incentives and lack of cooperation from employees. According to Movaghar (2016) managers and leaders should be satisfied that lean is a proper and useful organisational growth, while urging managers to assign responsibilities across all and sundry within the organisation. Construction firms should inculcate values to spread the goals of the organisation. Movaghar is of the view that

organisation cannot succeed lean principles without exhibiting healthy culture for the smooth implementation to take place.

2.7.8 PERSISTENCE

With the view to achieving a sustainable lean construction principles and practice there is the need to follow a suggestion that gives the entire staff to ensure continuing effort to achieve the right results. In spite of these obstacles and inconveniences of changing working culture, they should be firm and steadfast towards satisfying the demands of becoming a lean organisation (Bashir et al., 2015).

2.7.9 ROBUST PLANNING

An organisation should be able to develop a comprehensive programme to achieve a smooth implementation while maintaining a vigorous scheme designed to aid the practice so that goals can be obtained. This however, ensures that the organizational policy objectives are achieved in the implementation of lean construction principles and practice (Bashir et al., 2015).

2.7.10 WORKERS INVOLVEMENT AND EMPOWERMENT

Bashir recognized the importance of lean construction principles and practice and suggested the staff involvement, irrespective of their position is key to making decisions that relate to the organisation. However, the employees must be encouraged express their views as well as empower them to make variable suggestions concerning achieving lean organisation (Bashir et al., 2015).

2.7.11 GOVERNMENT POLICIES AND LEGISLATIONS

According to Bashir et al. (2015) government in respective countries must endeavor to support lean construction principles and practice by introducing policy that seek to compel the construction industries in way of engaging continuous improvement practices, like lean construction, to minimize various degrees of waste generation emanating from resources that do not add value to the product under construction.

2.7.12 GRADUAL IMPLEMENTATION OF LEAN CONSTRUCTION PRINCIPLES

Bashir et al. (2015) in their study suggested good ways of overcoming the resistance to cultural change exhibited by employees undergoing lean construction principles and practice to avoid hindrance in the implementation process. They are of the view that the principles should be gradually taught and implemented in stages over a period of time while the relevant targets of lean tools should also be gradually be applied over time to achieve the desire understanding.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter explains the research rationale used in this study to achieve the main aim and objectives. According to Collis and Hussey (2003) they proposed that research methodology approach is the basis in the design process for data collection and analysis. This current study is based on the qualitative research approach to access lean construction principles and practice toward effective project delivery at Consar limited. Furthermore, the chapter also gives a clear presentation on the processes and how this research was scientifically conducted. Though processes involve in the designing of sampling procedure adopted and the data collection technique used for conducting the research.

3.2 RESEARCH DESIGN

In order to satisfy the objectives of this study, a qualitative research method was considered because it characteristic is appropriate for small sample size while its outcomes are not quantifiable as well as measured (Stake, 2010). However, the design of the research has to function to ensure that the evidence obtained address the initial answer to the questions as reasonably as possible. Presentation of research paper is based on a single explanatory case study involving the collection of qualitative data with an in-depth semi structured interviews of professional key figures from Consar limited. The interview questions were conducted both at the main yard of Consar office in Accra and an ongoing project at GNPC at Manet. However, the research was primarily focused on the lean construction principles as a way of

improving the project delivery systems with regards to the area of budget, project delays and quality and performance.

3.2.1 QUALITATIVE RESEARCH DESIGN

Qualitative Research is primarily exploratory research. It is used to gain an understanding of underlying reasons, opinions, and motivations. According to Shank (2002) the definition of qualitative research is the systematic empirical inquiry into the meaning. Qualitative Research is also adopted to discover the trends in thought and opinions and get in dept knowledge into the problem under study. The nature of the qualitative research enables the researchers to develop a holistic approach to the phenomenon in question (Denzin and Lincoln 2005). Again, Denzin and Lincoln (2005) explains the underlining principles of qualitative research as that: (1) Qualitative research ensures holistic systematic approach to the bigger view with a search for understanding. (2) Qualitative research establishes the relationships in a system. (3) Qualitative research focus on understanding the parameters in the social set up and not necessarily making predictions about the setting. (4) Qualitative research is time consuming when making an analysis; it requires ongoing analysis of a data. (5) Qualitative research methods require an instrument from the researcher. It incorporates the researcher's bias and preferable ideology. (6) Qualitative research design requires incorporating a decision on ethical concern. Therefore, qualitative data collection methods with the adoption of either unstructured or semi-structured method requires some underlining principles to meet the criteria for the study. Examples of some of the methods include focus group discussions, individual interviews, and observations. Once the sample size is significantly small the respondents are able to select and fulfil a given quota.

3.3 STUDY POPULATION

According to Reid (2014) the population in the study domain possess certain characteristics which are of concern to researchers' interest. Population as define by Reid, constitute the entire groups within a community likely to be selected by the researcher for the study. However, the current study population is 463 permanent employees of Consar limited.

3.3.1 SAMPLE SIZE

Sample is a subset of a study population where the researcher selects to participate in the study. It represents the fraction of the whole population selected to participate in the research work (Polit and Hungler 1999). There is no set of criteria for selecting a sample size in a qualitative research study (Patton, 1990). However, some researchers like to commence with a minimum sample size required for the coverage and interest of the population under study (Patton, 1990). In this study, a purposive sampling technique was used to select 20 professionals for an in depth study out of the entire population of Consar limited employees.

3.3.2 SAMPLING TECHNIQUE

There is possible sampling technique to use when conducting research work, in a qualitative research the researchers mainly are concern in working with a small sample, which the outcomes is not been quantified. Therefore, the method use for the sampling of this study was a purposive sampling. However, this adopted method fall under a non probability sampling procedure where samples were selected on the basis of knowledge and expertise in the subject area (Freedman et al., 2007). The current study sample members are selected on

the basis of relationship with a phenomenon under study and also relevant work experience in the construction industry.

3.3.3 PURPOSIVE SAMPLING TECHNIQUE

The purposive sampling is a non probability sampling technique which are most effective when one needs to study a certain phenomenon with knowledgeable experts within. In non-probability sampling, randomly selecting samples is not necessary in the population of interest. Instead the use of subjective methods is preferred element included in the sample. Consequently, non-probability sampling technique are grouped in a process which do not give all respondent an equal chance of being selected with a population of study (Sulaiman, et al., 2016). Obviously, the researcher agrees to determine what kind of information are required and pursue it for respondent who can offer good information with regards to knowledge and expertise in the study area (Bernard 2002, Lewis and Sheppard 2006). Purposive sampling technique was used in selecting a sample size of Twenty (20) senior employees from the Consar main yard. The twenty consist of senior management members as well as project managers of Consar limited and a sister sub-contractor within the main yard namely Seepacs Engineering limited and Allemar aluminum system limited.

3.3.4 SEMI STRUCTURED INTERVIEW

The approach use for interviews was semi structured with access to open questions. Some of the advantages derive from semi structured interviews with access to open questions are that additional questions can be asked by the interviewer where the interviewee were required to produce their own answers to the questions (Ejvegard, 2009). However, semi structured

interviews are most preferred data collection method in qualitative research, which rely on a face to face interaction from both the interviewer and the interviewee while gathering detail information in the process of the interview to get data. (DiCicco-Bloom and Crabtree, 2006; Denscombe, 2003). Moreover, semi structured interviews are considered the appropriate data collection method for this research study (Barriball and While, 1994:330). It allows for flexibility when it comes to using semi structured interviews, where the interviewer has the benefit of asking the interviewee to discover inconsistencies in the responses so that data will be reliable. The schedule of the interview has been carefully designed to cover the research objective on lean construction principles. The interview respondent was to specify their current roles and experiences in the company.

3.3.5 DATA COLLECTION TECHNIQUE

The principles in relation to guiding themes require that the researcher establishes data collection procedures for the current study. According to Stake (2013) he emphasizes that a researcher must first appreciate the use of observation before considering interviewing respondent to collect data to support the study. The researcher had observed how Consar limited a construction company in Ghana had adopted the just in time principles with a view of practicing lean construction in their project delivery process. However, the interview was considered a very important method of data collection followed by observation. Beyond the data provided to this study, each interview also corroborated with the observational experiences of the researcher from the industrial settings. Describing interviews as the appropriate data collection Dexter is of the view that Interview is the preferred data collection method for providing better data at less cost effective than other methods. This

study adopted the semi structured approach with the view that structured interviews was considered to be solid while unstructured interviews were simple for this study.

3.4 DATA ANALYSIS

This study uses absolutely semi structured interviews as an instrumentation for the data collection. The gathered information from the data collected would be use to run analysis using the NVivo 11 software method. Furthermore, the coding was used to assist the researcher with the view to understanding of the perspective of respondent and the analysis process. The coding was created during the research process for the purposes of conducting analysis. (Urquhart and Fernandez 2013). Coding was conducted using the computer assisted qualitative data analysis software. A computer assisted qualitative data analysis software, NVivo 11, was used to assist in the data management and analysis process. Preparation of the research data that would be use for the analysis demand substantial effort with the use of qualitative method (Hirsijarvi et al., 1997). Mostly, the serious mistake in the qualitative research design is to combine the data without adding interpretation or analysis (Koskinen et al., 2005). With the avoidance of this, interview transcriptions were categorized and coded using the NVivo 11 software method. Yin (2011) formulated an obvious rule that assisted to the minimization of bias in the research work.

