ST. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES

ANALYZING THE MANUFACTURING PROCESS IN THE PERSPECTIVES OF LEAN PRODUCTION: A CASE IN GEOSYNTHETICS INDUSTRIAL WORKS PLC

BY

DESU BIRCHIT

JUNE, 2021

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A THESIS SUBMITTED TO ST.MARY'S UNIVERSITY, SCHOOL OF GRAGUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BUSINESS ADMINISTRATION (MBA GENERAL)

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STATEMENT OF DECLARATION

I, the undersigned, declare that this thesis is my original work prepared under the guidance of Tiruneh Legesse (Assistant Professor). All sources of materials used for the thesis have been duly acknowledged. I further confirmed that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

Desu Birchit _____

Name Signature

St. Mary's University, Addis Ababa June, 2021

ENDORSEMENT

This thesis has been submitted to St. Mary's University, School of Graduate Studies for examination with my approval a university advisor.

Tiruneh Legesse (Assistant Professor) _____
Advisor Signature

St. Mary's University, Addis Ababa June, 2021

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Abstract

This study was conducted with the objective of analyzing GIW's effort for ensuring success, by focusing on waste elimination and cost reduction in continuous improvement model. It makes use of both descriptive and explanatory research designs with detailed survey questionnaire in order to determine the different lean wastes, to determine the lean principles that are in use to eliminate the wastes, to analyze the association between waste elimination and cost reduction effort and to assess the relationship between continuous improvement and quality management system (the change management tool which the company implemented). The analysis of the data collected from survey questioner revealed that the company process has been tempted by wastes or muda of waiting, muda of re-workable materials inventory and muda of correcting defectives. The analysis also depicted another two major findings: the company's cost reduction effort is negatively affected by muda of waiting and the implemented quality management system helps the company to ensure continuous improvement in its production process. The findings are evidence that identifying and eliminating lean wastes are the paramount in reducing production costs and ensuring success by winning the competitions. Therefore, the company management is recommended to make the successful implementation of lean production system as part of the long term strategic direction and policy of the company.

***Key Words**:* Lean production, continuous improvement, waste elimination, cost reduction, lean wastes

Acronyms

GIW	……	Geosynthetics Industrial Works
PLC	……	Private Limited Company
QMS	……	Quality Management System
PDCA	……	Plan-Do-Check-Act
JIT	……	Just-In-Time
SPSS	……	Statistical Package for Social Science
5S	……..	Sort, Set-in-order, Shine, Standardize and Sustain
OEE	……	Overall Equipment Effectiveness

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CHAPTER ONE

INTRODUCTION

This introductory section includes background of the study, statement of the problem, research questions, objectives of the study, significance of the study, scope of the study, limitation of the study, definition of terms and organization of the study.

1.1. Background of the Study

Success in manufacturing industries is largely depends on their ability to effectively discern between hindrances and reinforcements for their competitive advantages and/or manufacturing performance and working strongly to minimize or eliminate the hindrances and maximize the reinforcements to the best level possible. To achieve this end, lean production is found to be a world class production system in this modern era of manufacturing. It is worthwhile of calling lean production as the world class production system because: it combining the advantages of mass production and craft production (Womack et al., 1990, p13); being fire proofed its practical applicability in the worlds' most successful car manufacturing company - Lean production, also known as the Toyota Production System (Dennis, 2015, p19); and it is applicable in both service and manufacturing organizations – "*although lean principles are rooted in manufacturing, I have found that they apply universally*" (Dennis, 2015, p19).

What the paramount to lean production is waste or muda eliminations. "Waste is any activity which does not contribute to operations" (Shingo as cited by Protzman et al., 2019, p35). According to Nicholas (2018, p61) the cornerstone of continuous improvement is the concept of value added and that anything in an organization or process that is not value added is considered as waste. From these perspectives, different authors and practitioners acknowledged seven different wastes which any company should identify, prioritize and work to eliminate them. These includes waste of overproduction, waste of waiting, waste of transportation, waste of over-processing, waste of inventory, waste of unnecessary employees movement and waste of making defective products.

In today's stiff competitive market customers are becoming more powerful than ever before. They have a wealth of choices, unprecedented access to information, and demand excellent quality at reasonable price. Considering these facts Pascal Denis (2015) argued, in his book of Lean Production Simplified, that adding profit margin typical for the industry to the cost of the product to determine the selling price of the item is no longer true in this twenty-first century. Hence, the formula has to be rearranged in such a way that cost should be deducted from the fixed price of the product to determine the profit (i.e. Price - Cost = Profit). This new formula for profit ascertains that the key to generate profit is cost reduction while maintaining reasonably fixed price of the products.

In lean perspective one focus area that helps companies to ensure their competitive advantage is continuous improvement. "*A premise of continuous improvement is that processes and products can be improved without limit*" (Nicholas, 2018, p24). The philosophy of continuous improvement is one of the pillars in lean manufacturing. If current manufacturing companies seek to become lean producers, they need to adopt: (1) a new way of thinking, focusing on products flow through uninterrupted processes, (2) a "pull" system based on what the client requests, quickly replacing only what the next operation takes, and (3) a culture in which everyone works hard to continuously improve (Luis et al., 2017, p1). Lean production uses both kaizen (i.e. incremental improvement) and innovation improvements to put the notions of continuous improvement in practice.

Wastes in the manufacturing processes can negatively affect not only the manufacturing company's competitiveness but also the country's goal of agriculture to industry transition and export promotion since these wastes impose significant limitations on the sectors attempt of enhancing quality, reducing cost and meeting the delivery schedules. Unlike the developed nations, business researches in Ethiopian context are too shallow to address the main challenges of manufacturing industry and recommend measures to overcome these challenges. Thus, this research was conducted with aim of analyzing the challenges that wastes imposed on manufacturing sector and recommending measures for policy makers and practitioners.

The researcher presents this work by analyzing the manufacturing process of Geosynthetics Industrial Works PLC (GIW) in light of the aforementioned three basic

focus areas of lean production: waste elimination, cost reduction and continuous improvement. Identifying the wastes apparent in the company production process and analyzing their effect on the cost reduction effort of the company are the important steps to address the problem and propose recommendations.

As it is stated in the company quality manual, GIW was founded in 2005 as a joint venture between previous Water Works Construction Enterprise and Golden Trade Co. The company quality policy addresses its commitment to deliver quality UPVC pipes, HDPE pipes, rigid conduits, plastic sheets and related services that satisfy its customers and interested parties through the application of ISO 9001:2015 quality management system to bring continual improvement and to maximize profit by the engagement of every employee and manager.

1.2. Statement of the Problem

Lean production means doing more with less – less time, less space, less human effort, less machinery, less materials – while giving customer what they want (Dennis, 2015, p19). In manufacturing environment, having such daunting obstacles to producers and a wealthy of choices to customers, no doubt it is too difficult to do more with less and at the same time to satisfy the customers need. So, to surmount this difficulty the lean approach focuses on elimination of waste or non-value adding activities and losses in all the aspects of the business, and hence benefited from the resulted cost reduction, in an environment fostering continuous improvement as an organization culture.

Nicholas (2018, p64) defined waste as anything other than the minimum amount of materials, equipment, parts, space or time needed to add value to the product or as any activity that doesn't have any value to the business. Another authors, Womack and Jones (1990) as cited in Simboli et al. (2014, p178), explain waste as any production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer and is a target for elimination. Referring the different definitions the seven common wastes identified in manufacturing organization are overproduction, defects making, inventory, transportation, waiting, unnecessary motion and over-processing.

Although the authors state these as wastes, it is too challenging in real life scenarios to draw a clear demarcation between activities as value adding and non-value added (or waste) and to eliminate the wastes for ensuring resource consumption to the minimum. The lean principles and tools of pull system, just-in-time management, quality at the source, 5S and overall equipment effectiveness are in place to overcome such challenges.

Cost reduction has become an essential tool for companies to constantly stay ahead of the increased competition in the business environment (Alizera & Mahdi, 2012 as cited in Egbide et al., 2019). The concept of continuously searching for new ways and avenue of reducing costs needs to be constantly promoted at all levels of an enterprise, which signifies that the enterprise has a strategic approach to this issue (Figar& Ivanoic, 2015 as cited in Egbide et al., 2019). In manufacturing companies cost is incurred at various levels and for different purposes and materials. Customers are willing to pay for the right amount of materials, labor, equipment, space and other resources needed to produce their products; but not for the extra amounts used by the company's fault of overproduction, defects making, waiting, transportation, inventories and extra processing. Hence, waste elimination is the number one lean approach for reducing manufacturing costs as each of the wastes use company resources and thus incurs costs.

Company's survival and success nowadays depend on its ability to continuously improve its products and services to meet and exceed customer expectations and it is measured in terms of producing things better, faster, cheaper, and being more agile (Nicholas, 2018, p23). Continuous improvement is a must to do in business environment as nothing will remain at the state of its establishment and competitors are coming with big capacity, new products features, new processes and new technologies. In order to stay ahead of the competition, lean production encourages companies to use all the possible improvement models.

In Ethiopia business researches don't give due attention to the manufacturing sector although it sunk with daunting challenges. The researcher believes that one of the reasons for such a slow pace of the sector's competitiveness is the result of shallow research and development, especially in key areas of excellence: eliminating wastes, reducing unit cost, improving quality and meeting delivery schedule. In traditional practice every organization

has a desire to do more in these key areas of excellence although the actual achievement is by far less than it should be. Scientific studies have prominent role in directing the company's effort to some sort of competitive advantage since they focus on cause and effect relationships and recommending measures based on critical findings. Hence, this study was conducted to analyze the company's effort with the perspective of internationally recognized production system and to spark the business researches involvement in key areas of excellence in manufacturing sector.

1.3. Research Questions

In line with the above stated problems, the researcher addressed the under mentioned questions.

1. What are the wastes apparent in GIW's production system?
2. What are the lean principles implemented in the company production process?
3. What are the associations between implementing lean principles and eliminating wastes?
4. How the cost reduction effort is affected by wastes in the production process?
5. What is the association between continuous improvement and QMS?

1.4. Objectives of the Study

1.4.1. General Objectives

To analyze GIW's effort for ensuring success, by working on waste elimination and cost reduction in continuous improvement model.

1.4.2. Specific Objectives

1. To determine the different wastes in GIW's production process;
2. To determine the lean principles implemented in GIW's production process;
3. To assess the association between lean principles and waste eliminations;
4. To analyze the effect of wastes on reducing manufacturing wastes;
5. To assess the association between continuous improvement and QMS.

1.5. Significance of the Study

As to the knowledge of the researcher, this thesis is new to the Ethiopian manufacturing industry in analyzing the lean production perspectives of waste or non-value adding activities elimination, cost reduction and ensuring continuous improvement in relation to a particular manufacturing firm. Thus, it is helpful in opening up the eyes of practitioners, like CEOs, presidents and any other actors in manufacturing sector, to look to their processes and designing measures that can add value to their customers.

The researcher also believes that not being competent at the national and international levels is the result of the limited effort, by the Ethiopian manufacturing firms, to excel in terms of quality, price and delivery time. This work will contribute its part in directing policy makers to focus on strategic areas that might help to ensure company wise continuous improvement by reducing or eliminating non-value adding activities and associated unnecessary costs.

The document can also help as a reference material for other researchers who want to make further study in the area.

1.6. Scope of the Study

Lean production covers all aspects of business activities that can create value to the customer in any business organization. For this study the researcher focused on manufacturing industries lean perspectives, particularly in Geosynthetics Industrial Works PLC, giving emphasis on eliminating various wastes, cost reductions associated with waste or non-value adding activities elimination and ensuring continuous improvements in its production process by recruiting the lean principles and tools of pull system, just-in-time management, quality at source, 5S and overall equipment maintenance. The study covers the activities of all functional units of the organization by approaching sampled organization employees through questionnaires in cross-sectional data collection research design.

1.7. Limitations of the Study

Considerable limitations are there in Ethiopian firms in collecting, organizing and maintaining relevant data and in making them accessible to users. This study was conducted with the data collected from the firm with the mentioned limitations.

The covid-19 crisis, that causes to impose restriction on personal gathering, face-to-face meeting and in-person learning, brought substantial limitation to the work. Data collection by using other methods like interview would provide a richer understanding of the process. But the aforementioned restrictions constrained the researcher from using such methods of data collection.

In manufacturing environment the technology and the production processes are updated from time to time because of intense competitions. Although researches by using longitudinal data collection method are advisable for such ever changing environment, the researcher makes use of cross-sectional data collection method because of time constraint.

1.8. Definitions of Terms

Mass Production – the production of large volume of complete and interchangeable parts that are easily attached them to each other (Womack et al., 1990, p27)

Craft Production - is the production of items as per customer specifications and by using highly skilled craftspeople (Womack et al., 1990, p22).

