Integrated Model for Continuous Productivity Improvement in Footwear Industry:

(A Case of Anbessa Shoe S.C.)

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I hereby declare that the work which is being presented in this thesis entitle "*Integrated Model for Continuous Productivity Improvement in Footwear Industry: A case of Anbessa Shoe S.C*" is original work of my own, has not been presented for a degree of any other University and all the resources of materials used for the thesis have been duly acknowledged.

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ABSTRACT

Productivity is one of the major determinants that enable manufacturing organizations to compete in the global market. A nation's effort to improve productivity must first begin with basic economic units namely, manufacturing and service organizations. The gains in productivity are one of the major weapons to achieve cost and quality advantages for competition.

Ethiopian Footwear Industries are not competitive in the global market. One of the main reasons is low productivity. The main objective of the study is to develop a method that supports productivity improvement. To achieve this objective, a literature survey has been conducted to get empirical knowledge. The existing productivity measurement and improvement practices, and productivity factors have been assessed using questionnaire and secondary data.

A case study has been conducted on Anbesa shoe s.c. The result shows that the productivity of the factory low when it compared with international bench mark and factory standard. There are multidimensional productivity factors related to human, machine, material, method, process and organizational factors. To solve the problems associated with these productivity factors, proactive, organized and continuous productivity improvement model is required.

To improve the productivity, Integrated Continuous Productivity Improvement model consisting lean, ergonomic and work study developed based on case study result.

Contents

List of Figures

List of Table

Acronyms

ADLI: Agriculture Development Led Industrialization

AGOA: African Growth and Opportunity Act

ASSC: Anbessa Shoe **S**hare **C**ompany

COMESA: Common Market for Eastern and Southern Africa

EFI: Ethiopian Footwear Industries

EU: European Union

FDRE: Federal Democratic Republic of Ethiopia

GoE: Government of Ethiopia

GTP II: Growth and Transformation Plan II

KPI: Key Performance Indicator

LIDI: Leather Industry Development Institute

LLP: Leather and Leather Products

LT: Lead Time

MoFED: Ministry of Finance and Economic Development

NIOSH: National Institute of Occupational Safety and Health

OWAS: Ovako Working Posture Analyzing System

QEC: Quick Exposure Check

RULA: Rapid Upper Limb Assessment

SI: Strain Index

SME: Small and Medium Enterprise

SWOT: strength, weakness, opportunity and threat

UNIDO: united nation industry development organization

USD: United States Dollar

WIP: Work in Process

WRMSD: Work Related Musculoskeletal Disorder

CHAPTER ONE

BACKGROUND AND JUSTIFICATION OF THE RESEARCH

1.1 Introduction

Leather and leather product industries are one of the oldest traditional industries which forma major part of manufacturing production, employment and trade in many developing countries. Because of periodically increasing labor cost and competition this industry recently started migrating from developed countries to developing countries such as Ethiopia.

The government of Ethiopia set strategic industrial development plan by identifying major priority areas based on the resource availability, job creating opportunity and contribution to transform the country from agricultural to industry led economy. Leather and leather products (LLP) industry is one of the areas identified based on the above criteria (LIDI L. I., 2010).

The presence of largest populations of livestock, which makes the country first in the continent, and unexploited business opportunities in the sector divert the focus of the government to make strategies and policies that shifts the major export items from the low value-added hides/skins to high value-added finished products in order to ensure fast and reliable development (Japan, 2007).The sector includes the manufacturing of leather, footwear, glove, leather garment, leather goods and articles. Among these sub sectors footwear manufacturing is given higher priority by the government of Ethiopia (GoE). To achieve this, government has planned projection of getting 485,861.83 million USD from the export of footwear products at the end of GTP II. This plan takes 60.73% of the total earning in Leather and leather products sectors (LIDI L. I., 2015). Because of the number of industries in footwear and accessories has shown an increase in recent times. According to LIDI report currently there are 4 clusters, 81 small and micro, 18 medium and large foot wear industries in Ethiopia.

Despite the efforts made to develop the sub sector by different stakeholder such as UNIDO, LIDI and other concerned bodies, still these industries are not competitive enough within the rapid pace of globalization as expected. One of the main reasons for this is their low productivity as compared to their competitors which are found in East Asia and European countries. The low

productivity of the sub sector is characterized by high production waste, poor working conditions, low utilization of capacity, absence of good work procedure, poor work standardization (Cherkos, 2011; Gebrewahid, 2015).

To survive the current and future influence of global competition firms within this sub sector should examine their operation and adopt a technique that brings continuous improvement in different level in the industry. These improvements generally involve better utilization of resources, higher level of quality and culture change. Essentially the focus is on enhancing productivity to meet or beat the competition on relevant cost, quality, time and flexibility issues. A continuous productivity improvement requires designing and successful implementation of sound programs but, still, many organizations fail to develop the appropriate organizational culture (Tadesse,2011).

There are number of techniques towards continuous productivity improvement, but one of each technique doesn't improve productivity comprehensively. This limitation of existing techniques forces researchers to find a more comprehensive improvement technique to improve the productivity of a company. One approach of this is the use of integrated approach to form a comprehensive and reliable set of manufacturing practices and their synergy supportive and contributes optimistically to continuous productivity improvement (Tesfaye, 2016).

The application of improvement tools and techniques, such as lean manufacturing, work study and ergonomics contribute significant improvement effort to solve productivity problem of Ethiopian footwear industries. This is because Lean focuses on eliminating the sources of waste, aiming a continuous process flow while, work study carrying out different yet related activities such as to improve the efficient use of resources and to set up standards of performance for the activities to be carried out. On the other hand ergonomics is the interaction between people and their environment occurs in order to optimize well-being and overall performance (Isabel, 2015; Prathamesh, 2014). Linking lean, work study and ergonomics can help the company to move ahead in the market competition by increasing production with minimum resource and keeping good health, well-being and safety of workers.

Generally, the uses of the Lean, Work Study technique and Ergonomics principles have the ability to empower the workers, motivating them with effective and efficient processes.

Therefore, this study focuses on identification of barriers to improve productivity and develop continuous productivity improvement model for Ethiopian footwear industries by taking Anbessa Shoe Sc. as a case company.

1.2 Problem Statement

The comparative advantages of footwear industry to produce footwear products at relatively lower cost, but only few firms can do this; due to problems facing the industry. One of the main reasons is low level of productivity in the sub sector. For instance, international benchmark has a production of 6500 pairs/shift/day whereas the achievement of most of EFI is not more than 2000 pairs/shift/day. Also, the international benchmark has labor productivity 16pairs/shift/person but Ethiopian shoe factories have about 4 pairs/shift/person (Yemane, 2014). Anbessa shoe sc. is among these EFI which faces lower productivity arises from factors such as human, material, machine, method, process and organizational factors. These factors are characterized by increased labor turn over (3.25%), high absenteeism (2.3%), inadequate capacity (56%), high waste, high defect rate (6.06%), downtime (10.78 %) and lack of proper ergonomics.

To solve the above problem the factory use disorganized and reactive problem solving approach which is not effective for improving productivity in a continuous manner. The main reasons for not using organized and continuous productivity improvement program are lack of understanding and commitment from top management. As (Beshah, 2011) mentioned on the study conducted in Harer Brewery S.C and some other Ethiopian manufacturing firms' those implemented Kaizen philosophy; Most organizations start improvement notion to come up with a solution to their problems but, they ignores continuous improvement effort. Similarly, in Anbessa shoe s.c. there was an indication that shows the implementation of 5s but the continuity of effort forgotten both by employees and management.

Therefore, the study developed an integrated model that solve the problems and bring continuous productivity improvement in the factory by using lean work study and ergonomics.

1.3 Research Questions

1. How is the level of productivity of the factory?
2. What are the factors that affect the productivity?
3. What are the intervention areas for productivity improvement?

4. What are the metrics to measure productivity of the factory?

5. What kind of productivity improvement model can be used to alleviate the problem?

1.4 Research Objectives

1.4.1 General objective

The main aim of this study is to develop a continuous productivity improvement model that integrate lean, work study and Ergonomics which coherently applies the principles to ensure gain in productivity and working conditions

1.4.2 Specific objective

- Study the current manufacturing conditions of the factory
- To identify factors that impede the productivity of the factory and their indicator
- Measure and analyze current productivity of the factory
- Identify intervention area for continuous productivity improvement
- Develop model for continuous productivity improvement

1.5 Significance of the Study

The study outcome benefits Anbessa shoe as well as other footwear firms through adoption of continuous productivity improvement technique that helps to improve the status of productivity factors available in the factory. More over the improvement technique bring tangible changes in the production process of footwear and general working conditions.

The other benefit of the study is that it will provide an integrated approach which is helpful to improve flexibility and efficiency of the production process.

The study findings used as an input for academician, research institutes and for any interested party who has the courage to learn about integrated productivity improvement techniques, and it can also be used as an input in other factories under this sub-sector with no or little modification.

1.6 Scope of the Study

The research was done in the production shop of Anbessa shoe Sc., which located in Addis Ababa. The scope of the study is bounded on productivity improvement through integrated approach of lean, work study and ergonomics which emphasize to identify and solve productivity

factors. Finally, it develops integrated improvement model to the problems identified and specifies the changes that should be done in the internal manufacturing chain.

1.7Limitation of the Study

The study limited to productivity improvement of foot wear production process. Regarding productivity there are many issues or problems that should be avoided, but in this study only production department productivity problems are considered due to lack of adequate time and data. Among the problem the following are assessed: ergonomic problems, different waste, working condition safety, material handling, design of work station and tools.

1.8 Organization of the Study

After discussion of first chapter on the background introduction, statement of the problem, research question, objectives, significance, scope and limitation of the study; the second chapter presents the review of available literature on lean, work study and ergonomics; Chapter 3 describes the methods of the research, ways of data collection and method of data analysis; Chapter four highlights the background of the sub sector and its performance; Chapter five provides the data collected from the factory and interpretation of the collected data; Chapter six discusses Improvement model for continuous productivity improvement. The final chapter consists of the conclusion, recommendation and future research work.

CHAPTER TWO

RELATED LITERATURE REVIEW

2.1 Continuous Improvement

Baghel.et. al (2005) defined CI more generally as a culture of sustained improvement targeting the elimination of waste in all systems and processes of an organization. It involves everyone working together to make improvements without necessarily making huge capital investments. CI can occur through evolutionary improvement, in which case improvements are incremental, or though radical changes that take place as a result of an innovative idea or new technology. Often, major improvements take place over time as a result of numerous incremental improvements (Habte, 2013).On any scale; improvement is achieved through the use of a number of tools and techniques dedicated to searching for sources of problems, waste, and variation, and finding ways to minimize them.

Need for CI in contemporary manufacturing scenario (Singh, 2013)

- satisfy global customers and achieve sustained organizational growth
- need to change and remain competitive
- need to critically monitor and regulate work-in-process (WIP)
- to improve organization's work culture and mind-set
- to improve productivity and quality
- obviating problems faced by organizations in form of internal factors like low productivity, high customer complaints, high defect rates, non-adherence to delivery time, increase in wages and salaries, lack of knowledge, skill of workers and high production system losses
- to make the job simpler and safer

In addition, CI implementation in an organization can also lead to realization of intangible benefits in the form of improved image of the organization, leading to the possibility of increased orders. Also helps to foster motivation in the workforce, through adequate empowerment, and training.

2.2 Productivity

The definitions of productivity depend on the perspective of individual or organization, due to this many puts their own meaning for it. According to (Durdyev, 2011) productivity is an effective utilization of the resources to achieve set objectives or it can be defined as "quantity of output of a process per unit of resource input", which aligns with several approaches.

2.2.1Productivity Measurement

Among the fundamental principles of productivity improvement is that the productivity of the existing process should be measured in as much detail as possible before any attempt is made to improve. Productivity is one of the various measures that are used to evaluate the performance of an organization. According to (Ephrem, 2015) productivity measurement has been practiced by almost all types of establishments regardless of their size and status.

Productivity can be measured through:

Total productivity: the ratio of total output to the sum of all input factors. Thus, a total productivity measure reflects the joint impact of all the inputs in producing the output.

Partial productivity: the ratio of output to one class of input. For example, labor productivity (the ratio of output to labor input) is a partial productivity measure. Similarly, capital productivity (the ratio of output to capital input) and material productivity (the ratio of output to materials input) are examples of partial productivities.

Surrogate Productivity: Surrogate productivity indicators are the measure of surrogate factors and they are not measured directly as ratio of output to input.

2.2.2 Indicators

Indicators represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization (David, 2010).Choosing the right indicators is a critical aspect in translating an organization's mission, or strategy into reality. Indicators and strategies are tightly and inevitably linked to each other. A strategy without indicators is useless; indicators without a strategy are meaningless.

Generally, the indicators for partial productivity measure are labor, capital, material and other. Similarly, the indicator for surrogate productivity includes Employee Satisfaction Rate (ES_t),

Motivation Rate (M_t), Skill Level Rate (SL_t), Absenteeism Rate (A_t) and Turnover Rate (T_t). Process indicators are internal transport, defect rate, WIP and down time (Tadesse, 2011).

2.2.3Continuous Productivity Improvement Techniques

There are several improvement techniques so far, the following are common ones:

1-Business Process Reengineering: Business process reengineering concentrates on radical change to improve operations. The radical change allows new revolutionary ideas to evolve which can help to improve operations (Gomaa, 2006). It is an approach to review and redesign organizational processes in order to achieve improved performance in terms of cost, quality of service and timeliness**.**

2-Ergonomics: Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (Narayanan, 2013)

3-Lean Manufacturing: Lean is a management approach for processes improvement as well as a methodology that is focused on reducing cost, cycle time, waste in processes and increase productivity (Louis, 1997).

4-Theory of Constraints: Theory of constraints pays attention on bottlenecks. It is important to increase throughput to the maximum in production bottlenecks (Grunberg, 2007). Also it is well established management theory that encompasses the correlated areas; production, performance measurement, and problem solving tools.

5-Agile manufacturing: is defined as the integration of organization, highly skilled and knowledgeable people and advanced technologies, to achieve cooperation and innovation in response to the need to supply customers with high-quality customized products. The term agile manufacturing came into common usage with the publication of the report 21st Century Manufacturing Enterprise Strategy (Kidd, 1994; Iacocca Institute, 1991).

6-Work Study: Work study is a generic term for method study and work measurement which are used in the examination of human work in all its contexts, which lead systematically to the

investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement.

Since footwear manufacturing is labor intensive sub sector it needs safe working condition, healthy worker and good ergonomics. Also, the production process consist many repetitive activities that need proper work procedures to enhance productivity. Beside this, the awareness on different production wastes also need consideration for better process flow. But, it is unlikely that a single technique would address all these needs. The better way to approach these problems is integrating the techniques in a systematic manner. To do this integration of lean, ergonomics and work study is an appropriate strategy. According Toyota production system peoples are the central pillars for any manufacturing system under lean, similarly ergonomic principles used to fit the work to the worker by creating conducive environment. Also work study create standard of performance considering human work in all contexts.

2.3 Lean Concept

Lean is a management approach for improvement as well as a methodology that is focused on reducing cost, cycle time, waste and increase productivity (Louis, 1997). It evaluates a process by comparing the value-added steps versus the non-value-added.

2.3.1Evolution of Lean

The Lean philosophy had its origins in Japan, on the Toyota Production System (TPS), by the end of World War II (Morse, 2014). Toyota has worked since the late 1940s to develop and hone an operations philosophy which cuts costs and lead time within their factories without sacrificing quality or customer service (Womack, 2007). The western companies produced massively, focusing on big volumes and minimal system flexibility (Womack & T., 2003). Hence, Eiji Toyoda - founder of the Toyota Motor Company - and its production director, Taiichi Ohno, concluded that mass production would never thrive in Japan (Womack, 2007). So, they created Toyota Production System (TPS). Hence, this system in essence changes the focus of engineer from individual machines and their utilization, to the flow of the product through the total process.

According to the TPS philosophy, quality improvement would be obtained essentially through the reduction of faults and rework on the production processes.

The *Lean Production* term was firstly utilized by the investigator John Krafcik, from the Massachusetts Institute of Technology, to designate the TPS system because it used less of everything compared with the mass production system. Meaning, less human effort, less fabric floor, less storage space, less investment in tools, fewer hours developing new models, less defects and less stock (Womack, 2007).

The lean philosophy principles were initially applied to motor's production in the 50s. From 2000 and onwards, the lean concept has involved a greater degree of contingency and the scope has been enlarged to include the organizational learning perspective (Nordin, 2012). Hence, currently the Lean concept is applicable to either production or services.

On Table 1 the different practices from the Lean philosophy and their characteristics are presented, according to a literature revision by Pettersen (2009).

Table 1Lean practices and their characteristics (Pettersen, 2009)

Practice	Characteristics
Just in Time (JIT)	• Production leveling • Pull system • Production according to Takt time • Process synchronization
Resource reduction	• Producing in small batches • Waste elimination • Reduction of set up time (SMED) • Reduction of lead time • Reduction of stock
Human relation management	• Team organization • Multidisciplinary training • Workers involvement
Improvement strategies	• Improvement circles • Continuous improvement (kaizen) • 5 why analysis
Defect control	• Automation

	• Failure prevention • 100% inspection • Line stoppage
Supply chain management	• Mapping value flow(VSM and flow charts) • Workers involvement
Standardization	• 5 s • Standard work • Visual management and control
Scientific management	• Policy deployment • Multi manning • Reduction of work force • Layout adjustment • Cellular manufacturing
Group techniques	• Statistical control technique • Total productive maintenance (TPM)

The lean production concept was to a large extent inspired by the Kaizen, a Japanese strategy of continuous improvement. This philosophy consists on the improvement of an organization as a whole, including management, production, human labor, resources and existent materials.

2.3.2 Lean principles

Lean thinking must start with a conscious attempt to precisely define value in terms of specific products with specific capabilities offered at specific prices through a dialogue with specific customers. Providing the wrong good or service the right way is *muda* (Womack, 2003). Hence, the main objective of the Lean management paradigm is to increase the value creation through waste reduction, meaning, create more value with fewer resources. As described on the book *Lean thinking*, Womack et.al (1996) distilled lean principles to five.

I. Value and Waste (*MUDA*): To identify "value", from the customer perspective, is important to answer the questions: What do clients want? When and how do they want it? What

combination of resources, abilities, availability and price is the ideal one for the client? (Holweg, 2004).

