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**Enhancing Productivity of Small and Medium Enterprise
through Value Stream Mapping: A Case of Zemen Shoe Factory
in Addis Ababa Arada Sub city**

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Declaration

This is to witness that this thesis entitled “**Enhancing Productivity of Small and Medium Enterprise through Value Stream Mapping: A Case of Zemen Shoe Factory in Addis Ababa Arada Sub city**” submitted in partial fulfillment of the requirements for the award of the degree of M.Sc. School of Mechanical and Industrial Engineering, Addis Ababa University done by Ms. Mistir Binyam under my guidance. The work contained in this thesis has not been previously submitted in whole or in part to another university for the award of any other degree.

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Abstract

Industries to be productive it is challenging that exceeding customer expectations with utilizing limited resource. Optimizing a process is one of the methods to face the challenges the most dares are reducing productivity, higher lead time, occurring non-value-adding activities. Here, value stream mapping plays important role in enhancing the process efficiency by identifying wastes, value-adding, and non-value-adding activities on the process then proposing improvement ideas for the wastes therefore the value-adding activities are tied up by standard. The study was conducted in Zemen Shoe Factory by selecting a major product of the company. Primary and secondary data collection methods were used for the methodology to conduct the study. The major factors for the company to have low productivity which is labour productivity is below 3 pairs/ person/day, also found wastes: waste of waiting (5026.8 sec), rework (4932 sec), waste of transportation(411.2meters), waste of inventory is (Average WIP 48), higher change over time (4755 sec), and waste of motion (46%). Cycle time and lead time is reduced from 16488.1sec to 3963sec and 8.2 days (708,480 sec) to 1.5 days (129,600). In the future state map by eliminating these factors and build up the capacity of workers finally use standard operational procedures were used in order to improve the productivity. Standard Operational Procedure was prepared for the optimized cycle time by adding allowances specified by the international labour organization. For men, the constant allowances, are 5% for the personal need allowance, 4% for basic fatigue allowance, and for women, 7% personal need allowance, and 4% basic fatigue allowance. The result has shown that the occurrence of wastes can affect the cycle time and lead time of a process. And if these problems are resolved a firm's productivity can be greater which 4.2 pairs/person/day.

Key words: Wastes, Value stream mapping, Standard Operational procedure

Table of Content

Declaration.....	i
Acknowledgement	ii
Abstract.....	iii
Table of Content	iv
List of Tables	viii
Acronyms	x
1. Introduction.....	1
1.1 Problem background	1
1.2. Company background	3
1.3. Statement of Problem.....	4
1.4. Research Questions.....	4
1.5. Objective of the study	5
1.5.1. General objective of the study	5
1.5.2. Specific objectives.....	5
1.6. Significance of the Study	5
1.7. Scope and Limitation of the Study.....	5
1.8. Organization of the Paper	6
2. Literature Review	7
2.1. Introduction.....	7
2.2. Leather Industries in Ethiopia.....	7
2.3. Highlight of Productivity	7
2.4. Overview of Small and Medium Enterprises.....	8
2.4.1. SMEs Roles Comparison in Globe and Ethiopia.....	8
2.4.2. SMEs Socio-Economic Impact.....	9
2.4.3. SMEs opportunities and Challenges.....	10
2.5. Productivity Measurement	10
2.5.1. Productivity Measurement Techniques	11
2.5.2. Factors Influencing SMEs Productivity	12
2.6. Productivity Improvement	12
2.7. Lean Concepts.....	13
2.7.1. Benefits of Lean.....	14

2.7.2.	The 7 wastes of lean	15
2.7.3.	Best Lean Practices and Tools.....	16
2.7.4.	Value Stream Mapping.....	16
2.7.4.1.	Symbols and Descriptions of Value Stream Mapping	17
2.7.4.2.	Steps for making VSM.....	18
2.7.4.3.	Measurement for analyzing productivity by value stream map	19
2.8.	Literature Gap analysis	21
3.	Research Methodology and Material	28
3.1.	Research Design.....	28
3.2.	Method of the Study.....	28
3.3.	Literature Survey	31
3.4.	Method of Data Collection.....	31
3.4.1.	Primary Data Collection Methods	31
3.4.1.1.	Direct Physical Observation.....	31
3.4.1.2.	Focal Group discussion	32
3.4.1.3.	Sampling Technique.....	32
3.4.1.4.	Questionnaire	32
3.4.1.5.	Interview.....	32
3.4.1.6.	Recording Time.....	32
3.4.2.	Secondary Data Collection Method.....	33
3.4.3.	Product Selection Methodology	33
3.4.4.	Method of Data Analysis and Presentation	34
3.4.4.1.	Method of Data Analysis.....	34
3.4.4.2.	Method of Data Presentation.....	34
3.5.	Ethical Consideration	34
3.6.	Research Dissemination	34
4.	Data Presentation and Discussion	35
4.1.	Introduction.....	35
4.2.	Quantitative data analysis	35
4.2.1	Questionnaire Data Analysis	35
4.2.2	Demographic Analysis	35
4.2.3	Awareness and knowledge that influences Productivity of Zemen shoe	36

4.2.4	Quality concerns that have impact on production process	38
4.2.5	All-purpose questions allied to the study	38
4.3.	Qualitative data analysis	39
4.3.1.	Data analysis for interview	39
4.3.2.	Field observation data analysis	40
4.4.	Factor Analysis for Productivity	40
4.4.1.	Inputs for the Shoe.....	41
4.4.2.	Product Family Selection.....	41
4.4.3.	Zemen shoe Manufacturing Process.....	42
4.4.3.1.	Cutting Section Operations	43
4.4.3.2.	Preparation 1 Section Operations	43
4.4.3.3.	Stitching Section Operations.....	44
4.4.3.4.	Preparation 2 Section Operation	45
4.4.3.5.	-Lasting and Finishing Section Operations	45
4.4.3.6.	Packing section.....	46
4.5.	Creating the Current State Map	47
4.5.1.	Production Process Description of Model 23.....	47
4.5.2.	Define customers of Model 23 Shoe	48
4.5.3.	Defining Value to Customers of Model 23 Shoe	48
4.5.4.	Components of Model 23 Shoe	49
4.5.5.	Activities Involved on the Production of Model 23 Shoe	49
4.5.6.	Takt Time Calculation	53
4.5.7.	Current State Value Stream Mapping.....	55
4.6.	Percentage of Value Adding Time.....	58
4.6.1.	Cycle Time Loss	59
4.6.2.	Cycle Time Efficiency.....	59
4.6.3.	Comparing Takt Time & Actual Time	60
4.6.4.	Categorizing Waste.....	61
4.6.5.	Analysis of Wastes for the case company	62
4.6.6.	Identifying the General Factors for Lower Labour Productivity	71
4.7.	Adapted Future State Value Stream Map	75
4.7.1.	Standard WIP calculation	76

4.7.2.	Maintaining Marking lines at the Cutting Section.....	77
4.7.3.	Organization of workplace	77
4.7.4.	Standard Quality Control Format with staffs	78
4.7.5.	Future State Map.....	79
4.8.	Work Standardization	80
4.8.1.	Standard Time for Each Process Steps.....	80
4.8.2.	Sustaining Standard	82
4.9.	Results obtained from the Future State Value Stream Map FSVSM.....	87
Chapter Five	88
2.	Conclusion, Recommendation and Future Work	88
5.1.	Conclusion	88
5.2.	Recommendation	88
5.3.	Future work.....	89
REFEERNCES	90
Appendix I	Survey Questionnaire.....	96
Appendix II :	The severely product (2011 EC - 2012 EC).....	103
Appendix III :	Standard Quality Control Format.....	104
Appendix IV :	Standard CAPA analysis Format	105
Appendix V :	Standard operational procedures for Stitching section SOP	106