Lead time – the time between the customer placing of order and receiving his/her order (Dennis, 2015, p31).

Cycle time – The time interval that elapses between two sequential activities (Nicholas, 2018, p83)

Work-in-process – partially finished goods awaiting completion (Hayes, 2021).

Muda – regarded as waste, means having more capacity than the work load (Chiarini, 2013, p18)

1.9. Organizations of the Study

This research paper organized into five chapters. Chapter one deals with the introduction which encompasses background of the study, statement of the problem, research questions, objectives of the study, significance of the study, limitation of the study and definition of terms. Chapter two deals with review of related literature; theoretical and empirical evidences related to the topic studied. Chapter three discuss the methods of the study – research approach, research procedure, sample size and sampling procedure, data source and instruments and methods of data analysis. Chapter four covers results and discussions of the study - the results/findings of the study summarized and interpreted as well as discussed with the use of related literature review. Finally, Chapter five contains, summary of major findings, conclusions drawn from the findings and recommendation based on the conclusions of the study. At the end, a list of reading materials is attached as references.

CHAPTER TWO

RELATED LITERATURE REVIEW

This chapter presents the theoretical and empirical review on lean wastes, principles and tools used to eliminate lean wastes, cost reduction and continuous improvements.

2.1. Theoretical Literature Review

Lean seeks to 'flush out' and fight wastes in every process: from marketing to production processes, from administrative processes to strategic ones although the most important wastes in traditional manufacturing companies are hidden in the production processes (Chiarini, 2013, p15). Lean manufacturing is such powerful manufacturing systems that numerous plants around the world have attempted to implement or adopt it to enhance their efficiency (Shoeb, 2017). The practices and principles of Lean manufacturing are widely used by industries to eliminate waste and make more efficient process. Some scholars argue that lean production is not only a system that enhances process efficiency but it is a means for raising process efficiency to the level that can assure companies' competitive advantage. For example, John Black (2008) pinpointed that a well-run process can result in the least waste, the highest quality, the lowest price, the shortest cycle time and the most satisfied customers. Processes that achieve these essential elements are more than just efficient; they are the key to competitive advantage. Such processes should be protected as core competencies and examined relentlessly for ways to improve or refine them.

2.1.1. Waste Identification and Elimination

Shoeb (2017) emphasized that lean manufacturing, which is developed for maximizing resource utilization through minimization of waste, is a valuable approach to identifying waste eliminating them and through continuous improvement. Dixit et al. (2015) on the other hand point out four main steps that lean manufacturing uses to identify and remove wastes from the system continuously: identify the fact that there is waste to be removed;

analyze and find the root cause of the waste; finding the solution for these root causes and application of these solutions and achieving the objectives.

2.1.1.1. Lean Wastes

Lean production system identified the seven common wastes and the problems they imposed in the manufacturing industries.

1. **Overproduction** – producing more than the customer demanded, or producing it too early before it is needed; which leads to risk of obsolescence, producing wrong things, excessive lead and storage time (Shah & Patel, 2018, p3794). Overproduction is number one waste in Toyota Production System and it is the hardest to remove (Portzman et al., 2019, p35). Overproduction is understood as producing unnecessary products that are independent of the demands or producing goods before they are required (Jasti & Kodali, 2014 as cited in Suissa, n.d.). The negative consequences of overproduction, according to Chiarini (2013), are increasing inventory, slowing down production process, reducing plan flexibility and increasing indirect costs such as transportation, inspection and so on. Hence, this is the most non-value adding activity that companies have to give due attentions. Following the pull production system, that is producing products in response to a particular need, is the best means to overcome problem of overproduction.

2. **Defects –** Defects are one of the seven wastes which occur when product or service deviate from what the customer requires or the specification (Lean Manufacturing Tools, n.d.). Poor purchasing practice, inadequate education and training, weak process control, deficient planned maintenance and not understanding the customer need are some of the causes for defects (Voehl et al., 2014, p76). Defective products multiply efforts to find and correct defects, incur additional labor and material expenses and delay production and increase production lead time (Nicolas, 2018, p65). If defects seem to haunt your process, causing customer complaints despite your best efforts to catch them or if your inspection costs are higher than similar processes in your industry, defects are likely built into your processes due to faulty equipment,

instructions, design, or beliefs and these are excellent opportunities for cost-cutting, as eliminating defects saves the scrap, rework, and repair costs while increasing yields and customer satisfaction (George, 2010, p36)

3. **Excess Inventory –** Inventory represents items or materials waiting for something to happen, a waste in that there are costs associated with items waiting since no value is being added to them (Nicolas, 2018, p67). Having more inventory than necessary to sustain a steady flow of works can lead to problems including: products defect or damaged materials, greater lead time in the production process, an inefficient allocation of capital, and problems hidden away in the inventory (Skhmot, 2017)

4. **Transportation** - any movement of materials that doesn't add value to the product; which causes prolonged cycle time, damage on products and inefficient use of space and labor (Shah & Patel, 2018, p3795). According to Skhmot (2017) waste in transport includes movement of people, tools, inventory, equipment, or products further than necessary. Excess movement of materials can lead to product damage and defect and excess movement of people can lead to unnecessary work, greater wear and tear and exhaustion.

5. **Waiting –** Muda of waiting is the most obvious form of waste and it frequently appear in the form that either tasks are idle because team members can't handle all of the work-in-process or tasks are queuing to enter the next process stage because there is no enough capacity to pull them through (Siderova, 2019). Waiting takes many forms, including waiting for orders, parts, materials, items from preceding processes, or for equipment repair (Nicolas, 2018, p65). Idle time means a machine operator is not doing anything of value added to the product while they are waiting for the next part to arrive or a machine to complete running part (Elbert, 2013, p10).

6. **Motion –** Any movement by an employee that doesn't add value to the products is waste. This can mean walking, looking for tools, ergonomically incorrect movements etc (Elbert, 2013, p10). Unnecessary motion can be refereed as wasting time caused by poor layout design, workers with lack of skills and/or poor training, poor staff

involvement, increase in staff or working hours, lack of order or cleanliness and activities performed in isolated areas (Chiarini, 2013, p23). Motion waste focuses on the movement of people and equipment is any movement beyond the minimum required for completing the process step (Lean East, 2019).

7. **Over-processing** – muda of over-processing, referred to also as doing more than is necessary, often comes from misunderstanding of why customers buy the product, and what looks better to the product owner might look worst to customer if the necessary market research and customer satisfaction data are not present (Siderova, 2019). Over-processing results from poor tool or product design creating unnecessary activity and it occurs any time more work is done on a piece beyond what is required by a customer (OTTO Motors, 2016). Over-processing, by definition, adds cost to a process because you are doing work and investing time and materials that you cannot expect a payback on (George, 2010, p34)

2.1.1.2. Principles and Tools to Eliminate Lean Wastes.

Lean manufacturing uses different tools and principles/philosophies that are necessary to identify and eliminate the wastes listed above. Although lean production system uses a number of principles and tools to eliminate wastes, the researcher center of was in the under mentioned five assuming that the successful implementation of these principles is instrumental to eliminate all the seven wastes.

1. **Pull Systems** – In a pull based supply chain, procurement, production and distribution are demand-driven rather than prediction while in push based supply chain, products are pushed through the channel from production up to the retailer (Koo, 2020). One of the major reasons why supply chain management is currently receives so much attention is that information technology enables the shifting of a production and sales business model from push type (or make to stock) to pull type (or make to orders) (Stern, 2017, p28)**.** Not only external customers but also sequential process steps can be described as "suppliers" and "customers". As one process step (customer)

consumes materials from the previous process step (supplier) this signals the supplier to replenish those materials that have been consumed. In a true raw material purchase, supply would be tied directly to the customer demand. In other words, pull system help organization to align all their activities with the customer demand.

2. **Quality at source** – Quality at the source is a lean manufacturing principle which defines that quality output is not only measured at the end of the production line but at every step of the productive process and being the responsibility of each individual who participates to the production or on time delivery of a product or service (Leanmanufacturer.net, n.d.). Quality at the source is making quality inspection at each stage in the production process by everyone involving rather than trying to inspect the final product. To minimize the chance of overlooking defects or of missing problems that originate from fleeting causes, it is necessary to do 100% inspection and to minimize the time lag between when a problem occurs and is remedied and it is also necessary to combine inspection, analysis, and corrective action with the original work task. To this end, wherever feasible these duties should be given to the people doing the work tasks, the frontline workers (Nicolas, 2018, p344).

3. **Just-In-Time (JIT)** – It refers just-in-time delivery of all services or materials to the next process in the value adding process. It helps to eliminate wastes like excess inventory, waiting, motion and transportation. JIT is a philosophy considers that waste in process can be reduced by decreasing inventory capacity, or better yet by eliminating unnecessary inventories and activities that don't add value to the operations (Shnaiderman & Ben-Baruah, 2016 as cited in Alcaraz et al., 2017, p4). Denis (2015, p92) pinpointed the basic rules JIT production follows: Don't produce something unless the customer has ordered it; level demand so that work may be proceed smoothly throughout the plant; link all processes to customer demand though simple visual tool and maximize flexibility of people and machinery. The objective of JIT is to make sure that we minimize the amount of materials that we have in our possession at any point in time (Voehl et al., 2014, p115).

4. **5S** – It is a work place organization and standardization program consists of: Sort – select target area, sort everything in that area and eliminate those that are not needed; Set-in-order – setting all items in order of use; Shine – Cleaning the entire area and items followed by sorting and set-in-order; Standardize – Continuous application of sort, set-in-order and shine activities in the work place and Sustain – making a habit of sort, set-in-order, shine and standardize activities. Nicolas (2018, p76) outlined the 5S as: Sort – proper arrangement (sort everything; toss out everything not needed); Set-in-Order – orderliness meaning specify a place for everything by number, color coding or name and placing everything in its place; Shine – wash, clean or paint everything so abnormal or problematic situations becomes obvious; Standardize – create procedures, rules or guidelines for maintaining the first three Ss and Sustain – develop habits and culture to maintain a clean, organized work environment.

5. **Overall Equipment Effectiveness (OEE)** – Overall equipment effectiveness is a combination of three factors that tell how efficient an asset is during the manufacturing process: asset availability, asset performance and products quality (Fiix, n.d.). Voehl et al. (2014, pp: 125-126) explained equipment availability, equipment performance and product quality as: Equipment availability is a measure of equipment readiness when the organization needs the equipment to add value; equipment performance is the target output for equipment running at maximum speed minus any speed losses that occur during operation and product quality refers the good products produced by the machine divided by the total output. OEE (Overall Equipment Effectiveness) is a "best practices" metric that identifies the percentage of planned production time that is truly productive (Lean Production, n.d.).

Geosynthetics Industrial Works PLC follows ordered base production system for the supply of its plastic pipes and Geomembrane. Customers satisfied with the products quality but they complain the company's ability not to meet the delivery schedule and on the rising products price. Unlike the finished goods store, a heap of material to be reworked is found in the defective products store and the defective products generation rate increase from time to time. Many of the production machinery in use are those installed at its starting of operation in 2006GC. Considering these situations of the company and comparing them

with the lean tools and principles of waste elimination, the researcher hypothesize the following:

H1.Low level of inventory in the finished goods store is associated with the company's practice of using pull system of production.

H2. Delay in product delivery or muda of waiting is associated with poor effort in implementing the pull system in all sequential activities of the company

H3. The increase in the defect rate is associated with overall equipment ineffectiveness

H4. High inventory of re-workable materials is associated lack of just-in-time (JIT) management system.

2.1.2. Cost Reduction

Cost reduction is defined as the achievement of real and permanent reduction in the unit cost of goods manufactured or services rendered without damaging the ability of the product to serve the purpose for which it was intended (Chartered Institute of Management Accountant as cited in Egbide et.al, 2019). One of the areas that many organizations overlook is the management of operational costs in the business and one of the areas that organization can directly control is the cost to operate the business (Stewart, 2011). Alireza and Mahdi (2012) as cited in Egbide et al., (2019) claims that cost reduction has become a vital tool for companies to constantly stay ahead of the increased competition in the business environment.