3.5 CHAPTER SUMMARY

Obvious goal is to lay out procedural process aimed at finding answers to the research question of this study. This show how the study was going to carry out by following the procedure for data collection as part of the interview that was conducted and how many

respondents were involved in the study. The analysis was conducted with the use of NVivo 11 a computer software which is aided in the qualitative research. Base on how the procedure was use in conducting the research will help achieve the aim of chapter four.

CHAPTER FOUR

DATA ANALYSIS AND RESULT DISCUSSIONS

4.1 INTRODUCTION

As reiterated earlier the analysis and the result discussions were derived from a purposive sampling technique from the population of senior employees of Consar limited branch at Accra. However, the reactionale behind the case study was to access lean construction principles and practice toward improvement of project delivery at Consar limited. The instrument use for this research was basically a qualitative study which enable the researcher ascertain with a view to getting an in-depth knowledge on the lean construction principles and practice philosophy. A total of 20 senior employees comprising of the branch manager, project managers, engineers, and quantity surveyor were interviewed on the lean principles. However, the chapter consist of three sections which corresponds to the objectives of this research includes: 1) to identify lean construction principles currently been practice at Consar limited. 2) to identify the challenges, they face in adopting the lean construction principles. 3) to identify ways of mitigating the challenges in adoption of lean construction principles and practice. Multiple sources of data were collected from within the main yard of Consar limited branch office at Spintex road, the interview lasted six weeks from July 29, 2019 to September 5, 2019. The participant interviews were grouped into themes based on the research objectives, upon the groupings the participant interviews were therefore coded into the themes and run analysis using the NVivo 11 software for qualitative analysis.

4.2 DATA ANALYSIS PROCESS

It is imperative to bring to light the steps taken to conduct the data analysis process. However, the process involved in the data analysis were grouped into these stages:

1) Stage one transcribes the interviewed scripts into word document.
2) Stage two imported the word document into NVivo 11 software.
3) Stage three established three broad themes.
4) Stage four coded the interviews into themes.
5) Stage five a query was run based on the themes.

While conducting the interview on the main yard of Consar limited office at Accra as well as one of their sites at Manet junction named GNPC project I realized that the organisation was committed to maintaining quality and waste reduction which reflected in the participants' response.

Stage one transcribes the interviewed scripts into word document: The interviews was conducted with the use of audio recorder for the entire participants, where later the interviews were transcribed using the NVivo 11 software into a word document. However, before starting to perform the transcribe into word document it is necessary to import it into the NVivo software listen and transcribe it accordingly.

Stage two imported the word document into NVivo 11 software: The first thing that must be done was to ensure that all the word document matches with heading styles, for an example you can match the questions as heading 1 while the respondent answers match as normal throughout all the interviews. This will help identify all the heading styles in your word document so that NVivo can identify it as such in order to be uniform.

Stage three established three broad themes: After importing the interviews into NVivo software, it is imperative to create your parent nodes as your research objectives as well as the child nodes so that it will coordinate all your nodes under the parent node also called themes.

Stage four coded the interviews into themes: The actual coding will than begins by either manual or automatic into the already created child nodes. When it comes to NVivo nodes are very important because it allow the researcher to establish several nodes in one location. NVivo allows you to create and organize your data with the use of the parent and child nodes before it can be analyzed.

Stage five a query was run based on the themes: When all these stages have been completely executed and structured into NVivo software, it put the researcher in a stage where he can run queries base on your objectives in order to identify the trend of the research.

Furthermore, there is the need to start sorting and organising the node into themes and sub themes respectively, while establish themes in the parent node and sub themes become the child node. It is obvious from the Table below how the organisation of the various nodes by themes and sub themes are grouped with the use of the NVivo software.

Table 4.1: The arrangement of themes and sub themes captured in NVivo 11 software.

Node	Interviewees Sources	References
Demographic Information	13	91
Professional background	13	13
Level of Education	11	13
Job Level	10	13
Work experience with the company	13	13
Understanding of lean construction	14	13
Job performance		
Importance of lean construction	13	13
Identify lean construction principles at Consar	13	128
Project planning	11	14
Collaborate to get a job done	12	22
Improve performance	9	18
Maintenance of project site	12	24
JIT principles	12	12
Built in quality	11	11
Work flow	12	14
Challenges	12	12
Causes	12	12
Mitigation measures	12	46
Alleviation of the challenges	12	46

The above table shows how themes and sub themes were derive to create nodes, some key words appear in the transcript severally within the software. For example, in the figure below is a word crowd that shows the frequency of the number of appearances of that word during the interview session. The researcher administered the NVivo software using the query system to run a word frequency cloud to examine the emerging themes. Some factors

drove the emerging themes at the forefront base on the frequency and similarity of specific words and phrases that was use by participant in addressing the objectives of the research. It is obvious from the figure that construction is the most occurring word meaning the frequency of it occurring is high among all the words.

However, further analysis of the nodes appears with a multiple triangulation and member checking out of which it was grouped into three main themes with sub themes beneath the main themes.

1) Theme 1: The demographic information of the participants interviewed
2) Theme 2: The identification of lean construction principles at Consar limited
3) Theme 3: Challenges
4) Theme 4: Mitigation measures to adopted to improve lean construction principles.

4.3 DATA ANALYSIS THEMES

A total of thirteen participants were interviewed on a one on one basis out of the anticipated number of twenty participant who agreed to be interviewed. However, due to some circumstances beyond their control they were unable to make time to be interviewed. The interviewed sessions were conducted with the same arrangement for each participant. Consequently, the thirteen participant's responses were later transcribed into a word document before importing it into the NVivo software for analysis to commence. The participant input however, significantly influenced the emergent of the themes the researcher discovered.

4.3.1.1 DEMOGRAPHIC PARTICIPANTS INFROMATION

The participants were interviewed with the view to capturing their characteristics in line with their professional background, level of Education, job level, years of working experience with the company, their understanding of lean construction principles, how they will get better in the performance of their job and the importance of lean construction in their organization.

Diverse views emerge from the participant as to how their understanding of the lean construction principles.

4.3.1.2 PARTICIPANT PROFESSIONAL BACKGROUND

The figure 4.1 shown below shows that a sizable number of percentages presented out of the interview participants were as follows: 14% of the participants are directors, 35% projects managers, 30% were engineers, 7% quantity surveyors and 14% are supervisors.

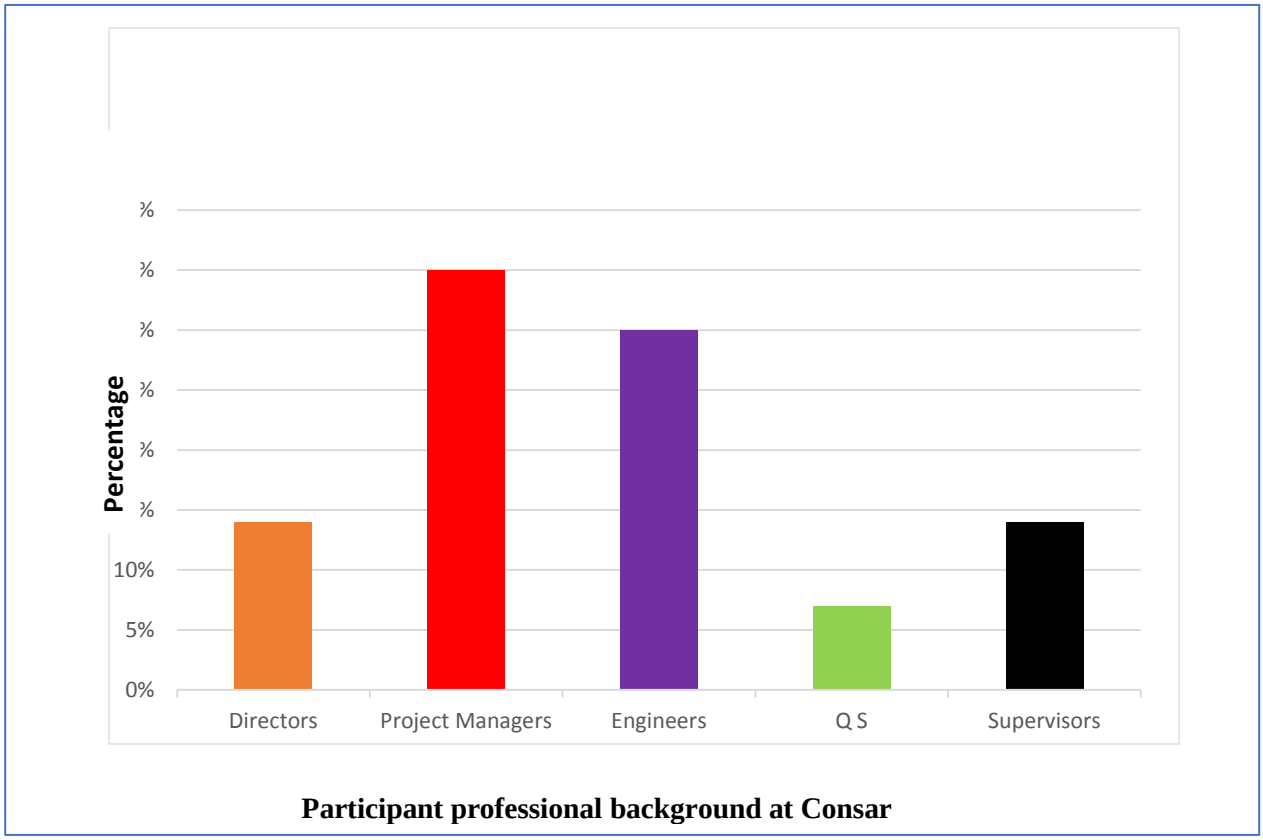

Figure 4.1: Participant professional background.