List of Tables

Table2. 1, Productivity Measurement Factors.....	11
Table 2. 2 List of factors affecting productivity.....	12
Table 2. 3: Symbols of Value Stream Mapping	17
Table 2. 4. Summary of different Findings of VSM Causes /difficulty, gaps and the outcome ...	21
Table 4. 1: Demographic Profile of participants during study period	36
Table 4. 2Awareness and knowledge that influence Productivity of Zemen shoe	36
Table 4. 3 Quality concerns that have impact on production process	38
Table 4. 4 All-purpose general questions	39
Table 4. 5 interview response related to productivities.....	40
Table 4. 6 Number shoe type and shoe model of Zemen factory	41
Table 4. 7: Product Prioritization with different families and their percentage share	42
Table 4. 8 Explanation for Activities Involved in Process for Production.....	47
Table 4. 9 : Flow Process Chart for model 23	50
Table 4. 10: Takt Time Calculation (5953/23) For 1-line	54
Table 4. 11: Summary of the Flow Process Chart and CVSM.....	58
Table 4. 12: Summary of the Flow Chart	58
Table 4. 13: Comparison of the Actual Cycle time and Takt time.....	60
Table 4. 14: Time taken for Wastes.....	62
Table 4. 15: Each sections of waste indicators.....	63
Table 4. 16: Identification of Work Element.....	69
Table 4. 17: Waste Identification by Motion Analysis.....	70
Table 4. 18: Explanation of the Root Cause.....	74
Table 4. 20: Opportunities for the improvement	76
Table 4. 21: Standard Time for the Process in all sections.....	80
Table 4. 22: Summary of Results	87

List of Figures

Figure 4. 1: Major Sections of the Company (Author).....	43
Figure 4. 2 Stitching section.....	45
Figure 4. 3: Preparation 2 Section	45
Figure 4. 4 Lasting and Finishing Section.....	46
Figure 4. 5: Packing section	47
Figure 4. 6: Major Components of Model 23 Shoe.....	49
Figure 4. 8 WIP rates of different sections.....	64
Figure 4. 11: Rework Rate Comparison (Author)	67
Figure 4. 13: Motion analysis (Author).....	71
Figure 4. 14: Analysis of Root Cause for lower productivity(Author)	72
Figure 4. 16 Takt time, Actual Cycle Time and VA Cycle Time Comparison	82
Figure 4. 17: Model for Standardized Process	83
Figure 4. 18 Importance of implementation of 5s	84
Figure 4. 19: Continuous Improvement to Standardized Work.....	86

Acronyms

BMT	Basic motion times
SMEs	Small and Medium enterprises
GTP	Ethiopian Growth and Transformation Plan
GDP	Growth Domestic Product
BPR	Business process reengineering
WIP	Work in Process
ILO	International Labour Organization
ISO	International Standards Organization
PCE	Process cycle Efficiency
ZSF	Zemen Shoe Factory
MTM	Methods- time measurement
NVA	Non value adding operation
SOP	Standard operating procedure
SW	Standardized work
TQM	Total quality management
VA	Value adding operation
VSM	Value stream mapping
CT	Cycle Time
CO	Change over Time
LT	Lead Time
TT	Takt Time
FMESDA	Federal Micro and Small Enterprise Development Agency

Chapter one

1. Introduction

1.1 Problem background

Productivity is the major important index for the wellbeing of an organization. It is significant in small, medium also large commerce; the importance is going up towards to national level. A nation's productivity with its feature together shows how the communities live, their quality of life, the employee level, the economic growth and improvement of the country. Productivity encourages participating and computing in a global market so that it has a positive impact on the life of the society of the country (Goetsch & Davis, 2000). Cooperation and commitment of top to low management of workers, reducing workplace anxiety, developing a sense of belongingness and recognition, avoiding bad workplace manners and poor management are crucial for the achievement and sustainability of productivity. Collectively these measures promote productivity by strengthening the ability and resources (Houghton et al., 2016).

SMEs provide large opportunities for employments, wellbeing of the society and increasing of people's wealth. Relatively from large industries it needs lower cost of capital. This sector plays a crucial role in maintaining high employment, and income generation. For instance, on Assefa et al (2014) study it plans to create 3million new jobs in the SMEs sector in the 5 years GTP. It further aims to provide trainings for about 10,000 taught in the sub sector thus, SMEs promotion and support is the vital strategy to fulfill this national plan of employment creation in the short-run and achieving industrialization in the long-run (Assefa et al., 2014). Therefore, SMEs are critical for achieving sustainable growth.

In SMEs, there is a great need of enhancing productivity, because it is one of the strategic tools for organization achievement. In industrial revolution, there is high level of global and local competition in manufacturing sector (Carpinetti et.al, 2000). The competitiveness edge of a business depends heavily on its ability to respond to the customer need with higher productivity by being flexible to the response of the customers' need. By the aim of reaching this edge, companies are introducing systems and techniques which are helpful to improve the efficiency of the firm. Process optimization is one of the methods to improve productivity, quality, delivery and also safety. Value stream mapping (VSM) is one of the methods of process optimization. VSM plays a vital to define and analyze the existing

situation for a manufactured goods value stream and design an upcoming condition by focusing on improving the flow of work, reducing unnecessary time through waste elimination and better lead-time (Rajenthirakumar, 2015).

Ethiopia is Africa's leading livestock producer & also there is a huge potential resource so that it will play a significant role for the footwear manufacturing industry, and has good opportunity for production footwear (Yiheyis, 2014). Footwear production is the major leather product industry known for being a labour intensive which paves another way to Ethiopia to be competitive on the sector since Ethiopian is one of the developing countries which have trainable labour suitable for footwear manufacturing (Tesfaye, 2009).

There are relatively large numbers of SMEs in Arada Sub city even if it is small in area relative to other sub cities in Addis Ababa. It has density of people per square meter, which is 22805.1 in 9.9 sq. km area (AACA, 2019). Therefore, giving opportunity for employment is desirable as well as advantageous for the domestic economy and positively impacts the population and the country (AAJCAEDB data, 2019).

In industries, the engagement of non-value adding activities leads to low productivity because they do not directly enhance the output. So, it is necessary to decrease non-value adding activities in order to enhance the production. Also, poor process control by the respective sections, material handling problem, and unexpected machine breakdown can be categorized as wastes or non-value adding activities (Jayaganthan and Scholar, 2014). Those listed above would be some of the theoretical causes that will cause reduction of productivity.

Productivity is about decreasing wastage of valuable resources such as, equipment, material, machine, tools, time, man etc. Organizations can effectively achieve their function by reducing the non-value activities and continuously optimizing the amount produced at possible extent. Balancing all factors of production leads higher productivity with the smallest effort and need their sustainability (Sanjay and NandKumar, 2007).

Therefore, the purpose of this study is to conduct and analyses the enhancement of productivity by identifying value adding (VA) & non-value adding (NVA) practices from the overall production process, using VSM process method of Zemen Shoes Factory found in Arada sub city SMEs.