Lean six-sigma is successful in cutting costs based on three fundamental insights about wastes: Processes are riddled with wastes; costs are created at the process level wherever waste exists and to reduce cost at the process level, you have to eliminate waste (George, 2010, p26). Portzman et al. (2019), the authors of the book titled Implementing Lean with twice output with half the input, list out a number of hidden costs like cost of set up time, cost of inefficient meeting and firefighting, cost of idle time, cost of not developing people, cost of rework and cost of poor customer service, which are in one way or another related to the different wasteful or non-value adding activities and have significant contribution to the loss of profitability. Lean is the best solution for such hidden costs as it is solely

focused on identifying and eliminating such non-value adding activities. In support of this idea Stern (2017, p19) mentioned that lean thinking is designed to shrink lead times, reduce setup times, save turnover expenses, avoid unnecessary expenses and increase profits. Generally lean tools focus on reducing waste, which by default will reduce cost, giving the management additional flexibility.

Low production costs has become one of the primary ways that organizations compete in a global economy, hence, cost reduction must continually be in the minds of managers of organization (McWatters et al., 2001 as cited in Egbide et al., 2019). Considering the simple formula: Profit = (Selling price – Cost)*Volume, Kato and Smalley (2011) locates the three possible means for increasing profit as increasing selling price, increasing the number of units sold or reducing cost. In competitive industries increasing prices is difficult as customers may simply turn to alternative offerings from competitors. Simply making more products also is no guarantee for making money; the result may just be excess inventory or waste. The only sustainable way to increase profits is to focus on cost reduction. Cost reduction doesn't mean simply cutting cost or job, but rather eliminate waste that doesn't add any value to the customer – less inventory, fewer waiting time, less defects and so on. A better approach to rapid cost-cutting is to focus on high cost areas of scrap, rework, repair, or customer escapes, instead of trying to raise quality levels in the value-add process steps (George, 2010, pp:35-36)

Kaizen costing, value analysis and budgetary control are the tools mostly used to ensure cost reduction in the manufacturing process. Kaizen costing is a procedure of constant cost lessening that happens when the product is at the production stage (Egbide et al., 2019). Moreover, Monden (2012) explained that kaizen costing covers a broader scope than the traditional cost control concept, which focuses on meeting cost performance standards and investigating and responding when those standards are not met. On the other hand value analysis is an organized universal method of identifying and eliminating unnecessary costs associated with the product and services by conducting an analysis of function of each component of the product. Leber et al., (2013) as cited in Egbide et al., (2019) highlighted that the very core of value analysis is the effort to determine and eliminate those characteristics of products or services with no real value for the customer or the product,

but which, nevertheless, cause costs in the production process or service delivery. Meaning identifying and eliminating wastes (or non-value adding processes) in the production process is such a notable means for ensuring cost reduction.

H5. The poor performance in reducing cost of production of GIW is the result of muda of waiting, making defects and lack of Just-in-time management.

2.1.3. Continuous Improvement

> The organization shall determine and select opportunities for improvement and implementation of any necessary actions to meet customer requirements and enhance customer satisfaction. These shall include improving products and services to meet requirements as well as to address future needs and expectations; correcting, preventing or reducing undesired effects and improving the performance and effectiveness of the quality management system (ISO 9001:2015 as cited in Ethiopian Standards Agency, 2019).

If there is a "secret" element to the Toyota Production System, it is continuous improvement – dynamic and ever changing process (Steward, 2011). Companies' survival and success nowadays depend on their ability to continuously improve their products and services to meet and exceed customer expectations (Nicholas, 2018, p23). Product innovation, supply chain efficiency and internal manufacturing execution are distinctive areas that require ongoing improvement (Kato & Smalley, 2011, p43). To meet the challenges posed by the contemporary competitive environment, the manufacturing organizations must infuse quality and performance improvement initiatives in all aspects of their operations to improve their competitiveness (Pintelon & Gelders, 1992 as cited in Singh & Singh, 2012).

After conducting extensive literary research of the history, paradigms and methodologies of continuous improvement, Filipe (2016) outlined his own guidelines; he called them the 10 commandments of continuous improvement, for any organization to enjoy successful continuous improvement of its operations and results. These includes being continuously improved, having a continuous improvement system, developing once own continuous improvement system, being prepared for a long-term effort, having top management

support, creating a culture of continuous improvement, improving everything, having ambitious improvement goals, being beware of inertia and improving the way of improvement.

Continuous improvement refers to a firm's unceasing efforts to upgrade product, manufacturing processes and other parts of its production system in order to meet customers' requirements while concurrently reducing inefficiency and cost (Cole & Mogab, 1994 as cited in Wilson et al.). In the view these authors continuous process improvements in companies can proceed either through a constant stream of alterations or adoptions in firm's production process, decision making practices and organization methods; through upgrading the workers skill and ability; or through a series of endogenous advances that relies on experimental learning within the firm.

Kaizen is the most frequently used term in describing the notion of continuous improvement. It refers small improvements as a result of ongoing efforts. Unlike innovation improvement, kaizen focus of bringing such a remarkable improvement because of the addition of a number of small improvements in different sections of the company. From strategic point of view, Kaizen is a systematic and long-term action aimed at accumulating improvements and savings in order to beat competition in terms of quality, productivity, costs, and delivery times (Luis et al., 2017, p16). On the other hand, innovation improvement means strong and continued commitment to research and development of new products and processes; at the corporate level, and openness to new and bold ideas, and willingness to try new ways of doing things; at the middle management and shop-floor workers level (Nicholas, 2018, p27). Kaizen generates process-oriented thinking since processes must be improved before improved results can be achieved (Singh & Singh, 2012). Just like kaizen, other change management tools like Total Quality Management (TQM) and Quality Management System (QMS) put such a great emphasis on the importance of continuous improvement in any company through the implementation of PDCA (Plan-Do-Check-Act) cycle.

PDCA (Plan-Do-Check-Act) cycle or Deming cycle is the notably used, simple and powerful continuous improvement. John Nicholas (2018) in his book of lean production for competitive advantage outlined the activities involved in these four steps. The planning

phase involves collecting data to understand the current situation, defining the problem, stating the goal or target for improvement and analyzing and solving the problem. In the "Do" step of PDCA Cycle the plan will be put into action and the outcomes of which will be assessed in the checking step. In the checking step data are collected and analyzed to assess the result and to determine to what extent the goals or the outcomes are being accomplished. The Act phase involves institutionalizing the planned changes if they were successful (i.e. making it documented guideline or procedure), expanding the planned changes if they were successful but implemented only in limited way and taking corrective action by reinvestigating the cause if the planned changes were unsuccessful.

With the intention of being benefited from its principles, GIW tried to implement Kaizen throughout the company processes although it stopped within a year time. Since 2009GC the company implemented quality management system – a system which incorporate continuous improvement as one its requirements and advocating to achieve it through Plan-Do-Check-Act cycle. Considering this fact the researcher draw the under mentioned hypothesis.

H6. Continuous process improvement in the company is associated with the implemented quality management system.

2.2. Empirical Literature Review

Toyota, the founder of lean production, make a critical discovery: when you make lead times short and focus on keeping production lines flexible, you actually get higher quality, better customer responsiveness, better productivity, and better utilization of equipment and space (Liker, 2004, p4). The focus for this design was to address the need for fast, flexible processes that give customers what they want, when they want it, at higher quality and affordable cost. According to the survey conducted in 40 manufacturing companies that had adopted lean manufacturing, typical operational improvements identified are: 90% lead time (or cycle time) reduction, 80% work-in-process inventory reduction, 50% increase in productivity, 75% reduction in space utilization and 80% improvement in quality (Shoeb, 2017, p43).

The guiding principles of lean mindset includes: *value added activities* – activities that transform the product or deliverable, in the view of the customer, to a more complete state; *value stream* – the total cycle of activity, from initial customer contact through receiving payment for the product that has been delivered; *flow* – seamless sequence of activity throughout the process, with no stalls, no disruptions, and no disconnections or backtrack loops; *pull system* – consumption driven system that encourage things to be done when they are required to be done, not before and *on-going and continuous elimination of waste* – eliminate wasteful activity and free up time and resources to be devoted to additional value-added activities. To implement these principles in any organization, and hence to improve customer satisfaction and profitability of the company, there must be driven from top management level and embraced by all individual within the company (Carreira, 2005, pp: 2-3).

In order to see how the concept of lean management is seen in practice, a research was conducted in employees working in the Wielkopolska regions' of Poland by using 1050 respondents to questionnaires concerning significant of lean principles. According to the results of the research, respondents identified rapid elimination of error (84.95% of response is important), continuous improvement (75.71% of response) and customer orientation (72.81% of response) were the identified top three most important principles of lean management in contemporary organizations (Grzelczak & Werner-Lewandowska, 2016, p2). The separate analysis made on the response of employees working at managerial level revealed the two most important principles of lean management are continuous improvement (91.82% of response) and rapid elimination of error (86.82% of response). This study therefore confirms manager's awareness that each process can further be improved and thus waste and the resulting error at source can be eliminated.

2.3. Conceptual Framework

Apart from the above numerical findings many scholars conceptualize that pull system, quality at the source, JIT, 5S and OEE are means for eliminating the lean wastes and improving efficiency. Pull system reduce inventory, cost, lead time and space needed,

while improving quality and safety (Dennis, 2010, p157). According to Chiarini (2013, p22) the traditional lean principles to remove excess inventory are: better balanced activities, pull system of production and quick changeover operations.

Quality at the source is the principle that is essential to eliminate wastes associated with overproduction and defect making. Quality at the source (or Jidoka in Japans term) guarantees that defective pieces will not pass to the next work station, and it makes sure that those that pass fulfill the required quality standards, thereby minimizing defects, waste, and overproduction (Alcaraz et al., 2017, p6).

Wastes associated from waiting and motion can be overcome by organizing the work place by the principle of 5S. Organizing the workplace by using tools of 5S, Leveling activities, improving layout and preventive and predictive maintenance are measures that are used to overcome wastage associated with waiting (Chirini, 2013, p29). Changes that might be needed to eliminates wastes associated with motion includes organizing the work place by using 5S tools, improving workers skill, increasing awareness concerning movement and installing appropriate layout (Chiarini, 2013, p23).

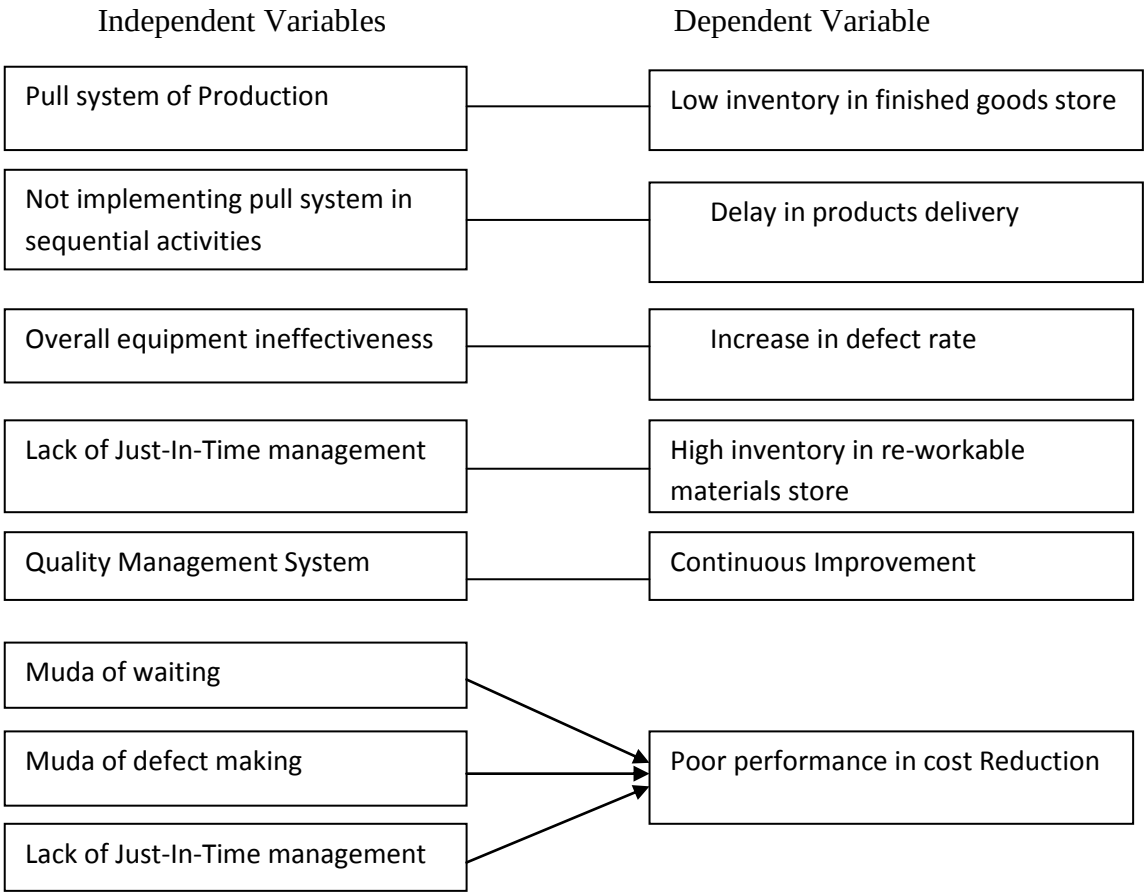
Wastes related with rework, inventory and waiting can be eliminated by implementing the principles of OEE and JIT. Improving the OEE not only increases product throughput, it reduces variability in product quality and production schedules, and, as a result, reduces the need for inventory, overtime, rework, and other costly ways of dealing with output variability. That is why lean manufacturing plants strive for high OEE plant wide (Nicolas, 2018, p184). The right purpose behind JIT is to reduce the inventory in the system in order to make problems more visible and expose the waste (Portzman et al., 2019, p9).