4.3.1.3. PARTICIPANT'S YEARS OF EXPERIENCE AT CONSOR LIMITED

The figure 4.2 below shows the participant experience acquired in the construction industry to be precisely Consar limited. However, out of the total number of participant that were interviewed 10% of them have worked with the company from 1- 5years, 35% have also worked for 6-10years, 30% of the participant have worked for 11-15years, 15% have had experience with the company for 16-20years and 10% have spent between 21years and above working with Consar limited.

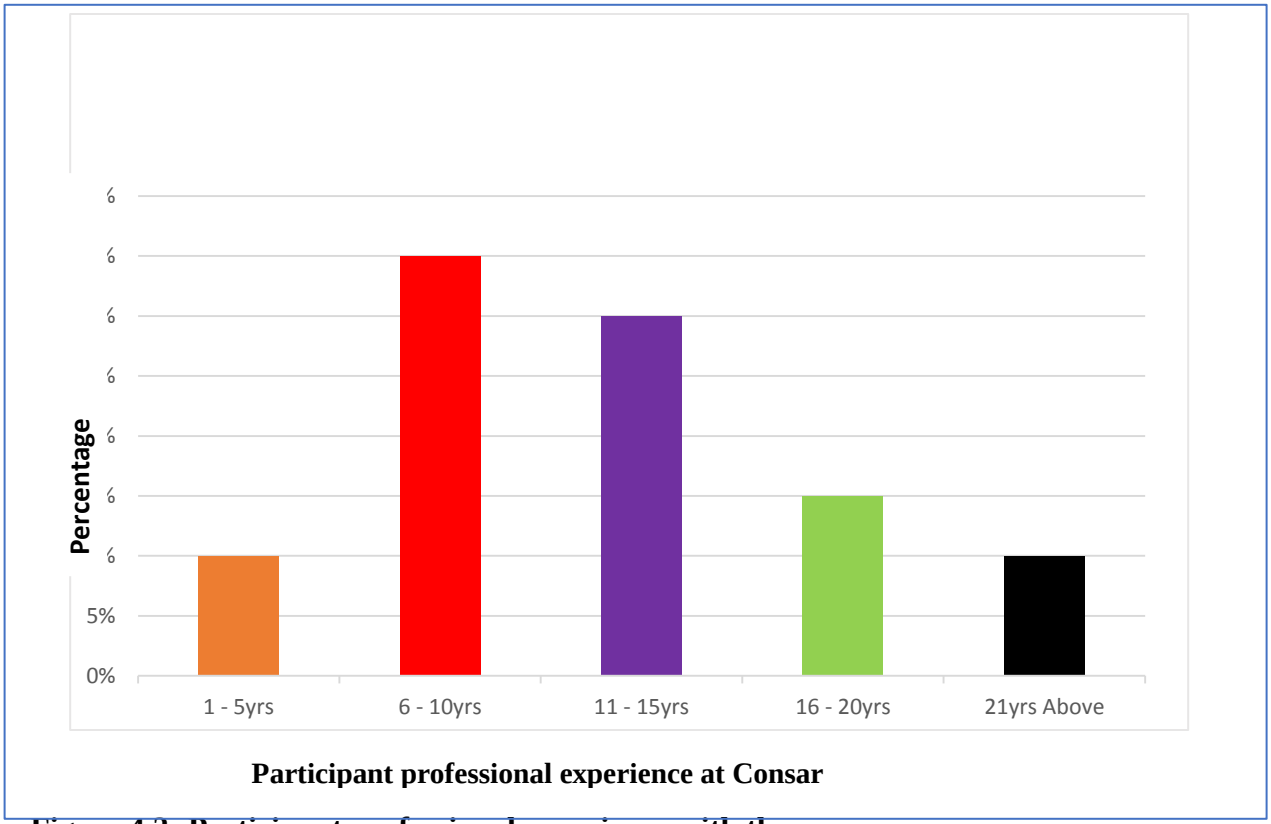

Figure 4.2: Participant professional experience with the company.

4.3.1.4 PARTICIPANT ACADEMIC QUALIFICATION

It is obvious that quite appreciable number of the participants had acquired academic qualification in the area of B.Sc., while the rest of the participant had master's degrees as their qualification. Preferably none of the participants had attained academic qualification at the Ph.D. level.

4.3.1.5 THE JOB LEVEL OF PARTICIPANT

From the figure 4.3 below, it was observed that out of the entire participant who were interviewed 25% of them had attained the job level as director at Consar limited, while 15% percent of them are at the managerial level and the rest of the participant are attained a job level as a senior staff within the Consar setup.

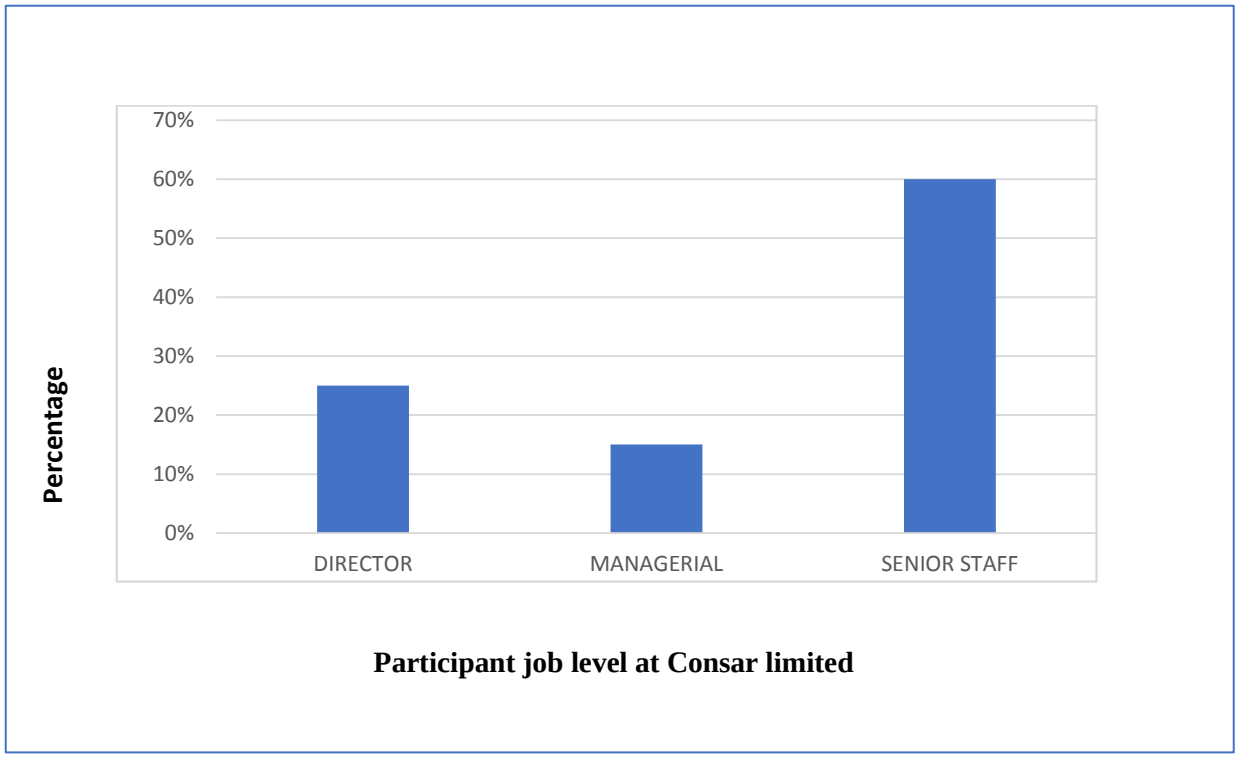

Figure 4.3: Participant job level in the company.