Muda is the Japanese word for "waste", specifically any human activity which absorbs resources but creates no value: mistakes which require rectification, production of items no one wants so that inventories and remaindered goods pile up, processing steps which isn't actually needed, movement of employees and transport of goods from one place to another without any purpose, groups of people in a downstream activity standing around waiting because an upstream activity has not delivered on time, and goods and services which don't meet the needs of the costumer (Womack, 2003).

The seven types of waste identified by Taiichi Ohno (1912-1990), its individual description of waste is explicated on Table 3 adapted from Walder,(2007).Many practitioners and teachers of lean thinking add an eighth type of waste: the underutilization of the workers.

Table 2 Types of wastes, their definition and causes in manufacturing (Walder, 2007)

Types of waste	Definition	Causes
Over-production	Produce only the amount of goods necessary-not faster, sooner, or more	- volume incentives (sales, pay, purchasing) - high capacity equipment - line imbalance; poor scheduling - poor production planning - cost accounting practices that encourage buildup of inventory
Defect	Perform each operation without error. Build quality into every process	- unclear customer specifications - incapable processes - lack of process control - unskilled personnel - incapable suppliers
Unnecessary inventory	Provide material when needed by the customer and only in the quantity required	- over-production - unbalanced line - long lead times

		- high rework rate - lack of material requisition and issuance standards
Inappropriate processing	Provide only the required amount of processing and effort for each operation	- unclear customer specifications - frequent engineering changes - unclear work instructions
Excessive transportation	Minimize the distance between processes, and avoid temporary material locations	- poor route planning - complex material flows - poor layout - disorganized workplace
Waiting	Assure machine availability. Perform preventive maintenance. Use man/machine charting to ensure optimization of operator's time	- line imbalance - inflexible work force - unscheduled machine downtime - long set-up - material shortage or delay - manpower shortage or delay
Unnecessary motion	Simplify standardized work sequence to eliminate unnecessary movements	- poor lay-out and housekeeping - disorganized work place and storage locations - unclear, non-standardized work instructions - unclear process and materials flow
unused Talent and creativity	encouraging and making constructive use of the creativity	ingenuity of the people actually doing the work

Often, work activities are placed into two categories: value added and everything else, where "everything else" is waste. There is a third category that should also be considered: incidental

work. Incidental work regards all activities that are transparent to the customer, but necessary to complete the value added tasks.

Table 3 Summary of lean wastes and the researchers who identified them in their papers

Waste	Description in manufacturing	Researchers
Over-production	1. Production in excess of demand 2. Be unsure about non-conformance 4. High transportation costs	Shingo, 1996; Womack and Jones, 2003; Ohno, 1988; Sanchez and Perez,2001;
Defect	1. Lack of training 2. Defective raw material 3. Inadequate Production processes	Shingo, 1996; Womack and Jones,2003
Unnecessary inventory	1. Excess of in-process inventory 2. Difficulty and inefficiency in dealing with production planning	Shingo, 1996; Womack and Jones,2003
Inappropriate processing	1. Use of more resources than the Necessary 2. Production of parts with quality level above specification 3. Use of inadequate tools	Askin & Goldberg 2002; Brassard & Ritter,1994
Excessive transportation	1. Producing large quantity of parts 2. Inadequate layouts	Sanchez and Perez, 2001; Liker, 2004
Waiting	1. Up-stream process interruption 2. Lack of material, tools or information 3. Unpredicted events at production Processes	Sanchez and Perez, 2001; Liker, 2004
Unnecessary motion	1. Lack of standard procedures 2. Excess of movements to reach objects, supplies and tools 3. Bad workstation organization 4. Search for lost objects, supplies and tools	Askin & Goldberg,2002; Liker, 2004
unused Talent and creativity	Lack of time for improvement actions	Luis Armendariz, 2009

II. Value Stream: A value stream is the set of all the actions (both value added and non-value added) currently required to bring a good through the main flows essential to every product: the production flow from raw material into the arms of the customer, and the design flow from concept to launch. Within the production flow, the movement of material through the factory is the flow that usually comes to mind. Also, information, tells each process what to make or do next. Taking a value stream perspective means working on the big picture, not just individual processes, and improving the whole, not just optimizing the parts.

III. Flow: After World War II, Taiichi Ohno and his technical collaborators, including Shigeo Shingo, concluded that the real challenge was to create continuous flow in small-lot production when dozens or hundreds of copies of a product were needed, not millions (Womack, 2003).

The most basic problem is that *flow thinking* is counterintuitive; it seems obvious to most people that work should be organized by departments in batches (Womack, 2003). According to Melton (2005), the lack of a continuous value flow is the main responsible for huge piles of stock either on storage houses as throughout the production line, constantly consuming human capital.

IV. Pull: The MRP (Material Requirement Planning) approach implicates a sales forecast based on statistical methods, meaning that production is *pushed* to the client - push system (Carvalho J. L., 2010). The *pull* system, on the other hand, is the ability to design, schedule and make exactly what the customer wants just when the customer wants. It means you can throw away the sales forecast and simply make what customers actually tell you they need. That is, you can let the customer *pull* the product from you as needed rather than pushing products, often unwanted, onto the customer (Womack, 2003).

V. Perfection: This principle implies the strongest and continuous commitment of people in order to improve all the processes and activities in companies. Such improvement has to do not only with the process and operations improvement as referred, but also, and more important, with the worker conditions and behaviors improvement. This is implicit on the key idea of Lean Production: "*doing more with less*" and less means less space occupied, less transports, less inventories, and most important, less human effort (Lehtinen, 2005).

The four initial principles interact with each other in a virtuous cycle. It dawns on those involved that there is no end to the process of reducing effort, time, space, cost, and mistakes while offering a product which is ever more nearly what the customer actually wants.

2.3.3 Lean's Benefits and Restrictions

Countless studies have been showing the benefits of implementing the Lean on company's productive systems. Walder et al. (2007) refers that removing waste from systems and processes has many benefits, including:

- Decreasing lead-time – removing waste shortens the supply chain as well as shortening the internal value added processes;
- Increasing quality – removing waste also removes excess steps and inventory waiting that may hide quality problems or hide the quality problem until it is too late to fix easily;
- Decreasing costs – removing waste decreases the inventory that must be held and may decrease costs of equipment, facilities, and people as well;
- Increasing productivity – removing waste removes unnecessary movement, inventory, and double handling, leaving the people and machines available to be more productive.

On the other hand, (Melton, 2005)also pointed out that change review is important to control and sustain a lean manufacturing system.

According to a study developed by (Silva, 2010), the main reasons for not implementing the Lean paradigm are:

- Lack of knowledge about the organizational model and how to implement it;
- Lack of knowledge and understanding of the Lean principles;
- Lack of support from top management;
- Ignorance about the benefits of the model or about the way to quantify them;

The process of moving the organization from A to B cannot go well without changing the people processes (Bartholomew, 2015). Hence, many researchers had argued that the transition from the traditional to lean environment is more of a cultural change within the organization issue rather than a manufacturing or technical issue (Nordin, 2012).

Table 4 barriers and critical success factors of LMS implementation (Nordin, 2012)

Lean Barrier	Critical Success Factors
Misunderstanding the concept and purpose of lean	Effective leadership
Lack of resource availability (time, expertise, financial)	Comprehensive change plan

Cultural difference	Team development
Lack of clear communication	Communication
Lack of top management support for change	Education/Training
Lack of interest and commitment in lean	Change agent
company culture	Culture readiness
Lack of continual evaluation on lean	Employee autonomy
	Lean change evaluation
	Worker empowerment
	Rewarding system

2.3.4 Tools and Techniques

The implementation of the Lean management paradigm could be based on several techniques, but it has to be done in a coordinated and structured way (Hunter, 2004). The fundamental principles of the paradigm must be respected at all times. All the techniques and tools used to support the Lean paradigm are unique, meaning that all of them have their own method and approach to fulfill a specific goal. The tools and methodologies that contribute to the implementation of Lean are represented on Table 5, all aiming to make companies more efficient and competitive.

Table 5 Lean tools and methodologies

Techniques	Tools
Kaizen	Standard work,
Just in Time	Value stream mapping(VSM)
5s	Poka yoke
PDCA cycle	Brainstorming
SMED	Spaghetti diagram
Visual control	Overall equipment effectiveness(OEE)
Total productive maintenance (TPM)	Kanban, standard operation & procedure (SOP)
	One piece production
	Takt time
	Single minute exchange of die(SMED)

	Layout configuration
	5 why technique

2.4 Ergonomics

The definition of Ergonomics is discussed together with some context about its origins. Then, a few characterizations and related principles are discussed. Furthermore, relevant concepts such as ergonomic risk factors and work-related musculoskeletal disorders discussed. The most commonly utilized tools and methodologies are overviewed.

2.4.1 Definition and Concepts

The word *ergonomics* derives from the Greek word "*ergon*" meaning work and "*nomos*" for law. Ergonomics is a science which objective is to adapt the work station, equipment or tasks to the person working, so to improve its security, health, comfort and performance without compelling the person to adapt to the task. Also it deals with the design of work and leisure systems, tools, procedures and practices (Cocci, 2005).

The International Ergonomics Association defines Ergonomics (or human factors) as "*the scientific discipline concerned with the understanding of interactions among humans and other elements of a system. It is also the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Practitioners of ergonomics and ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people*" (Morse, 2014).

According to (Nunes, 2012), managers still associate Ergonomics with occupational safety and health (OSH) and its legislation. But it is a method that utilizes a widespread and multidisciplinary approach toward process improvement. It looks the interaction between the environments, operator and machine holistically and as a system. Environmental factors (e.g., nature of task, ambient conditions) interact with human variables (e.g. competence, age) and machine characteristics (e.g., automation, other design features) to influence performance (e.g. productivity, quality). One of the main goals of ergonomics is to increase the overall efficiency and to reduce absenteeism and medical costs by improving the interaction between humans and all other parts of the system (Cocci, 2005; Morse, 2014). The continuous improvements that

come from ergonomic initiatives often lead to the reduction of waste and non-value added time in process (Zeng, 2007).

This science is not only constituted by anthropometry and biomechanics, but searches fundamentally to adapt the work to the worker, so to provide satisfaction and incentive. This adaption doesn't concern only the environmental, but also physiological conditions (Tavares, 2012). The IEA Council (2000) also affirms that "*there are domains of specialization within the discipline, which represent deeper competencies in the specific human attributes or characteristics of human interaction". These are broadly the following: physical ergonomics, cognitive ergonomics and organizational ergonomic.*

Physical ergonomics

Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health (Morse, 2014).

Cognitive ergonomics

Cognitive ergonomics concerns mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. Relevant topics include mental work load, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design (Morse, 2014).

Organizational ergonomics

Organizational ergonomics regards the optimization of sociotechnical systems, including their organizational structures, policies, and processes.

Ergonomics principles and guidelines are useful in the prevention of operator fatigue and stress leading to potential work-related musculoskeletal and neurovascular disorders (Walder, 2007). Nunes (2007) confirm that the consequences of not applying ergonomic principles to the work system are both to the worker and to the company. The emergence of muscular discomfort, fatigue, work stress, and/or musculoskeletal disorders is the most common consequence for workers. For the companies the results may be the increase of errors, workers' absenteeism, or the diminishment of productivity and employees' morale. Some of the key ergonomics principles for a sound workplace design, provided by Walder, (2007), include:

- Avoiding prolonged, static postures
- Promoting use of neutral joint postures
- Locating work parts, tools, and controls at optimal anthropometric locations
- Providing adjustable workstations and a variety of tool sizes
- When appropriate, providing adjustable seating, arm rests, back rests, and foot rests
- Accommodating for a broad variety of workers with respect to size, strength, and cognitive abilities.

As indicated by NIOSH, 2007 many of these principles can be met by using techniques such as redesigning work, standardizing work, and reducing or eliminating risk factors for potential development of WRMSDs, especially the physical risk factors (Walder, 2007).

Ergonomic interventions improve significantly the efficiency, productivity, safety and health of workers. Actions occur in every front of any situation at work or leisure, from physical stress to ambience factors that affect hearing, vision or comfort (IEA Council, 2000).

2.4.2Ergonomic Occupational Risk Factors

An ergonomic risk factor is a condition or practice that can act as an obstacle to productivity, a challenge to consistent quality, or a threat to worker comfort, safety and long-term well-being (Burke, 1998).

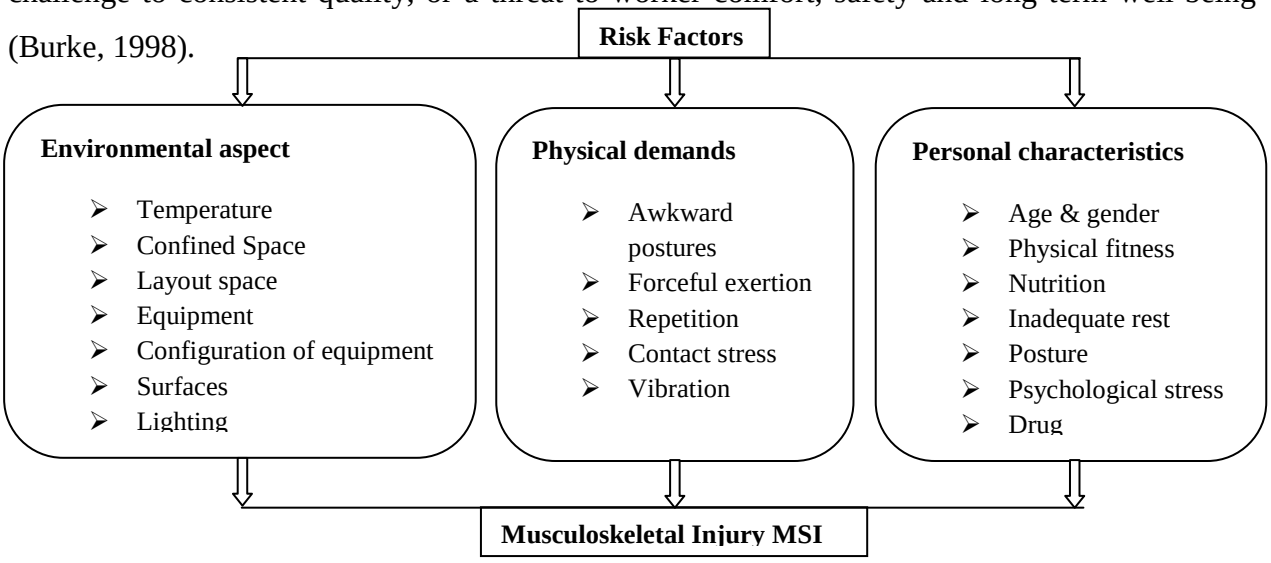

Figure 1Occupational risk factors (Amare, 2016)

These risk factors are the cause for potential development of work-related musculoskeletal disorders WRMSDs in manufacturing, caused by cumulative trauma.

Work-Related Musculoskeletal Disorders (WRMSDS)

Work-related musculoskeletal disorders are described by Nunes (2006) is pathological states of the musculoskeletal system, that arise as a consequence of the cumulative effect of the lack of balance between the mechanical repetitive stress at work and the capacity of the hit part of the body to adapt, for a long period of time while recovery time isn't enough. Any body part can be affected, although upper limbs, neck and the lumbar area stand the majority of incidence parts.

These injuries develop due to the exposure to adverse conditions throughout the time (months or years), such as highly repetitive activities, keeping joints in extreme positions for long periods of time, external pressure or exposure to vibration. Additionally, the personal characteristics, ambience and socio-cultural factors are also recognized as risk factors to the development of these illnesses (Nunes, 2006).

The prevalence of these disorders, they create one of the biggest occupational problems that workers meet, generating enormous human and economic costs. The economic impact of the WRMSDs can be analyzed considering direct and indirect costs. The direct costs regard claims and medical costs paid to injured workers. The indirect costs concern the value of the work loss that results from loss of productivity and quality, turnover and training of new employees, when these individuals are absent from work or experience diminished productivity at work while recovering from the illness (Pauly, 2002).

2.4.3 Tools and Methodologies

As stated by Nunes (2006), when defining the strategy for an ergonomic intervention that aims to prevent the manifestation of WRMSDs, one has to identify and evaluate the existent or potential risk factors, either in a new or already existing work station. This evaluation is done based on the available scientific knowledge, practical experience, labor laws and norms and using ergonomic analysis tools and methodologies. Among the vast amount of available methodologies, OWAS, RULA, STRAIN INDEX and QEC are major ones.

OWAS – Ovako Working Posture Analyzing System: a swift way to analyze and control inadequate postures in an industrial environment. The practiced postures are compared with previously defined positions and consequently classified.

RULA – Rapid Upper Limb Assessment: intends to evaluate the worker's exposure to wrong postures, excessive force and non-healthy muscular activities.

STRAIN INDEX: it a semi-quantitative method that evaluates intensive manual activities concerning hands, wrists and elbows exposure to the risk factors. It provides a final score named the SI score, which is related with the risk level of developing WRMSDs on that specific body part. This methodology is based on the six risk factors existent in each task: effort, wrist posture, work rapidness, percentage of the duration of the effort for every work cycle, effort per minute and the duration of the task (per day). To apply the Strain Index method, one has to utilize the "User Guide".

QEC – Quick Exposure Check: this method analyses the body exposure to the most relevant risk factors, in the most endangered body areas: back, shoulders, arms, hands/wrists and neck. It was conceived with the objective of having a quick, easy and training-free implementation. It's based on two forms – one with questions, both directed to the analyst and the operative; the other is for registering and calculating the scores.

2.4.4 Benefits of ergonomics

While ergonomics improvements to the work environment are primarily used to create a safer and more healthful work environment, other benefit may companies experience include (Khedkar, 2015): Increased productivity, increased work quality, reduced turnover, reduced absenteeism, Increased morale, reduced health insurance charges and reduced fatigue and discomfort that plague relatively sedentary workers

2.5 Work Study

Work study is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set-up standards of performance for the activities being carried out. It is one of the most powerful tools that management can use to improve productivity (Kanawaty,1992). It is a generic term for those techniques, particularly method study and work measurement, which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement

Work study mainly focused at investigating the way an activity is being carried out, simplifying or modifying the method of operation to reduce unnecessary non-value adding activities in terms of rework, wastage, and finally fixing the standard time for an activity. Therefore, the relationship between productivity and work study is noticeable (Yadav,2016).

The objective of applying work study is to obtain the optimum use of the human and material resources, which are available to it. The benefit may stem from improvements in one or more of the following: increased production and productivity, reduced cost-labor, material, overheads, improvement of conditions, which involve an element of excessive fatigue or danger, improved quality and better control of cost.