Many others also conceptualized unit cost increment because of wastes in the production process. Inventory means having unnecessary high level of raw materials, works-in-process and finished products; which lead to high defect rates and inventory financing and storage costs (Shah & Patel, 2018, p3794). Over-processing means unintentionally doing more processing work than the customer requires in terms of product quality or features such as polishing or applying finishing in some areas of product that will not be seen by the customer, which increases the production cost and production lead time (Shah & Patel,

2018, p3795). When demand determines how much of a product must be produced, production orders are small and adjusted. Therefore, no such high costs are generated by inventories, and the risk for product obsolescence decreases, since companies only produce what is to be delivered (Alcaraz et al., 2017, p5).

Implementation of continuous improvement also strengthens the effort of identifying and eliminating wastes in the company's product or service delivery. Lean manufacturing is a systematic approach to identifying and reducing waste (non value-added activities) through continuous improvement by flowing the product or service at the pull of the customer in pursuit of perfection (Dixit et al., 2015).

The graphical presentation of conceptual framework below summarizes the narratives in this literature review parts by using independent variables in rectangular boxes at the left hand side and dependent variables on the right hand side. Arrows drawn from left to right is used to indicate casual relationship between variables while lines are used to show correlation between variables.



CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

Research methodology and research methods are two commonly used terms in research work bearing different meanings. Kothari (2004, pp: 7-8), explain the meaning of these two terms as research methods are all those methods which are used by the researcher; methods concerning for the collection of data, methods concerning statistical techniques which are used for establishing relationship between the data and the unknowns and methods concerning for evaluating the accuracy of the results obtained, during the course of studying his research problem. On the other hand, he explained research methodology as the various steps generally adopted by the researcher in studying his research problem along with the logic behind them. It encompasses the research methods or techniques and the logic behind them in the context of the research study and explain why the researcher uses a particular method or technique and why are not using others so that the research results are capable of being evaluated by the researcher himself or by others. According to Adams et al. (2007, p25) research method is a way of conducting and implementing research while research methodology is the science and philosophy behind all research, which goes into the heart of how we know what we know and allows us to understand the very strict constraints placed upon our concept of what knowledge actually is.

3. Research Design and Methodology

3.1. Research Design

"*A research design is a master plan that specifies the methods and procedures for collecting and analyzing the needed information*" (Zikmund et al., 2009, p66). These authors emphasize the importance of including the objectives of the study in the research design to ensure that the information collected is appropriate for solving the problem. Research design constitutes decisions regarding what, where, when, how much and by what means concerning the collection, measurement and analysis of data in a manner that

aims to combine relevance to the research purpose with an economy in procedure (Kothori, 2004, p31).

Considering the above explanations and the research objectives and questions, the researcher employed descriptive research design with survey questionnaire in order to determine the different wastes or non-value adding activities in GIW and explanatory or hypothesis testing research design with detailed survey questionnaire and analysis in order to assess the lean principles in place to eliminate the non-value adding activities, to analyze the association between elimination of waste and cost reduction effort and to analyze the implementation of continuous improvement model for ensuring waste elimination.

Apart from research purpose, time constraint is another important factor that should be taken in to consideration in formulating research designs. Because of limited time duration for the study, the researcher makes use of cross-sectional data gathering method.

3.2. Population and Sampling Design

Geosynthetics Industrial works PLC (GIW) has 231 employees working in managerial, supervision, expertise and daily laborer positions of production, technical, marketing, quality control and product development, procurement and supply, human resource management and administration, finance, planning and business development and ICT departments and service units. Out of the total 231 employees, 111 employees have an education level ranging from TVET 10+1 certificate to second degree while the rest 120 employees are 12^{th} grade complete and less.

The researcher chooses these 111 employees having an educational level TVET 10+1 certificate to 2^{nd} degree as a sample for the study. The samples are chosen by using non-probability judgmental or purposive sampling technique; considering that these are the employees that can reply the questionnaire with understanding. Since some issues rose in the questionnaire are new to the respondents, choosing those with better education level is helpful in obtaining responses that are reflecting the real situations in the company. Survey questionnaire was distributed to 103 of the employees chosen as a sample and 88 respondents replied the questionnaire; the response rate is 85.4%. The samples are truly

representatives because employees from all departments and service units are included and the attributes found in samples is almost proportional to those in the population. Since the samples size is such a manageable one, the data collection was carried out with reasonable time and cost.

3.3. Types of Data to be Collected and Used

Data collection is a very important aspect of research design and the ability to achieve the research aims and answer the research questions depends on the effectiveness of data collection (Adams et al., 2009, p108). Data are generally classified as primary data, those which are collected afresh and for the first time, and thus happen to be original in character, and secondary data, data already been collected by someone else and which have already been passed through the statistical process (Kotheri, 2004, p95). The study makes use of primary data collected through questionnaire on April, 2021 by the researcher. With the aim of enhancing the truthfulness of the collected data, the respondents were awared ahead about the lean wastes and the lean principles by the researcher himself and three other supervisors assigned for the purpose.

3.4. Methods of Data Collection

Kotheria (2004, p95) explained the very facts that surveys are the most widely used methods of data collection in business and management research and in conducting surveys the construction and design of instruments or questionnaires is critically important, as is the sample collection and administration. Data collection through questionnaire is also advantageous in giving sufficient time to respondents, in collecting large number of data, in obtaining respondents which are not yet easily approachable and in avoiding interviewer bias; although it is associated with a notable drawback of low response rate. Thus, this study uses survey questionnaire for data collection.

3.5. Data Analysis Methods

Adams et al. (2007, pp: 171- 191) pinpointed that descriptive statics helps to understand and summarize the frequency, mean, median, mode, variance and standard deviations of quantitative data in either tabular or graphical forms. Bhandari (2020) on the other hand explained that inferential statics uses to make estimates about population and testing hypothesis to draw conclusion about population.

Considering the above facts the researcher employed descriptive statics to present respondents demographic information and to summarize the mean and standard deviations of different type of wastes in GIW and the lean principles that the company uses to eliminate these wastes. Inferential statics of correlation and simple linear regression were used to test hypothesizes drawn in the theoretical literature review part. Statistical Package for Social Science (SPSS) version 20 was the data analysis tool used by this study because of its popularity and its nature of user-friendly.

3.6. Validity

Validity involves the degree to which the researcher is measuring what he/she is suppose to, more simply, the accuracy of measurement (Adams et al., 2007, p237). Validity is the most important criterion and indicates the degree to which an instrument measures what is supposed to measure (Kothari, 2004, p73). The questionnaire for the study was based on relevant literature review. It was prepared in both English and Amharic languages in order to make clear and easily understandable by the respective respondents. The researcher review literatures and consult three subject matter experts for construction, clarity, appropriateness, adequate coverage of the topics, relevance and the similarity between the English and Amharic versions of the questionnaire.

3.7. Reliability

Reliability is a test of sound measurement and an instrument is reliable if it provides consistent results (Kothari, 2004, p74). Adams et al. (2007, pp: 235-236), also clarifies that reliability is essentially about consistency and there are two ways by which reliability is usually assessed: test-retest method - administering the measuring instrument more than once for the same sample, in similar conditions and checking the stability over time and split half method (or internal consistency) – splitting the measures into two, calculating the result from each half and comparing the consistency of the results. Reliability of an item is acceptable if the value of alpha is within 0.70 to 0.99 (Fraenkel & Wallen, 1996 as cited in Mohammed et al., 2014). The study makes use of calculating internal consistency (or calculating Cronbach's alpha coefficient) to determine the reliability of the measure. Accordingly, the values in the table below are indicative that all the scales have good reliability because the Cronbach's alpha coefficients are greater than 0.7.

Reliability Statistics

Scale	Cronbach's Alpha Coefficient	N of Items
Wastes or non-value activities in GIW	0.732	16
Implementation of lean principles and tools	0.890	19
Cost Reduction	0.74	7
Continuous improvement	0.858	8
Quality Management System	0.874	8

3.8. Ethical Considerations

Recognizing that research data has been collected from people and/or about people, Creswell (2014, pp: 92-101), list out a number of ethical issues that a researcher should taken into consideration prior to beginning the study, in conducting the study as well as in presenting the findings. Respecting code of ethics, obtaining the necessary permissions and negotiating ownerships for publication prior to the study; identifying beneficial research problem, disclosing purpose of the study and respecting norms and charters of indigenous cultures at the beginning of the study; respecting the site and potential power imbalance,

not deceiving and not exploiting participants and not collecting harmful information at the data collection stage; and not falsifying data and findings, not plagiarizing, not disclosing information that harm the participants and making clear communication at the data analysis and reporting stages.

The study had been conducted by taking into considerations of the research code of ethics. Respondents well informed about the purpose of the study, keep confidentiality of their response and of course are not yet forced to respond. The researcher give due credit for the work of others, paraphrased or used as a reference. Data, results and findings were clearly presented without any falsifications and conclusions and recommendations were drawn from the findings. Moreover, the study not discloses any information that is harmful to anyone else.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

In this study, the manufacturing company continuous effort on eliminating non-value adding activities or wastes with the aim of creating value to the customers was measured. Theoretically it is believed that, whatever the principles they follow, all manufacturers have strong desire to eliminate non-value adding activities, reduce manufacturing costs and continuously improve their product and service delivery as these are pillars for their excellence. The researcher's center of focus was measuring the actual company performance in implementing these principles against the lean model of eliminating non-value adding activities, reducing manufacturing cost and continuously improving processes and products; as the lean models are pervasive and practically proofed one. Samples of the measures includes, a focus of identifying and eliminating non-value adding activities, a focus on implementing lean principles and tools, a focus on cost reduction and a focus on continuously improving processes and products. Respondents were asked their level of agreement to the different issues raised in the respective focus areas in a 5 point likert scale ranging from 1 (Strongly disagree) to 5 (strongly agree).

Order based production, defect rate, level of inventories, unnecessary man and material movements, waiting and over-processing are the parameters used to identify the non-value adding activities. The lean principles of pull system, quality at the source, JIT, 5S and OEE were analyzed to determine their role in eliminating the identified wastes. The cost reduction effort of the company was analyzed though meeting delivery schedules, on-time supply of inputs, change in defect rate and corrections for defect and unnecessary stockings. Identifying and capitalizing opportunities for improvement, commitment to ensure continuous improvement, connecting the improvements to PDCA cycle and through emphasis on core business are instruments to measure practice of continuous improvement.

4.1. Results

4.1.1. Respondents Demographic Information

Table 1 – Profile of Respondents

Respondent Profile	Group	No of Respondents	% of Respondents
Sex of Respondents	Male	80	90.9
	Female	8	9.1
	Total	88	100
Age group of Respondents	23 to 28 years	10	11.4
	29 to 34 years	20	22.7
	35 to 40 years	30	34.1
	Greater or equal to 41 yrs	28	31.8
	Total	88	100
Respondents level of Education	Certificate	22	25
	College Diploma	28	31.8
	First Degree	27	30.7
	Second Degree	11	12.5
	Total	88	100
Respondent's job position in the company	Managerial	10	11.4
	Supervision	12	13.6
	Experts	52	59.1
	Assistant to experts	12	13.6
	Not mentioning position	2	2.3
	Total	88	100
Respondent's service year in GIW	Less or equal to 3 years	6	6.8
	4 to 7 years	24	27.3
	8 to 11 years	18	20.5
	Greater or equal to 12 yrs	40	45.5
	Total	88	100

Source – Survey Result (April, 2021)

Table 1 above revealed that 90.9% of the respondents are males and the rest 9.1% are females. The less percentage of female respondents is associated with facts that their number in specified sample category is relatively low and some of them were unwilling to respond mentioning that some parameters are strange to them.