4.3.1.6 PARTICIPANT UNDERSTANDING OF LEAN CONSTRUCTION

The researcher sorts the participants understanding of lean construction and out of the entire participants interviewed 65 percent of them had a good understanding of lean construction, while 30 percent had fare idea of lean construction and the remaining 5 percent of participant do not have any idea of the lean construction.

4.3.1.7 PARTICIPANT JOB PERFORMANCE

It is observed from the interview participants that 65% admitted they would improve upon their job performance by constantly upgrading their knowledge on the lean construction principles as well as new emerging technologies. The remaining participants also admitted that they will improve on their job by working hard to achieve results.

4.3.1.8 PARTICIPANT IMPORTANCE OF LEAN CONSTRUCTION

All the participant interviewed were of the view that lean construction is very much of importance to the organisation, because the company's strategies and their way of doing things allied with lean construction principles and it seem to be working for them.

4.3.2 CODING METHODS

The method adopted in this section deals with steps taking to completing the participants interviews and transcribing the audio recording into word document before importing it into NVivo software to be coded. However, the data derived from the interviewees were sorted and organized into main categorization and themes accordingly. As the researcher utilizes the NVivo software coding, which is also referred to as verbatims coding or literal coding (Saldana, 2016). However, the participant own words were used by utilizing work frequency query that emerge from the top synonyms from the data. The first cycle coding was reduced to create initial nodes. Nodes containing significant volume of references were broken down further into multiple nodes. The process created significant number of codes, while the data was further condensed by different categories of pattern and themes. The researchers however, adopted comprehensive approach for coding to capture a sense of the complete

contents and the possible categorization which was developed further in the analysis (Miles et al, 2014). Consequently, thirteen nodes were created at different categories which emerge 343 codes identified during the process. The researcher read and scrutinize the scripts to remove all the unnecessary material from the codes. The NVivo 11 being the qualitative analysis data was designed to assist in the analysis of non-numerical data, which the system determines as a data from the interview transcripts, while subsequently the transcripts were imported into system by the researcher. The software has the ability to assist the analysis of non-numeric descriptive text from interview transcripts for the purpose of collecting data to aid in the qualitative study. The software allows the researcher identify, arrange and code data respectively. The process involve in the data analysis consists of data collection, coding, analyzing and reporting the information from the participants (Creswell, 2014). Utilization of the NVivo software predominantly process word frequency query command, which assist the researcher to present a word cloud figure where emerging themes occur as a result of their frequency of participants interview sessions. Figure 4.4 below represent the word cloud that emerge as a result of running word frequency.

Figure 4.4: An example of word crowd that emerge as a result of the word frequency query analysis

This word cloud enables the researcher to visualize the frequent use of key words that is important to Consar limited the case study environment. The researcher further explores to identify recurring words with the use of the frequency functions. However, the researcher further explores by highlighting statements and place them in a node. The node represents a container where statement that matches the objective of the research are highlighted and place in it, which assist the researcher in finding answers corresponding to the objectives of the study.

4.3.3 RESULT DISCUSSIONS

The outcome of the research study results is discussed with that of literature from the chapter two above. With regards to literature accessed in chapter two, the researcher compared the last planner system from the literature review with what the participant alluded to during the interview session with regards to questions ask them about the last planner. Participant perspectives about the questions regarding planning was that once a project is conceived employees collaboratively work together and come up with a plan that seek to bring to light the project objectives for the execution of the project. According to the literature Aziz and Hafez (2013) recognized the most effective ways to increase efficiency of construction industry is to improve planning and control process. They recognized that planning defines the criteria and creates strategies required to reach project objectives, while controlling makes sure that each event will occur following the planned sequence. However, the last planner is one of best lean principles which has been demonstrated to be a very useful tool for the management of construction process, and continuous monitoring of the planning efficiency, to assist in developing foresight, smoothing workflow variations, and reducing or removing uncertainties plaguing construction processes. Furthermore, Mossman (2013) reiterated that in his study which explain that adopting to the last planner system in construction amid at delivering projects more safely, to create a reasonable programme of production, better manage cost implications on projects, alleviate stress on management of staff, help improve overall production process, and make projects customer reliability for the just in time deliveries. The study establishes the current practice of construction project at Consar as observed in the interviews of participants generally align partially with some of the principles of the last planner acknowledge in the literature. Furthermore, the participant

interviews revealed that Consar limited as a construction company is keen on project planning and controlling to establish safe working environment while improving on customer reliability for just in time delivery of projects. Moreover, the participants perspective about how to create and maintain project site as well as dealing with waste on site reflected on the fact that management strategy are to ensure all site are clean, keep and maintain all project sites for free movement of activities and employees which seeks to prevent accident on site and make the site a safe working environment, while minimizing loses which comes as a result to failures and improve on the quality of their product. This is in line with what the literature has said which indicated according to Flilip and Marascu-Klein, (2015) that 5S is the methodology of creating and maintaining well organized, clean, high effective and high-quality workplace. Its result is the effective organisation of the workplace, reduction of work environment, elimination of losses connected with failures and breaks, improvement of the quality and safety of work. The challenges identified during the interview session with regards to the implementation of the lean construction principles as to do with the traffic situation in Accra which is hindering the progress of the just in time principles. Furthermore, corruption and delay in clearing imported goods at the ports came up during the interviewing participants as they alluded is a challenge to the lean construction implementation. However, some of participants also alluded to the fact that there is lack of motivating employees by management. Situating it to the literature Bashir, et al., (2015) was of the view that strategies for the implementing and innovating lean construction need enough funds to motivate the workers by providing relevant materials and equipment as well as employ lean construction specialist to guide both employers and employee in the concept implementation process. However, Olatunji, (2009) identified poor professional wages,

corruption, lack of incentives and motivation and poor risk aversion to be common challenges. The answers obtain from the participants interviewed attest to the fact that the organisation has not done enough in terms of educating employees on the lean construction principles application. Again, some of the interviewees agreed that the language of the lean is not common to them while others seems to be aware of some of the principles. However, the literature review agrees with the result as it was reported by Bashir et al., (2015) who were of the view that organisations should endeavor to engage their staff in enlightenment meetings, workshops and other events on the benefits of lean construction principles implementation. However, simplification of the language of lean was suggested by Bashir et al., (2015) work that organisation should use terms that are simple to understand which can be easily apply by the employees at all levels. Further established that all instructions, directives and terms should be made easy to understand in order to achieve compliance and successful execution of the assigned tasks. According Bashir et al., (2015) every organisation seeking to improve on the lean construction principles must endeavour to engage their staff in a continuous learning process to acquire all the necessary knowledge and skill required to achieve a smooth and full implementation. Porter, (2016) in his studies on integrated project delivery put emphasis on promoting collaboration among the key project participants namely the sponsor, Architecture, Engineers and lead Contractor of the construction industry. Participants in integrated project delivery require flexibility in adapting to new and evolving discipline. Any member of the integrated team can make comment on any aspect of the design while the participant in the design team collaborate to ensure that a collective effort to decide to amend and resolve matter in the design phase. Some case studies alluded to the fact that integrated delivery project have met as well as

exceeded sponsor's objectives including favorable budge, schedule and safety outcomes. However, relating the literature to the findings identified the researcher realized collaboration among project participants from the client side is not the best in addressing design discrepancies in order to eliminate its entirety from the design process. Furthermore, the road network in Accra is not the best to support the Just in Time principles application because it delays the material delivery.

4.3.4 FINDINGS OF THE STUDY

The aim of the study was to access lean construction principles and practice toward improvement of project delivery at Consar limited. This research is a case study solely conducted at Consar limited a construction company licensed in Accra to be precise Ghana. Findings of the study will be beneficial to the research objectives: (a) to identify lean construction principles currently been practice at Consar limited, (2) to identify the challenges they face in adopting the lean construction principles, (3) to identify ways of mitigating the challenges in adoption of lean construction principles and practice. However, these main themes and sub themes emerge from the mind mapping and arrange them into main and sub themes respectively. The procedure for arranging the themes and categorizing them in the research work are defined below with the discussion in relation to the findings.

1) Categories: Organizing words into nodes with similar meanings before grouping them using automatic coding method.
2) Concept: Categorization of the words into respective nodes for the data preparation on the study.
3) Themes: Arranging the data into themes and start running queries.

Main Theme 1: to identify lean construction principles currently been practice at Consar limited

The findings from the participants interviewed indicated lean construction principles that were in operation at the Consar limited. Various subthemes emerge from the findings which alluded to the fact that lean construction principles such as the just in time principles, visualization of work flow, planning process, minimization of waste, improvement in the process, built in quality, continuous improvement among others.

Sub Theme 1: Just in time principles was a sub theme that emerge from the parent theme which philosophy is based on inventory system direct management strategy to align raw material orders in the suppliers' chain directly with production schedules. JIT delivery in construction, is an inventory management approach designed to eliminate waste by receiving goods only as they are needed in the production processes. The findings indicated that Consar limited frequently uses inventory strategy to increase efficiency and decrease waste by receiving goods only as they need them for the production process, which reduces inventory costs. For an example they have adopted premix of concrete in all most all their site. This management strategy has help them to reduce material waste on the site. Most of the participant interviewed alluded to the fact that all their material is ordered from the main yard of the Consar office which disable them from storing material at the site. For an example, five participants admitted that the just in time principles is indeed encouraging the company in it project delivery. They acknowledge that project site may request the need of a material to the operation manager at Consar main yard indicating the day and time they will need the operation team to deliver their request to them at the right time and with the right quantity.