2.5.1Techniques of Work Study

1. *Method Study:* Method study is the systematic recording and critical examination of existing and proposed ways of doing work. It is concerned with the reduction of work content of a job or operation. Sometimes it is called Work Method Design (Kulkarni, 2014). This method consist tools such as Process flow chart, man machine chart, SIMO chart and other.

The following steps depict the procedure for creating a method study.1.Select (the work to be studied), 2. Record (all relevant information about that work), 3. Examine (the recorded information), 4. Develop (an improved way of doing things), 5.Install (the new method as standard practice), 5. Maintain (the new standard proactive)

2. *Work Measurement:* estimation of standard time for an activity that is the time specific for completing one job by using the predicted method. Standard time can be defined as the time utilized by an average experienced skillful operator for the job with provisions for delays beyond the operator's control (Kulkarni, 2014).

After the job of interest has been selected, work measurement can be examined1) recording all information about the job, 2) breaking the job down into elements, 3) examining those elements and determining the sample size, 4) recording the time to perform each element using a stop-watch, 5) assessing the speed of working, 6) converting the observed time to basic time, 7) determining the allowances, and 8) determining the standard time (Pisuchpen, 2014).

A work has to be measured to identify and eliminate missing or ineffective time, to install standard times for performance & quality measurement, to measure performance against original expectations and to set manufacturing & operating objectives (Kulkarni, 2014).

Techniques of Work Measurement: The work measurement is carried out by using following principal techniques (ILO,1986).

- *Time study:* technique of work measurement to establish time for a qualified worker to carry out specified task under specified conditions and at defined level of performance. Basic time study equipment consists of – a stop-watch, a study- board and time study forms.
- *Work Sampling:* technique in which a statistically competent number of instantaneous observations are taken, over a period of time, of a group of machines, process or workers. Each observation records what is seen to happen and the percentage of observations recorded for a particular activity or delay is a measure of percentage of time observed by the occurrence
- *Predetermined Motion Time Study (PMTS):* is a technique whereby time established for basic human motions are used to build up time for job at a defined level of performance. It utilized the time study and micro motion techniques.
- *Standard Data:* When similar elements and jobs are present throughout a plant, the standard data system of work measurement can be used. It consists of tables, curves and charts built up from various basic job constituents. Standard data elements must first be measured by any of the three work measurement techniques.

2.5.2 Benefits of work study

better employment prospect, little or no capital expenditure, procedures doesn't overlooked factors affecting situation, set standards of performance and the base for incentive, it take every fact in to account and reveal weaknesses overlooked day to day, Standardize method, materials and equipment used in the production process (Chandra, 2013).

2.6Relation between Lean, Ergonomics and Work study

2.6.1 Why lean, ergonomics and work study?

Several studies in the literature discussed lean assessment with ergonomic risk analysis and lean with work study approach separately. But there is no a single study that explores the relation of lean strategies with ergonomics and work study together. The current research seeks to better understand the impact on productivity from lean improvements implemented with ergonomics and work study for a single process improvement framework. A single process improvement framework would allow for companies to see benefits in multiple areas and aid the company culture for continuous improvement (Morse, 2014).

Lean transformations emphasize worker participation, but too often the role of the human resources organization is overlooked (Bartholomew, 2015). Having good working conditions presents one strategy for attracting and retaining high-quality employees (Dul, 2009).

The implementation of new production paradigms that reduce the work cycle times and task variety, such as Lean manufacturing, tend to increase the physical and psychological strain on workers. Such approaches demand particular care with the issues related with human factors, in order to avoid health and safety problems to workers and losses to companies, due to productivity lost, absenteeism, compensations and law suits. Ergonomics plays an important role on the elimination or at least the diminishing of the problems on the Man-Machine-Environment system and on the improvement of the safety and health conditions (Nunes, 2007). Hence, ergonomics may help companies to control the negative human effects of the downsizing, lean production in order to obtain the real benefits from this strategy (Dul, 2009).

Transportation and unnecessary motion are two of the seven types of wastes that can be significantly reduced with the implementation of ergonomic assist systems and equipment. With the correct ergonomic assist product in place, waste can be removed from the system creating an increase in production, decreased costs, and an upsurge in quality (Walder, 2007). Also, employee creativity can be enhanced by stimulating organizational and physical work environments (Dul, 2009).

2.6.2 How lean, ergonomics and work study integrate?

Lean processes can make jobs highly repetitive while eliminating critical rest time for employees. When ergonomics is not integrated into the process, the repetitive jobs take their risk on employees as stressful postures and high forces are repeated continuously throughout the day. In the long run, the financial savings from the productivity gains and quality improvements may have to be used to fund the higher costs of cumulative trauma disorder claims (Wilson, 2005).

Dul (2009) denote that strategy may be a useful connection point through which organizations might begin to internalize ergonomics because strategy: (a) has top management priority; and (b) is normally broadly communicated and implemented in the organization. Connecting Ergonomics to the company's strategy may provide managers with a more 'positive' motivation to apply this discipline.

Integration of lean, ergonomics and work study improve work condition and productivity in a continuous manner. Also they can be applied from operation to firm level.

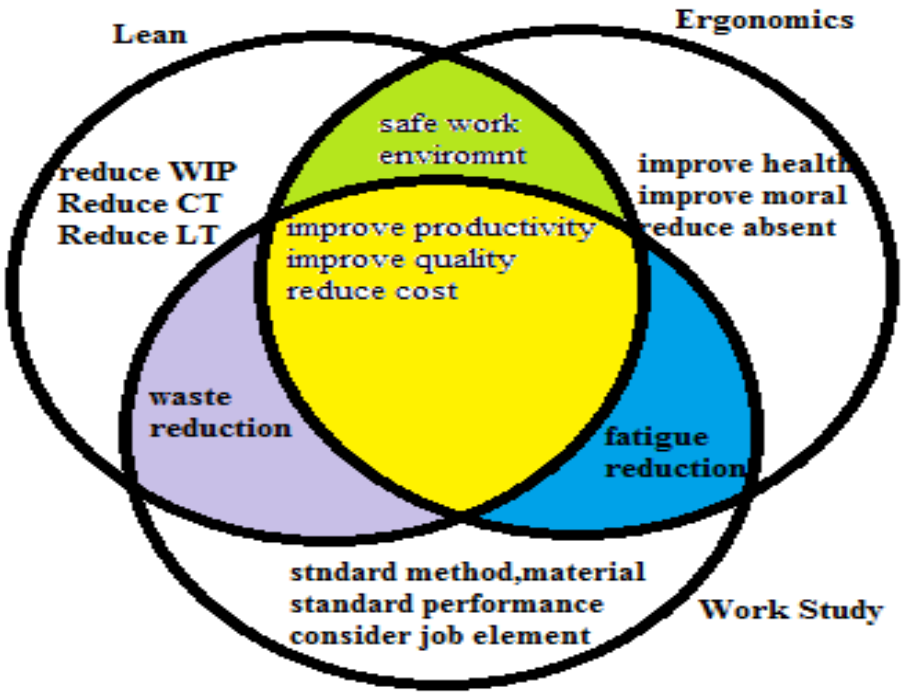

Figure 2 Synergy between Lean, Ergonomics and work study

2.7 Summary and Literature Gap

To get enough information about the topic raised so many literatures are reviewed from different sources, among these journal articles, conference preceding, and unpublished master these are the main one. During literature survey recent documents concerning lean, ergonomics and work study are collected from different sources then each document critically examined in order to filter gaps. Table 6 summarizes main articles with regard to lean, ergonomics and work study.

Table 6summary of main articles

Author	Product analyzed	Technique used	Benefits derived
ArifulHaque et al ,2012	T-shirt	Lean, simulation	Reduce LT,WIP
Yusuf A. Abdu et al,2016	Brake panel	Lean	Reduce rework, waste, flexibility style c/o, improve productivity
Al-Rufaifi et al,2012	Shoe	Lean, simulation	Reduce LT, WIP, waiting
Habte Bekele,2013	Tannery	Lean	Reduce rework, compliance, risk
Faisal Aqlan et al,2013	Fab test	Lean, Ergonomics	Reduce ergonomic risks, waste, increase operator performance, improve corporate image
Malay Niraj, 2016	Automobile	Lean, Ergonomics	Improve productivity
Joel James,2011	Modular home	Safety, Lean	Improve productivity, reduce risk, hazard
Rohan Gade,2015	Garment product	Ergonomic	Reduce injury, absenteeism, stress
M. K. Sain, 2016	SSI	Ergonomic	improved occupational health, productivity and cost benefits
D.Battini et al,2008	shower enclosure	Ergonomic, Simulation	Improve productivity, reduce fatigue and injury of operators
JitendraMandloi et al,2014	Automobile	Lean, Work study	Improve productivity
Mayank D. Singh et al,2015	Casting industry	Work study, Ergonomic	Improve productivity, reduce fatigue
Rishabh Mishra,2015	Automobile	Method study	Improve productivity, reduce fatigue
Parthiban.P et al,2013	shoe	Method study	Improve productivity, reduce fatigue
Morse,2014	Automobile	Lean, Ergonomics, Safety, job satisfaction	Improve productivity, safety, health

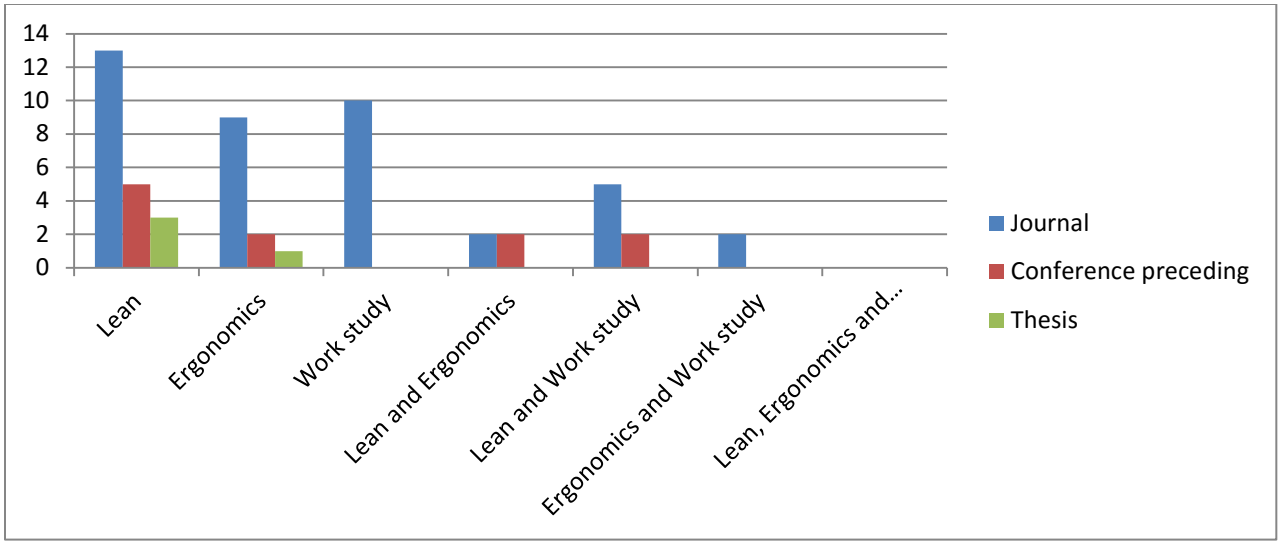

Figure 3 Literature review summary

Literature Gaps Identified

Gap 1: Integrated Lean, Ergonomics and Work study approach in Industries is not explored and not much has been found in Ethiopian context.

Gap 2: Very little literature is available on Lean Manufacturing, ergonomics and work study separately focusing on footwear Industries.

Gap 3: The organizations are not able to reap out the benefits of Lean Manufacturing, Ergonomics and work study Practices due to lack of proper awareness and commitment.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter discusses the methods that were used in the collection and analysis of data to answer the research questions. Both qualitative and quantitative research methods were used in carrying out this research.

3.1 Research Framework

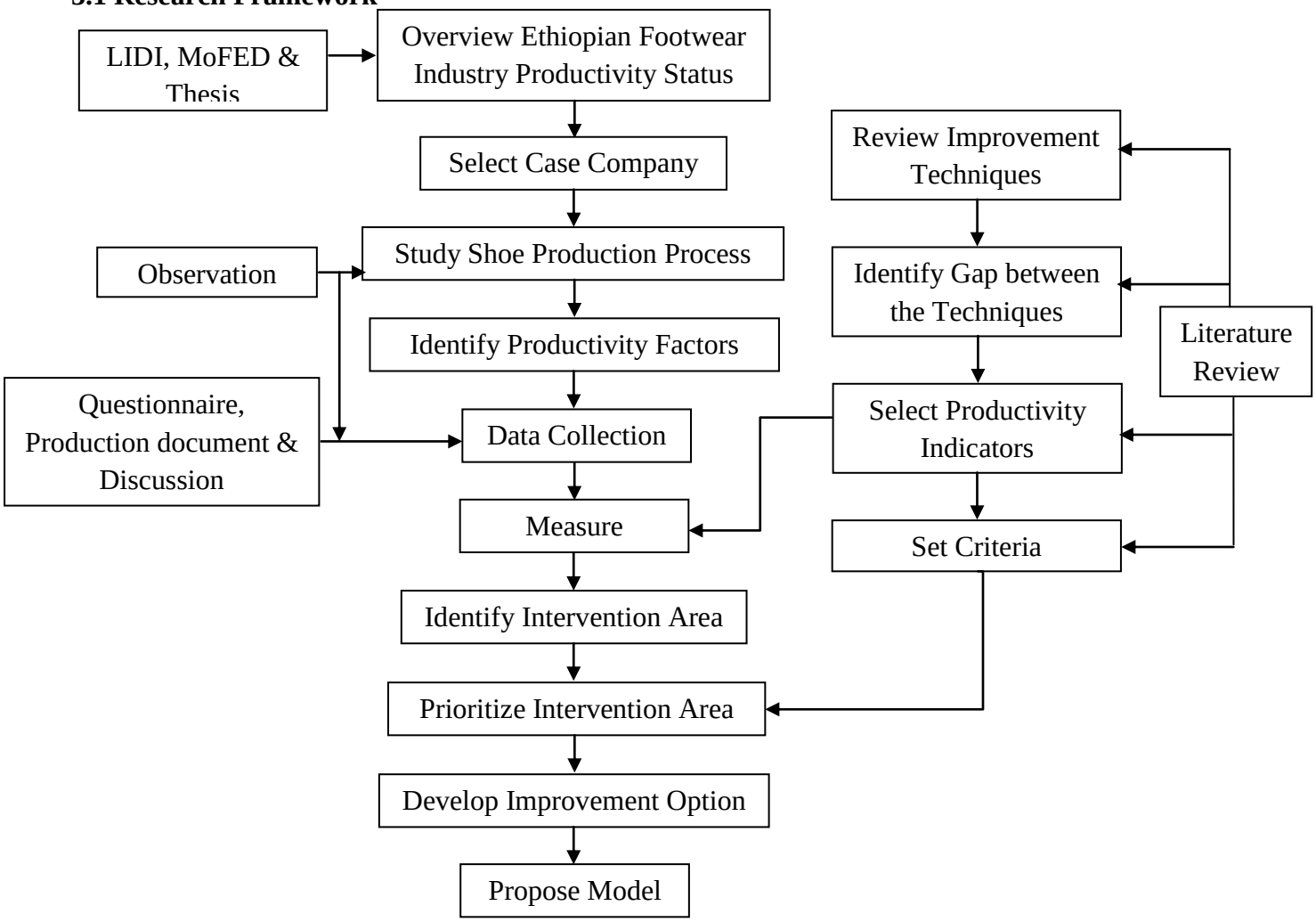

Figure 4 Research framework

Over view of EFI such as export performance and SWOT are studied to know the productivity status; to see the issue of productivity in depth in the sub sector a situational study conducted in a selected footwear factory.

The study focus on understanding shoe production process, identifying productivity factors, and their measurement. In addition, intervention areas identified and prioritized based on suitable criteria; finally improvement options are developed and a continuous productivity improvement model proposed.

3.2 Data Source and Research Methodology

Different sources are identified and used during the research period for the purpose of getting an input for the methodologies of the research. Methodology applied on the research includes Literature review, primary and secondary data collection methods.

1. ***Literature Review:*** different recently published journal articles, proceedings and books were surveyed in order to understand the concept, principle and benefit gained by implementing lean, ergonomics and work study together. Also the review process helpful to identify improvement tools, different wastes, physical and working environment factors, equipment, work procedure that affect production process and the performance of operator.

2. ***Primary Data:*** direct data collection from the production line through direct observation, questionnaire, informal communication with manager and shop floor workers to get better understanding of the problem area.

I. **Direct Observation-**during visit of the case company necessary data gathered through careful observation of operator movement, material handling, work station design, working environment and process flow of production department.

II. **Questionnaire-** structured questionnaires are used to get complete information about the company. The questionnaires are developed from ideas of different literatures which focused on ergonomics issues in manufacturing area. After preparation of the draft; it is pre-tested with academicians to check its content validity and modified accordingly. Furthermore, the questionnaire is translated from English to Amharic to make suitable for the respondent. The questionnaire was directed to Production and quality department of the company.

Table 7 show the detail of the questionnaire which had 29 questions; 5 on General information, 10 on Prevalence of musculoskeletal Symptoms, 6 on general work Place condition and 8 on organizational and psychosocial condition of work place. As shown on appendix A the questions

that were used in the questionnaire contain five-point likert scale (from A= "very low" to E= "very high").

Table 7 Questionnaire Summary

Variables	No. of question
General information	5
Prevalence of musculoskeletal Symptoms	10
General work Place condition	6
Organizational and psychosocial condition of work place	8

3. ***Secondary Data:*** secondary data used in this research includes different documents regarding footwear from case company, government and non-government institutions.

Document review- to show the existing problems of productivity in the case company different company documents are reviewed such as production and quality records, attendance sheet, working manual and other related report on the company from external sources.

SWOT analysis- conducted using data from leather industry development institute and previous thesis focus on export performance of the sub sector.

3.3 Sampling Strategy

This section consist description about the target population, sample size and the sampling procedure used to evaluate the current ergonomic aspect of the work place.

3.3.1 Target Population

According to Fraenkel et.al (2002), population refers to the complete set of individuals (subjects or events) having common characteristics in which the researcher is interested (Legesse, 2016). The target population of this study includes operators, helpers, quality controls and supervisors working on the shop floor. Totally the company has more than 750 workers, from which 400 employees are direct labors engaged in production; the remaining staffs are working in administrative area.