34.1% of the respondent's lay in the age group of 35 to 40 years. Respondents with the age group of greater than or equal to 41years, 29 to 34years and 23 to 28years in the descending order of their percentage are 31.8%, 22.7% and 11.4%. On the other hand 45.5% of the respondents' serve the company for twelve years or more. The service year for the rest of the groups is 27.3% from 4 to 7years, 20.5% from 8 to 11 years and 6.8% less than or equal to 3 years. Almost two third of the respondents have serve the company for more than 8 years. This has meaningful contribution in obtaining relevant data since they now the company very well; even the changes that the company experienced through time.

College diploma and first degree holders are in higher proportion in the group with 31.8% and 30.7% respectively. Certificate holders with 25% percentage and second degree holders with 12.5% lay in the next ranks. Majority of the respondents (i.e. 59.1%) are working in the job position of experts followed by supervisors and assistant to experts each with 13.6% and managers with 11.4%. Incorporating educated staffs working in experts, supervision and managerial position also have meaningful contribution in obtaining pertinent information because these are the employee groups closer to the problem under scrutiny.

4.1.2. The non-value adding activities in GIW

The mean and standard deviations of the transformed variables for each of the non-value adding activities were calculated to determine the major wastes or non-value adding activities in GIW.

Table 2 – Mean and Standard Deviations of non-Value Adding Activities/Wastes.

SN	Response Items	Mean	Standard Dev
1	Muda of overproduction	1.70	0.623
2	Muda of defect making	3.11	0.898
3	Muda of inventories	2.85	0.852
4	Muda of transportation	2.40	0.944
5	Muda of waiting	3.63	0.821
6	Muda of motion	2.61	0.896
7	Muda of over-processing	2.32	0.834

Source: Survey Result (April, 2021)

Table-2 above shows that the respondents are strongly disagreed and disagreed on the presence of wastes/mudas associated with overproduction (M = 1.70 and SD = 0.623). This finding is evident that the company produces products to the quantity requested by the customer. Majority of the respondents are also disagreed on the existence of waste/muda associated with transportation (M=2.40 and SD = 0.944). Meaning, there is no unnecessary movement of materials and products as well as the distance travel in moving items (materials or products) is considerably low. For questions concerning muda of motion, majority of the respondents are either undecided or disagreed (M=2.61 and SD = 0.896). This result attests that neither the movement of employees in looking for tools nor their physical movement associated with machines' layout are not to the extent to consider them as wastages. Great number of the participants are contrary to the items enquiring their agreement on the presence of wastes associated with over-processing (M=2.30 and SD = 0.834). This means there are no production processes and product features that are added apart from the customer requirement. The mean and standard deviation values for questions concerning muda of defect making (M=3.11 and SD = 0.898), muda of inventories (M = 2.85 and SD = 0.852) and muda of waiting (M = 3.63 and SD = 0.821) show some tendency of respondents agreement on the presence of such wastes. Since the values on table-2 above are calculated from the transformed variables, the researcher found that it is essential to determine the mean of each of the questions that had been raised to the

respondents with regard to the these three wastes in order to determine the specific muda/waste type and is presented in table 3 below.

Table 3 - Mean and Standard Deviation of the three Identified Mudas/Wastes

SN	Response Items	Mean	Std Dev
1	The production process makes defective products/scraps more than the unavoidable minimum	3.02	1.208
2	Production time is lost in making correction for the defect	3.22	1.127
3	Significant amount of finished products are found in finished goods store	2.13	1.159
4	Considerable amount of re-workable material is stocked in scrap/defective products store	3.58	1.153
5	Production time is lost in waiting the output from the former process	3.34	1.261
6	Equipment repair takes more time than the allowed standard	3.36	1.129
7	Delay in inputs supply is the bottleneck for the company's manufacturing process	4.17	1.310

Source: Survey Result (April: 2021)

The first two questions in table-3 above are related with muda of defect making followed by the other two questions concerning muda of inventories and the last three for muda of waiting. The result in the table disclosed that respondents are undecided on the question seeking their agreement on the making of defective products more than the unavoidable minimum (M= 3.02 and SD = 1.208) and some degree of agreement on the loss of production time in making correction for the defect (M = 3.22 and SD = 1.127). So these are indicative that production time lost in making correction for the defect is the waste associated with muda of defect making. Concerning questions about muda of inventories majority of the respondents agreed on the stocking of considerable amount of re-workable materials but disagreed with the stocking of finished products. Hence, stocking significant amount of re-workable materials is the wastage associated with inventories. Majority of the participants expressed their agreement on existence of wastages related to delay of in input supply (M=4.17 and SD = 1.31), loss of production time in waiting output from the former process (M = 3.34 and S = 1.261) and the more time taken to make equipment repair (M =

3.36 and SD = 1.129). This findings are evidence that muda of waiting the most apparent in GIW production process compared with the other six muda types.

4.1.3. The lean Principles and tools used to eliminate the non-value adding activities in the Company

To determine which lean principles are in place to eliminate the non-value adding activates, five point likert scaled questionnaires enquiring the agreement of the respondents were administered. The mean and standard deviations of the transformed version of the questionnaires are presented in table-4 below.

Table 4 – Mean and Standard Deviations of the Different Lean Principles

SN	Response Item/ Lean principle in work/	Mean	Std Dev
1	Pull System	3.85	0.759
2	Quality at the source	3.67	0.714
3	Just-In-Time management (JIT)	3.0	0.860
4	5S (sort, set-in-order, shine, standardize and sustain)	3.48	0.857
5	Overall Equipment Effectiveness (OEE)	3.09	0.680

Source: Survey Result (April: 2021)

Table-4 above depicted that the respondents concurred by expressing their agreement on the presence of pull system of production (M = 3.85 and SD = 0.759). This finding has three major implications: the company produces products only after receiving orders from the customers, the company sequential process steps are designed in such a way that the preceding activity produces only those outputs needed by the subsequent one and all the company activities are aligned to the customer need. Majority of the respondents are also agreed with the issues enquiring their concord on the implementation of the lean principle of quality at the source (M = 3.67 and SD = 0.714). This implies that performers are well equipped to ensure fulfillment of the quality requirement of their output at each stage of the production process and the company has system to ascertain that defective pieces will not pass to the next step. Although not to equal extent as the former two, the respondents agreed with the implementation of 5S tools in the work place (M = 3.48 and SD = 0.857).

This is to mean that items not needed are sorted out from the work place, needed items are organized in a manner that helps to eliminate wasted motion, work area and needed items are cleaned regularly, sorting out unnecessary items, organizing the needed items and cleaning are carried out on regular basis and are promoted to be the culture of the company.

But it seems that the respondents are undecided on the other two lean principles: just-in-time management (M = 3.0 and SD = 0.86) and overall equipment effectiveness (M = 3.09 and SD = 0.68), which are presented in expounded form in the table below.

Table 5 – Mean and Standard Deviations for Individual JIT and OEE Questions

SN	Response Item (JIT/OEE)	Mean	Std Dev
1	Each of the company's process steps deliver the service to the next step just-in-time needed	3.11	1.156
2	The company reduce inventories at finished products store by aligning process steps to deliver what is needed just-in-time needed	3.15	1.062
3	The company reduce inventories at re-workable products store by aligning process steps to deliver what is needed just-in-time needed	2.72	1.124
4	The company ensures equipments readiness whenever they are needed	3.33	1.117
5	Equipments are capable of delivering output to their effective capacity	2.76	1.207
6	The equipments produce products that fulfill the standard requirements	3.43	1.081
7	The time taken for die-change is kept to the allowed minimum	3.07	1.009
8	The overall machines down time has been kept to the unavoidable minimum	2.66	1.113
9	Minor machine failures are repaired earlier in order to prevent machine breakdown	3.34	1.133

Source: Survey Result (April, 2021)

The first three questions in table-5 above enquire respondent's agreement on the implementation of just-in-time management in the company while the rest six are concerned with overall equipment effectiveness. The results for the first two questions shows that respondents agreed to some extent on just-in-time delivery of the service that the next process needed from the former one (M = 3.11 and SD = 1.156) and on the

reduction of inventories at finished product stores by aligning process steps to deliver what is needed just-in-time needed (M= 3.15 and SD = 1.062). But most of them are either undecided or disagreed on the implementation of just-in-time management for the reduction of inventories at re-workable material store (M = 2.72 and SD = 1.124).

For questions concerning overall equipments effectiveness, the result in the table disclosed participants agreement on the company's capability to ensure readiness of the equipments to production (M = 3.33 and SD = 1.117), the machine's capability to produce products fulfilling the standard requirement (M = 3.43 and SD = 1.081) and on the carrying out of minor maintenance works with the aim of preventing machine break down (M = 3.34 and SD = 1.133). They were undecided on the question enquiring the respecting of allowed minimum time for die-change (M = 3.07 and SD = 1.009). The results for questions concerning equipments capability to deliver output to their effective capacity (M = 2.76 and SD = 1.207) and maintaining machinery downtime to unavoidable minimum (M = 2.66 and SD = 1.133) are indicative that the participants tend to disagree with the issues. Meaning equipments are not capable of producing output to their effective capacity and the machine downtime more than the unavoidable minimum

4.1.4. Results of Hypothesis Testing

4.1.4.1. Role of lean principles for eliminating non-value adding activities

In the theoretical literature review part the researcher hypothesized that *low level of inventory in the finished goods store is associated with the company's practice of* using *pull system of production (H1)*; *Delay in product delivery or muda of waiting is associated with poor effort in implementing the pull system in all sequential activities of the company (H2); The increase in the defect rate is associated with overall equipment ineffectiveness (H3) and High inventory of the re-workable materials is associated with lack of just-in-time (JIT) management system* (H4). Pearson correlation is used to test these hypothesizes and the results are presented in table 6 below.

Table 6 - Pearson Correlation between Implementing Lean Principles and Eliminating Wastes

Correlation between Independent variable Vs Dependent variable	Correlation Results
Pull system of production Vs inventories in finished products store	-0.254* 0.018
Pull system in sequential activities Vs Muda of waiting	-0.149 0.169
Overall equipment ineffectiveness Vs muda of Defect making	0.131 0.134
Lack of JIT Vs Muda of inventory in re-working material store	-0.147 0.182

* - Correlation is significant at the 0.05 level (2 tailed)

Source: Survey Result (April, 2021)

Hypothesizes drawn and the interpretations of the correlation results are summarized in the table below.

Table7- Hypothesis Testing on the Association b/n Lean Principles & Lean Wastes

Hypothesis	Results
low level of inventory in the finished goods store is associated with the company's practice of using pull system of production (H1)	The significant negative correlation between pull system of production Vs inventories in finished products store in table 6 above [corr.= -0.254*; sig (2-tailed) = 0.018] is indicative that the low level of inventories in finished products store is the result successful implementation of pull system of production. In other words the finding proves the hypothesis drawn.
Delay in product delivery or muda of waiting is associated with poor effort in implementing the pull system in all sequential activities of the company (H2)	The lack of significant correlation between pull system at sequential process steps and muda of waiting [corr. = -0.149; sig. (2-tailed) = 0.169] is an indication that muda of waiting is not associated with poor effort in implementing pull system in all sequential activities of the company. Hence, the finding refutes the hypothesis. It is identified above that muda of waiting is the notable wastage of the company but here the result shows it is not because of lack of pull system in sequential activities of the company. Thus, further research is needed to determine its cause.
The increase in the defect rate is the result of overall equipment ineffectiveness (H3)	The insignificant correlation between overall equipment ineffectiveness and muda of defect making [corr. = 0.131; sig. (2-tailed) = 0.134] is evidence of the lack of association between increase defect rate and overall equipments ineffectiveness. Meaning, the finding refutes the hypothesis.
High inventory of re-workable materials is the result lack of just-in-time (JIT) management system (H4)	Again the insignificant correlation between lack of JIT & muda of inventories in the re-workable materials [corr. = -0.147; sig. (2-tailed) = 0.182) is an indication that the high inventory of re-workable material is not the result of lack of JIT system. The finding doesn't support the hypothesis.

Source: Survey Result (April, 2021)

4.1.4.2. Cost reduction resulted from elimination of wastes

It was hypothesized that *the poor performance in reducing cost of production of GIW is the result of muda of waiting, making defects and lack of Just-in-time management.* Multiple regression analysis seems ideal for determining the effect of the three independent variables: muda of waiting, making defects and lack of JIT on the dependent variable (cost reduction). But the correlation and normality tests presented here under are evident that simple linear regression is the best tool to analyze the effect of muda of waiting on cost reduction.

4.1.4.2.1. Correlation Between Dependent and Independent Variables & Multicollinearity Test

To test the correlations of each independent variable with the dependent variable and the correlations between each pair of independent variables, Pearson correlation analysis was conducted and the result is presented in the table hereunder.