1.2. Company background

Zemen Shoe Factory was established on 06/2010 E.C by the owner Mr. Tesfalem Gebremedihen with capital of 5,000,000 Birr. It is found in Arada sub city woreda 07 around Genfle. When it started operation, the number of employees was about 26 workers.

The capacity of production was 48 pairs per day with an average production rate of 28 pairs of shoes per day. Now the company has made it to a production capacity of 144 pairs of shoes per day with a total of 58 workers. The Manufacturing services compose up of 5 different departments which are cutting, preparation, stitching, lasting & finishing and packing.

In Ethiopia, the involvement of SMEs is very low compared to that of other countries. This is due to different factors such as interior and peripheral aspects of financial difficulty, shortage of raw materials, shortage of skilled workforce, marketing troubles, lack of working premises and proper financial records (Abera, 2012). Even if it has been one of the fastest growing countries, productivity and high value added activities have made limited contributions to this growth (Brixiova and Ncube, 2013). Despite providing a huge share of global employment, SMEs still face major challenges when it comes to working conditions, productivity and informality.

Different studies done on Ethiopian leather footwear industries have shown the footwear sector is not performing well (UNIDO, 2012). Ethiopia's share in the global footwear market is lower than its place in leather trade (Lakew, 2015). In 2015, Ethiopia market share accounted 0.02% of the total world export footwear while China and Italy accounted 20.1% and 14.2 % respectively (Fitsum, 2018). This productivity gap leads to low income generation, informality and poor growth performance. We must first understand the problems faced by SMEs to close the gap (ILO, 2019). The 2nd GTP (GTP II - 2016 to 2020) continues to prioritize SMEs but places greater emphasis on manufacturing, increased productivity & competitiveness. This implies that we need to give attention to SMEs because of their contribution for development of the country.

Currently, Zemen Shoe Factory makes men shoes with model of 68 types mainly buttes shoe, short shoe, torsion shoe and, skin(leather) shoe with shoes number of 40, 41, 42, and 43. The company plans to include women, sort, and children shoes to its product mix in the future. Thus, the study intends to enhance productivity by optimizing the process by eliminating wastes.

1.3. Statement of Problem

In Ethiopia, despite that the enormous importance of the SME sector to the national economy with regards to job creation and the alleviation of abject poverty, many of the SMEs are unable to realize their full potential due to the existence of different factors that inhibit their productivity, growth and performance (Amha and Ageba, 2006).

The worldwide standard of labour productivity is 16 pairs/day in person (Cherkos, 2011). When it comes to Zemen shoes production, its capacity is 300 pair of shoes per day but the current production capacity on average is 144 pairs of shoes per day. And the labour productivity is below 3 pair/person/day in reason that they are utilizing only around 48% of their capability from 2 years' data of company.

The main reasons for the declining of the manufacturing production are the existence of numerous wasteful or non-value adding activities within the process. For the past two years, the export share of the organization has been the lowest in contrast to other footwear producers in Ethiopia. Thus, Zemen is generally not competitive with the leader industries in the Ethiopian footwear sector due to lesser output in contrast to the capacity.

In Arada sub city leather shoes manufacturing sector, Zemen Shoes Factory is the one and only SME to send samples in order to begin exporting to other countries. This study attempts to enhance the productivity by process optimization via reducing wastes and non-value activities in order to maximize the production for both for local as well as export market.

1.4. Research Questions

The following research questions are set out from the problems identified in the company.

1. What are the factors affecting productivity of the SMEs and sources of wastes within the system that causes lower productivity?
2. What is the existing value stream for production process of shoe? What are the operations involved in the existing production process?
3. How to improve and optimize the productivity of SMEs?

1.5. Objective of the study

1.5.1. General objective of the study

The general objective of the study is to propose a framework that can enhance the productivity of small and medium enterprises of Zemen shoes in Arada sub city Addis Ababa through value stream mapping.

1.5.2. Specific objectives

- To identifying the factors that affects the existing production process.
- To identify non-value adding activities that can lower labour productivity.
- To show how operational effectiveness can be improved as the proposed VSM framework is implemented.

1.6. Significance of the Study

In Ethiopia, SME is one of the recognized sectors in this country's industry development plan. It is believed that SMEs serve as a means for reducing poverty and unemployment at urban center as it reinforces economic development. As specified in Ethiopian government national plan, the industrial strategy has given outstanding focus to strengthen small and medium enterprise. This is because it's believed that they are the foundation for the establishment and expansion of large-scale industries; and open up opportunities for urban employment generation, expansion of urban development, and provide close support for further development (GTP I, 2010).

1.7. Scope and Limitation of the Study

SME is a vast area to study all sections due to different constraints. It is difficult to cover all areas of the sectors so; this study mainly focuses on productivity improvement of leather products of Zemen shoes. This study aims to assess the wastes that influence and decrease the productivity, improve the existing performance & efficiency by measuring the current productivity and enhance the existing practice to gradually minimize problems.

The study only focuses on the process part of the system. Moreover, the countermeasures on the study have not been implemented and the study doesn't include other types of wastes rather than the known 7 wastes types (overproduction, inventory, motion, transportation, waiting, over processing and defect). Furthermore, the study does not consider different factors that affect productivity of the production line

since they have an inconsiderable share. The research limited to only Zemen Shoe Factory. Also there are data constraints through Covid 19, even though the data that are needed for the study are collected. ZSF has poor documentation system so that it is hard to trace and get easily the information in order to execute the study.

1.8. Organization of the Paper

The organization of the study is presented to give details and to think about the flow of the work. The paper organized into five chapters. The first chapter is introduction. It introduces the background and problem justification, overview of the company, statement of the problem, objective, scope, significance and the limitation of the study. Chapter two contains the literature review that shows theoretical reference on other studies and mainly focuses on the concept of productivity, SMEs, VSM and related subjects. Chapter three is methodology of the study which includes research design, method of the study, data collection and data analysis. The fourth chapter comprises the result and discussion sections. The last chapter contains the conclusion, recommendation and future work of the study.

Chapter Two

2. Literature Review

2.1. Introduction

In this chapter different literature have been reviewed concerning productivity related to this study to provide insight into information from previous researches. These includes highlight of productivity, Leather Industries in Ethiopia, overview of small and medium enterprises, productivity measurements and lean concept and studies will be discussed from different researcher views aspect. The studies is on improving productivity through waste reduction by using Lean tool, which is value stream mapping and then standardize the process. .

2.2. Leather Industries in Ethiopia

Ethiopia is the 10th livestock population in the world and also first in Africa, but these resources were not exploited yet despite the abundant raw material and cheap manpower. The country is working hard to exploit this huge potential so that the sector contributes its 3 shares to the growth of GDP and the wellbeing of the key role players in this sector is enhanced. Significant efforts have been made by the country to upgrade this sector in order to make it competitive at international level and these days many of the footwear factories are trying to advance in to international market (Umar, 2012).

Leather and leather products industry is one of the priority industries expected to contribute considerably to export diversification and foreign exchange earnings through greater value addition and productivity improvement (FDRE, 2010).