3.3.2 Sample Size

The sampling method which applied in this study is the simple random sampling method. A simple random sample is a sampling method in which every member of the population has an equal and independent chance of being chosen. To get a representative and reasonable sample size that supports the research findings, the following equations were used. Equation (1) is applied to compute the initial sample size. Since the population is finite (less than 50,000), Equation (2) is used to compute the new sample size. These equations developed by Johnson et.al, (2009) and Freedman et al., (2007) according to (Othman, 2014).

$$n_0 = \frac{Z^2 * p(1-p)}{c^2} \quad \ldots\ldots (1) \qquad\qquad n_f = \frac{n_0}{1+\frac{n_0-1}{N}} \quad \ldots\ldots.. (2)$$

Where:

n_0 = initial Sample Size

n_f= target sample size

Z = Z-values for confidence levels are (1.645 for 90% confidence level, 1.96 for 95% confidence level and 2.576 for 99% confidence level)

p = percentage picking a choice, expressed as decimal 0.5 used for sample size needed

c = confidence interval, expressed as decimal; 0.08 = ±8

N = Population = 400 workers

$$n_0 = \frac{1.96^2 * o.5(1-0.5)}{0.08^2} = \underline{150.063} \quad n_f = \frac{150.063}{1+\frac{150.063-1}{400}} = \underline{109.277 \approx 109}$$

3.3.3 Sampling Procedure

Stratified random sampling is used to get the desired representation from the various employees' subgroups in the population. The subject was selected in such a way that the existing subgroups in the population are more or less reproduced in the sample. After sampling at each subgroup, simple random sampling proportional to size based on the relative number of employees in each section was used. A sample should be optimum; fulfills the requirements of efficiency, representativeness, reliability and flexibility (Kothari, 2004).Proportionate allocation was used by sampling fraction in each of the strata that is proportionate to that of the total population.

Table 8 Target Respondents

Section	Responsibility	Total staff	Sample size
Cutting	Operator and helper	64	64*(109/400)=17
	Quality control	3	1
	Supervisor	2	1
Stitching	Operator and helper	205	55
	Quality control	6	2
	Supervisor	4	1
Lasting	Operator and helper	110	30
	Quality control	3	1
	Supervisor	3	1

3.4 Tool and Method of Data Analysis

The data was analyzed by taking the information from primary and secondary sources. During analysis of the data Microsoft Office 2010 Excel used to manipulate the raw data collected from secondary sources and the response rate of questionnaire. Also it is used to present the result of the data through different charts; 5 why template to show root cause of wastes, pie chart to illustrate percentage share of sections, bar graph to show the status of each parameter and radar chart to explain survey pattern between the five likert scales.

CHAPTER FOUR

OVERVIEW OF THE ETHIOPIAN FOOTWEAR SUB-SECTOR

4.1 Background the Sub-Sector

4.1.1 Historical Background of Ethiopian Footwear Industry

The leather footwear sub-sector accounts for 72 percent of all leather and leather products enterprises in Ethiopia. The production of leather shoes in Ethiopia dates back from the late 1930s when Armenian merchants founded two shoe factories in Addis Ababa namely Tikure Abay and Anbessa Shoe factories. These were nationalized by the military government in 1974 and remained the largest and second largest shoemakers in Ethiopia. These factories nurtured a number of shoemakers, who opened their own factories in Addis Ababa and trained their workers. Since the beginning of 1990's, Ethiopia has been moving towards a liberalized regime.

Now the country is one of the leading footwear exporters in sub-Sahara Africa along with South Africa. However, Ethiopia's share in the global footwear market is lower than its place in leather trade. In the year 2015, Ethiopia accounted for 0.02% of the total world export while China and Italy, the two dominant producers, accounted for 20.1% and 14.2 % of the global export respectively.

The export of leather footwear started only in 2005; the export value has been growing steadily since then and is expected to make a big impact on the Ethiopian economy. Also the job opportunities the industry creates could make a significant impact on poverty reduction. At the end of 2014/15 budget year total of 11,138 jobs are created in the sub sector among this females employee took 6,114 and the remaining 5,024 are taken by male employees. On the other hand, 8,310 employees (4,973 female and 3,337 male) are working in large and medium factories; 2,828 workers (1,141 female and 1,687 male) involve in different cluster and micro and small enterprises.

In, General there are 18 medium and large scale footwear exporting manufacturing companies which have installed capacity of 10.34 million pairs per year in average, but the actual production is currently around 6.47 million pairs per year in average. Also, additional 3.53

million pairs per year in average expected to be produced from different micro and small enterprises (LIDI L. I., 2015).

4.1.2 Incentive Mechanism to Promote Ethiopian Foot Wear Industries

The industrial development strategy as a sectoral strategy issued in 2009 has preceded the GTP. It recognizes the private sector as an engine of development and emphasizes the need to follow export-led growth, the need to pursue Agriculture Development Led Industrialization (ADLI).

The Ethiopian Government has provided various institutional and policy support in order to realize the development of these sector. In addition, incentive schemes to encourage exports are also put in place (MoFED, 2010). These include

- Exemption from income tax and Importing equipment free of tax
- Improving service delivery (shortening period of license, renewal of permits)
- Exemption of imported inputs for export purposes from indirect taxes
- Credit guarantee scheme to avoid problems of working capital for exporters
- Allotment of finance for loan for those engaged in export activities
- Provision of access to infrastructure for those engaged in export
- The establishment of industrial zones in all regions addresses the infrastructural needs and land requirements of investors
- Creating linkages with foreign investors in marketing and production; and improving the transport and transit services

4.1.3Export Performance of Ethiopian Foot Wear Industries in GTP I

The Ethiopian industrial development strategy guides the way that the sector should involve in the international market by producing competitive products in terms of quality, quantity and price. Some of the problems were less understanding of stakeholders on the strategy, under capacity production due to lack of skilled man power, raw material and advance technology (Tadesse, 2011).

As can be seen from table 10 below, the export earnings performance and the plan for each year show huge deviation despite gradual increment in each consecutive year. This shows the necessity of extra effort from all the stakeholders working in the sub sector.

Table 9 Export performance of foot wear in GTP I *Source: (LIDI, 2015)*

Shoe export(in millions)					
Year (E.c)	2010/11	2011/12	2012/13	2013/14	2014/15
Plan	9.22	13.18	15.38	17.98	21.03
Performance	.68	.82	1.43	3.08	3.37
Shoe export(in millions USD)					
Year(E.c)	2010/11	2011/12	2012/13	2013/14	2014/15
Plan	119.89	177.96	215.43	260.75	315.52
Performance	8.64	10.16	19.19	30.86	34.58
Shoe export(in percent)					
Year(E.c)	2010/11	2011/12	2012/13	2013/14	2014/15
Plan	50.03	60.09	61.2	62.32	63.5
Performance	8	9.06	16	23.27	26.03

During the first growth and transformation period has been planned to earn 119.89 million US dollar in the beginning of the five year plan 2010/11 with more than 50.03% growth rate every year and at the end of the five year plan 315.52 million US dollars table 10 above.

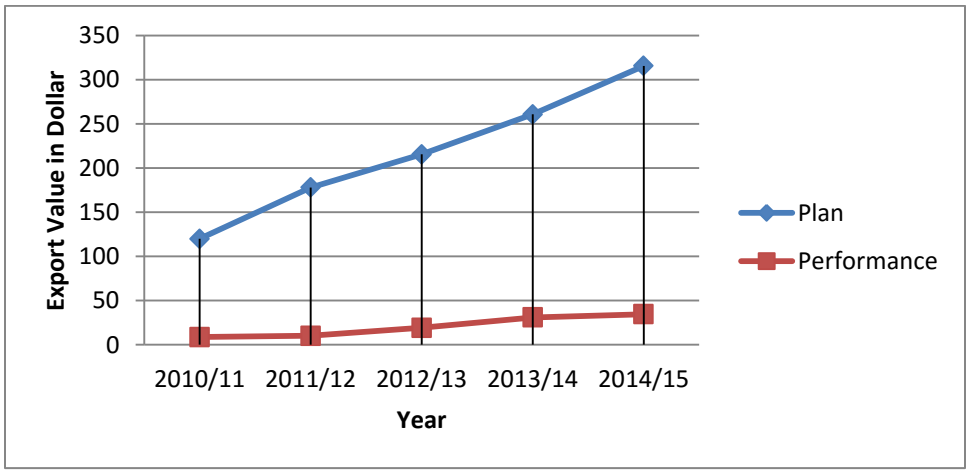

Figure 5 GTP I Foot wear export

To some extent, the export performance of the footwear industry reflects the stage of development of the leather sector as a whole since, for a fully integrated leather sector, its

cumulative outcome is reflected in the end product of the leather products sub-sector. The less integrated and inefficient footwear industry in Ethiopia, have little to export.

4.1.4 Export Performance of Ethiopian Foot Wear Industries in GTP II

The next five year development plan of the foot wear sub sector is based on the industrial developmental strategic plan, potential of the sector and the direction of the developmental policies. The plan will be achieved by capacitate the current competence of the private sector, promote the new investors, create the market value chain to increase the share of export value.

Table 10 GTP II footwear sub sector export plan Source*: (LIDI, 2015)*

Shoe export(in millions)					
Year (E.c)	2015/16	2016/17	2017/18	2018/19	2019/20
Plan	17.888	24.746	35.768	52.3	75.225
Shoe export(in millions USD)					
Year(E.c)	2015/16	2016/17	2017/18	2018/19	2019/20
Plan	67,994.56	126.973.79	195,550.85	329,600.95	485,861.83
Shoe export(in percent)					
Year(E.c)	2015/16	2016/17	2017/18	2018/19	2019/20
Plan	36.75	42.32	48.89	54.93	60.73

4.1.5 SWOT Analysis of Ethiopian Footwear Industries

SWOT analysis is a study about the strengths, weaknesses, opportunities and treats. The strength and weakness are internal and the opportunities & treats are external aspects or factors.

Table 11 SWOT analysis of Ethiopian footwear (Institute, 2011; Cherkos, 2011)

SWOT components	SWOT analysis
Strength	• Involvement of key funding organizations such as UNIDO • Availability of labor which are open to learn and develop • Government is active in promoting development of the industry • Low cost labor • Availability of market access through: COMESA; AGOA • Support from LIDI

Weakness	• Poor automation and workstation which result a low productivity • Poor managerial skills at the line supervisors and managers level • The varying quality of leather • Poor facilities for training • Missing industrial mentality of workforce and management • Shortage of skilled workers and updated technology, Poor finishing, low productivity • Slow responsiveness to changing shoe models • lack of usage of continuous improvement culture • Weak product development, design or research development capabilities and little diversification
Opportunity	• Free US market access through AGOA • Presence of Cheap labor force • Access to raw leather locally • Strong support from LIDI • Full support from the government • Regional market exposure such as COMESA • Availability of potential local market
Threat	• Frequent power failure • Capability of local managers to efficiently implement programs • Lack of attractive shoe design • Time frame of actual agreements with US and EU

4.2Anbessa Shoe S.c.

Anbessa shoe Sc. selected for the study because of the following main reasons:

1. Long time experience in shoe manufacturing business

2. The largest producer of footwear relative to other local footwear factories

3. Poor work environment of production room

4.2.1 Company Background

ANBESSA Shoe Share Factory, formerly known as the Darmar Shoe Factory, was established in 1939. The company has more than 70 years' experience in shoe making either for the local or global market. The firm started to export shoes, in small quantities, in the early 1980s. Before its current structure as ASSC, it was managed by different groups. The first groups were the Armenian investors and then transferred to Italian investor. Following the changeover of the government the factory was nationalized and reorganized as shoe factory and a tannery separately. And finally the factory is transformed in to a share company in 2012.

The factory is located in two premises in the capital. The main factory located in Lidetta sub city. In addition, the factory has a branch unit (MANPO Branch) in around keera.

4.2.2 Vision and Mission

- The company vision is to be a number one producer of high quality leather footwear and leather articles.
- The mission of the factory is to add value to livestock resource through processing natural leather in to various leather-footwear, leather-articles and leather-shoe-upper that meet the requirements of both local and export market.

4.2.3 Products and Capacity

Company's main products in both factories include leather shoes (casual, military and safety shoes), leather articles (bags, wallets, and belts) and outsole. Currently the main factory manufactures a full range of footwear. There are nearly 200 different kinds of models including sport shoe.

ASSC has made renovation of old equipment with the installation of new and advanced machineries which enabled the company to increase its capacity. This has enabled the factory to increase its capacity. Following with the expansion project, now the designed production capacity of the company has reached 3500 pairs of shoes per day in a single shift. It has good machineries and layout. It produces finished shoe and other leather articles for both local and international market.

Figure 6 main products of the company

4.2.4 Quality Control of the Company

Being a quality driven company, the company laid emphasis on the quality of the products. There is quality control division even though it is not well organized in terms of staff, equipment and laboratory. The quality inspection begins from the receiving of raw materials. Once cleared, the raw materials are adopted for production. All the company products are subject to in-house inspection at the end of succeeding operation.

4.2.5 Human Resource of the Company

Currently the company has 1140 employees both in main factory and Manpo branch. Among this 750 are in the main factory. Also 460 are direct labors in the main factory which participate in the production of products. Also, most of these workers are young. The current organizational structure of the company is shown in Appendix A.

CHAPTER FIVE

SITUATIONAL STUDY

5.1Define the Process

ANBESSA shoe factory have different process such as production, design and product development, sales and marketing, distribution, finance and accounting, and human resource development and administrative. Among these shoe production process is major one. Company Production process consist sub process.

5.1.1 Function of each process

1. Cutting

In this section the main operation is cutting of materials. The cutting of leather to different shoe components is done by modern cutting machines. The working area of all sections is in one building with a little partition. In this department, the top part of the shoe or the "upper" is made. In the cutting department there are different types of operations. Some of them are:

Upper cutting: The cutting operation uses cow and sheep leather, a worker cuts out pieces of various shapes that will take the form of "uppers" using metal strip knives.

Lining cutting: the lining cutting's purpose is to form the inner side component of a shoe.

Material cutting: textile fabrics, nylon, plastic materials, sponge foam and cloth are the materials cut that are to be attached with some of the upper components to avoid tiring while the leather parts are stitched and it helps the shoe to have strength and flexibility.

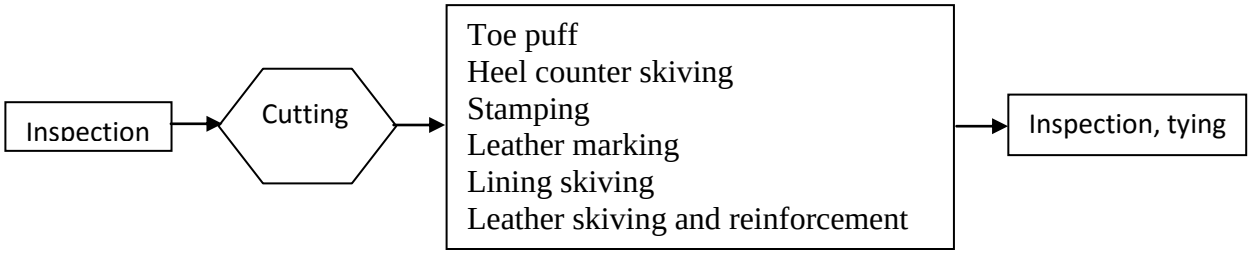

Figure 7 cutting operation

2. Preparation

Preparation is the starting stage to begin the stitching operation.

Marking: Guide marks help stitching machinists to accurately overlap upper sections and to correctly position fancy stitches, buckles, eyelets and trims.

Skiving: this is the term used to describe the tapering required on the flesh side of some edges of upper components. On fabric backed materials, it may be necessary to skive the top rather than the flesh surface.

Re-enforcement material attachment: Different types of re-enforcement materials are cemented with glue and attached with some of the upper components to avoid tiring while the leather parts are stitched and it helps the shoe to have strength and flexibility.

Stamping: To enable the various sizes and widths of insoles to be identified, the producer thread mark and customer order is stamped. Numbers and letters are normally stamped onto them. The component which undergo on stamping is the inner layer of the sole.

Loading: all components that are necessary for one complete shoe are counted and stored until it is loaded and distributed to the stitching department.

3. Stitching

At this stage the main task is stitching components by machine. In this section assembly of the different components of the upper parts of shoes is done by different types of flat bed, post bed, zigzag, eyeleting machines and others. Parts of shoes referred as an upper are vamp, tongue, apron, toecap, counter, quarter and mudguard etc. Operation under stitching includes:

Stitching: Guide marks help stitching machinists to accurately overlap upper sections, and to correctly position fancy stitches, buckles, eyelets and trims.

Trimming: useful to remove the unnecessary parts of the edge of the upper components.

Folding: the upper components are folded to inside so that it can have good shape and appearance.

Back Part Molding: The heal side of the TOMAY is molded using mold machine to keep the shape of the TOMAY heel shape.

Trade burning: the threads left out from stitching operation are pulled out and burned and they are cleaned properly

Back height Fixing: join main assembled Components. The main fixing activities include; Component to component, toe puff fixing, counter stiffness fixing, sub-assembled lining fixing and foam fixing.

4. Lasting

Completed uppers are molded into a shape of foot with the help of a "Last". Last is a plastic shape that simulates the foot shape. Later it is removed from the finished shoe to be used further in making other shoes.

***Manual Lasting*:** Hand lasting usually requires greater skill than any other footwear manufacturing task. The aspects of the job that are most difficult to master are the attainment of the correct directions and degrees of strain, and the achievement of uniformity between a pair of shoes in terms of squareness , back height and the fit and shape of the top line.

***Hammering Nail*:** the DABAN with the form and the TOMAY with the form are firmly attached with nail to avoid misalignment during the next steps.

***Closing/ folding*:** here the component pieces are sewn together by highly skilled machinists so as to produce the completed upper.

Roughing: The object of this operation is to provide a good keying surface for the adhesive used to attach the lasted margin of the upper to the sole unit.

***Heating and Pressing*:** it's used for holding the shape of the last.

***Cooling Activity*:** is cooling process of the shoe to return it to its original shape to recover the distorted nature of its elasticity due to so many activities such as ironing and brushing applications.

***Removing the last*:** done manually using a lasting jack to support the last, or with the help of a pneumatically powered last-slipping machine.

5.1.2 Productivity Factors

The main productivity factors in the factory includes human, material, machine, process and organizational. These factors are explained through specific factor or problems in each section in the main process.