Table 8- Correlation between Dependent/Independent Variable and between Independent Variables

	Cost Reduction	**Muda of defect making**	**Muda of Waiting**	**Lack of JIT Management**
Cost Reduction	1			
Muda of defect making	-0.113 0.229	1		
Muda of Waiting	-0.479* 0.000	0.272* 0.010	1	
Lack of JIT management	0.049 0.652	-0.002 0.985	-0.243* 0.023	1

*- Correlation is significant at the 0.05 level (2 tailed)

Source – Survey Results (April, 2021)

The results in the table indicates that only the correlation between muda of waiting and cost reduction is significant; but the other two independent variables have no significant correlation with the dependent variable. Hence, only muda of waiting is the independent

variable qualified to be considered in the regression analysis and hence the analysis to be used is simple regression analysis. Multicollinearity can't be an issue for this analysis since only one out of the three independent variables is considered in the regression analysis.

4.1.4.2.2. Normality Test

To decide which type regressions to be used, the z-values of skewness and kurtosis and the p-value of Shapiro-Walk test were determined to check whether the dependent variable is normally distributed for each category an independent variable or not and the analysis result is presented in table 9 below.

Table 9 - Z-value of Skewness and Kurtosis and P-value of Shipro-Walk Test

Mean (for distribution of cost reduction over each category of muda of waiting)	Skewness	Kurtosis	Shapiro-Walk P-value
2.33	1.155	-	0.391
2.67	1.54	0.735	0.295
3.0	0.015	-0.212	0.885
3.33	0.556	0.305	0.361
3.67	-1.82	1.46	0.191
4.0	0.193	-0.257	0.766
4.33	-0.44	-1.31	0.065
4.67	0.892	-0.836	0.230

Source – Survey Results (April, 2021)

The cost reduction is normally distributed for each category of muda of waiting because the z-value of skewness and kurtosis for mean of each response lie in between ±1.96 and the Shapiro-Wilk test p-value is greater than 0.05.

Normality of the distribution was also visually checked by using histogram and Q-Q plot and found that it is approximately normally distributed. Therefore, simple linear regression, which is parametric method of regression, is recruited to analyze the effect of the independent variable (muda of waiting) on the dependent variable (cost reduction).

Table 10 – Simple Linear Regression Analysis Results

Parameter	Value
R-square	0.229
Adjusted R-square	0.220
Standard error of the estimate	0.531
F-ratio	25.546
Standardized coefficient (Beta)	-0.479
Unstandardized Coefficient (muda of waiting)	-0.441
Unstandardized Coefficient (constant)	3.883

Dependent variable – cost reduction and Independent variable – muda of waiting

Source: Survey Results (April, 2021)

The R square value of 0.229 indicates that 22.9% of the data are explained by the regression analysis model. It is relatively lower percentage which might be associated with the small sample size used in the analysis. The 25.546 F ratio is indicative that the overall analysis is statistically significant or the model used is such a good one as this value by greater than the critical F distribution value at 95% confidence interval (critical F(1,86) at 0.05 = 4.00 – this is from statistical F-distribution table). The standardized coefficient (bata) of -0.479 is the correlation between the independent variable (muda of Waiting) and the dependent variable (cost reduction). The Unstandardized coefficient of -0.441is evidence that muda of waiting negatively affects the cost reduction effort of the company. The equation for this simple linear relationship with slop of negative can be expressed as: -

E(Cost Reduction) = 3.883 – 0.441*muda of waiting.

From the linear equation we can learn that a unit increases in muda of waiting decreases the cost reduction effort by 0.441.

4.1.4.3. Role of implemented Quality Management System in ensuring Continuous Improvement in the Company

Considering that quality management system is a change management tool that campaign continuous improvement, it was conceptualized that *continuous process improvement in the company is associated with the implemented quality management system.*

Table 11 – Correlation between Quality Management System and Continuous Improvement

		Continuous_I	QMS
Continuous_I	Pearson Correlation	1	.678**
	Sig. (2-tailed)		.000
	N	88	86
QMS	Pearson Correlation	.678**	1
	Sig. (2-tailed)	.000	
	N	86	86

**. Correlation is significant at the 0.01 level (2-tailed).
Source: Survey result (April, 2021)

The Pearson correlation result in the above table supports the hypothesis as the correlation between Quality Management System (QMS) and Continuous Improvement (Continuous I.) is significant even at 0.01 level.

4.2. Discussions

The lean wastes have been studied by different scholars in different public and private organizations. This study differs from the antecedents in many ways. It: (1) is the first in its type in the context of Ethiopian manufacturing firms; (2) develops hypothesis on the importance of lean principles to eliminate lean wastes; (3) analyzes the limitations that the different wastes imposed on the company's attempt of reducing production costs and (4) examines the associations between the lean campaign's of continuous improvement and quality management system which the company implemented. The findings of this work and suggestions for further research are presented hereunder.

Similar to Grzelczak and Werner-Lewandowska (2016) finding of muda in contemporary organization, muda of defect making and muda of inventories are the wastes identified in the GIW manufacturing process. Contrary to the mentioned authors finding, muda of waiting is the number one waste found in this study. Delay in the supply of the required inputs, the lengthy time needed to conduct equipment repair and the loss of production time in waiting the former process are the wastes associated with muda of waiting. Stocking considerable amount of re-workable material and the loss of production time in making correction for the defect are the common wastes associated with muda of inventories and muda of defect making respectively.

Pull system, quality at the source and organizing work place by the 5S tools (sort, set-in-order, shine, standardize and sustain) are the lean principles and tools that the study determined for their implementation in the company's production process. Stocking significant amount of re-workable materials and the machines incapability to produce output to their effective capacity are the instruments attested that the implementation of just-in-time management and overall equipment effectiveness principles not to the same extent as the former three. The lean production system encourages the implementation of each one of these and other lean principles to the extent of establishing spotless production process; which is not usual in many manufacturing firms in Ethiopia. Thus, the researcher recommend further study in this area by using longitudinal data and by creating additional awareness to the respondents about what these principles really mean.

The theoretical proposition of Denis (2010, p157) about the role of pull system to reduce inventory and unit cost of production is proved by the findings of this work. The significant negative correlation between pull system of production and inventories in finished products store is an interesting finding of this work that assures fewer inventories in finished product store is associated with successful implementation of pull system in production process. Similarly the linear negative relationship between cost reduction and muda of waiting is another important finding of the work that ascertains the impracticality of cost reduction without eliminating muda of waiting. It is true in real life situations that every additional day elapsed without production because of delay in input supply, equipment repair or making correction for defective products incurs additional costs

associated with fixed overheads, soaring price of inputs and penalties for not meeting the obligation. The small R^2 in the regression analysis of the relationship between muda of waiting and cost reduction and the insignificant correlation between cost reductions with muda of defect making as well as with lack of just-in-time management might be associated with small sample size; of which the author recommends to be proved by another similar research using large sample from multiple organizations.

The significant correlation between quality management system and continuous improvements, at 99% confidence level, reaffirmed that the implemented change management tool helps the company to ensure continuous improvement in its production process. But quality management system, which is mainly based on continual improvements derived from the successful implementation of Plan-Do-Check-Act (PDCA) cycle, is not the only continuous improvement tool that lean production system recommends. The premise of continuous improvement lies on the fact that challenges in this modern era of business comes from many fronts: competitors introduce new products and services, industries create more agile processes and technologies, the challenges imposed by globalization surges and the scope of business environment expands. Thus, improvements based on quality management system only can't help the company to beat all these challenges and stay ahead of the competition because others can ensure better and faster improvements by implementing a combination of two or more improvement tools like innovative or breakthrough improvement and kaizen improvements. Considering these the lean production system encourages companies to use all the possible improvement tools to stay tip-top in the race. Therefore, the researcher recommends further research on the role of other improvements tools to ensure continuous improvements in the context of Ethiopian manufacturing firms.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents summary of major findings, conclusions and recommendations derived from the analysis conducted on the manufacturing practice of Geosynthetics Industrial Works PLC (GIW) in the perspectives of lean production.

The study was conducted in GIW by using survey questionnaire data collection method. The respondents were the company employees having an education level of certificate and above, chosen by using judgmental sampling technique. The bases for using such sampling technique is that these are the employees that can better understand the lean wastes and the lean principles and can reframed their company processes to relate with the response items. Pertinent data was obtained for each response item and subjected to statistical analysis of reliability test, descriptive statics, correlations and regressions by using SPSS version 20.

5.1. SUMMARY OF MAJOR FINDINGS

The findings of the study revealed that wastes associated with muda of overproduction, motion, transportation and over-processing have not yet been recognized in the production process of the company. But wastes associated with waiting, defect making and inventories are there to the varying extents. Delay in the supply of the required inputs, the lengthy time needed to conduct equipment repair and the loss of production time in waiting the former process are the wastes associated with muda of waiting. Stocking considerable amount of re-workable material and the loss of production time in making correction for the defect are wastes associated with muda of inventories and muda of defect making respectively.

The company is successful in implementing pull system of production, quality at the source and 5S principles. But limitations are there in implementing JIT and OEE which were manifested by stocking significant amount of re-workable materials and the machines incapability to produce output to their effective capacity respectively.

The significant negative correlation between pull system of production and inventories at finished goods store is assurance that fewer inventories at the finished goods store are the result of successful implementation of the system. Also the significant linear negative relationship between cost reduction and muda of waiting is another important finding of the work that ascertains the impracticality of cost reduction without eliminating muda of waiting.

The outstanding role of quality management system in ensuring continuous improvement in the company production process is reaffirmed by such significant positive correlation between quality management system and continuous improvement at 99% level of confidence.

5.2. CONCLUSIONS

The findings of this study noted that: wastes associated to muda of waiting, muda of inventories and muda of defect making are the common ones that seek the company's management attention; successful implementations of lean principles are the paramount to eliminate lean wastes; lean wastes are the causes for increasing manufacturing cost and quality management system is such a change management tool that companies should promote to ensure continuous improvement in their process.

Regarding the lean wastes in the company's production process, respondents ascertain the absence of wastes associated with overproduction, motion, over-processing and transportation by expressing their disagreement on the questions soliciting if any of such wastes are there. On the other hand, waiting is the primary wastage of the company followed by defect making and inventories. Delay in the supply of the necessary inputs, the longer the time taken to carry out equipment repair and the loss of production time in waiting the output from the former process are the parameters that make waiting as the

major waste of the company. Concerning wastes associated with inventory, stocking significant amount of re-workable materials is the prominent one. The production time loss in making correction for the defectives and the stocking of significant amount of re-workable materials are indicatives for the existence of wastes associated with defect making.

The findings from questions concerning the implementation of lean principles and tools are confirmatory that the company makes use of pull system of production, quality at the source and organizing the work place by 5S tools to enhance its operation efficiency. But limitations are there in implementing just-in-time management as it is shown by the pitfall in reducing inventories at re-workable material store by aligning process steps to deliver what is needed just-in-time needed. The machines incapability to produce output to their effective capacity is manifestations for the limited effort in implementing overall equipment effectiveness principle.

As it is proved by the negative correlation between pull system and muda of overproduction, the successful implementation of the system in receiving and processing orders is the paramount to overcome wastes associated with overproduction. Although muda of waiting is differentiated as the common waste of the company, the hypothesized idea that it is resulted from poor effort in implementing pull system in sequential activities of the company is refuted by the finding; which might call further research to identify its cause. The results of the hypothesis are also conclusive that neither defect making is the result of overall equipment ineffectiveness nor high inventory at re-workable material store is the result of lack of just-in-time management system.

The negative linear relationship between cost reduction and muda of waiting is the proof for the challenges that the lean wastes imposed on the business sectors' effort of reducing production costs. This finding confirms the more the production time lost in waiting for production inputs, equipment maintenance and services or outputs from the former process the higher is the unit cost of production. Although not confirmed by the findings of this study, it is generally believed that muda of defect making and muda of inventories

have significantly lessened the cost reduction effort; which needs to be attested by further research by using large sample size.

The implemented quality management system provided valuable support in ensuring continuous improvement as it is confirmed by the significant positive correlation between continuous improvement and quality management system. Practicing Plan-Do-Check-Act cycle, of which continual improvement model of quality management system based, is vital in ensuring continuous improvements in the production process

Generally, the study supports the suggestion that lean production is this day's most important production system that companies seeking to stay on top of the competition should implement it.

5.3. RECOMMENDATIONS

Since lean production is the practically proofed system that generates enormous benefits to the manufacturing firms, due attention has to be given by the company management, employees and board of directors in making it part of the long term strategic direction and policy of the company.