2.3. Highlight of Productivity

Productivity is defined as a relationship between output produced by a system and quantities of input factors utilized by the system to produce that output. The input factors are person and physical resources like man, material, machine, and so on that are used in a process, and output can be any result of a process such as products or services (Pekuri et.al, 2011). According to Parthiban and Raju (2008), productivity is a measure of the efficiency and effectiveness to which organizational resources (inputs) are utilized or the creation of products or services (output)

In footwear industry, “output” can be taken as the number of products manufactured, whilst “input” is the people, machinery and factory resources required to create those products within a given time frame. Yogyakarta states that productivity shows how resources such as, capital, labour, material and energy are used to produce a definite quantity of output. For example, in terms of capital, the productivity can be shown by: $\text{Productivity} = \frac{\text{output} \times \text{unit price}}{\text{input costs (labour, material, and overhead)}}$ (Parthiban and Raju, 2008).

2.4. Overview of Small and Medium Enterprises

There is no universally accepted definition of SMEs. There is no single criterion for classifying business enterprises as small and medium in the world. Each country tends to derive its own definition based on the role of small-scale industries because in each economic system, every country has its own classification according to their industrial regulation. Varying definitions among countries may arise from differences in industrial organization at different levels of economic development in parts of the same country (Anamekwe, 2001).

"Small manufacturing industry" means an industry having a total capital, excluding building, from Birr 10,001 to Birr 1,500,000 in the manufacturing sector and engages from 6 to 30 workers including the owner, his family members and other employees. (Federal Negarit Gazette, 2016).

“Medium manufacturing industry” means an industry having a total capital, excluding building. From Birr 1,500,001 to Birr 20,000,000) in the manufacturing sector and engages from 31 to 100 workers including the owner, his family members and other employees (Federal Negarit Gazette, 2016).

2.4.1. SMEs Roles Comparison in Globe and Ethiopia

Small and medium enterprises in developed countries are different from those of developing countries. In developed countries they are known as micro enterprises while they are named as small or medium in developing countries. The reason for that is the amount of capital invested and the number of people employed in operating and implementing (Ekpenyong and Nyong, 1992).

For all intends and purposes, the contribution of Small and Medium Enterprises (SMEs) in spurring the development of world economy, has become an established fact (Feeney and Riding, 1997).

Most description of SMEs depends up on the policy makers (financiers, labour officers, traders and service personnel). The common criteria that are used by different countries are number of employees, asset employed, sales turn over or combination of the above three factors.

The influence of small and medium-sized enterprises (SMEs) on the structure, performance and future prospects of a nation's economy is the subject of increasing interest among policymakers at the national, regional and global level. This reflects the fact that in most countries, SMEs constitute the over whelming majority of firms and are major sources of employment. Add to this evidence that SMEs, and in particular young small firms, have been net contributors to employment growth since the 2008 financial crisis, and the rationale behind the greater focus on SME performance becomes clear (Criscuolo et al., 2014).

The development of the sector in Ethiopia is believed to be the major source of employment and income generation for a wider group of the society in general and urban youth in particular. The five-year Growth and Transformation Plan (GTP) of Ethiopia envisages creating a total of three (3) million micro and small-scale enterprises at the end of the plan period (NBE, 2011). Citing the source from the Federal Micro and Small Enterprise Development Agency (FMESDA), the EEA Research Brief noted that a total of seventy thousand five hundred (70500) new SMEs were established in 2011/12 employing eight hundred six thousand three hundred (806300) people across the country. The performance is below the target set in GTP (EEA, 2015).

2.4.2.SMEs Socio-Economic Impact

The impact of SMEs in the worldwide economy is a very important role in a society, in order to free of poverty. The reason is that they not only provide job opportunities to the society but also ensure the money flow across the various ranks of society. There is a mutual relationship between an economy and Small and medium enterprises (SMEs). The growth in economy ensures the establishment of more SMEs. The establishment of more SMEs guarantees an improvement in the economy (Muritala, et al., 2012).

The SME sector in Ethiopia is taken as an instrument in bringing about economic transition by effectively using the skill and talent of the people particularly women and youth without demanding high-level training, much capital and sophisticated technology. Also provide large opportunities for employments, wellbeing of the society & wealth of the peoples.

The Small and Medium Enterprises informal and Small Manufacturing Enterprise sector (SMEs) contributed value added of Birr 8.3 million in 1996. Based on the 1992/93 data, and constitutes about 3.4% of the GDP, 33% of the industrial sector's contribution and 52% of the manufacturing sector's contribution to the GDP of the same year (Gebrehiwot, 2006).

SMEs and the informal sector are the predominant income generating activities and thus they have a significant contribution to local economic development and used as the basic means of survival (Gebregziabher and Demeke, 2005).

2.4.3. SMEs opportunities and Challenges

According to Muriithi, (2017), some significance of SMEs as well as problems and challenges are listed below. In a developing country like Ethiopia, the role and importance of small-medium scale industries are very significant towards poverty reduction, employment generation, rural development and creating regional balance in promotion and growth of various development activities. Those industries play an important role in the growth process of economy of country. Better utilization of local resources, employment generation, mobilization of entrepreneurial skills and resources, and supporting the growth of the large industries are the different ways SMEs can contribute to economic growth. On the contrary, raw material shortage, lack of skill manpower and managerial, lack of machinery and equipment, limited capital, and absence of adequate infrastructure are the main challenges of small and medium enterprises. Lack of knowledge is another restriction that threatens to stymie the flow of credit to SMEs.

Small businesses depend on creativity to stay afloat. The constant pressure to develop and build new options, on the other hand, leads to complexity and confusion. Nonetheless, for a small company to succeed, creativity is the only choice (Winborg and Landstrom, 2001).

2.5. Productivity Measurement

Productivity is one of the various measures that are used to evaluate the performance of an organization. Productivity can be measured in various methods and differs according to the organizations' productivity measurement factors. According to Ephrem (2015), productivity measurement is a significant managing instrument and it is used as an indicator of organizations' efficiency and effectiveness.

2.5.1. Productivity Measurement Techniques

Ephrem (2015) states that there are three methods to measure productivity that are commonly used. They are:

1. Partial Factor Productivity (PFP) — the ratio of output to single or one class of input. For example, labour productivity (the ratio of output to labour 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.
2. Total Factor (All factor) Productivity (TFP) — 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.
3. Surrogate (multi factor) Productivity— Surrogate productivity indicators are the measure of surrogate factors and they are not measured directly as ratio of output to input and use more than a single factor. A subsection of inputs may contain only labour or materials and labour or it can only contain capital.

There are two main categorizations of productivity measurement. Those are single factor productivity measure or partial productivity measure (total output per unit of single input type) and multifactor productivity measure or total factor productivity measure (total output to a multiple of input) (Lieberman & Kang, 2008).

Table 2.1: Productivity Measurement Factors (OECD, 2015)

Type of output measure:	Type of input measure			
	Labour	Capital	Capital & labour	Capital, labour & intermediate inputs (energy, materials, Services)
Gross output	Labour productivity (based on gross output)	Capital productivity (based on gross output)	Capital - labour MFP (based on gross output)	KLEMS multi-factor Productivity
Value-added	Labour productivity (based on value-added)	Capital productivity (based on value-added)	Capital – labour MFP (based on value-added)	-
	Single factor productivity measures		Multi-factor productivity (MFP) measure	

2.5.2. Factors Influencing SMEs Productivity

There are three productivity definition categories those are effectiveness and efficiency, and put up the organization purpose improved (Linna, 2010). To a certain extent there is a variety of factors which can affect productivity, both positively and negatively. These include:

Table 2. 1: List of factors affecting productivity (Yadav and Marwah, 2015)

Factors that affect productivity			
1	Capital investments in production	10	Procedures
2	Capital investments in technology	11	Systems
3	Capital investments in equipment	12	Quality of products
4	Capital investments in facilities	13	Quality of processes
5	Economies of scale	14	Quality of management
6	Workforce knowledge	15	General levels of education
7	Skill resulting from training & experience	16	Legislative & regulatory environment
8	Technological changes	17	Social environment
9	Work methods	18	Geographic factors

The first 13 factors are highly controllable at the company or project level. Numbers 14 and 15 are marginally controllable, at best. Numbers 16 and 17 are controllable only at the national level, and 18 are uncontrollable (Yadav and Marwah, 2015).