Sub Theme 2: From the number 4.5 below participant interview explain that visualizing work flow assist in minimizing work in progress which reduce the idle time in the process within the construction industry. In order to improve any process, it is important to have good understanding of how the process currently works which allows them to examine the flow of work. By examining the flow of work enable the project team analyzed the amount of work that need to be done, the process of accomplishing and ultimately optimize process by incremental improvements. The flow of work again the scope of work of the process helps to equate the start date and end date of the process. These identify scope determines who is doing the process and what they want to achieve when they execute the process. Furthermore, it assists them to be able to follow up on those executing the work to ensure the work is executed on time to meet schedule of activities. Visualization of work flow is very important for the project team and therefore are concern with getting the job done well while reducing idle time spent in the execution of the work.

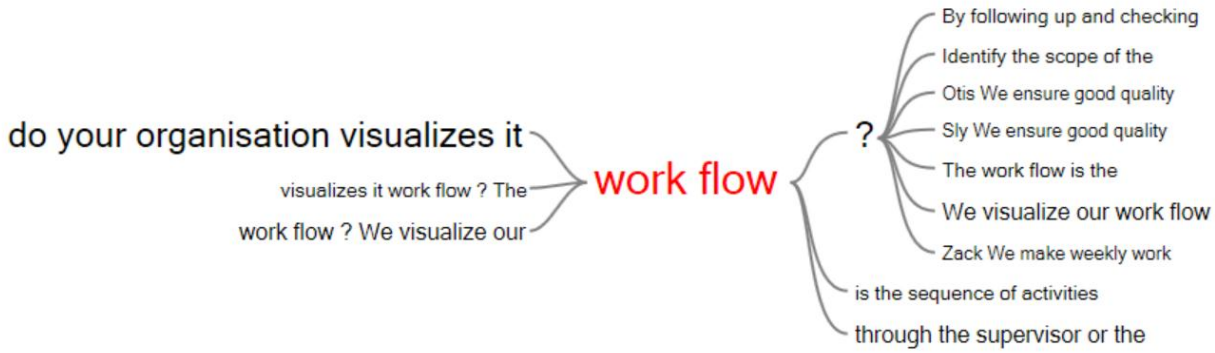

Figure 4.5: Representing the visualization of the flow developed from NVivo 11 software

Subtheme 3. Participant interviewed are of the view that various stakeholders in the construction are involved in planning process which seeks to successfully picture the views of everything within the scope of works and how it will be achieved. According to the figure 4.6 below it is obvious the internally during project planning groups of professionals are brought on board to brainstorm to get the job executed successfully. However, after winning the contract the management and staff of Consar collaborate to establish a clear plan toward the execution of the project, where planners, project managers, engineer's quantity surveyors and others are involved in the establishment of individual task aimed at producing project plan for the execution of the project. Consequently, helps identify the possible areas of design mismatch during the planning process and possibly proposing immediate solutions to the client for consideration. An observation has been followed by the researcher where during the planning process they have time to go through the drawing and the bill of quantities to ensure possible areas of variation as well as discrepancy if any existing in the contract for the client to be aware before the start of the project. Furthermore, after understanding the scope of works as well as clearing all doubt in the design drawings then the project team moves into execution.

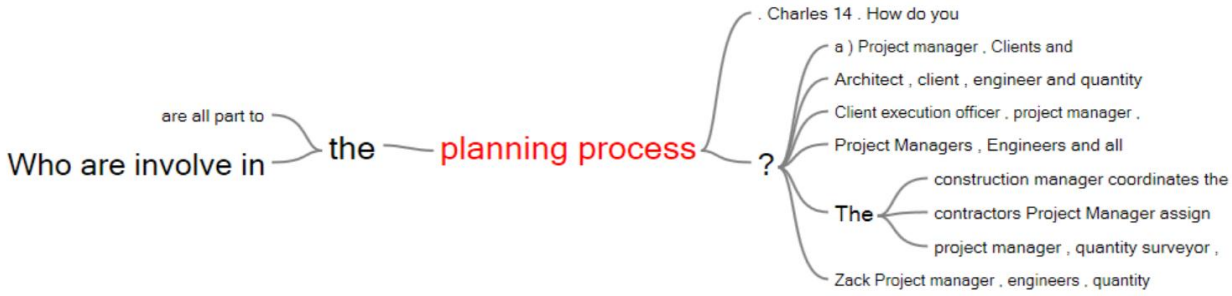

Figure 4.6: An example of the planning process developed from NVivo 11 software

Subtheme 5: Minimization of waste emerge during the running of the query for the word frequency, however the participant interviewed had this to say as presented in the figure 4.7 below. Analyzing the figure, it is obvious from the participants interviewed all spoke concerning the site maintenance which address one of the objectives in the study. Participants are of the view that Consar limited adhere to site cleanness as a way of maintaining a clean site to prevent the accident and maintain free movement at all their respective site. They alluded to the fact that in all their project they maintain good workmanship which makes them stand out from all the competitors in the industry.

Figure 4.7: An example of material waste developed from NVivo 11 software

Subtheme 6: participants interviewed brought to light how Consar limited perceive Quality as an important phenomenon in providing quality for their client as illustrated in the figure 4.8 below. However, in order to maintain a good quality for their client they ensure materials use for the production is of good quality. Furthermore, Consar limited always look for good suppliers who they can rely on to supply good quality materials. They have both foreign and local suppliers who deals with quality materials and also adhere to quality in their production system.

Figure 4.8: An example of quality materials developed from NVivo 11 software

Main Theme 2 identify the challenges they face in adopting to the lean construction principles

The finding derive from the participants as the researcher engages them in an interview to discuss the challenges that are encountered as a result of adopting to the lean construction principles implementation. Participant CLE1 acknowledge an appreciably number of challenges as they implement the lean construction principles at Consar limited. This participant has worth of experience at the company with over fourty years of serving this company in various capacity. The participant mentioned that there is lack of coordination between the client consulting team and main contractor with respect to the design process which he holds the view that it is a challenge. He further reiterated some of the challenges encountered are due to vehicular traffic congestion which comes at the point of delivery of material to the site through the just in time principles. Furthermore, the most challenge is that when delivery materials for an example like the premix concrete to the site they face several road traffic which hinders their delivery system and to him is a worrying situation for the company. This situation affects the company a lot and sometimes discourages them from using the just in time principles. Participant CLE1 and CLE4 also propose another challenge they face as a result of adopting to the lean construction principles application is

the delay comes as result of clearing imported goods. For them this type of delay discourages them anytime they import materials for a specific project. However, participants CLE5 and CLE8 also reiterated that lack of knowledge of lean principles is a challenge for some of the employees of the company. Furthermore, participants of CLE6 and CLE10 also admitted lack of education of lean construction benefit to employees from management was a challenge in this organization. The rest of the participant also shared their thought on some of the challenges as lack of lean awareness by the employees of the company. The figure below 4.9 shows how the participants express their opinion on the challenges of lean construction principles application. CLE1 mention a challenge as lack of collaboration among stakeholders in the industry for example in our settings the design drawings are prepare solely by the consultant and impose on the contractor to execute without the involvement of contractor and if the need be add the subcontractor in the collaborative stakeholders engagement to seek their opinion on the design before the final the drawings are produce. This number was developed from the NVivo 11 software when running word frequency query of how participant contributed to the interview session to come out of these findings.

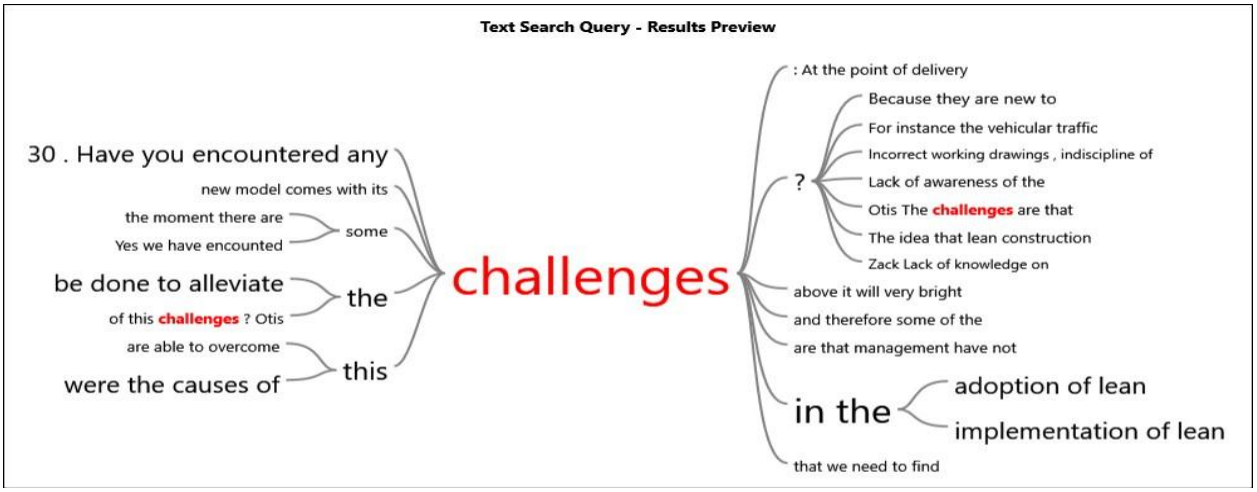

Figure 4.9: An example of challenges developed from NVivo 11 software.