Cutting: this section has relatively skilled operators but poor quality of leather and lack of regular maintenance on the cutting dice affect the productivity of the operator and the section, because it take time to select and cut the area without defect. On the other hand the operators' efficiency is affected by the poor work place organization characterized by narrow space, improper placement of equipment and materials.

Stitching: in this section there is shortage of raw material, low conveyor speed and lack of standardization, because of the skill of operator and inadequate process; this result delay in production and increased quality problem. Also the poor work organization and working environment of the section affects the performance of the employee.

Lasting: problem in this section mostly related to the machines installed in the section; this is due to the heat emitted from the machine and the physical requirement of the process.

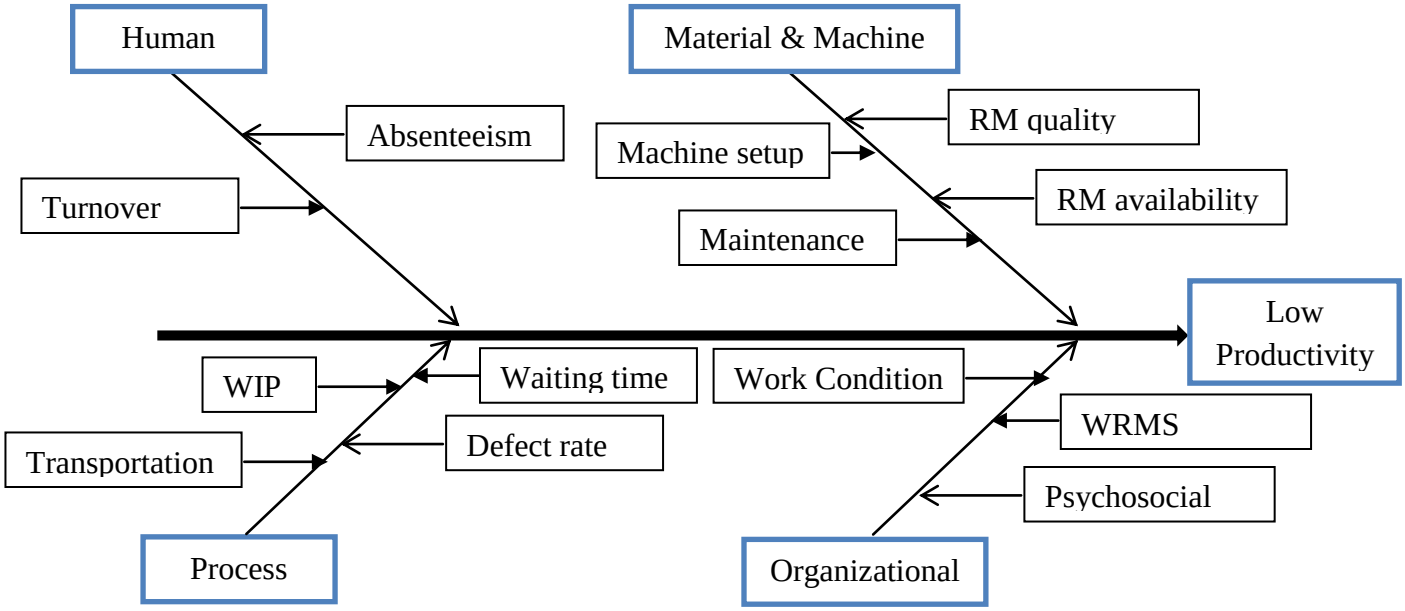

Figure 8 Productivity Factors Cause & Effect Diagram

5.1.3 Indicators

Indicators represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization. These are rarely new to the organization (Carvalho, 2016). During the study shop floor productivity measured through labor productivity, waste, absenteeism, employee turnover, Pain, work condition and psychosocial condition.

5.2 Record Relevant Information

5.2.1 Process Flow

Summarized factory shoe production operation process is shown in the figure 9 below and the description is as follow: Shop order to planning & control then then production control reviews the order and checks the bill of materials to verify that the correct materials are on hand any materials that are not in stock will be ordered. Production control then releases the work order to the shop floor to start production of the shoe. The operation stages include cutting, stitching and lasting mainly but moccasin operation include depending on the model. At the end of these operations there is quality inspection that evaluates the product.

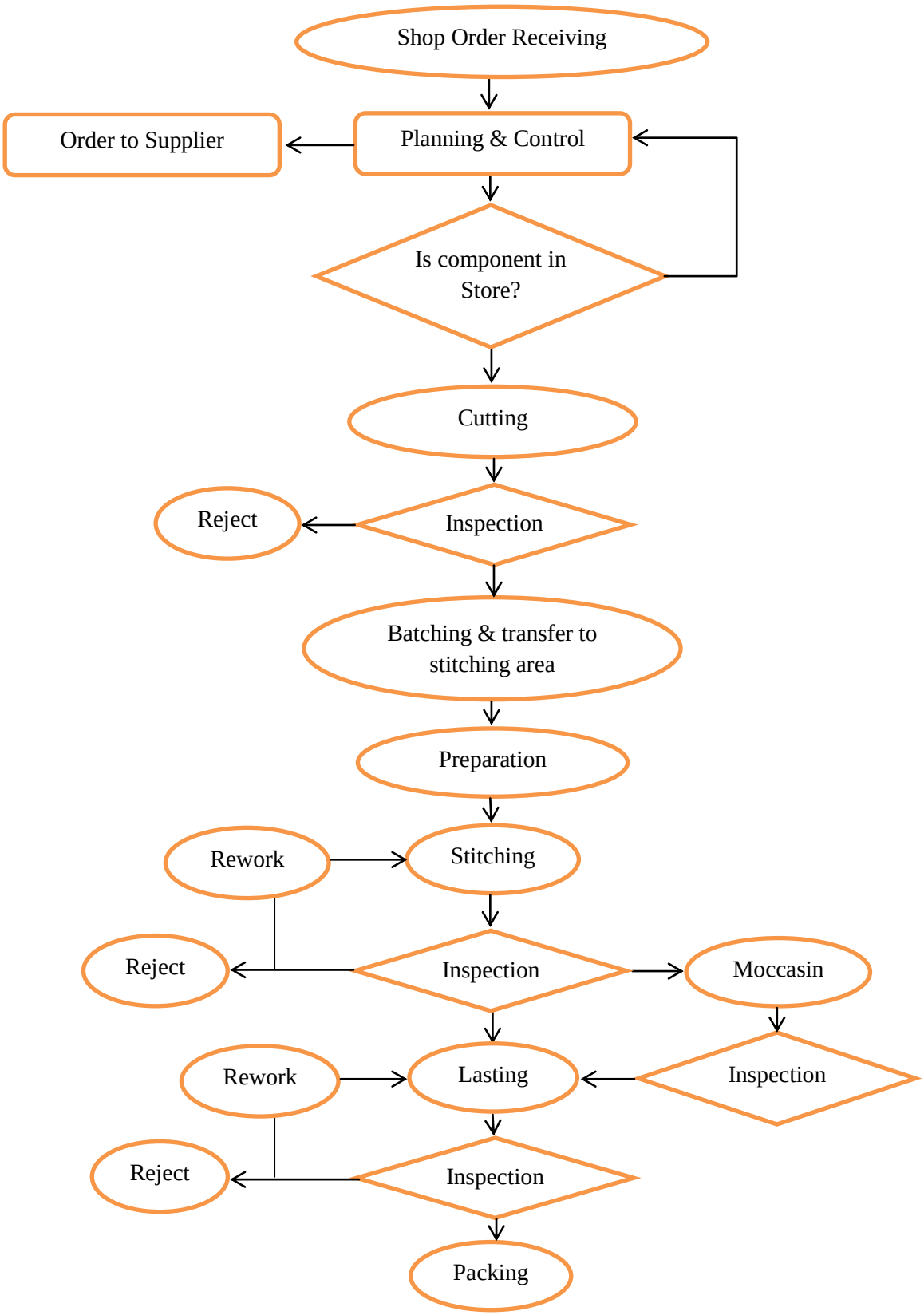

Figure 9 Shoe manufacturing process of the factory

5.2.2 Data Collection

To get understanding about productivity related issues in the company observation, questionnaire and informal discussion has been conducted with production head and supervisors. These include productivity awareness, waste, absenteeism, turnover and different ergonomic issue.

1. Monthly and Daily production

The firm has high production capacity relative to other footwear factories; but it is not using the capacity effectively. Main factory has a designed capacity of producing 3,500 pair of shoes per day but its current attainable capacity on average1819pairs of shoes per day. The firm has a trend of preparing timely (quarterly) production reports which show production against the plan.

Table 12 Daily production, (April, 1/2017-30/2017)

Days	Pairs	Worker	Days	Pairs	worker	Days	Pairs	worker
1	1914	480	11	1812	468	21	1796	458
2	1899	478	12	1905	480	22	1785	448
3	1890	478	13	1871	478	23	1802	463
4	1998	480	14	1843	473	24	1832	473
5	1793	453	15	1820	468	25	1800	460
6	1679	423	16	1811	463	26	1763	428
7	1766	430	17	1798	458	27	1787	453
8	1760	428	18	1807	463	28	1803	463
9	1782	443	19	1775	443	29	1798	458
10	1846	473	20	1821	469	30	1815	468

3. Waste

During observation the processes on the shop floor, the researcher understood the following priority problems regarding lean wastes such as high WIP inventory, waiting time, transportation, motion and defects.

3.1. Waste of Inventory

There are many forms of inventory: finished goods in a warehouse that are unsold, work in progress tied up in the process and raw materials awaiting production. In manufacturing a major concern of unnecessary inventory is work-in-progress (WIP) which cannot be readily sold either

to customers or to other companies. The WIP inventory of ASSC occurs in cutting, stitching and lasting.

Table 13 WIP by section (*Source: planning & control department, 2015/16 annual report*)

	Cut	Stitch	Last	Total
input	641063	818991	554440	2014494
output	514391	779633	519291	1813315
WIP	131896	62860	47945	242701

3.2 Waiting

As described in the literature waiting is any state of idleness occurred at workplace in the normally assumed working hours. Such condition of waste may be visible on the machineries engaged in production and/or operator in that work place. The occurrence of idleness in one of the role player has an influence on the other which can be considered as double effect.

Table 14 Downtime (Source: planning and control department, 2015/16 annual report)

section	Machine failure (In Hr.)	Material shortage (In Hr.)	Power failure (Hr.)	Machine setup (Hr.)	Labor shortage (Hr.)	Other (Hr.)	Total (Hr.)	Available time(Hr.)	Production loss(pcs)
Cutting	13.1	10	1	5.3	103	11.4	143.8	2325	20718
Stitching	35.61	45.23	3	9.25	278	62.67	433.76	2325	53476
Lasting	21.63	13.25	1	8.4	115	15.13	174.41	2325	16825
Total	70.34	68.48	5	22.95	496	89.2	751.97	6975	91019

3.3 Defects

Table 15 2015/16 Annual quality inspection (Source: Quality department)

	Cutting	Stitching	Lasting
Inspected (in pcs)	10,661,980	503,496	539672
Defect (in pcs)	37,940	49,560	43148

3.4 Transportation

Table 16 Transportation

Operation time in a day	Average normal Transportation time/day	Extra time beyond the normal
465 minute (7.75 hr.)	96.2 minute	23.6 minute

4. Absenteeism

The work conditions of the factory can be expressed using the absence rate, because it can reflect the employees' well-being and happiness. Below in table 18

Table 17 Absenteeism by section (Source: planning and control department)

	Cutting	Stitching	Lasting	Total
Total workers absence Day in 2015/16	596	2202	638	3436

5. Labor Turnover

Labor turnover indicate employee hired to replace vacant position in the factory; according to the data record which found in human resource department of the factory during the year 2015/16 and 2016/17(9 month) the amount of hired employee are 39 and 28 respectively.

6. Ergonomic Work Place Evaluation Survey

A survey was done on the operators, in order to assess about the work load, fatigue, and work environment influence on their performance. The survey form is shown on Appendix C. This survey helped to identify problems in the company from an ergonomic point of view. Similarly, a positive impact was created on the work force, since they could see that someone was looking after their interests and caring about their well-being.

One hundred nine questionnaire (109) distributed to cutting, stitching and lasting out of which twenty (24) questionnaire were not returned, eight (8) not completed and the remaining seventy seven (77) retrieved successfully.

The respondents are characterized by a domination of female workers (52 versus 25 of men) and the ages vary from 18 to 54 years-old, the two third of the population (52) is below 31 years of age. Among this operators and helpers working in different section took greater portion of the sample which is 52and 8respectively.

Regarding educational background of 30 were primary, 27 were secondary, 12 were preparatory and the remaining 8 were TVET and above. Concerning work experience the workers were below one year take (24) and between1-2 year take (30).

The survey organized in to three broad groups in order to get a broader perception of the information comprised in the survey. These include:

6.1 Prevalence of Musculoskeletal Symptoms- with aim of to evaluate pain perception or discomfort of the respondent.

6.2Environmental Condition of Work Place- with the aim to evaluate discomfort of the respondent about his surrounding work environment.

6.3 Organizational and psychosocial condition of work place- assesses psychosocial issues in the working area.

5.3 Critical Examination

5.3.1 Productivity Measurement and Analysis

1. Labor Productivity Measurement

In order to calculate labor productivity the ratio of daily average output of product to the available daily average work force is used. Based on this the labor productivity of the factory calculated as follow:

$$labor\ productivity = \frac{average\ output\ of\ product\ per\ day}{average\ labor\ input}$$

$$labor\ productivity = \frac{1819}{460} = \underline{3.97}\ \text{pair of shoe/shift/worker}$$

As per the international bench mark for shoe manufacturing the labor productivity is 16 pair of shoes per shift per day but the factory labor productivity far from this standard due to productivity factors mentioned above.

The sources for low labor productivity are low operator skill and poor supervision. These accompanied by lack of regular training regarding the work procedure and supervision. Training manuals in the factory are not well organized and revised timely; this is due the lack of understanding and focus on the way trainings are given.

Figure 10 5 why? on low labor productivity

2. Waste

2.1 Waste of Inventory

Taking the data from table 13 the percentage of WIP calculated as follow:

$Total\ WIP = \frac{number\ of\ WIP}{total\ number\ of\ input}$ *100 = $\frac{242{,}701}{2{,}014{,}494}$ = 12.05%; similarly WIP for each sections are 20.57%, 7.68% and 12% respectively. But the factory set target below 5% WIP inventory as an acceptable in each section.

Figure 11 5 Whys technique representation about WIP waste

There is unnecessary WIP inventory in the shop floor, Because of low efficiency of their process this is due to long production lead time in each section (at least 6 days). Poor process flow is mainly due to lack of standard work procedure and low of skill of operators'.

2.2 Waiting

International bench mark for downtime is 0% and company bench mark level for downtime should not exceed above 5%.

$$Down\ time = \frac{Total\ down\ time}{total\ working\ time} * 100 = \frac{751.97}{6975} * 100 = \underline{10.78\%}$$

Similarly using table 14 and the above formula, the current down time for cutting, stitching and lasting is 6.18%, 18.65% and 7.5% respectively, this deviates from target value in the sections.

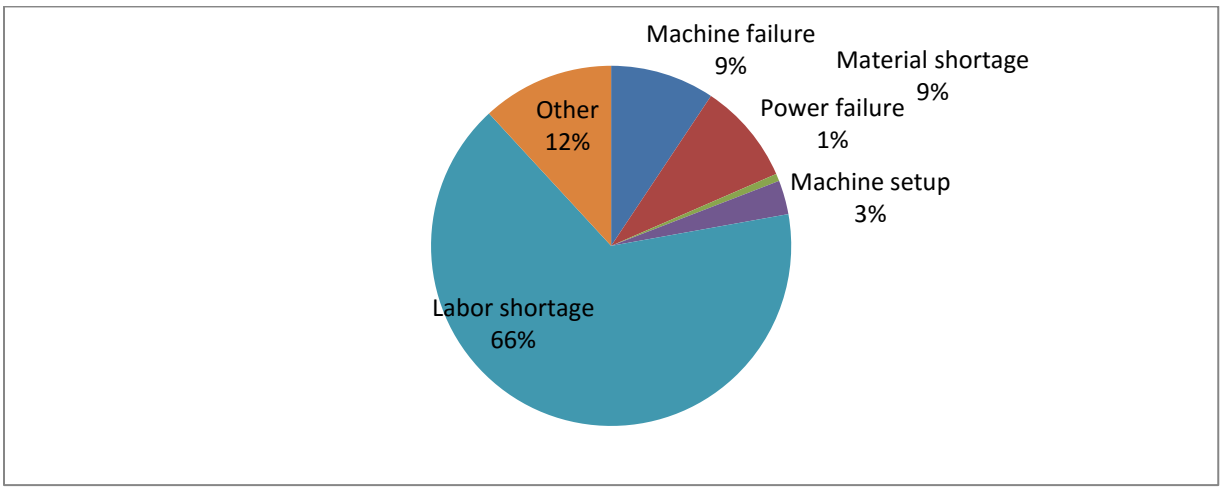

Figure 12 Sources of down time

On figure 13 waiting due to labor shortage take higher proportion because either the operator is unavailable temporarily or permanently, the reason for waiting illustrated on figure using 5 why.

Figure 13 waiting analysis using 5 why technique

Waiting occurred on the shop floor, because operator and material shortage and unavailability of machine. This is because of technical and operational reason. Operational reason includes absenteeism, upstream process interruption and other. On the other hand technical reasons are machine breakdown and low speed of the conveyor. The lack of regular maintenance, lack of motivation and attitude of the worker are the reason for operator inefficiency and this is the reason for low speed of conveyor. Also, unsatisfactory supervision on the upstream process reason for interruption.

2.3 Defect

From table 15 the defect rate for cutting, stitching and lasting is 0.36%, 9.84% and 7.99% respectively, but ASSC set 1.5% control limit for each section in the shop floor but this target not achieved so far. As shown from the figure only cutting section reaches the target. The reason for quality problem is illustrated below using 5 why technique.

Figure 14 5 why Technique on the cause of defect

Defect level in the factory currently above the anticipated target value because of wrong method and limited quality control activities on checking, inspection also inadequate way of identifying quality problems to take corrective actions by using different statistical quality control tools. Also the quality of raw material is not satisfactory. These problems arise from lack of awareness on cost of quality, shortage of quality professionals and raw material defect due to natural and manmade causes. Also the previous problem originated from lack of regular training focusing on quality, use of inadequate quality manual and procedures and low processing capacity of tannery. Such problems basically originate from lack of understanding and commitment from management to adopt quality proper quality management system.