There are also both internal and external factors that influence productivity. Some of internal factors includes organization system and procedures, structure of organization, marketing, work methods, process of production, labour force etc. And the external once is power, water, transportation, raw material, communications, policy of government, political, social and economic conditions etc. (Yamfwa, 2001). For the case of this study wastes which are considers internal factors related to the process.

2.6. Productivity Improvement

Productivity improvement is one of the core strategies towards manufacturing excellence and it is also necessary to achieve good economic and operational performance. It enhances customer satisfaction and reduce time and cost to develop, produce and deliver products and service. Productivity has a positive and significant relationship to performance measurement for process utilization, process output, product costs, and work-in-process inventory levels and on-time delivery.

Improvement can be in the form of elimination, correction (repair) of ineffective processing, simplifying the process, optimizing the system, reducing variation, maximizing throughput, reducing cost, reducing wastes, improving quality or responsiveness and reducing set-up time (Naveen and Babu,2011). Productivity improvement relies on higher use of resources and equipment's and removing all forms of wastage. It can be achieved by means of decreasing cost, working smarter and effectively, paring down and managing growth (Parthiban and Raju, 2008).

Improvement of Productivity improvement occurs when: Manufacturing more production or output by equal or smaller number of inputs, equal or similar number of outputs is produced with a lesser input and additional output is produced with more input (Islam and Khan, 2013).

Steps for Productivity Improvement

According to William (1999), a company or branch can also undertake a quantity of key steps towards enhancing productivity. Those steps for productiveness enchantment are:

1. Grow the productiveness measures and procedures altogether; the primary stage in managing and controlling an organization is measurement.
2. Look the total system completely to finding out which processes is serious or critical; it is over-all productiveness that is significant.
3. Develop strategies for accomplishing productiveness improvement such as asking ideas or thoughts from workers (by organizing managers, teams of employees and engineers), teaching companies how to increase their production, and revising the technique of their works.
4. Create realistic and practical dreams (goals) for development.
3. Consider incentives to reward employees for contributions to boost and encourage productivity improvement & management support.
4. Measure the developments (improvements) and announce them

2.7. Lean Concepts

The lean philosophy (lean thinking, lean manufacturing or Toyota Production System) was developed by the Japanese in the mid 50's and is nowadays used worldwide by companies. The term "lean thinking" includes a set of lean practices and was earliest proposed (Womack et al., 1992).

Shingo (1996) cites the Toyota Production System as a process of continuous waste elimination. After World War II, the Japanese industry had a very low productivity and huge lack of resources, which, of

course, prevented it from adopting the mass production model. Lean always focuses on identifying and eliminating waste and fully utilizing the activities that add value to the final product (Islam and Khan, 2013).

Value adding activities are activities that transform materials and information into products and services the customer wants.

Non-value adding activities are activities that consume resources, but do not directly contribute to product or service.

Non-value adding activities are considered waste in Lean Manufacturing. Waste can be created from incapable processes, poor work methods, lack of training, ineffective production planning/scheduling and lack of workplace organization.

By eliminating wastes in the overall process and through continuous improvements, the product's lead time can be minimized. By reducing lead time organizations can obtain operational benefits (enhancement of productivity, reduction in work-in-process inventory, improvement in quality, reduction of space utilization and better workplace organization) (Islam and Khan, 2013). Lean production systems have different methods for improving productivity than TQM and Six Sigma, although some of tools may be utilized jointly. The importance of lean systems is reducing waste (Muda) of all types like space, time, energy, motion, materials, inventories, and defects (Spear and Bowen, 1999). Sahoo et al., (2008) mention that lean manufacturing is an approach used for assembling, operating, managing and continuously improving industrial manufacturing systems with the use of standard lean tools and techniques, which include value stream mapping (VSM), kaizen, 5S, single, just-in-time (JIT).

2.7.1. Benefits of Lean

According to Walder et al. (2007), removing waste from systems as well as processes has several benefits and the general advantages include:

1. Increasing productivity – removing waste removes unnecessary movement, inventory, and double handling, leaving the people and machines available to be more productive.
2. Decreasing lead-time – removing waste shortens the supply chain as well as shortening the internal value-added processes.

3. 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.
4. Decreasing costs – removing waste decreases the inventory that must be held and may decrease costs of equipment, facilities, and people as well.

The Lean Production model has been around for a long time and is also regarded as the most effective technique that manufacturing companies can use to achieve global success. It has a range of advantages; including shorter delivery times, lower inventory, better management, and less rework (Melton.T, 2005).

2.7.2. The 7 wastes of lean

Dennis (2008) defines waste with the Japanese word “Muda”, the opposite of value. It is also common to see the definition of seven wastes that the lean philosophy seeks to eliminate. Those are over production, defects, waiting transport, inventory, and motion and over processing or incorrect processing.

1. Overproduction

It is not necessary to produce more than the customer demands or producing it too early before it is needed (Capital, 2004).

2. Defects

A defect is any work that is less than the level the customer has requested (Shaikh, 2015). And also it occurred by frequent errors in paperwork, product quality problems lead to producing defective products, and poor delivery performance (Hines. and Taylor, 2000).

3. Waiting

It is the waste of time from one process to another which is ineffective and time consuming. There are different types of waiting: job plan, order, machine parts and e-mail, over processing or incorrect processing (Chahal et al, 2017). Taking unnecessary steps to process the parts lead to waste of time. Some of the more common examples of this are reworking, inspecting, rechecking etc. This is due to poor layout, poor tools and poor product design which cause unnecessary motion and producing defects (Islam and Khan 2013). Over processing can be described as putting more into the product than is

valued by the customer and doing more than a customer asks or needs (Leanmanufacturingtools.org, 2015).

4. Inventory

Extra inventory includes having unnecessarily high levels of raw materials, works-in-process and finished products. Extra inventory leads to higher inventory financing costs, higher storage costs and higher defect rates. (Capital, 2004).

5. Motion

Unnecessary motion is unproductive because it involves movements by workers that are not directly related to the job (Desta et.al, 2014). It involves poor ergonomics of production; where operators have to stretch, bend and pick up when such actions could be avoided (Rawabdeh, 2005).

6. Unnecessary Transportation

Unnecessary transportation is delivery of products from one location to another, or handoff from one employee to another which does not generate added value to the product (Jackson, 2013). Transport waste is material movement that is not directly associated with a value adding process.

7. Over-processing

Over-processing is about process the work using wrong set of systems, tools or procedure when easier method may be effective (Desta et.al,2014).

2.7.3. Best Lean Practices and Tools

There are many tools to obtain higher productivity such as overall equipment effectiveness (OEE), just-in-time (JIT), value stream mapping (VSM), kaizen (Continuous Improvement) (Son, et al, 2011). Rother & Shook (2003) state four lean practices and most commonly used tools: Those are value stream mapping (VSM), production balancing, just in time (JIT) and 5S standardization.