The company management has to devise measures to overcome wastes associated with waiting, inventories and defect making since they hindered their competitive advantages and imposed limitations on the cost reduction efforts. Attention has to be given to the successful implementation of just-in-time management system and enhancement of overall equipment effectiveness since they are instrumental in reducing inventories at re-workable material store and in shortening the time needed to make correction for the defects. It is also important for the management that system has to be established to shorten the time needed to supply inputs and to conduct equipment repair as these are prominent cause for muda of waiting.

The management also has to design program to train employees about the lean wastes and the powerful lean principles that are instrumental to eliminate each one of these wastes. The benefits obtained because of the successful implementation of pull system of

production and quality management system could be ramp up and presented as evidence by management to motivate employees for the successful implementation of the other lean principles.

Employees have to be engaged and fully cooperate with the implementation of the systems since these are systems that not only increase the company's efficiency but also enhance their benefits by easing the work load, creating conducive work environment, enhancing their professionalism and increasing their monetary benefits. Since employees are closer to the problems under scrutiny, they have to analyze the cause and effect relationships and come up with appropriate system to eliminate each waste.

The board of director of the company should provide unwavering support to the management in availing the needed resources as this production system brings drastic improvement not only in the company production process but also in the countries manufacturing sector as a whole.

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APPENDIX A

St. Mary's University
School of Graduate Studies
Masters of Business Administration (MBA General)
English version of the Questionnaire

Dear respondents;

The questionnaire is prepared to solicit information for academic purpose. This is to mean, for collecting data to conduct research on the topic "Analyzing the Manufacturing Process in the Perspectives of Lean Production: A Case in Geosynthetics Industrial Works PLC" for partial fulfillment the requirements of degree of masters in Business Administration. The researcher kindly request you to make your response as true and genuine as possible since the findings and the resulted conclusions and recommendations are solely depend on your information. It is fully guaranteed that the information you give will be kept at high level of confidentiality and be used for academic purpose only. Finally, I would like to present my gratitude and appreciation for your cooperation and wiliness to give me your valuable time to respond the questions.

If you have any doubt or questions, please don't hesitate to contact me with the following addresses

Name: Desu Birchit email: luhena@yahoo.com Phone No: 0911900790

Section 1 – Respondents Demographic Data

1. Gender Male ☐ Female ☐
2. To which age group do you belong?
   Less or equal to 22years ☐ 23 to 28years ☐ 29 to 34years ☐
   35 to 40years ☐ more than 41 years ☐
3. What is your Level of educational?
   Certificate ☐ College diploma ☐ First ☐gree

Second Degree ☐ More than Second Degree ☐

4. What is the position you held in the Company?

Managerial ☐ Supervision ☐ Experts ☐ Helpers/Assistances ☐

5. What are your service years in GIW?

Less or equal to 3 years ☐ 4 to 7 years ☐

8 to 11 years ☐ more than 12 years ☐

Section 2 – Questions Related to Waste or non-value adding activities

(Overproduction, Making Defects, Excessive Inventories, Transportation, Motion, Waiting and Over processing)

Please indicate your level of agreement by putting a mark '√' in the space provided

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

SN	Statement inquiring respondent agreement	1	2	3	4	5
1	GIW produce products before receiving customer order					
2	Production unit produce products more than the quantity ordered by the customer					
3	The production process makes defective products/scraps more than the unavoidable minimum					
4	Production time is lost in making correction for the defect					
5	Significant amount of finished products are found in finished goods store					
6	Considerable amount of re-workable material is stocked in scrap/defective products store					
7	There is unnecessary movement of raw materials					
8	There is unnecessary movement of products					
9	The distance traveled in moving raw materials is considerably high					
10	Production time is lost in waiting the output from the former process					
11	Equipment repair takes more time than the allowed standard					
12	Delay in inputs supply is the bottleneck for the company's manufacturing process					
13	Experts make unnecessary movement in looking for tools					
14	The machinery layout results unnecessary physical movement by workers					
15	There are unnecessarily added production processes					
16	The company add more feature in products than is really needed by the customer					

Section 3 – Questions Related to Lean Principles and tools (Pull system, Quality at Source, Just-in-time, 5s and Overall equipment effectiveness)

Please indicate your level of agreement by putting a mark '√' in the space provided

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

SN	Statements inquiring respondent agreement	1	2	3	4	5
1	GIW produce only those products ordered by the customers					
2	The company sequential process steps are designed in such a way that preceding activities produce only those needed by subsequent one					
3	All the company activities are aligned to the customer need					
4	Performers are well equipped to ensure fulfillment of the quality requirement of their outputs at each of the processing stages					
5	The company has a system to ascertain that defective pieces will not pass to the next step					
6	Each of the company's process steps deliver the service to the next step just-in-time needed					
7	The company reduce inventories at finished products store by aligning process steps to deliver what is needed just-in-time needed					
8	The company reduce inventories at re-workable products store by aligning process steps to deliver what is needed just-in-time needed					
9	Items not needed are sorted out form the work place					
10	Items needed for work are organized in a manner that can eliminate wasted motion					
11	The work area and the items needed for work are cleaned properly					
12	Sorting out unnecessary items, organizing the needed items and cleaning the work place and items are applied in continuous manner					
13	Sort, set-in-order, shine and standardize activities are promoted to be the culture of the company					
14	The company ensures equipments readiness whenever they are needed					
15	Equipments are capable of delivering output to their effective capacity					
16	The equipments produce products that fulfill the standard requirements					
17	The time taken for die-change is kept to the allowed minimum					
18	The overall machines down time has been kept to the unavoidable minimum					
19	Minor machine failures are repaired earlier in order to prevent machine breakdown					

Section 4 – Questions Related to Cost Reduction

Please indicate your level of agreement by putting a mark '√' in the space provided

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

SN	Statements inquiring respondents agreement	1	2	3	4	5
1	Not meeting the delivery schedule limits the company ability to reduce manufacturing cost					
2	Delay in supply of inputs incurs additional costs on the company					
3	The high defect rate is one of the cause for increasing the company's manufacturing cost					
4	Stocking significant amount of re-workable materials in defective products/scrap store contribute its part in increasing manufacturing costs					
5	Not conducting value analysis to identify and eliminate unnecessary costs associated with products and services limits the company ability to reduce manufacturing cost					
6	The company incur additional costs to make correction for the defect					
7	GIW has been making substantial expenditure for handling and storage of inventories					

Section 5 – Questions Related to Continuous Improvement

Please indicate your level of agreement by putting a mark '√' in the space provided

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

SN	Statements inquiring respondents agreement	1	2	3	4	5
1	GIW strives to improve its product and service delivery continuously					
2	The company continuously identifies opportunities for improvement					
3	The company is converting opportunities into something that can increase its benefit					
4	The company management is committed to ensure the successful implementation of continuous improvement					
5	Plan-do-check-act cycles are effectively in place to help the implementation of continuous improvement					
6	Manufacturing process is the area that the company is working to ensure its continuous improvement					
7	Improving supply chain efficiency is the unit encompassed in the company's continuous improvement plan					
8	The company continuously works to bring improvement in products innovation					

Section 6 Questions related to Quality Management System

Please indicate your level of agreement by putting a mark '√' in the space provided

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

SN	Statements inquiring respondents agreement	1	2	3	4	5
1	The company is benefited from the quality management system in fulfilling customer requirements					
2	The company management is committed for the successful implementation of quality management system requirements					
3	The company uses quality management system as a tool to identify key processes that seek special attention					
4	Quality management system enable the company to make evidence based decisions					
5	Implementing quality managements system helps the company to create a culture of risk based thinking					
6	The company avail resources needed for ensuring continual improvement of the quality management system					
7	Quality management system helps the company to implement plan-do-check-act cycle in all of its processes					
8	Quality management system creates a fertile ground for implementation continuous improvement					

APPENDIX B

St. Mary's University
School of Graduate Studies
Masters of Business Administration (MBA General)
Amharic version of the Questionnaire

ውድ መላሾች

ይህ መጠይቅ የተዘጋጀው በ"Business Administration" የሁለተኛ ዲግሪ ለማግኘት ከሚያስፈልጉ መስፈርቶች ውስጥ አንዱ የሆነውን ጥናታዊ ፅሁፍ "Analyzing the Manufacturing Process in the Perspectives of Lean Production: A Case in Geosynthetics Industrial Works PLC" በሚል ርዕስ ጥናት ለማድረግ የሚረዳ መረጃ ለማሰባሰብ ነው፡፡ የጥናቱ ግኝት እንዲሁም ግኝቱን ተከትሎ የሚደረገው ማጠቃለያ እና ምክረ ሀሳብ ሙሉ በሙሉ እናንተ በምትሰጡት መረጃ ላይ መሰረት ያደረገ ስለሆነ የምትሰጡት መረጃ በተቻለ መጠን እውነተኛ እና ያለውን ነባራዊ ሁኔታ በትክክል ያገናዘበ እንዲሆን አጥኚው አበክሮ ይጠይቃል፡፡ በዚህ መጠይቅ የሚሰበሰበው መረጃ በከፍተኛ ጥንቃቄ የሚያዝ እና ጥናታዊ ፅሁፉ ለማካሄድ ብቻ የሚያገለግል ይሆናል፡፡ በመጨረሻም ውድ ጊዜያችሁን በመስጠት ይህን መጠይቅ ለመሙላት ፈቃደኛ በመሆናችሁ አጥኚው ልባዊ ምስጋናውን ያቀርብላጓል፡፡ በመጠይቁ ውስጥ ግልጽ ያልሆኑ ወይም ማብራሪያ የሚያስፈልጋቸው ጉዳዮች ካጋጠማችሁ ከዚህ በታች በተገለፀ የመገናኛ ዘዴዎች ሁሉ መጠየቅና ማብራሪያውን ማግኘት የምትችሉ መሆኑን ልገልፅላችሁ እወዳለሁ፡፡

ስም - ደሱ ብርጭት ስልክ - 0911900790 email: luhena@yahoo.com

ክፍል 1 - የመላሾችን ሁኔታዎች የሚገልፁ መረጃዎች

1. ፆታ ሴት ☐ ወንድ ☐
2. እድሜ 22ዓመት እና ከዛ በታች ☐ ከ23- 28 ዓመት ☐ ከ29-34 ዓመት ☐
   ከ35-40ዓመት ☐ 41ዓመትና ከዛ በላይ ☐
3. የትምህርት ደረጃ
   ሰርተፍኬት ☐ የኮሌጅ ዲፕሎማ ☐ የመጀመሪያ ዲግሪ ☐
   ሁለተኛ ዲግሪ ☐ ከሁለተኛ ዲግሪ በላይ ☐

4. በድርጅቱ ውስጥ ያሎት የስራ መደብ

ስራ አስኪያጅ ☐ ተቆጣጣሪ ☐ ባለሙያ ☐ የባለሙያ ረዳት ☐

5. ድርጅቱን ያገለገሉባቸው ዓመታት

3ዓመት እና ከዛ በታች ☐ ከ4-7ዓመታት ☐

ከ8-11 ዓመታት ☐ 12ዓመት እና ከዛ በላይ ☐

ክፍል 2 - ብክነቶችን ወይም እሴት የማይጨምሩ ስራዎችን የተመለከቱ ጥያቄዎች (ከሚፈለገው መጠን በላይ ማምረት፣ እስክራፕ/እንከን ያለባቸው ምርቶችን ማምረት፣ ከሚፈለገው መጠን በላይ ማከማቸት፣ ቀዳሚውን ስራ በመጠበቅ ጊዜን ማባከን፣ አላስፈላጊ በሆነ መልኩ ዕቃዎችን ከቦታ ቦታ ማጓጓዝ፣ አላስፈላጊ እንቅስቃሴዎች ማድረግ እና ደንበኛው ከሚፈልገው በላይ ምርቶችን ለማሳመር መሞከር)