2.4 Transportation

There is problem when moving material from one section to other due to the layout of the shopfloor; the presence of burrowed floor result fatigue on the worker during movement of material from store to different sections. This results 24.53% of wasted transportation time and fatigue on the worker who are assigned on transportation of material. Also the presence of temporary material location due to disorganized work place make transportation time to increase.

Figure 15 5 why technique about transportation waste

3. Absenteeism

The absenteeism in the factory calculated below using the data from table 17. The available time for the company is calculated below: In one shift there is a working time of 9 hour.

$Lunch$ Time = $1hr/shift$; $Tea\ Break$= 15 $min/shift$; average number of workers in the shop floor= 460; working day in a year 310; total absence day 3436 (see table 19)

Operation time= total work hr. - lunch time- break time = 9 hr-1hr-.25hr= 7.75 hr

Total human hour= average workers*working hr. = 460*7.75=3565hr/shift/day

Annual absence time= number of working hour per day* number absence day= 7.75 hr.*3436= 26,629 hr.

Annual human hour= number of working hour per day* average number of worker*total working days in a year

= 7.75*460*310 = 1,105,150 hr.

$Absenteeism = \frac{number\ of\ absence\ time}{total\ human\ hour}$ *100 = $\frac{26{,}629}{1{,}105{,}150}$*100=2.41

The absenteeism rate of the company is 2.41 % as calculated above but the target set by the factory is 1.5%.

4. Turnover

One of main problem in the factory is constant depart of employees which indicate that the job does not satisfy them. Among the reasons, poor work conditions have their role in it. The problem is that, this flow of people leaving creates the necessity of finding new worker, which implies a lot of work, time and costs are required to hire new employee. As shown on Figure 18 (data history in 2015/16), the majority of reasons to hire new staff is the fleeing of workers particularly the operators working in different sections, this supports the above statement concerning the work condition. Only 30% was hired due to the fact that the business is growing (authorized personnel increase).The remaining 2 % of hiring was to replace absences.

Using labor turn over data recorded in previous section for the year 2015/16 & 2016/17, factory turn over rated calculated as follow.

$Turnover = \frac{number\ of\ employee\ hiered}{number\ of\ month}$ *100 = $\frac{39}{12}$ = 3.25 for year 2015/16 similarly 3.11 for 2016/17

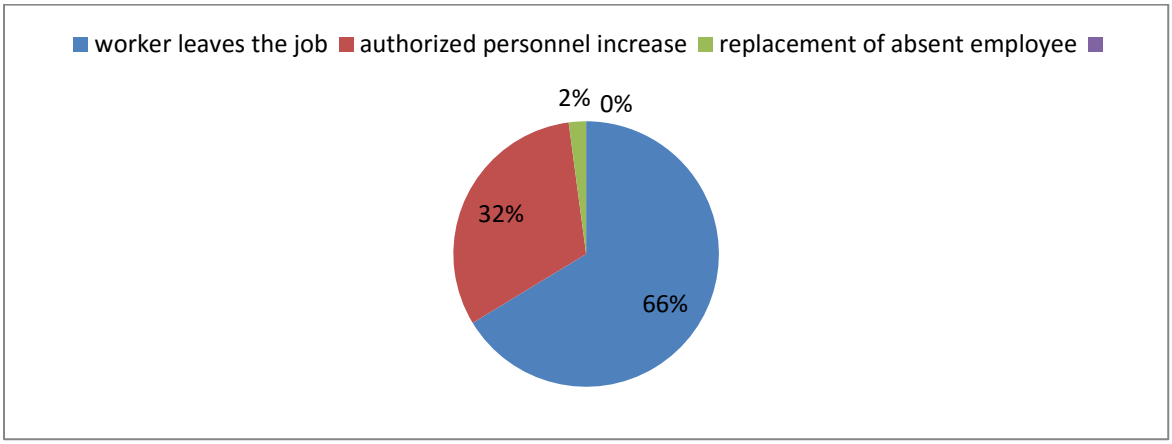

Figure 16 cause for new employee hiring

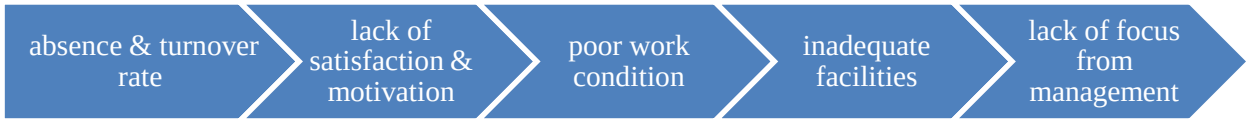

Figure 17 5 why on absence and turnover rate

Absenteeism and turnover is an indication for lack of motivation and satisfaction. This is due to poor work condition of the factory which have no adequate facility for workers. This in turn needs the focus of the management to make improvement together with the workers.

5. Ergonomic Work Place Evaluation Survey

5.1 Prevalence of musculoskeletal symptoms

At the beginning this section of the survey all the respondents are asked yes or no question about the pain they experience during execution of their duty. Those who answer yes instructed to answer the next question and the remaining group starts answering questions in the next section. According to the result 58% (45) of the worker experience discomfort during their working time the rest 42% (32) do not experience pain in the work place.

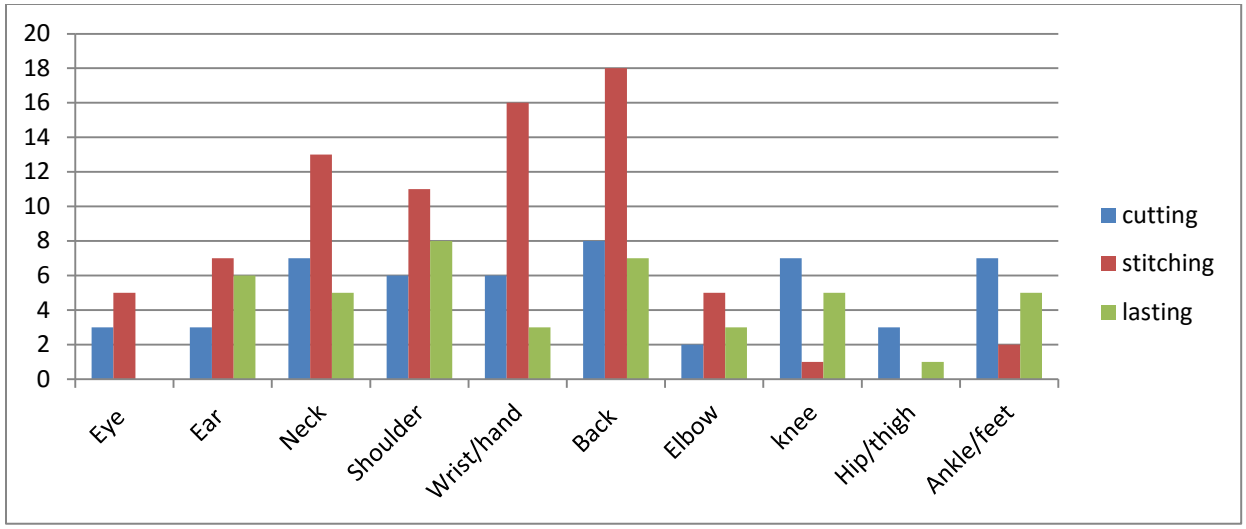

Figure 18 WRMS symptom of worker

Experiences of the discomfort or pain on various body parts, reported on the questionnaire, and are summarized on Appendix C. As shown on figure 20 above, most of the reported pain or discomforts are in the neck, shoulder, wrist /hand and back are relatively high.

Figure 19 5 why technique for Pain

From figure 21 the pains on the workers are caused by WRMSD, which is developed from physical demanding task and unfavorable work environment.

Inadequate design of workstations, tools and poor welfare services due to the lack of attention to physical ergonomic in the work place.

5.2 General work place condition survey

Section two of the questionnaire tries to assess the influence of company's working environment on the workers. The questionnaire items and the survey result described below on figure22.

Concerning the suitability of production room temperature majority of the respondent rated low and modest. The main reason for this is the position of the roof from the ground, the heat release from the machine and lack of proper ventilation.

The noise from the machine has influence to perform his/her daily routine properly as the survey response shows. This is because of lack of sound protective equipment that decreases sound the noise.

The lighting in the room rated modest and high this is due to the availability of light in each work station.

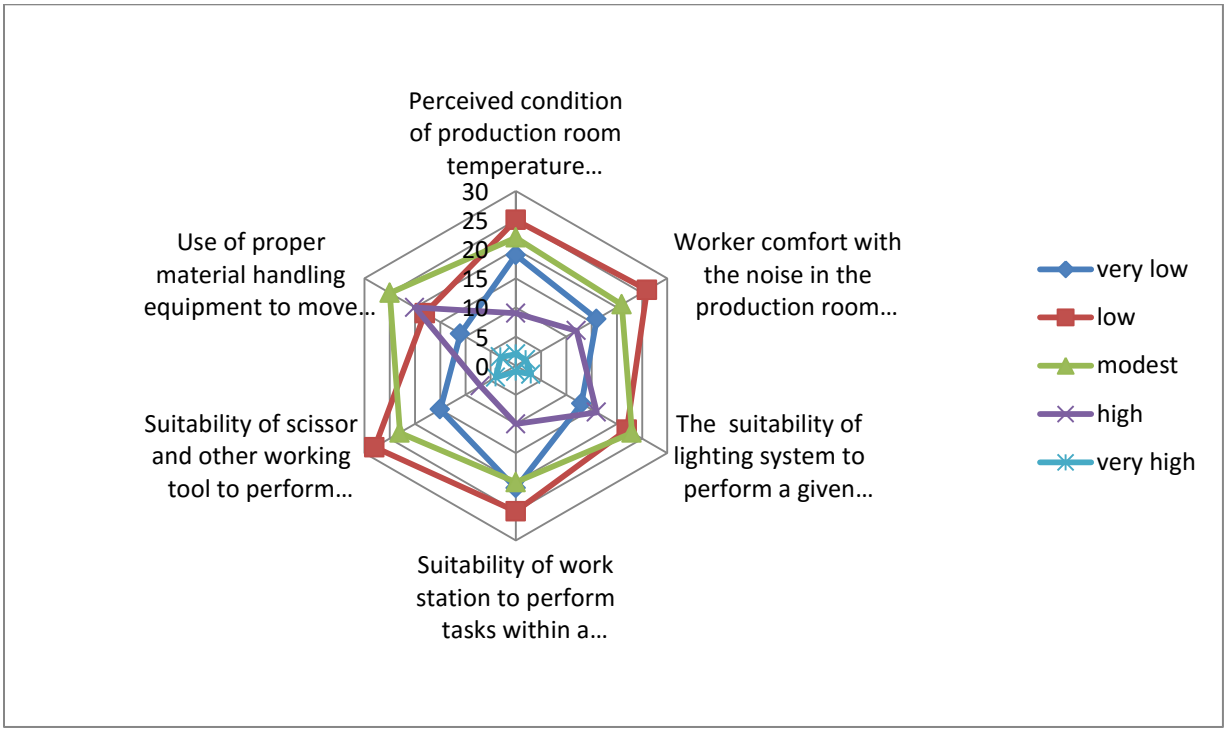

Figure 20 General work place condition survey

The suitability of work station and working tool to perform activities rated low and modest by most of the workers. The reason for this is lack of back rest on the chair, lack of adjustability on the working table and other.

Concerning the material handling equipment to move material within the shop most of the respondent rated modest and high. This is due to the presence of different basket and trails to move material.

Generally production room temperature and noise level rated as non-suitable to perform operation. But the lighting system is modest for intended operation. Also work station, working tools, material handling system and space are rated low. This indicates the lack of safety and

proper work organization that result pain, dissatisfaction and reduced performance of work. Generally application of ergonomic concept ignored, to alleviate these problem the factory must introduce the concept of ergonomics.

5.3 Organizational and psychosocial condition of work place

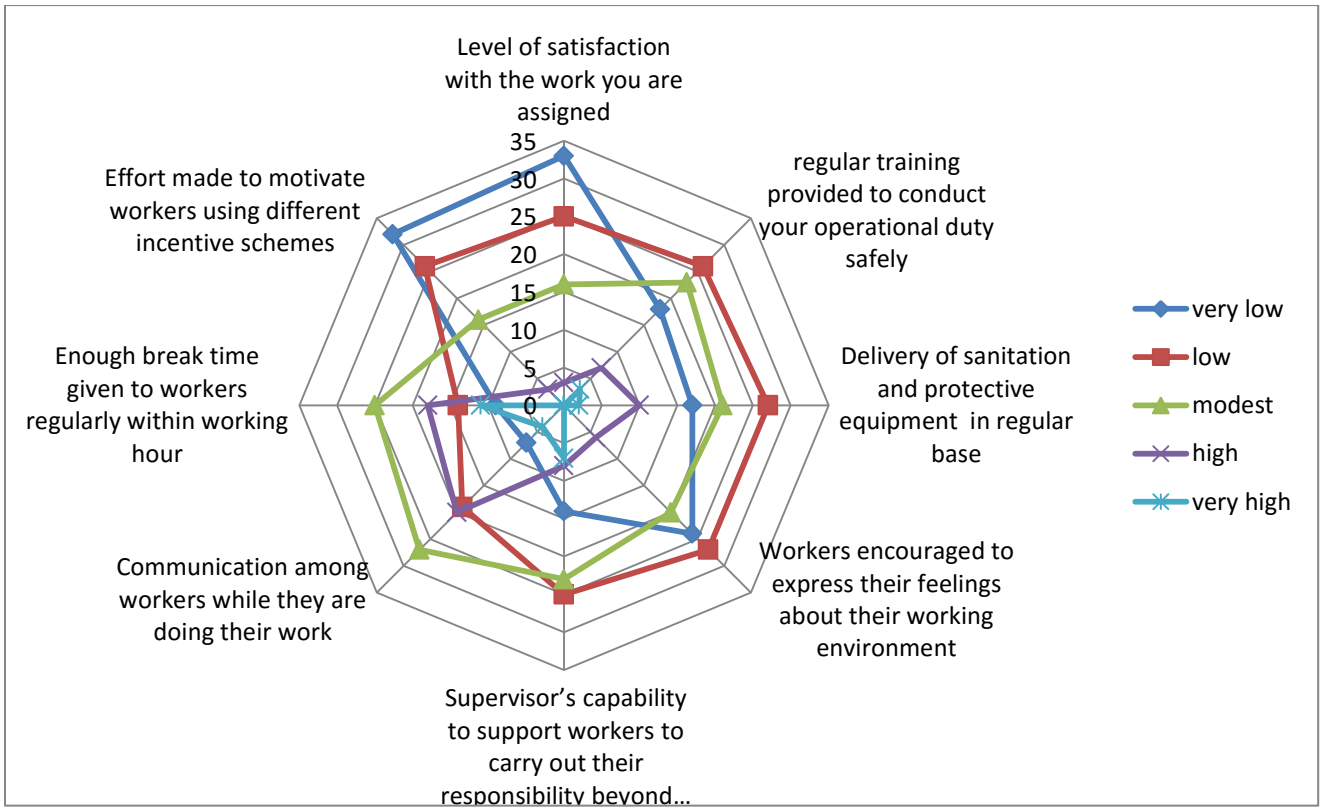

Figure 21 work place organizational & psychosocial condition survey

Organizational and psychosocial condition the survey result presented above in the figure 23.This section of the questionnaire deals about the influences that arise on the workers psychology and social interaction.

Survey response on the satisfaction of workers show low and very low by most of the respondent as the study discussed in literature review satisfaction of worker have influence on productivity but this can be affected by the stress from superiors, work condition, physical and psychological fatigue.

Regular training related to safety procedure rated low, modest and very low. But previous discussion in the literature shows regular training concerning safety will have benefit by maintaining worker health for better productivity.

Response on delivery of PPE and sanitation device rated low, modest and very low, due to carelessness of management. But regular deliveries of PPE and sanitation equipment have contribution for better work activity and reducing insurance cost for accidents as previously stated on the literature.

Listening worker opinion towards the work rated low, very low and modest, this contradict from lean pillars that stated in the literature which put people in the center; listening to workers bring idea that add improvement on productivity.

Respondents view about the operators low, modest and very low. This indicates that Supervisors are not trained in the middle management jobs such as team building, motivation, planning, and monitoring focus only on controlling activity.

The response regarding incentive scheme rated very low and low. This shows the presence of greater complain about the lack of incentive in the factory and this result demotivation of the workers.

Most of the respondents are not satisfied with the present organizational and psychosocial condition of their company. Due to these, most of the survey question rated repeatedly low. This indicates the importance of organizational ergonomics application for productivity improvement.

6. Walk through Investigation on Shop Floor

i. Jobs were varied with respect to products, processes, and operations, and were performed both individually and in groups.
ii. Jobs were neither well-structured nor routinely organized.
iii. Tasks were generally repetitive and burdensome to workers
iv. Workspace was congested and sitting postures were typically constrained and uncomfortable. Leaning forward was common.
v. Gripping and pinching with considerable forces and for extended durations was common

vi. Seats were devoid of a backrest, which gives small breaks for resting the back of the worker after stressful bending of the trunk and neck.

Figure 22 congested work environment

vii. In the cutting section raw leathers are kept in appropriate way as shown on figure 24; and operator who are working in standing position have no more space to move their feet

viii. no exchange of work and work place which motivate and help workers to get multiple skill, also no incentive given for the workers who cut more and this de-motivates the workers to increase productivity.

ix. Safety materials are not available some of the workers whose task need chemical for cleaning or gluing materials doesn't have any kind of protective mask.

x. There is no any safety first caution posted rather there are different warning notices posted on the wall

xi. Many seats are hard and wooden, without a cushion to prevent tissue compression some of the workers use foam to make comfort, but this increase their sitting height and result awkward posture.

xii. The operators have no any room to change and keep their cloth. they put their it in empty card board found under the conveyor or nearby empty space

Figure 23 operator cloth kept under conveyor

xiii. Material such as basket, card board and other material are found on the pass ways

xiv. Different colored t-shirts are given in each respective section to differentiate workers section but it is not applicable so far

xv. In some place the floor is burrowed which is difficult to move material handling carts

Figure 24 improper material handling

xvi. Workspace and equipment design features that would have allowed workers to assume a more upright posture with less trunk or neck flexion, as recommended or tested by Wick

and Drury (1985) were absent. For example, the sewing table surface was neither adjustable in height nor tilt able. Equipment, including sewing machines, was generally old and inappropriately designed.

xvii. Sharp bending of the neck was common, combined with sharp bending of the trunk among taller workers, or moderate bending, among shorter workers.

xviii. There was a general fear of being dismissed for reporting stressful or unsafe working conditions.