2.7.4. Value Stream Mapping

Value stream mapping is a lean tool which has been proven to be very useful for analyzing processes through reduction of process wastes with the goal of creating value. VSM has proved as one of the

efficient tools for the analysis of production. And its application is for the analysis of waste in production process (Stefanic, et al., 2010).


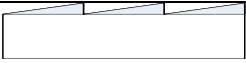
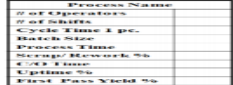
VSM is a tool of lean used to help in the visualization of material and information flow, cycle time and best utilization of the resources (Islam and Sultana 2011). Value stream mapping is special type of flow chart that uses symbols known as "The Language of Lean" to depict and improve the flow (Hasan, et al., 2017).





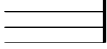


Rother and Shook (2003) give details about why VSM is a useful tool. VSM helps to identify not only wastes but their sources as well. It also shows the linkages between information and material flows and identifies the constraint of resource whose capacity is less than customer demand. VSM also provides a common language for the production process. It helps to make decision flows apparent and to form the basis of an implementation plan. VSM is an important tool to visualize interactions and flows.

It is preferable to design the processes that are free from waste. The objective is maximum efficiency, exactly described processes and traceable ways of communication, and clearly defined responsibilities. The other way is takt time that means harmonizing the actual production with the demand of the customer and aligning the production completion with the due date of customer. When we produce earlier takt time the outcome becomes overproduction that causes wastes. In addition, producing slower than takt time, results in bottleneck. Customer dissatisfaction due to completion of orders later than the desired due date is the consequence of bottleneck. Cycle time is the time used to manufacture a product; lead time is the amount of time from which an order was first requested by the customer till the customer has received it (Meteken, 2013).

2.7.4.1. Symbols and Descriptions of Value Stream Mapping

Table 2. 2: Symbols of Value Stream Mapping (Jayaganthan and Schloar, 2014)

No	Symbol	Symbol Description
1		Process
2		Customer/ Supplier
3		Data Box

4		Inventory
5		Truck Shipment
6		Manual Information
7		Push Arrow
8		Supermarket (Kanban stock point)
9		Material Pull
10		1 Process lead time and 2 Process value added time

2.7.4.2. Steps for making VSM

According to a study by Massachusetts Institute of Technology (2012), steps for making VSM are:

1. Define customer value and the process

Identify tasks and flows and identify value-added and waste process steps. To gather the needed data that are used for the selected product at different workstations in order to draw the current state map is through observation, interviews and document review.

2. Create the “current state” VSM

Gather data on resources, time, and quality for each step. In order to draw the current state map using standardized symbols to show operators, cycle time, workplace and inventory levels (Seth & Gupta, 2005). There are 3 types of signs or symbols. Those are information flow, material flow and general symbols. These signs create together the big picture. The symbols are explained above on Table 3.

The material flow symbols represent suppliers, machines, customers, levels of inventory, shipments, operators and the information collected is recorded in a process data box. Information flow is illustrated through lines which could be manual, electronic, and so on (Womack, 2006).

Before mapping, it is vital for everyone in the organization to understand the principles of lean manufacturing (Seth & Gupta, 2005). The next phase is defining the current state both from clients and

organizations perception (Womack, 2006). After knowing the flow, it is essential to walk the whole shop floor a second time to collect and identify the lean metrics from the process such as inventories, days of inventories, value-added(VA), non-value added(NVA), cycle time(CT), change overtime(CO) and lead time(LT) (Singh, 2019). All of this information is recognized and documented in a box of process. Once all of the data are documented in the map, the production system is connected with information flow by arrows of communication.

3. Analyze map to determine opportunities for improvement

Identify bottlenecks (Bottleneck is a section of function with the lowest capacity, usually the operation with the lengthiest cycle time per unit (Abrham, 2016). Bottleneck impacts the production process by causing impediments to workflow. Brainstorming actions to eliminate waste and add value promotes improvements.

4. Create a “future-state” map to visualize the desired and realistic next state

Future state value stream map is a tool that helps to create how the value stream ought to be in your mind (Brunt, 2000). It is the significant step for improving process and to achieve implementing lean.

The future state map would offer responses to the following requests (Womack, et al, 2003): those are the takt time for selected product, follow continuous flow of the manufacturing, can met request of demand and so on. The second step is to identify and list all enhancements that would help in achieving continuous flow such as replacement of old equipment, new equipment, standardizing processes. (Rasi, 2014)

5. Create action plans to move toward future state.

The ultimate goal of VSM is to identify all types of waste in the value stream and to take steps to try and eliminate these wastes (Grawal, 2008). VSM aims at identification of the production process, communication between departments, determining bottlenecks and all types of waste. VSM can be a starting on it for managers, engineers, production associates and suppliers to identify wastes and find the causes. Consequently, VSM not only serve as a strategic planning tool but also a change management tool.

2.7.4.3. Measurement for analyzing productivity by value stream map

Productivity improvement is a common issue in achieving manufacturer demands and customer demands. Value Stream Mapping is the initial point for implementation of lean within an organization and is an influential tool for analyzing the current or existing manufacturing processes. A value stream map creates a visual representation of how information and materials flow through a system and shows

non-value-added activities and value-added, inventory level at different stages, and so on. Once a detailed map is created for where the company currently stands, then future state maps are created to show where Lean tools should be directed for advanced advantage. The following divisions show the types of data to be collected when making a value stream map (Abraham, 2016).

Process Data

Process data shows information about a piece of equipment and is useful in determining where a bottleneck happens.

Cycle time (CT): The time takes to complete one particular task. Cycle time is typically measured from the starting of one products processing to the start of the next or subsequent process.

Number of people: How many workers operate an equipment or workstation.

Batch size: unit number for a given job.

Production lead time: the time between the customers places an order and when it sent as a finished good.

Inventory Data

Inventory data in production process helps to identify how long work-in-progress, raw materials, (WIP), and finished goods must wait before moving to the next phase.

Process Cycle Efficiency

The process Cycle efficiency is calculated including the waiting time in line also in the storage. In all section the product is produced accordingly one-piece flow (from one product within the process passes to the next process). It is common for more than 97% of lead-time (LT) to be non-value added, or waste.

Takt Time

Once future state planning has created, one of the first steps is to calculate Takt time. TT is a rate of available production time in order to meet the customer demand. Or TT is matching actual production to customer demand.

2.8. Literature Gap analysis

Findings of VSM Causes /difficulty, the outcome /expected improvement results and gaps

Table 2.3 shows and expected outputs and different findings by using a VSM approach in different industries of the globe. It also shows an improvement as well as enhancement in a process by minimization of non-value-added activities from the process in order to increase the productivity.