Theme 3 identify ways of mitigation the challenges in the adoption of lean construction principles and practice.

Findings from the interviewees are documented as CLE1 propose some mitigating measures to alleviating the challenges earlier mentioned as presented in the figure 4.10 below. He is of the view that adopting to this mitigation measures ensures government takes policy to expand the road network in various locality within Accra. Government can as well establish policy to eliminate corrupt officials at the ports engaging them to implement paperless system of clearing goods.

Figure 4.10: An example of continuous improvement developed from NVivo 11 software.

4.4 CHAPTER SUMMARY

The chapter established the result of the implementation of lean construction principles to improve project delivery a case study at Consar limited. An event leading to result was a face to face interview where primary data was concluded, the data was collected with the assistance of participant employees at Consar limited who devoted their time and energy in assisting to put this data together. The qualitative analysis software called NVivo 11 assisted the researcher to transcribe audio interviews into word document then coded into the software with the use of automatic coding command. Running further analysis using the word frequency query command, where the analysis was derived 13 major categories emerged and condensed it to three objectives of the study: (1) identify lean construction principles currently been practice at Consar limited, (2) challenges in the adoption of lean construction principles and (3) mitigation the challenges in the adoption of the lean construction principles. The result which supported the visual presentation was derived from NVivo 11 software in the analysis process.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The overall purpose of this case study was to establish how to access lean construction principles and practice toward improvement of project delivery at Consar limited. However, the result of this case study is basically gear toward specific case and hence cannot be generalized to other construction company in Ghana in the sense that the outcome is not dependent on other organisations. Furthermore, an in-depth study of lean construction principles was established that it has yielded positive result while reaping benefit as a way of eliminating waste by improving on the projects delivery for the company. Consar is an organisation established to undertake a construction project in this country, however, management strategy might be completely different from others and indeed most of the participants interviewed alluded to the fact that minimizing waste of material into the production system require particular attention in order to eliminate it entirety from the production system. Consequently, they also pay particular attention to making their project site as clean as possible to prevent accident occurring while ensuring good quality in all the product which is as a result of using quality materials in their production system to satisfy their client. They can as well go to the extent of importing good quality materials from outside the country to be use in their production process.

5.2 SUMMARY OF FINDINGS

The current case study is conducted with respect to interviewing participants at Consar limited on the implementation of lean construction principles for the improvement of project delivery. The research findings have been summarized based on the objectives for the study. However, this opportunity gives a summary of how I have demonstrated in answering the objectives connected with the study.

5.2.1 OBJECTIVE ONE

The findings from the research study reveals from the study has established that the Just in Time principles as one of the lean construction principles is in full operation which eliminate waste of materials resources during construction process in order to save cost in their production process. This was identified in the participants interview session where they alluded to the fact that the Just in Time principles is encouraging their production process and has predominantly reduce waste of materials to turn into a cost savings for the company. Furthermore, the findings also identify that the last planner system of project planning and control in the organisation needs more room for improvement especially in the area of schedule and budget control. It was also identified that the 5S system which is also one of the lean construction principles was in full operation. The company has policy that seeks to establish a clean and maintenance system of a well-organized site that ensures the safety of performing activities as well as employees operating on a good environment devoid of dirt, while ensuring all activities are monitored and controlled to avoid mistake. However, the study reveals that the company is not keen on establishing continuous improvement by organizing workshops for their employees with the assistance of expects.

5.2.2 OBJECTIVE TWO

The objective two reveals how the researcher has respondent to the challenges the company faces in adopting to the lean construction principles. The first challenges identified was lack of collaboration among stakeholders in the industry especially between the client and contractor during the design process. They are of the view that consultant does not engage them at the design stage, that is how come variations occurs as result of the design errors. Obviously, this development leads to budget escalating, as well as schedule overrun which in turn prolong the duration of the project. Furthermore, another challenge identified was a vehicular traffic congestion on the roads within Accra metropolis posing difficulty for them as an organisation during the Just in Time delivery. Finally, another established finding was lack of the knowledge of lean construction principles among some employees particularly at the lower level employees in the organisation was a worrying situation, because management do not have means of training the employees in the lean construction awareness.

5.2.3 OBJECTIVE THREE

Findings observed regarding objectives three from the case study seeks to address ways of mitigating the challenges in adopting to the lean construction principles and practices at Consar limited. From the findings it obvious that good collaboration among project participants will go a long way in addressing inconsistency with regard to the design errors. Furthermore, management must introduce policy that seek to ensure that employees are engage in workshops training to enlighten their knowledge base in the area of lean construction principles. Moreover, management must as well introduce policy that seek to

engage in continuous learning process with respect to the lean construction principles applications. Another finding is that Government must ensure that policies are put in place to check it employees from indulging in corrupt practices at the ports. However, participants indicated that more road network must be created in order to ease traffic in the Accra metropolis. They are of the view that Government should invest in the road sector so that various access can be created to ease traffic congestions. Also, Government must have policy that seek to encourage the use of private transports in Accra rather than the rampant use of private transportation system.

5.3 CONCLUSION ON RESEARCH OBJECTIVES

The objectives of the current study (1) to identify lean construction principles currently been practice at Consar limited. (2) to identify the challenges, they face in adopting the lean construction principles. (3) to identify ways of mitigating the challenges in adoption of lean construction principles and practice. However, the main aim is to access lean construction principles and practice toward improvement of project delivery at Consar limited. The researcher having gone through an in-depth study of lean construction principles and having established the result has made conclusions.

5.3.1 OBJECTIVE ONE

The reasonale of the objective one was to explore the lean construction principles currently been practice at Consar, however, the findings established from the study identify that currently Consar limited is practicing the just in time principles in way to reducing the waste of materials during construction process in order to save cost in the production process. This

was identified during the participant interview session where they alluded to the fact that the just in time principles is encouraging their production process and has predominantly reduce waste of material in their production system and has turn into cost savings for the company. Again, it was identified upon asking question about planning and controlling in project delivery where participants revealed form the interview that the last planner was in operation in the organisation. Participants revealed that the organisation is committed to planning and controlling to ensure efficient project delivery for its customers.

5.3.2 OBJECTIVE TWO

The objective two was to ascertain the challenges they faced in the adoption of the lean construction principles and practice in the organisation. Various challenges were revealed during the participants' interview session. However, the challenges identified was lack of collaboration among project stakeholders in the industry especially from the consultant perspective during the design stage, where it was identify from the findings that the consultant do not engage the contractors at the time of the design so that they can bring to bear their input regarding the design errors in order to collaboratively identify and make corrections accordingly. Another challenge revealed was as a result of vehicular traffic congestion hindering their quest to carry out the JIT principles within Accra metropolis, which is a stumbling block to the project delivery. Also lack of the knowledge of lean construction principles awareness among some employees especially the lower level employees which is causing a worrying situation for the organisation.

5.3.3 OBJECTIVE THREE

The study objective was to find ways to alleviate the challenges with regards to the implementation of the lean construction principles and practice at Consar limited. Study reveal from literature established as it was reported by Bashir et al., (2015) who was of the view that organisations should endeavour to engage their staff in enlightenment meetings, workshops and other events on the benefits of lean construction principles implementation. They further suggested that workers should be enlightened on the need for change from the traditional practice and should be made to understand the difference between lean and non-lean practice. The employees should be informed about how they can comply with the demands of lean practices. This could address the challenges of misconceptions about lean and lack of cooperation from employees. Other ways that can improve on the lack of collaboration among project participants during the development of the design of the construction drawings was to consider integrated project delivery. Government must ensure that policies are put in place to check it employees from indulging in corrupt practices. More road network must be created in order to ease traffic and government must have policy that seek to encourage the use of private transports rather than private transportation. Government should invest in the road sector so that various access can be created to ease traffic conduction on the road.