5.3.2 Intervention Areas

During the study the problems that affect productivity of the factory observed and recorded to find their source through critical examination. Based on the result from the critical examination the problems are summarized on the table below.

Table 18 Summary of case study

No.	Problem identified	Source	Finding
1	Inadequate process control	Observation	Production variation
2	Low labor productivity	Discussion	Low skill and motivation
3	Low capacity utilization	Factory record	Because of WIP inventory
4	Inadequate QC	Factory record	Higher defect rate compared to bench mark
5	Shortage of labor, material & machine	Factory record	Waiting
6	Unsuitable work station & tool design	Observation questionnaire	Unwanted motion, pain, absenteeism
7	Poor work environment	Observation	Discomfort, turn over
8	Poor shop floor & work organization	Observation	Transportation
9	Poor psychosocial condition	Observation	Low satisfaction & motivation

10	physical demanding task	Questionnaire	Pain & discomfort
11	Low worker involvement in decision	Observation & discussion	Lack of continuous improvement culture
12	Lack of awareness & poor leadership	Questionnaire	Organizational problem

Intervention Areas and their Relative Weight

Since, the problems listed were independent, it is impossible to get common measurement unit to prioritize. Hence, the researcher used rating of improvement team consisting supervisor and department head to decide which problem comes first based on specified criteria's. The problems are rated based on criteria set by the researcher, production and quality heads after intensive literature review and discussion on production activities. These include resource requirements, impact on productivity, impact on safety and health; also easiness to correct. The average score value to each problem rated was summarized in appendix D.

Table 19Intervention area relative weight

	Problem Identified	Weight	Ranking
1	Inadequate process control	41	2
2	Low labor productivity	43	7
3	Low capacity utilization	38	9
4	Shortage of labor, material & machine	36	6
5	Inadequate quality control	50	1
6	Poor shop floor & work organization	45	5
7	physical demanding task	40	11
8	Inadequate work environment	46	3
9	Unsuitable work station & tool design	47	2
10	Low worker involvement in continuous improvement	37	8
11	Poor psychosocial condition	39	10
12	Lack of awareness & poor leadership	42	12

5.4 Develop Improvement

At this stage, the proposed developments are presented, so as to face the improvement opportunities of the identified intervention areas exposed in previous stage.

1. Implement standard operations procedures (SOP) and training to ensure that the correct methods. Proper documentation and interpretation of inspection reports by using proper quality control tools help to reach the source of defect in the process.

2. Empowerment of teams to solve and prevent their own problems. By harnessing the talents of employees they are able to quickly and efficiently prevent the occurrence of defects.

3. Engineering solution such as redesign of adjustable working tables, chairs with cushion and back rest. Design tools that decrease excessive twisting and force.

4. Reduce non value added activities such as cutting waste leather repeatedly before throwing to waste container and Unnecessary transportation or time wasted due to lack of organization and method, like looking for things because they are not always in the same place.

5.Working environment improved through installing air conditioning system, administrative control (design of safety rules, safe work practices and procedures as: Training in the recognition of risk factors, Adjusting the work place and Rotating workers)

6. 5s implementation will solve work organization problems through introduction of continuous improvement culture. Also conducting easy repair will improve the condition of shop floor.

7. Labor productivity will be improved through continuous skill development training and incentive schemes.

8. Balance production processes using Takt time; Improving machine reliability and quality using Total Productive Maintenance (TPM) and quality tools.

9. Select operators who have the best skill set for each operation, especially the bottleneck, so that workflow is executed smoothly and effectively. It is also important to have good training for operational personnel.

10. Prepare suggestion box to gather ideas about the work from lower workers; give recognition and reward to those who achieve good success.

Table 20Match between Intervention Area and Improvement Proposal

No.	Problem	Improvement Proposal
1	Inadequate process control	1,4,8,9
2	Low labor productivity	2,3,4,6,7,9
3	Low capacity utilization	1,4,
4	Shortage of labor, material & machine	3,4,7,8
5	Inadequate quality control	1, 2,8,9
6	Poor shop floor & work organization	3,4,5,6
7	physical demanding task	3,4
8	Inadequate work environment	5,6
9	Unsuitable work station & tool design	3,6
10	Low worker involvement in continuous improvement	2,3
11	Poor psychosocial condition	2,3,4,6
12	Lack of awareness & poor leadership	3,5,10

CHAPTER SIX

PROPOSED CONTINUOS PRODUCTIVITY IMPROVEMENT MODEL

6.1 Introduction

In the era of rapid technological advances continuous upgrading is not only expected to create a major source of competitive advantage, it is often seen as a prerequisite for the survival of today's organizations. Due to this improving productivity is one major strategy for competitiveness. To improve productivity an integrated framework is proposed based on actual facts.

6.1.1 Model Development Criteria

To develop the model some criteria are considered based on the case study and literature review. These include: focus on work condition in addition to process, easily understandable and having proper metrics; addressing the possible root cause of productivity problems; being continuous improvement tool; having clearly defined productivity goal; flexibility to apply from operation to firm level and involving all, including top management to low level worker.

6.1.2 Overview of the Model

The model constructed mainly based on method study concept but on each step different concepts are added to bring the desired objective of the model to be developed.

1. Preparation: awareness creation to top management, team formation, employee training.

2. Define: consist selection of process, describe function and goal, identify factors and identify indicators.

3. Record: record information about the process and map the flow.

4. Examine: measure, find the cause using lean and ergonomics concepts and prioritize.

5. Develop: identify intervention option improvement

6. Install: implement improved solution by using the necessary resource.

7. Maintain: regularly check whether the solution is working or not.

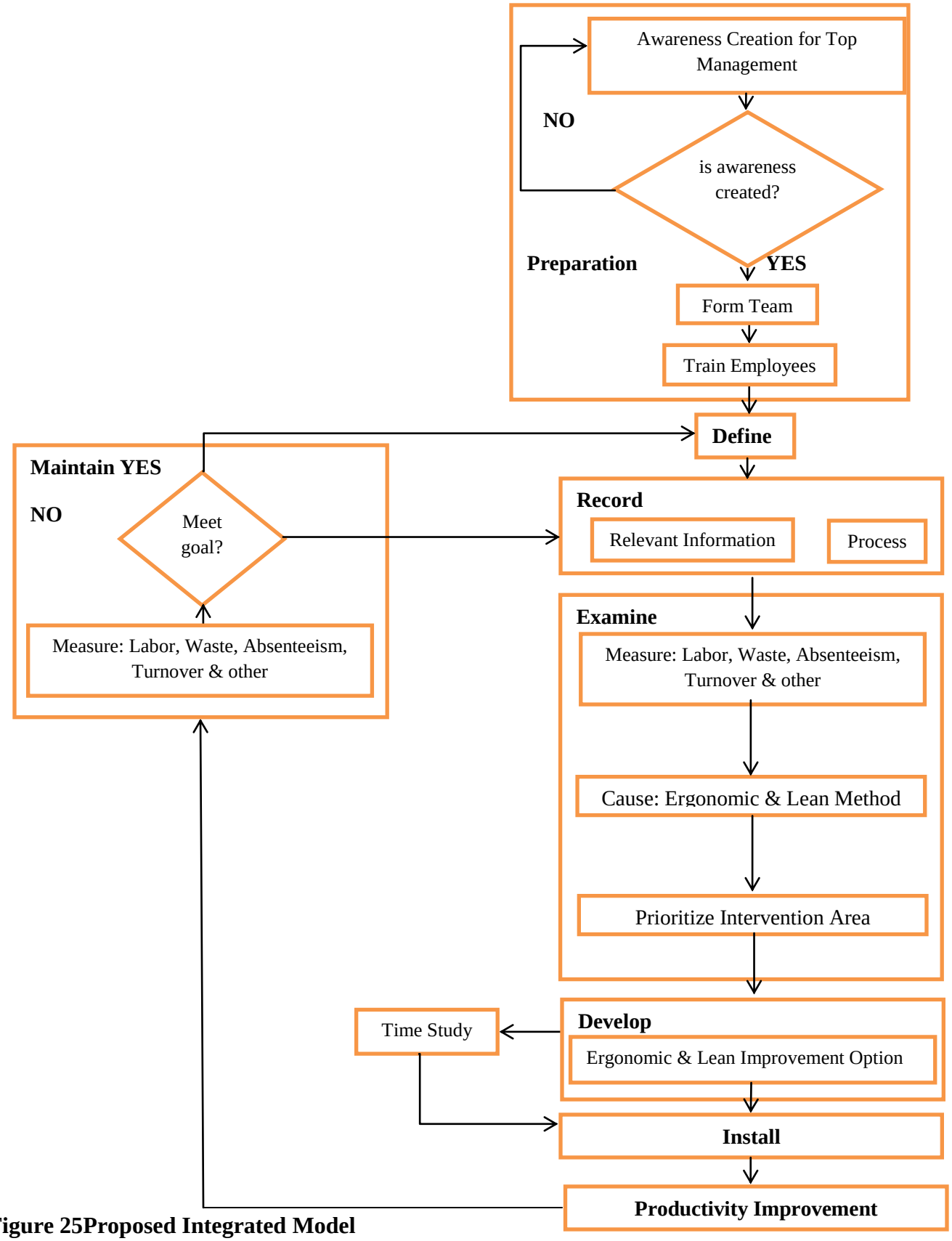

Figure 25Proposed Integrated Model

6.2 Detail of the Proposed Model

6.2.1 Preparation

1. Awareness Creation to Top Management

Decision a company took without top management is a waste of time and effort. If the senior management will not take the time to understand, then no one is going to do (Habte, 2013). Only the top management of the factory can show how important the change is, make people believe in the change and positively influence the factory culture.

Therefore, this step gives brief description of the model to capacitate the understanding of the management concerning the factors that affect their productivity; these include human, material, machine, process and organizational factors. Also, the way to identify, measure, analysis, improve and implement these factors are explained. This will be done by giving information about different indicators, Lean, Ergonomic and Work study methods.

2. Form Team

Once the model is accepted by the management the next step is establishing continuous improvement team. The team is responsible to the management and performs different activities such as establishing sub teams, planning schedules for regular meeting, conducting training to employee regularly, controlling activities, prepare awards for those who show greater achievement.

The team includes multidisciplinary working group within the factory. This small working group involves a mix of participants, including production staff, quality controllers, middle management and technicians. The duration of the team last as long as the factory exists in the business but the members change in regular interval of time decided by the team.

3. Train Employee

Employees are lined on the front to the success or failure of an organization due to this huge attention needed to make them a change agent through continuous capacity building programs. Therefore, the employees at all levels must be given a training program about productivity factors and the model used to solve them. Concerning the model lean, ergonomics and work study principle and methods are explained. Also during training workers are encouraged to give feedback about the problem and the possible solution from their experience.

6.2.2 Define

This step of the model includes the following activities: 1-select the process, 2- describe major functions of the process, 3- identify major factors and their specific problem, and 4- identify productivity indicators of the process

1. Select

Select the process to be studied based on systematic review of available data, normal monitoring or control processes, high levels of dissatisfaction and complaint or as part of a management derived change in policy, practice, technology or location.

1.1 Available data review: the data reviewed may be previous reports on production and other process related data.

1.2 Monitoring: take a process view and make online supervision to understand about the condition of the process.

1.3 Dissatisfaction and Compliant: gather complaints from inside and outside customer of the factory concerning the process and its output.

2. Functions of the Process

The profound knowledge of each process and the relations between each one of their activities required to make improvement.

3. Identify major factors and specific problems

Productivity factors and their respective detail problems are identified considering the lean and ergonomic principles stated in chapter two.

4. Identify Productivity Indicators

Indicators represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization. KPIs are rarely new to the organization. Either they have not been recognized or they were gathering dust somewhere unknown to the current management team (Parmenter, 2010).

5. Set Goal

Productivity targets can be done by trend analysis and by using forecasting techniques for each productivity measures.

5.1 Trend analysis-Here productivity goals are based on historical data. The targets can be set by experts and management. This technique can be used to set goals for WIP, Defect rate, Absenteeism and other.

5.2 Forecasting- Productivity targets can be also set by using forecasting techniques especially exponential smoothing. This technique is used to found the forecasted values such as labor productivity.

6.2.3 Record Information

Obtain the facts about the factors affecting the process and record them. In order to improve process or an activity or procedure the fact information is collected from the place where the study is being executed by direct visual observation (Gelan, 2009). This can be done by:

i. Recording movement of machines or materials.

ii. Recording the procedure in the job or process.

iii. Recording the operator performance.

iv. Recording the path of movement of workers with respect to machines and allied operations.

v. Recording the path of movement to improve work place layout.

vi. Recording the scrap generated.

vii. Recording complains about the tools and working condition

There are many lean, ergonomic and work study tools available which may be used for proper recording and presentation for further analysis as described in the literature. The choice of technique depends on the type of information which is to be recorded. This is an important step since the improvement in existing method or development of new method depends on how exactly the facts about the existing method have been recorded.

Among the tools lean include (standard work, Takt time, VSM), ergonomic include (RULA, OWAS),and work study includes (process flow chart, diagram, graph,).

6.2.4 Examine

At this stage critical examination of the process done based on the measurement of productivity indicators identified above, this helps to know the productivity level for productivity analysis and

improvement. Then effort will be made to find the root cause using different tools such as 5 why technique, ishiwaka diagram and other. Then the causes prioritize by using improvement matrix or pareto chart based on predefined criteria.

$$labor\ productivity = \frac{volume\ of\ output}{volume\ of\ human\ input} \quad \text{.....1}$$

$$Absenteeism = \frac{number\ of\ absence\ time}{total\ human\ hour} * 100 \text{.....2}$$

$$Turnover = \frac{number\ of\ employee\ hiered}{number\ of\ month} \text{.....3}$$

$$Down\ time = \frac{Total\ down\ time}{total\ working\ time} * 100 \text{.....4}$$

$$WIP = \frac{number\ of\ WIP}{total\ number\ of\ input} * 100 \text{.....5}$$

$$Defect = \frac{total\ number\ of\ Defect}{total\ number\ of\ inspected} \text{.....6}$$

6.2.5 Develop

At this stage, improvement option developed after studying all the alternatives presented in response to the causes identified. This improvement should applicable into the changes that eliminate the problem and even its root-causes. To do that tools and techniques provided applied for the reduction or elimination of all the ergonomic and waste problems.

Best efforts made using this tools and techniques to design improved process and work condition through:

1. Eliminating unnecessary process or activities

2. Simplifying the process,

3. Sequencing process or activities

4. Combining the activities of Person and means of the processor

5. Seeking the best possible alternative by applying the various problem solving techniques such as Mechanical aids, Manual control, visual instruments, equipment re-design, jigs and fixtures,

local working conditions and etc. are some of the possible alternatives for designing the new and efficient process (Patel, 2017).

6.2.6 Install

Once the productivity improvement option has been developed, all the staff from top management to shop floor worker should be committed to implement it according to their role in the process. Continuous support and involvement from top management encourage the employees to strive hard for the success of designed improvement process and help to develop sense of ownership for the job this will improve the worker attitude towards the job and improve satisfaction beside productivity improvement.

During installation training will be given by the team for those who are going to utilize the new method concerning the procedure, tools utilized, route they follow during movement, safety rules and other issue that helps to the successful installation of the method. Also the training session helped to improve cooperation from both supervisory staff and operators to the successful installation of any proposed and selected method. So the installation of the new method implemented can be further improved by way of continuous observation and discussion s. the trails runs may be carried out during which minor modifications may be made to facilitate working.

6.2.7 Maintain

The improvement installation from the previous stage solves the problem in a short-term. However that doesn't give any guarantee for us that the problem won't occur again, but also that the redeveloping improvement processes should continue to be in the future. For this, it is necessary to maintain the processes through regular checking to achieve better working condition, reduction of fatigue, improve use and condition of resources; equipment's and man power which makes ultimately the productivity to improve and verification utilizing the adequate metrics and tools listed above. Therefore, through this we can guarantee the continuity of the implemented development.

To check whether the process is in the required status or not measured by using the indicator as a metric then cross check with the goal set at the beginning; if there is major deviation to fulfill

the goal the steps are repeated and correction will be made otherwise if things are fine next process improvement begun.

6.3 Benefit

The integrated model is used to define the processes, sub-processes and operations to make productivity manageable, identify main productivity factors and indicators. Also examine the process.

The integrated framework can improve productivity by enhancing effective utilization of different resources and improve wastes by minimizing defect rates, WIP inventory, waiting, transportation time, motion and other; increase welfare service, correct working condition and satisfaction. For academicians and researchers, the framework can be used as guideline how to develop a method that supports productivity improvement of manufacturing company.

CHAPTER SEVEN

CONCLUSION, RECOMMENDATION AND FUTURE WORK

7.1 Conclusion

From the situational study the following concluding remarks have been made.

- Labor productivity is lower than the best practice by 75.6%. Inadequate capacity utilization 56%, WIP, waiting, defect rate and Transportation of the factory are increased by 5%, 5.78%, 1.05% and 24.53% from the benchmark values respectively. In addition, the ergonomic condition of the factory shows poor status.
- The productivity factors are multidimensional ranges from human to material to machine to process to organizational factors. But all these factors do not have equal effect on productivity. And the resources are limited to solve all the problems associated with the productivity factors. Therefore, deciding the intervention areas which are potential for productivity improvement is very important.
- Decreasing defect rate, Pain, absenteeism, unwanted motion, turnover, transportation, lack of skill, organizational, decreasing down time and work in process are priorities for productivity improvement of the factory.
- The integrated model developed can be considered as organized and sustainable productivity improvement technique.
- Compatibility with the knowledge and skill of the user (i.e. easy to use), compatibility with the existing tools and techniques, addressing the possible productivity factors, being continuous improvement tools, having clearly defined objectives, and flexibility to apply from operation level to firm level are the important characteristics of the integrated model which make it preferable to apply.
- Implementing the integrated model can improve productivity by enhancing effective utilization of resources. Also, it can improve quality by minimizing defect rate; it can increase both internal and external customer satisfaction.

7.2Recommendation

From the results of study, the following points have been recommended.