Table 2. 3. Summary of different Findings of VSM Causes /difficulty, gaps and the outcome /expected

No	Authors	Problems/Causes	Findings and Outputs	Gap
1	Sorin Briciu, Dimi Ofileanu , 2015 (Briciu and Ofileanu,2015)	Improving productivity & cycle time reduction in the process.	The process of cutting and preparing Cycle time is reduced in 8%, sewing and for manufacturing operations 20 %; in the condition of productivity improvement, the number of manufactured and put on the market products increases to 700 pairs/day or 14 % improvement using the equal number of workers as the previous.	There are no clear points shown to depict about factors of productivity measures such as energy, capital, raw material and so on.
2	D.Rajenthirakumar,R.Joswa Caxton and S.Sivagurunathan,A.Balasuadhakar3 (Rajenthirakumar, 2015)	Application of VSM to know the present actual time of the processes and a line balancing to ensure that maximum work utilization is attained.	The process has become smooth without any mismatch between planned time and production time as well as improving productivity	The approach of measuring productivity is inadequate. Present actual time of the processes and a line balancing are not sufficient, enough to ensure and attained maximum work utilization.
3.	Manikandaprabu S & Anbuudayanakar S,2019	Improving productivity and process performance in manufacturing industry.	The bottleneck process time is reduced from 270 sec to 65 seconds. Production cost is reduced by 38%. The raw material wastage minimized by 3%. The significant achievement in productivity is increased by 10% & reduction in turning cycle time is 45%. Improved productivity from 1200 to 1330 units per day.	Different aspect is used for investigation, but the impacts are not stated clearly.

4	Dinesh Seth a & Vaibhav Gupta ,2015	Improvement of productivity in the process.	Enhance the amount of production output per employee has enhanced in 20%, decrease (WIP) work in process & finished goods in 83%, processing time also reduced in 10%.	The study has further of data for presentation and assessment of factors, but not showing the clear effect in broad about the productivity improvement in the process.
5	Nguyen Truong Son, Salwa Hanim ,Abdul Rashid, Kuala Lumpur/ Nguyen ,Masaru Nakano November 2011	To attain higher productivity of the current situation and realize the existing waste in the factory	The factory process turns into improve different production parameters by using Value stream mapping to improve their productivity: such as Improved on time delivery, Decreased Lead time, minimize idle time, changeover time and total time, eliminate defects, lower work-in-process inventory	The study shows how those three dimensions how to improve the productivity that is Method (<i>M</i>), Performance (<i>P</i>) and Utilization (<i>U</i>). But not regard as relations between productivity measurements parameters.
6	Aayush Saboo, Jose Arturo Garza-Reyes*,Ahmet Er, Vikas Kumar 2014	In Indian manufacturing industry their current challenges are to improvement their Operations of process especially among SMEs is limited.	Production lead time reduced from 49days/8147 seconds to 11.6days/2323 seconds. In Terms of inventory, WIP was reduced from 28.15 days to 7.6 days; Raw material reduced from 20.69 days to 3 days. As a result, the company has been able to reduce its operational cost & improve its productivity and quality.	The proposed approach is specifically customized for Indian Manufacturing Industry, rather than considering other manufacturing.
7	Ashish Thakur, Eshetie Kassegn,2016	Long delivery time, high production cost due to additional internal failure costs, and occurrence of all wastes in different levels, no clear flow of information along processes from request receiving	Improvements of overall process by identifying major wastes and minimizing those wastes encountered the company. Also, the following major goals achieved. Average machine and operation uptime are increased from 72.5 percent to 95.4 percent. Completed dry cargo trailer are shipped to the customer once per two days to once per day. Process lead time is reduced from	The paper demonstrates how value stream mapping is effective tools for improving the productivity, but it only gives more emphasis for current situation rather than further investigation.

		to delivering the product.	115.86 days to 34.067 days: and Processing (cycle) time is minimized from 3,437 min or around 3.82 days to 3,335 minutes or around 3.71 days	
8	Amir Azizia, Thulasi a/p Manoharanb,2 015	To remain competitive in the global market and continuously finding a better way to cut down the production costs and increases production volume.	The machine setup time in the insertion process reduced from 145 seconds to 54 seconds. The study recommends that the insertion process may possibly convert from batch operation to continuous flow operation to reduce more wastes.	The study only focuses on machine setup time in the insertion process. It also has to consider other feature in order to improve, enhance the productivity.
9	Rajendra Kumar Gupta, M.P. Singh, Lalit Kumar Sharma ,2014	Wastage minimization by using value stream mapping on production of steel handle	The amount of workstation decreased from 12 to 8 which is 33% of development, Lead time is reduced by 172 seconds. Which is 27 %. WIP stock minimized by 45%, stock of finished goods also reduced by 12%.	The examiner did not use enough data in order to investigate productivity measures and define them clearly.
10	Ramesh et al., 2008	Improving productivity through some of lean manufacturing tools for Ethiopian garment industry.	The productivity increased to 292 pieces with 25 labours in a day. Formerly they work 250pieces with 32 labours per line in 1 day. by Using 5S the area has been utilized effectively, attractive and cleaned working area formed. WIP and raw material storage areas marked using standard colors. Also, WIP parts has been coded and sorted with lot or batch number.	It presents Generic way of measured productivity. Major productivity feature are not measured and mentioned.

Briciu and Ofileanu, (2015), highlight improving productivity & cycle time reduction in the process. The research also points to what percentage cycle time, sewing, manufacturing operations and the number of out puts per day. The cycle time is reduced in 8%, sewing and for manufacturing operations reduced in 20 %. The condition of productivity improvement, the number of products manufactured and put on the market increases to 700 pairs/day. This means 14 % improvement using the equal number of workers used as the previous was achieved. However, in the paper there are no clear points shown to depict the factors of productivity measures such as energy, capital, raw material, lead-time, WIP and so on.

According to Rajenthirakumar (2015), a study elucidates the application of VSM to know the present actual time. Using value stream mapping, allows for a smooth process without any mismatch between planned time and production time, as well as improved productivity of the processes and a line balancing. This helps to ensure and attain maximum work utilization. However, without taking into account the approach to assessing efficiency as thoroughly as possible. Rajenthirakumar productivity measurement is inadequate to make use of and enhance productivity. Present actual time of the processes and a line balancing are not sufficient, enough to ensure and attained maximum work utilization.

Manikandaprabu S & Anbuudayasankar S (2019) stated that it is better to consider bottleneck process time to improve productivity and process performance in manufacturing industry. These assist to decrease, reducing Production cost, minimization of raw material wastage. The significant achievement in productivity is increased by 10% & reduction in turning cycle time is enhanced by 45%. Improved productivity from 1200 to 1330 units per day by reducing the following

- The bottleneck process time is reduced from 270 sec to 65 seconds.
- Production cost is reduced by 38%.
- The raw material wastage minimized by 3%. (Manikandaprabu S & Anbuudayasankar S ,2019)

Even though different aspects are used for investigation in order to attain higher productivity, but the impacts are not stated clearly (Seth a & Gupta, 2005). Identified some aspect in order to improve productivity in the process such as work in process, finished goods and processing time. When showing in percentage, the amount of production output per employee has enhanced in 20%, decrease (WIP) work in process & finished goods in 83%, processing time also reduced in 10%. However, the study has more data for presentation and evaluation of causes, but it does not indicate a strong impact in general on process quality improvement.

Son et al, (2011) presents about how to attain higher productivity of the current situation and realize the existing waste in the factory by considering different factors. The factory used different production parameters by using value stream mapping to increase their productivity such as improved on time delivery, decreased lead time, minimized idle time, changeover time and total time, eliminate defects, lower work-in-process inventory.