5.4 RECOMMENDATIONS

After the intense rigorous study undertaking by the researcher during interviewing participants on the implementation of lean construction principles to improve project delivery at Consar limited and having gone through in-depth study and observations of the

lean construction principles currently been practice at Consar. The study presents some recommendations which will enable improvement on the challenges identified above with respect to the lean construction principle implementation:

1) There should be intensive collaboration among project participants both the sponsor and contractor during the design stage to prevent the design and documentation errors to improve projects delivering.
2) Management must develop policy to ensure that employees are educated on the lean construction principles with the assistant of lean specialist in order to increase lean awareness among employees to reap all the benefit that comes with it.
3) Management must introduce lean construction policy deployment to serve as way to build on the already existing lean construction principles.
4) Project managers must endeavour to tailor all required project stakeholders to be present in construction planning meetings so various input can be brought on board during the planning process.
5) Managements must endeavour to strategically situate the last planner system and fit into organizational project delivery.
6) Government must be encouraged to expand the road network within the Accra metropolis to ease traffic congestion.
7) Government must have policy that seek to eliminate corrupt officials from the ports with the full enforcement of the paperless system.

REFERENCES

Abdullah, S. Razak, A. Bakar, A. Hassan, A. and Sarrazin, I. (2009). Towards Producing Best Practice in the Malaysian Construction Industry: The Barriers in Implementing the Lean Construction Approach. Building, 1–15.

AIA National and AIA California C. (2007). Integrated project delivery: A guide. Retrieved 01/25, 2011, from http://www.ipdca.net/images/IPDeliveryGuide_final_revised.pdf

Alvesson, M. (1996). Leadership Studies: From Procedure and abstraction to reflexivity and situation. Leadership Quarterly, 7(4), 455-485

Ahmad, M. O. Dennehy, D. Conboy K. and Oivo, M. (2018) "Kanban in software engineering: A systematic mapping study," *The Journal of Systems and Software*, vol. 137, pp. 96-113.

Ankomah, N. E., Baiden, K.B., Ofori-Kuragu K. J., (2015). 'Lean Techniques Approaches to Managing Ghanaian Contractor Supply Chains'. International Journal of Construction Engineering and Management, 4(3), 87-94.

Anerao S. D. and Deshmukh S. S., (2016). Waste Minimization by Lean Construction Technology, International Research Journal of Engineering and Technology TAE Pune, Maharashtra, India.

Ansah, R.H. Sorooshian, S. and Mustafa, B. S. (2016). "Lean Construction: An effective approach for project management". Journal of Engineering and Applied Science, ARPN Vol. 11 No. 3, pp 1607.

Ayarkwa, J. Ayirebi-Dansoh, and Amoah, P. (2010). Barriers to implementation of EMS in the construction industry in Ghana. International Journal of Engineering Science, 2(4).

Ajarkwa J. Agyekum K. and Adinyira E. (2011). Exploring waste minimization measures in the Ghanaian Construction industry, West African Built Environment Research (WABER) Conference pp. 443-452.

Ayarkwa, J., Agyekum, K., Adinyira, E., and Osei-Asibey, D., (2012). 'Perspectives for the Implementation of Lean Construction in the Ghanaian Construction Industry' Journal of Construction Project Management and Innovation, 2(2), 345-359.

Azharul K., Kazi A., (2013). A methodology for effective implementation of lean strategies and its performance evaluation in manufacturing organizations. Business Process Management Journal, 19(1), 169 - 196.

Aziz, F., R., and Hafez, M., S. (2013). Applying lean thinking in construction and performance improvement. Alexandria Engineering Journal, 52(4), pp. 679–695.

Ballard, G. and Howell, G.A. (2003), "An Update on Last Planner", in, 11th Annual Conference of the International Group for Lean Construction, Virginia, USA,

Ballard G. and Howell G. A. (2003) lean project management, Building Research and Information, Berkeley, USA.

Banton, C. (2019) Corporate Finance and Accounting, Access on 10th May, 2019. https://www.investopedia.com/terms/j/jit.asp

Banawi, A. (2013). Improving Construction Processes by Integrating Lean, Green, and Six-Sigma. PhD. ProQuest, UMI Dissertations Publishing.

Barriball, K. and While, A. (1994) Collecting data using a semi-structured interview: a discussion paper, Journal of Advanced Nursing, 19(2), pp.328-335.

Bashir, A. M. Suresh, S. Oloke, D. A. Proverbs, D.G. and Gameson, R. (2015) Overcoming the challenges facing lean construction practice in the UK contracting organization, International journal of Architecture, Engineering and Construction Vol.4

Bernard, H. R. (2002). Research Methods in Anthropology: Qualitative and quantitative methods. 3rd edition. AltaMira Press, Walnut Creek, California.

Bryman, A. Bresnen, M. Beardsworth, A. and Keil, T. (1988). Qualitative Research and the Study of Leadership. Human Relations, 41(1), 13-30

Carvalho, C. P., Goncalves, L. W. N., and Silva, M. B. (2019). Value stream mapping as a lean manufacturing tool: A new account approach for cost saving in a textile company, *International Journal Management and Engineering* Pp 1-2.

Chen, Y. Q., Liu, J. Y., Li, B., and Lin, B. (2011). Project delivery system selection of construction projects in china. Expert Systems with Applications, 38(5), 54565462.

Collins, J., and Hussey, R. (2003). Business Research: a practical guide for undergraduate and postgraduate students. New York: Palgrave Macmillan.

Construction Industry Institute (2007), Lean Implementation at the Project Level, vol. 234-1, The University of Texas at Austin, research summary, pp. 1–36.

Conger, J. (1998). Qualitative Research as the cornerstone methodology for understanding leadership. Leadership Quarterly, 9 (1): 107-121

Cooke-Davies, T. 2002. The "real" success factors on projects. International journal of project management, 20(3): 185-190.

Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks, CA: Sage.

(CSI) Construction Specifications Institute. (2011). The CSI project delivery practice guide. United States of America: John Wiley and Sons.

Dal Forno, A. J. Forcellini, F. A Kipper, L. M. (2014) Value stream mapping: A study about the problems and challenges found in the literature from the past 15 years about application od lean tools, *International Journal of Advanced Manufacturing Technology* Vol. 71.

Darwish, Mohamed (2017) Construction Project Delivery Method, https//www.researchgate.net/publication

Demeter, K. and Matyusz, Z. (2011). The impact of lean practices on inventory turnover. International Journal of Production Economics, 133, 154-163.

Denscombe, M. (2003) The Good Research Guide for Small-Scale Social Research Projects. Second edition. Buckingham: Open University Press. 310 pp. ISBN: 0 3352 1303 0

Denzin, N. K. and Lincoln, Y. S. (2005) Introduction: The Discipline and Practice of Qualitative Research. In: Denzin, N.K. and Lincoln, Y. S., Eds., Handbook of Qualitative Research, 3rd Edition, Sage, Thousand Oaks, 1-32.

Deshmukh, S., Upadhye, N. and Gard, S. (2010). Lean manufacturing for sustainable development. Glob. Bus. Manag. Res. Int. J, 2, 125.

Dexter, L. A. (1970). Elite and specialized interviewing. Evanston, IL: ECPR Press.

Diekmann, J. E. and Thrush, K. B. (1986) Project control in design engineering. Construction Industry Institute, University of Texas at Austin

DiCicco-Bloom, B., and Crabtree, B. F. (2006). The qualitative research interview. Medical Education, 40, 314-321.

Ejvegard, R. 2009. Vetenskaplig metod, Lund, Studentlitteratur, ISBN: 9789144054742.

Filip, F. C. and Marascu-Klein, V. (2015). The 5S lean method as a tool of industrial management performances, IOP Conf. Series: Material Science and Engineering 95, Modern Technologies in Industrial Engineering. Pp-1-2.

Forbes, L. H., and Ahmed, S. M. (2011). Modern construction: lean project delivery and integrated practices. New York: USA, CRC press Taylor and Francis group

Gao, S. and Low, S.P. (2014) Lean Construction Management: The Toyota Way, Springer New York. USA.

Ghassemi, R. and Becerik-Gerber, B. (2011). " Transitioning to integrated project delivery: potential barriers and lessons learned". Lean construction journal, pp 32-52

Hirsjärvi S. Remes, P. and Sajavaara, P. (1997) Explore and Write. Helsinki, Book Corporation

Issa, U. H. (2013) Implementation of lean construction techniques for minimizing the risks effect on project construction time, Alexandria Engineering Journal, Faulty of Engineering, Minia University, Egypt.

Kenig, M. E. (2011b). Project delivery systems for construction. 3rd ed. Arlington: The Associated General Contractors of America.

Koskela, L. (1992) Application of the New Production Philosophy to Construction, CIFE Technical Report 72, Stanford University.

Koskinen, I. Alasuutari, P. and Peltonen, T. (2005) Qualitative Methods Economic Sciences, Tampere, Counterweight.

Layeequddin, K. and Khatoon, S. (2017) Lean Construction – Application of value stream mapping on Infrastructure project, *International Journal of Engineering Trends and Technology* Vol. 45.

Lichtig, W. A. (2006). The integrated agreement for lean project delivery. Construction Lawyer, 26(3) Lopez-Fresno, P. (2014) Contribution of Lean Management to Excellence. Nang Yan Business Journal, 1, 90-98.