- Productivity is one of the major determinants of competitiveness. Therefore, the factory should improve their productivity in organized and sustainable way so that to compete in the market place.
- Currently factory apply productivity indicator (i.e. labor productivity). Hence this may misdirect productivity improvement efforts. Therefore, the factory should focus on other indicators such as waste, absenteeism, turnover and other.
- It is recommended that the factory will be beneficiary if they implement the newly developed model. Because these is an organized and sustainable productivity improvement technique developed to improve productivity from operation to firm level.
- Productivity improvement through the integrated model should be considered as normal task of every employee within the factory. For better coordination of the technique, the factory should set up a standing productivity team. The proposed members of this team includes multidisciplinary working group within the factory. This small working group involves a mix of participants, including production staff, quality controllers, middle management and technicians.
- The team is responsible to the management and performs different activities such as facilitate the implementation of the framework, establishing sub teams, planning schedules for regular meeting, conducting training to employee regularly, controlling activities , prepare awards for those who show greater achievement and other.
- It is better for the factory to give priority on decreasing defect rate, Pain, absenteeism, unwanted motion, turnover, transportation, lack of skill, organizational problems, work in process and decreasing down time are potentials for productivity improvement of the factory at low effort.
- Currently the factory does not have research and development process, so it is recommended to have this process for the design and development of different types of shoe styles by identifying customers' needs and requirements, and for introducing new tools and techniques.

7.3 Future Work

1. Identifying additional productivity indicators which are not considered in the study due to data shortage.

2. Implementing the model on operational level considering specific product family in the production and other process in the factory.

3. The study focus on Anbessa shoe Sc. due to time constraint, so that it is necessary to see the impact of the model by implementing in other factories.

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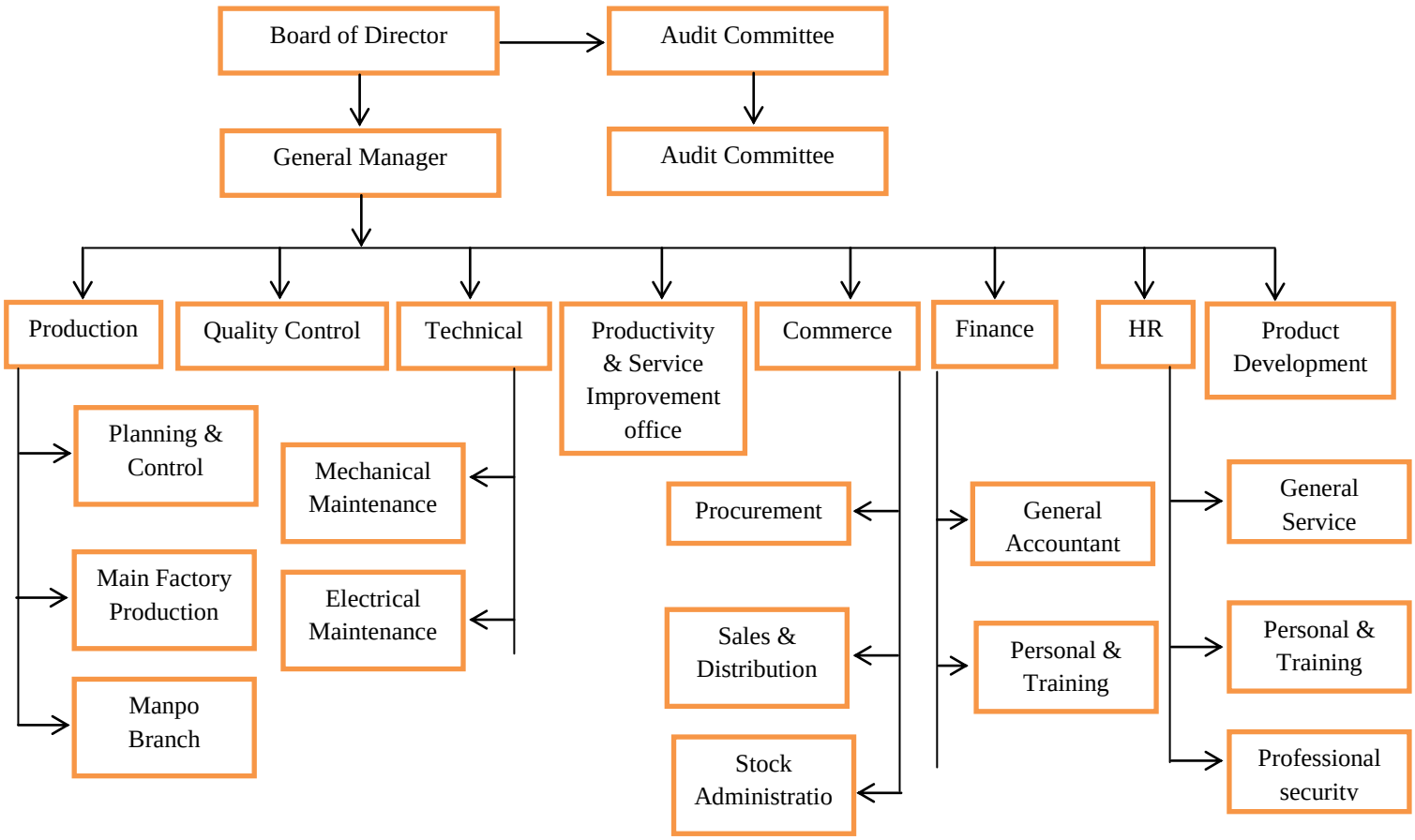
APPENDIX

Appendix A: Organizational structure of Anbessa shoe Share Company



Appendix B: Survey questionnaire Amharic version

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ሞባይል፡- 0910195687 ኢሜይል፡- emigbez@gmail.com

አማካሪ፡- ኘሮፌሰርዳንኤልቅጣው (ኢንዱስትሪያልምህንድስናትምህርትክፍልሰብሳቢ - አ.አ.ቴ.ኢ)

ረ/አማካሪ፡- አቶገዛኸኝተስፋዬ (3ኛዲግሪተማሪ፣ኢንዲስትሪያልትምህርትክፍልመምህር - እ.ኤ.ኢ)

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በቅድሚያይህንመጠይቅለመሙላትስለተባበራችሁንከልብየመነጨምስጋናዬንአቀርባለሁ፡፡ይህመጠይቅየተዘጋጀው ‹‹ ***Integrated Model for Continuous Productivity Improvement in Footwear Industry: A case of Anbessa Shoe SC.***›› በሚልለሚካሄደውጥናታዊፅሁፍሲሆን! አላማውም የምርት ሂደትን ለማሻሻልና ምርታማነትን ለመጨመር የሚያስችል የተሻሻለ የአሠራር ዘዴን ለማፍለቅ ነው፡፡

መጠይቁን በሚሞሉበት ጊዜ ስምዎንም ሆነ ፊርማዎትን ማስቀመጥ የማያስፈልግ ሲሆን ከመጠይቁ የሚገኙ ምላሾች በጥንቃቄና ሚስጥራዊነቱ በተጠበቀ መንገድ የሚሞላና የሚቀመጥነው፡፡ይህንንም ግምት ውስጥ በማስገባት መጠይቁን ሲሞሉ በነፃነትና በትክክለኛ መንገድ እንዲሞሉ በአክብሮት እየጠየኩ ጥናቱን በተመለከተ ለሚኖር ማንኛቸውም ጥያቄና አስተያየት ከላይ የተገለፀውን አድራሻ መጠቀም እንደምትችሉ በትህትና እገልፃለሁ፡፡

ማሳሰቢያ፡-ለእያንዳንዱ ጥያቄ ከተሰጠው ክፍት ቦታ በአንዱ የ(x) ምልክት ያድርጉ መመለስ ያልፈለጉትን ጥያቄያ ለመመለስ ሙሉ መብት አለዎት የተሰጠው ክፍት ቦታ ካነሰዎት በጀርባ መፃፍ ይችላሉ፡፡

ክፍልአንድአጠቃላይመረጃ

1. በድርጅቱውስጥያለዎትኃላፊነትወይምየስራድርሻ

   ኦኘሬተር□የኦኘሬተርረዳት□ሱፐርቫይዘር□ጥራትተቆጣጣሪ□

   ሌላከሆነእባክዎይግለፁት_____

2. ፆታወንድ□ሴት□

3. እድሜ

   ከ18 አመትበታች □ ከ18-30 አመት □ 31-42 አመት □ 43-54 አመት □ ከ55 አመትበላይ □

4. የትምህርትደረጃ

   1-8 □ 9-10 □ 11 – 12 □ ቴክኒክናሙያ □ ዲፕሎማ □ የመጀመሪያዲግሪእናከዚያበላይ □

5. እዚህፋብሪካውውስጥያገለገሉበትጊዜ

   ከ0-1 አመት □ ከ1-2 አመት □ ከ2-5 አመት □ ከ5-10 አመት □ ከ10 አመትበላይ□

ክፍል አራት የስራሁኔታ

1.የሠራተኛጤናመገምገሚያ

1. በሚሠሩትስራምክንያትየመጣየህመምወይምየጤናችግርአለብዎ? **አዎ** □ **አይደለም** □ እባክዎ አዎ ከሆነ መልስዎ ተራቁጥር ሁለትን ይመልሱ
2. በየትኛው የሠውነት ክፍል ነው የህመም ስሜት የሚሠማዎ?

አይን	
አንገት	
ትከሻ	
እጅናየእጅመገጣጠሚያ	
ክርን	
ጀርባ	
ወገብ	
ጉልበት	
እግርናቁርጭምጭሚት	

2. የምርትስራቦታውናመሳሪያዎችለሰራተኞችምርታማነትያለውአመቺነትበተመለከተ፣

ሀ.በጣምዝቅተኛ **ለ.**ዝቅተኛ **ሐ.**በመጠኑ **መ.**ከፍተኛ **ሠ.** በጣምከፍተኛ

		ሀ.	ለ.	ሐ.	መ.	ሠ.
1	የስራ ክፍሉ የሙቀት ሁኔታ የእለት ተእለት ስራዎችን ለማከናዎን ያለው አመቺነት					
2	በስራ ክፍሉ ውስጥ ያለው የድምጽ መጠን በሰራተኛው ላይ የሚፈጥረው ተጽእኖ					
3	በክፍሉ ውስጥ ያለው የብርሀን መጠን ለስራ ያለው አመቺነት					
4	የስራክ ፍሎች/ቦታዎች ተፈጥሯዊ የሆነ የሰውነት ቅርጽን ሳያዛቡ ለስራ ያላቸው ምቹነት					
5	መቀስና ሌሎች የስራ መሳሪያዎች ለስራ ያላቸው አመቺነት					
6	የስራ መሣሪያ፣ ጥሬ እቃና ምርት ማጓጓዣ መሳሪያዎች ላቸው ምርታማነት					

3.የማምረቻ ቦታው ያለው የአደረጃጀት ሁኔታና በሰራተኛው ላይ የሚፈጥረው ማህበራዊና ስነቦናዊ ጫና በተመለከተ፣

ሀ.በጣምዝቅተኛ ለ.ዝቅተኛ ሐ.በመጠኑ መ.ከፍተኛ ሠ. በጣምከፍተኛ						
		ሀ.	ለ.	ሐ.	መ.	ሠ.
1	በስራዎ ላይ ያለዎት የደስተኛነት ስሜት					
2	ሰራተኞች መደበኛ የሆነ የስራ ላይ ደህንነት ስልጠና በየጊዜው እንዲያገኙ ስለመደረጉ					
3	የስራቦታ ደህንነትና ጤንነት መጠበቂያ ቁሳቁሶች በበቂሁኔታ ስለመኖራቸው					
4	ሰራተኞች ስለስራ ቦታቸው ያላቸውን አስተያየት እንዲሰጡይ በረታታሉ					
5	ሱፐርቫይዘሮች የበታች ሰራተኞች ሥራቸውን በአግባቡ እንዲያከናውኑ ከመቆጣጣር በዘለለ የሚያደርጉት ድጋፍ					
6	ሰራተኞች ስራ በሚሰሩበት ቦታ እርስ በርሳቸው ያላቸው መግባባትና መደጋገፍ					
7	በቂ የሆነ መደበኛ የእረፍት ጊዜ በየስራስአቱ መካከል ስለመኖሩ					
8	ለሠራተኞች የተለያዩ ጥቅማ ጥቅሞችን በመስጠት ለማበረታታት የሚደረገው ጥረት					

Appendix C: Survey questionnaire English version

ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAiT)

School Of Mechanical and Industrial Engineering

Graduate Program in Industrial Engineering

Survey Questionnaire on Anbessa Shoe Sc.

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This questionnaire is prepared to gather data for the purpose of research entitled **"Integrated Model for Continuous Productivity Improvement in Footwear Industry".** The objective of the questionnaire is to improve worker productivity by identifying workplace conditions which have influence on the workers performance. Also to test their understanding about different production wastes those affect both the worker and the process.

I would be very grateful if you could spend a small amount of time to answer the attached questionnaire. All the questions are designed for quick and easy response. I would also like to assure you that all responses given will be treated as ***strictly confidential*** and used for educational paper purposes only. If you need further clarification, please contact me on the address given above:

Thank you for your committed cooperation, time and consideration!!!

1. General Information

i. Indicate your responsibility in your company

Operator ☐ Helper ☐ Supervisor ☐ Quality control ☐

other: please specify it----------

ii. Sex male ☐ female ☐

iii. Age

Below 18 ☐ 18-30 ☐ 31-42 ☐ 43-54 ☐ 55 and above ☐

iv. Indicate your educational background

1-8 ☐ 9-10 ☐ 11-12 ☐ TVET ☐ Diploma ☐ BSc ☐

v. Your work experience in this company

below 1year ☐ 1-2 year ☐ 2-5 year ☐ 5-10 year ☐ more than 10 year ☐

2. Ergonomics

I. Prevalence of Musculoskeletal Symptoms

1. Do you feel pain when you perform your task? Yes ☐ No ☐
2. Which part of your body you feel pain during work

Pain/ Discomfort	Cutting section		Stitching section		Lasting section		Total	
	n=10	%	n=22	%	n=13	%	n=45	%
Eye	1	10	4	18.18	0	0	5	11.11
Ear	0	0	1	4.55	6	46.15	7	15.56
Neck	5	50	11	50	5	38.46	21	46.67
Shoulder	5	50	3	13.64	7	53.85	15	33.33
Wrist/hand	3	30	15	68.18	0	0	18	40
Back	6	60	12	54.55	2	15.38	20	44.44
Elbow	5	50	6	27.27	3	23.08	14	31.11
knee	5	50	1	4.55	3	23.08	9	20
Hip/thigh	3	30	0	0	1	7.69	4	8.89
Ankle/feet	5	50	2	9.09	3	23.08	10	22.22

II. General Work Place Condition

No.	A. **Very Low** B. **Low** C. **modest** D. **High** E. **Very High**							
	Questionnaire Item		**A**	**B**	**C**	**D**	**E**	**Tot**
1	Perceived condition of production room temperature suitability to perform their daily activities	frequency	19	25	22	9	2	**77**
		%	24.68	32.48	28.57	11.69	2.6	**100**
2	Worker comfort with the noise in the production room while doing their job	frequency	16	26	21	12	2	**77**
		%	20.78	33.77	27.27	15.58	2.6	**100**
3	The suitability of lighting system to perform a given operation without difficulties	frequency	13	22	23	16	3	**77**
		%	16.89	28.57	29.87	20.78	3.9	**100**
4	Suitability of work station to perform tasks within a natural posture	frequency	21	25	20	10	1	**77**
		%	27.27	32.47	25.97	12.99	1.3	**100**
5	Suitability of scissor and other working tool to perform tasks without any risk of injury	frequency	15	28	23	7	4	**77**
		%	19.48	36.36	29.87	9.09	5.19	**100**
6	Use of proper material handling equipment to move material within the shop floor area	frequency	11	18	25	20	3	**77**
		%	14.29	23.38	32.47	25.97	3.9	**100**

III. Organizational and psychosocial condition of work place

No.	A. **Very Low** B. **Low** C. **modest** D. **High** E. **Very High**							
	Questionnaire Item		**A**	**B**	**C**	**D**	**E**	**Tot**
1	Level of satisfaction with the work you are assigned	frequency	33	25	16	3	0	**77**
		%	42.86	32.46	20.78	3.89	0	**100**
2	regular training provided to conduct your operational duty safely	frequency	18	26	23	7	3	**77**
		%	23.38	33.77	29.87	9.09	3.89	**100**
3	Delivery of sanitation and protective equipment in regular base	frequency	17	27	21	10	2	**77**
		%	22.08	35.06	27.27	12.99	2.59	**100**
4	Workers encouraged to express their feelings about their working environment	frequency	24	27	20	6	0	**77**
		%	31.17	35.06	25.97	7.79	0	**100**
5	Supervisor's capability to support workers to carry out their responsibility beyond controlling the routine activities.	frequency	14	25	23	8	7	**77**
		%	18.18	32.47	29.87	10.39	9.09	**100**
6	Communication among workers while they are doing their work	frequency	7	23	27	16	4	**77**
		%	18.18	29.87	32.47	14.28	5.19	**100**
7	Enough break time given to workers regularly within working hour	frequency	9	14	25	18	11	**77**
		%	11.68	18.18	32.46	23.37	14.29	**100**
8	Effort made to motivate workers using different incentive schemes	frequency	32	26	16	3	0	**77**
		%	41.56	33.76	20.77	3.89	0	**100**

Appendix D: Average score of the problems rated based on criterias

Problem	Criteria	Resource requirement to correct (3)		Impact on productivity (4)		Impact on health & safety (4)		Easiness to correct (2)		Total Score
	Weight	score	Wtd. score	score	Wtd. score	score	Wtd. score	score	Wtd. score	
Inadequate process control		3	9	5	20	3	12	4	8	49
Low labor productivity		3	9	5	20	2	8	3	6	43
Low capacity utilization		3	9	4	16	2	8	3	6	39
Shortage of labor, material & machine		4	12	5	20	1	4	4	8	44
Inadequate quality control		4	12	5	20	2	8	5	10	50
Poor shop floor & work organization		3	9	3	12	4	16	4	8	45
physical demanding task		2	6	2	8	4	16	3	6	36
Inadequate work environment		4	12	3	12	4	16	3	6	46
Unsuitable work station & tool design		3	9	3	12	5	20	3	6	47
Low worker involvement in continuous improvement		2	6	4	16	3	12	4	8	42
Poor psychosocial condition		1	3	4	16	3	12	3	6	37
Lack of awareness & poor leadership		2	6	3	12	2	8	4	8	34
***Wtd**.-*weighted score*; **Very low=0 Low=1 Moderately low=2 Medium=3 High=4 Very High=5**										