ከተነሳው ሀሳብ ጋር ያሎትን ስምምነት ወይም ተቃርኖ በተዘጋጀው ቦታ ይህን ምልክት '√' በማድረግ ይግለፁ

1 = በጣም አልስማማም 2 = አልስማማም 3 = ገለልተኛ 4 = እስማማለሁ 5= በጣም እስማማለሁ

ተቁ	የመላሾችን ስምምነት/ተቃርኖ የሚጠይቀው ሀሳብ	1	2	3	4	5
1	ጂአይደብሊው በደንበኛው ከመታዘዙ በፊት ምርቶችን ያመርታል					
2	የምርት ክፍሉ ደንበኛው ካዘዘው ቁጥር በላይ ያመርታል					
3	በማምረት ሂደት የሚወጣው ስክራፕ መሆን ካለበት ዝቅተኛ መጠን በላይ ነው					
4	እንከን ያለባቸው ምርቶች ለማስተካከል በሚል ምርት ማምረቻ ሰዓት ሲባክን ይስተዋላል					
5	ብዛት ያለው ምርት በመጋዘን ውስጥ ተከማችቶ ይገኛል					
6	ብዛት ያለው ስክራፕ የተበላሹ ምርቶች መጋዘን ውስጥ ተከማችቶ ይገኛል					
7	አላስፈላጊ በሆነ መልኩ ጥሬዕቃ ከቦታ ቦታ ሲጓጓዝ ይስተዋላል					
8	አላስፈላጊ በሆነ መልኩ ምርት ከቦታ ቦታ ሲጓጓዝ ይስተዋላል					
9	ጥሬዕቃ ለማጓጓዝ የሚኬደው ርቀት ረጅም ሊባል የሚችል ነው					
10	ቀድሞ መሰራት ያለባቸው ስራዎች በሰዓታቸው ባለመጠናቀቃቸው ቀጣዮቹን ስራዎች ሲዘገዩ ይስተዋላል					
11	ለማሽኖች ጥገና የሚወስደው ጊዜ መሆን ካለበት ዝቅተኛ መጠን በላይ ነው					
12	የግብአቶች የአቅርቦት መዘግየት አንዱ የምርት ሂደቱ ማነቆ ነው					
13	መሳሪያዎችን ፍለጋ አላስፈላጊ እንቅስቃሴዎች ይደረጋሉ					
14	የማሽኖቹ አቀማመጥ ሰራተኞችን ለአላስፈላጊ እንቅስቃሴ የሚዳርግ ነው					
15	በማምረት ሂደት ውስጥ መስፈርቱ ከሚፈልገው በላይ የስራ ሂደቶች ሲጨመሩ ይስተዋላል					
16	በምርቶቹ ላይ ደንበኛው ከሚፈልገው በላይ የማሳመር ስራዎች ይሰራሉ					

ክፍል 3 - የሊን መርሆች እና መተግበሪያዎችን (Lean Principles and tools) የተመለከቱ ጥያቄዎች (ትዕዛዞችን መሰረት አድርጎ መስራት፣ ጥራትን ከመነሻው ማረጋገጥ፣ አስፈላጊውን ሁሉ በሚፈለገው ሰዓት ማቅረብ፣ የስራ አካባቢ በ5ቱ 'ማ'ዎች ማደራጀት እና አጠቃላይ የመሳሪያዎች ውጤታማነት ማረጋገጥ)

ከተነሳው ሀሳብ ጋር ያሎትን ስምምነት ወይም ተቃርኖ በተዘጋጀው ቦታ ይህን ምልክት '√' በማድረግ ይግለፁ

1 = በጣም አልስማማም 2 = አልስማማም 3 = ገለልተኛ 4 = እስማማለሁ 5= በጣም እስማማለሁ

ተቁ	የመላሾችን ስምምነት/ተቃርኖ የሚጠይቀው ሀሳብ	1	2	3	4	5
1	ጂአይደብሊው ምርቶችን የሚያመርተው የደንበኞችን ትዕዛዝ መሰረት በማድረግ ነው					
2	በድርጅቱ ውስጥ ያሉ የስራ ሂደቶች የተዋቀሩት ቀዳሚው ለተከታዩ የሚያስፈልገውን ለማቅረብ በሚያመች መልኩ ነው					
3	ሁሉም የድርጅቱ የስራ ሂደቶች ከደንበኛው ፍላጎት ጋር የተጣጣሙ ናቸው					
4	ሰራተኞች የስራቸው ውጤት የሚጠበቀውን መስፈርት ሚሟላቱን ማረጋገጥ በሚችሉበት የብቃት ደረጃ ላይ ናቸው					
5	ድርጅቱ የተበላሸን የስራ ዉጤት ወደ ቀጣዩ የስራ ሂደት እንዳይተላለፍ መቆጣጠር የሚችልበት ስርዓት አለው					
6	እያንዳንዱ የስራ ሂደት ተከታዩን የስራ ሂደት የሚፈልገውን በሚፈልገው ሰዓት ያቀርባል					
7	ቀዳሚው የስራ ሂደት ተከታዩን የስራ ሂደት የሚፈልገው በሚፈለገው ሰዓት እንዲያቀርብ ተደርጎ ስለተዋቀረ በድርጅቱ መጋዘን ያለውን የምርት ክምችት ዝቅተኛ እንዲሆን አስችሎታል					
8	ቀዳሚው የስራ ሂደት ተከታዩን የስራ ሂደት የሚፈልገው በሚፈለገው ሰዓት እንዲያቀርብ ተደርጎ ስለተዋቀረ በድርጅቱ መጋዘን ያለውን የስከራፕ ክምችት ዝቅተኛ እንዲሆን አስችሎታል					
9	በስራ አካባቢ ያሉ ለስራ የማያስፈልጉ ነገሮችን ተለይተው ተወግደዋል					
10	ለስራ አስፈላጊ ናቸው ተብለው የተለዩ ቁሳቁሶች በስርዓት ተደራጅተዋል					
11	የስራ አካባቢው እና ለስራ አስፈላጊ ናቸው ተብለው የተለዩ ቁሳቁሶችን በአግባቡ ይፀዳሉ					
12	አላስፈላጊ የሆኑነትን ማስወገድና አስፈላጊ የሆኑትን ማደራጀት እና ማጽዳት ሁሌም በስራ አካባቢ የሚዘወተሩ ተግባሮች ናቸው					
13	ድርጅቱ አላስፈላጊ ነገሮች ማስወገድን፣ አስፈላጊ የሆኑትን ማደራጀትና ማፅዳትን በተደጋጋሚ የሚከወኑ የስራ ባህሎች እንዲሆኑ በቁርጠኝነት ይሰራል					
14	ድርጅቱ ማሽኖቹን በሚፈለጉበት ሰዓት ለስራ ዝግጁ ሆነው እንዲቀመጡ ያደርጋል					
15	ማሽኖቹ የሚጠበቅባቸውን የምርት መጠን የማምረት ብቃት አላቸው					
16	ማሽኖቹ የሚያመርቷቸው ምርቶች የሚፈለገውን የጥራት መስፈርት ያሟሉ ናቸው					
17	ለዳይ ቅየራ የሚወስደው ጊዜ መስፈርቱ የሚያስቀምጠው ዝቅተኛው መጠን መሰረት ያደረገ ነው					
18	ማሽኖች ሳያመርቱ የሚቆሙበት ሰዓት ዝቅተኛ ነው					
19	ጥቃቅን የማሽን ብልሽት የማሽኖችን መሰበርን እንዳያስከትሉ በማሰብ በጊዜው መፍትሄ ይሰጣቸዋል					

ክፍል 4 - የማምረቻ ወጪን ከመቀነስ ጋር የተያያዙ ጥያቄዎች

ከተነሳው ሀሳብ ጋር ያሎትን ስምምነት ወይም ተቃርኖ በተዘጋጀው ቦታ ይህን ምልክት '√' በማድረግ ይግለፁ

1 = በጣም አልስማማም 2 = አልስማማም 3 = ገለልተኛ 4 = እስማማለሁ 5= በጣም እስማማለሁ

ተቁ	የመላሾችን ስምምነት/ተቃርኖ የሚጠይቀው ሀሳብ	1	2	3	4	5
1	ምርቶችን በወቅቱ አምርቶ ማስረከብ አለመቻል የማምረቻ ወጪን በመቀነስ ሂደት ውስጥ የአቅም ውስንነት ፈጥሯል					
2	ግብዓቶችን በወቅቱ አለማቅረብ በድርጅቱ ላይ ተጨማሪ ወጪ እየፈጠረ ነው					
3	እስክራፕ መጠን መጨመር የድርጅቱ የማምረቻ ወጪ እንዲጨምር አድርጎታል					
4	ከፍተኛ መጠን ያለው እስክራፕ በመጋዘን ውስጥ መከማቸቱ የማምረቻ ወጪ ለመጨመር የራሱ አስተዋጾ አድርጓል					
5	ከእያንዳንዱ የስራ ሂደት ጋር ተያያዥነት ላላቸው ወጪዎች የወጪ ትንተና አለማድረግ ወጪን በመቀነስ ሂደት ውስጥ የአቅም ውስንነት ፈጥሯል					
6	እንከን ያለባቸውን ምርቶች የማስተካከል ሂደት ድርጅቱ ለተጨማሪ ወጪ እየዳረገው ነው					
7	በማከማቻ መጋዘን ውስጥ ያሉትን ንብረቶች ለማስተዳደር ድርጅቱ ተጨማሪ ወጪ እያወጣ ነው					

ክፍል 5 - ቀጣይነት ያለው መሻሻል ጋር የተያያዙ ጥያቄዎች

ከተነሳው ሀሳብ ጋር ያሎትን ስምምነት ወይም ተቃርኖ በተዘጋጀው ቦታ ይህን ምልክት '√' በማድረግ ይግለፁ

1 = በጣም አልስማማም 2 = አልስማማም 3 = ገለልተኛ 4 = እስማማለሁ 5= በጣም እስማማለሁ

ተቁ	የመላሾችን ስምምነት/ተቃርኖ የሚጠይቀው ሀሳብ	1	2	3	4	5
1	ድርጅቱ ምርትና አገልግሎቱን ለማሻሻል በቁርጠኝነት ይሰራል					
2	ድርጅቱ ለመሻሻል የሚያግዙትን መልካም አጋጣሚዎች የመለየት ስራዎችን ቀጣይነት ባለው ሁኔታ ይሰራል					
3	የተለዩትን መልካም አጋጣሚዎች የድርጅቱን ተጠቃሚነት ወደሚያረጋግጡ ደረጃዎች ያሸጋግራል					
4	የድርጅቱ አመራር ቀጣይነት ያለውን መሻሻል እንዲረጋገጥ በቁርጠኝነት ይሰራል					
5	ማቀድ-መተግበር-ማረጋገጥ-ማስተካከያ እርምጃ መውሰድ የሚለውን የስራ ዑደት ቀጣይት ያለው መሻሻል ለማረጋጥ በሚረዳ ሁኔታ ስራ ላይ ውሏል					
6	ቀጣይነት ያለው መሻሻል ከሚፈልጉ ዘርፎች አንዱ የምርት ሂደቱ መሆኑ ድርጅቱ ተረድቶት እየሰራበት ነው					
7	በድርጅቱ ቀጣይነት ባለው መሻሻል ማዕቀፍ ውስጥ ከተካተቱት አንዱ የአቅርቦት ሰንሰለቱን ማሻሻል ነው					
8	በአዳዲስ ፈጠራዎች ቀጣይነት ያለው መሻሻል እንዲረጋገጥ ስራዎች እየተሰሩ ነው					

ክፍል 6 - ከጥራት ስራ አመራር ጋር የተያያዙ ጥያቄዎች

ከተነሳው ሀሳብ ጋር ያሎትን ስምምነት ወይም ተቃርኖ በተዘጋጀው ቦታ ይህን ምልክት ‘√’ በማድረግ ይግለፁ

1 = በጣም አልስማማም 2 = አልስማማም 3 = ገለልተኛ 4 = እስማማለሁ 5= በጣም እስማማለሁ

ተቁ	የመላሾችን ስምምነት/ተቃርኖ የሚጠይቀው ሀሳብ	1	2	3	4	5
1	ድርጅቱን የደንበኞችን ፍላጎት በሚሟላት ሂደት ውስጥ የተተገበረው የጥራት ስራ አመራር ጠቀሜታ አስገኝቶለታል					
2	የጥራት ስራ አመራር በትክክል እንዲተገበር የድርጅቱ አመራር ቁርጠኛ ነው					
3	የጥራት ስራ አመራርን ድርጅቱ ውስጥ ልዩ ትኩረትን የሚሹ ወሳኝ የስራ ሂደቶችን ለመለየት አግዟል					
4	የጥራት ስራ አመራር በመረጃ የተደገፉ ውሳኔዎች ለማሳለፍ አግዟል					
5	የጥራት ስራ አመራር ስጋቶችን ለይቶ ለመከላከል የሚያስችሉ ዝግጅቶች ላይ መሰረት ያደረገ የስራ ባህል እንደሰፍን ረድቷል					
6	ድርጅቱ የጥራት ስራ አመራሩን ለማሻሻል የሚያግዙ ግብአቶችን ቀጣይነት ባለው መልኩ ያቀርባል					
7	የጥራት ስራ አመራር መተግበሩ የማቀድ-የመተግበር-የማረጋገጥ-እርምጃ የመውሰድ ዑደትን በሁሉም የስራ ክፍሎች እንዲተገበር አግዟል					
8	የጥራት ስራ አመራር ቀጣይነት ያለው መሻሻል በድርጅቱ ውስጥ እንዲተገበር ምቹ ሁኔታ ፈጥሯል					