Lean Construction Institute. (2014) What Is Lean Construction? (Retrieved on 25 February, 2015) http://www.leanuk.leanconstruction.org/whatis.htm.

Lewis, J. L. and Sheppard S.R.J. (2006) Culture and communication: can landscape visualization improve forest management consultation with indigenous communities? Landscape and Urban Planning 77:291–313.

Luborsky, M. R. and Rubinstein R. L. (1995) Sampling in Qualitative Research: Rationale, Issues, and Methods. Res Aging pp113.

Miles, M. Huberman, A. M. and Saldana, Johnny (2014) Qualitative data analysis: A methods sourcebook (Third ed.).

McMahon, T. (2013). Top 10 reasons why lean transformation fails, http://www.aleanjourney.com/2013/05/top-10-reasons-why-lean-transformation.html.

Moujib, A. (2007). Lean project management. Paper presented at PMI® Global Congress 2007—EMEA, Budapest, Hungary. Newtown Square, PA: Project Management Institute.

Movaghar, E. M. (2016) Identifying the barriers of implementing lean construction principles in developing countries, A thesis submitted to the graduate school of natural and applied science Middle east technical university.

Mao, X. and Zhang, X. (2008) 'Construction process reengineering by integrating lean principles and computer simulation techniques', Journal of Construction Engineering and Management, Vol. 134, No. 5, pp.371–381.

Mayilsamy, T. and Pawan Kumar, E. (2014) Implementation of E-Kanban System Design in Inventory Management, *International Journal of Scientific and Research Publications*, Vol. 4.

McMahon, T. (2013). Top 10 reasons why lean transformation fails, http://www.aleanjourney.com/2013/05/top-10-reasons-why-lean-transformation.html.

Nikakhtar, A. Hosseini, A. A. Wong, K.Y. and Zavichi, A. (2015) 'Application of lean construction principles to reduce construction process waste using computer simulation: a case study', Int. J. Services and Operations Management, Vol. 20, No. 4, pp.462–480.

Peter H. Anders B. Per L. J. Pia B. (2012) Lean and the working environment: A review of the literature. International Journal of Operations and Production Management, 32(7), 829 - 849.

Project Management Institute (PMI 2015). PMI's Pulse of the Profession In-Depth Report: Capturing the Value of Project Management. Retrieved from: http://www.pmi.org/-/media/pmi/documents/public/pdf/learning/thought-leadership/pulse/pulse-of-the-profession-2015.pdf

Patton, M. (1990) Qualitative evaluation and Research methods. London: Sage publications.

Polit, D. and Hungler, B. (1999) Nursing Research: Principle and Method, 6th ed.; Philadelphia: Lippincott Company, pp 416-417.

Project Management Institute (PMI 2016). PMI's Pulse of the Profession In-Depth Report: The High Cost of a Low Performance. Retrieved from: http://www.pmi.org/-/media/pmi/documents/public/pdf/learning/thought-leadership/pulse/pulse-of-the-profession-2016.pdf

Pulaski, M. H. Pohlman, T. Horman, M. J. and Riley, D. R. (2003). "Synergies between sustainable design and constructability at the Pentagon." Proceedings of the Construction Research Congress (CRC), winds of change: integration and innovation in construction, Honolulu, HI.

Pakdil F. K and Leonard, M. (2015),"The effect of organizational culture on implementing and sustaining lean processes", Journal of Manufacturing Technology Management, Vol. 26 Iss 5 pp. 725 – 743

Reid H. M., (2014) Introduction to Statistic (California: Sage, 204)

Saldana, J. (2016) The Coding Manual for Qualitative Researchers (3rd Ed.) London, UK: Sage.

Sulaiman, I. E Musa, A. and Alkassim, R. S. (2016) Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics. Vol. 5, No. 1, pp. 1-4.

Shah, R. and Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. Journal of operations management, 21, 129-149.

Sarhan, S., and Fox, A. (2012). Performance Measurement in the UK Construction Industry and its Role in Supporting the Application of Lean.

Shank, G. (2002). Qualitative Research. A Personal Skills Aproach. New Jersey: Merril Prentice Hall.

Sarhan, S. and Fox, A. (No date) Trends and challenges to the development of lean culture among UK construction organization, proceedings for the 20th Annual conference of the international group of lean construction.

Sayer, N. J. and Williams, B. (2007) Lean for Dummies, Wiley Publishing Inc. 111 River St. Hoboken, NJ 07030-5774, Indianapolis, Indiana.

Stake, R. E. (2010). Qualitative Research: Studying How Things Work. New York, NY: Guilford Press. 244 pages.

Stake, R. E. (2013). Multiple-case study analysis. New York, NY: Guilford.

Thomas, H. Horman, M. Minchin, R. Chen, D. (2003) Improving labor flow reliability for better productivity as lean construction principle, Journal of Construction Engineering and Management 129 (3) 251–261.

Tommelein, I.D. (2014) Journey Toward lean Construction: Pursuing A Paradigm Shift, ASCE Peurifoy Award Presentation, Atlanta GA. Pp 2.

Urquhart, C. and Fernandez, W. (2013), Grounded Theory Method: The Researcher as Blank Slate and Other Myths, Journal of Information Technology, 28, 224-236

Vidalakis, C. Tookey, J. E. and Sommerville, J. (2011) 'Logistics simulation modeling across Construction supply chains', Construction Innovation: Information, Process, Management, Vol. 11, No. 2, pp.212–228.

Young, B. K. Hosseini, A. and Lædre, O. (2016). "Project Alliances and Lean Construction Principles" In: Proc. 24th Ann. Conf. of the Int'l. Group for Lean Construction, Boston, MA, USA, sect.3 pp. 33–42. Available at: (www.iglc.net).

APPENDIX

Kwame Nkrumah University of Science and Technology

College of Architecture and Planning

Department of Building Technology and Management

TOPIC;

IMPLEMENTATION OF LEAN CONSTRUCTION PRINCIPLES TO IMPROVE PROJECT DELIVERY SYSTEMS. (A CASE STUDY CONSAR LIMITED ACCRA BRANCH.)

INTERVIEW QUESTIONS

Section A: General demography

1. What is your professional background?

(a) Project Manager

(b) Civil Engineer.

(c) Quantity Surveyor

(d) Architects

(e) Others specify …….

2. What is your level of Education

(a) Diploma/HND

(b) Bachelor's Degree

(c) PGD/Master Degree

(d) Doctorate Degree (PhD)

3. What is your job level?

(a) Senior Staff

(b) Managerial

(c) Director

4. How many years have you been working with the company?

(a) Less than10yrs

(b) 10-19yrs

(c) 20-29yrs

(d) 30-39

(e) Above 40yrs

5. What is your understanding of lean construction?

……

6. Describe how you get better in the performance of your job?

……

……

7. What is the importance of lean construction in this organization?

……

……

Section B: Main Questions

8. Are you practicing lean construction principles in this organisation?

……

9. What are the lean construction principles currently been pursued in this organisation?

……

……

10. From the above responses are there any other lean construction principles you are aware from literature?

……

……

……

11. What other lean construction principles in literature do you think can be emulated at Consar?

……

……

12. Can you describe the processes involve in project planning?

……

……

13. Who are involve in the planning process?

……

14. How do you collaborate in managing the network of relationship among project team during project delivery?

……

……

15. How do you procure materials from your suppliers to aid in project execution?

……

……

16. Describe the method adopted during project execution to improve performance?

……

……

17. How do you create and maintain your project site?

……

18. Describe how the JIT principles is applied in this organisation?

……

……

19. Describe how you deal with waste in the process of executing a task?

……

……

20. What do you do to improve on your process?

……

21. What is your organisational ultimate goal for the customer in delivering a project?

……

……

22. Describe your organisational lean construction policy deployment?

……

23. Describe the processes for implementing built in quality at the project level?

……

……

24. How do your organisation visualizes it work flow?

……

……

25. Describe how you share information with project team to get a job done?

……

……

26. How do you manage to track your work in progress?

……

……

27. Do you have any information showing up to date key performance indicators that can drive the use of continuous improvement?

……

……

28. How does the current practice of lean construction principles compare to traditional method?

……

……

29. How were the lean construction principles a priority in this organisation?

……

……

30. Have you encountered any challenges in the implementation of lean construction principles?

……

……

31. What do you think were the causes of this challenges?

……

……

32. What can be done to alleviate the challenges in the adoption of lean construction principles?

……

……

33. Do this company have management support with regards to lean construction implementation?

……

34. As a company do you have any policy that seek to establish continuous improvement of lean construction principles?

……

35. Do the company and its suppliers have confidence in the lean construction principles approach?

……

36. Does this company engage in a continuous learning process by organizing workshops for employees with the assistance of lean consultants?

……

37. Do you have any means of communicating lean construction benefits to your employees?

……

38. Do you feel that lean construction principles have been successful in your organisation?

……

39. Can you share some of the success achieved?

……

40. How do you see the future of lean construction principles and practice in the Ghanaian Construction Industry?

……

……

Thank you for your input.