The study shows how three dimensions - Method (*M*), Performance (*P*) and Utilization (*U*) improve the productivity. But it does not include relations between productivity measurements parameters. Saboo et al, (2014) studies focus on Indian manufacturing industry. Their current challenges are limited improvements in their operations of process especially among SMEs. The paper presents the successful application of lean manufacturing VSM approach to reduce the production lead time, inventory, and changeover time and align all the process operations to the customer demand. Production lead time reduced from 49days/8147 seconds to 11.6days/2323 seconds. This reduction in lead time has helped the organization to provide better service levels for customers and reduce the inventory. In terms of inventory, WIP was reduced from 28.15 days to 7.6 days; raw material reduced from 20.69 days to 3 days. This was a strategic decision taken by the organization to be able to timely meet customer demand. As a result, the company has been able to reduce its operational cost & improve its productivity and quality. The proposed approach is specifically customized for Indian Manufacturing Industry, rather than considering other manufacturing.

Thakur and Kassegn (2016) study for the improvements of overall process they consider long delivery time, high production cost due to additional internal failure costs, and occurrence of all wastes in different levels, no clear flow of information along processes from request receiving to delivering the product.

So, in order to improve the overall process, they identify major wastes and minimize those wastes encountered by the company. They also achieved following major goals.

- Average machine and operation uptime are increased from 72.5 per cent to 95.4 per cent.
- Completed dry cargo trailer are shipped to the customer once per two days to once per day.
- Process lead time is reduced from 115.86 days to 34.067 days: and
- Processing (cycle) time is minimized from 3,437 min or around 3.82 days to 3,335 minutes or around 3.71 days

The paper shows how value stream mapping is effective a tool for improving the productivity, but it only gives more emphasis for current situation rather than further investigation.

Azizia, (2015) highlight the importance of finding better ways to cut down the production costs, and in parallel increasing production volume to remain competitive in the global market. They also consider and focal point of machine setup time and insertion process. The machine setup time in the insertion process reduced from 145 seconds to 54 seconds. The study recommends that the insertion process may

possibly convert from batch operation to continuous flow operation to reduce more wastes. The study only focuses on machine setup time in the insertion process. It also has to consider other feature in order to improve, enhance the productivity.

Wang et al, (2019) studies focus on wastage minimization by using value stream mapping on production of steel handle. They consider different factors like finished goods, and number of workstations, work in process and lead time. The amount of workstation decreased from 12 to 8 which is 33% of development, lead time is reduced by 172 seconds which is 27 % development. WIP stock minimized by 45% and stock of finished goods also reduced by 12%. The examiners did not use enough data in order to investigate productivity measures and define them clearly.

Ramesh et al., (2008) studies focus on improving productivity through some of lean manufacturing tools for Ethiopian garment industry by taking into account the 5S, WIP, raw material storage areas, and labour. Those are

- The productivity increased from 250 pieces with 32 labours per line to 292 pieces with 25 labours in 1 day.
- By using the 5S, area has been utilized effectively and attractive & cleaned working area was formed. WIP and raw material storage areas marked using standard colors. Also, WIP parts has been coded and sorted with lot or batch number. Generic way of measured productivity or major productivity features are not measured and mentioned.

From studies of literatures related to enhancing productivity of different production firms, there are studies related to partial factor productivity. But very few researches carried out their research when it comes to small and medium enterprises. Almost there is few or no related work done on productivity improvement through value stream mapping in our country even though SMEs are the key for the development of countries.

In Ethiopian context, lean approach is not discovered and well established in industries. Also, the academic literature shows that the appliance of lean principles and tools in the Ethiopian manufacturing industry, especially among SMEs, is limited. Very little literature is available on Lean Manufacturing that focuses on footwear industries. Yet, it is a very important approach for small and medium enterprises to set up a successful implementation of lean in order to meet higher productivity and face up to the growing industrial market.

This paper presents a successful application of the lean manufacturing value stream mapping (VSM) approach to reduce the production lead time, inventory, changeover time and align all the process operations with the customer demand (i.e., takt time) by identifying and reducing wastes of the production process of Zemen Shoes Factory. The three measures (factors) of productivity used are Partial Factor Productivity (single factor productivity), Multi Factor Productivity and Total Factor (all factor) productivity.

Assessment of the existing productivity of the company reveals that the existence of wastes in the processes is one of the reasons for the lower output. Partial factor productivity (PFP) is considered and calculated. PFP works on only the ratio of total output to a single input in the ratio. It can be calculated as output/machine or, output/energy or, output/labour or, output/capital.

One of the indications for the occurrence of wastes is poor labour productivity in Zemen Shoes Factory by selecting one factor as mentioned above. In order to find out the labour productivity of the company with respect to the product, total number of outputs (amount of footwear in pair) & total labour hours spent for the production of the output are considered. The current productivity is calculated as follows:

Productivity = Total number of output / Total labour hours spent for production (number of workers * working day in a year)

Application of value stream mapping method is one of the solutions to improve the productivity by decreasing unnecessary wastes. To accomplish this research, it's been looked at different reference books, journal articles, theses and other related literatures.

As stated in literature reviews, there are insufficient studies on standardization in value stream mapping in order to increase productivity and consistent improvement. Standardized work has clear starting and ending points of the process which includes detailed information to perform a task with procedure, and provide quality control information. The other advantages of standardization of work are manufacturing a product with lesser cost, and maintaining work methods & sequence that are secure and consistent (Surekha S., 2013).

Chapter Three

3. Research Methodology and Material

3.1. Research Design

The objective of the study is enhancing production process by identifying wastes for both non value adding and value adding activities in the production process.

This research design is explanatory as well as descriptive. The research starts with a description of factors that leads down the productivity. Based on this, major problem areas were identified through direct process follow up from the beginning of the process to final the output of the shoes by detail analysis of investigation of both qualitative and quantitative method in order to enhance the currently production performance.

3.2. Method of the Study

To carry out the objective of study, the following methods were used.

- 1. Identifying the problems:** The problem was identified by finding out the gap of Zemen Shoes Factory by observation, from secondary data which is currently known.
- 2. Gather the literature reviews:** Gather the literature reviews is a base for any research. It is important to collect relevant information in order to proceed to the study. Collecting different literature works contribute to realize and be aware of the problem of the research that is studied.
- 3. Select highly demanded shoe model to be studied:** It's better to select a single product which is been manufactured by Zemen Shoe Factory, because it is very hard to concentrate on every single one the product kind due to source and time constraint. There are different points to make out critical product. The data needed for selection of the product is gathered by examining the company records, and interviewing managers and supervisors. The whole shoes models are assessed by considering ordering demand of customer, number of process, quantity of components and number of workers.
- 4. Collect the relevant information of flow and materials:** In order to carry out the study, having clear information and gathering data about the material used for shoes making and the understanding the flow from beginning up to the end was necessary.

5. Study the process flow of the selected manufactured goods: Studying the process flow of the selected products strengthens our understanding of how each procedure is performed from the start to the end point. Also, it helps us to understand the operations and materials that are used in every step.

6. Illustrate Value Stream Mapping: Point up value stream mapping to show the current process based on information collected. VSM is a method of visually mapping a product's production path including material and information flow. It takes a look at the activity required (both value adding and non-value adding) to move a product from raw material to customer. This tool has been used to identify the areas of waste and opportunities along the production flow line.

The main data gathered for the current state value stream mapping is beginning from raw material storage and throughout all the operations carried out for the production of the selected footwear model. Each and every step of activities were evaluated and categorized as value adding and non-value adding.

7. Identify the main problems and then possible improvement in the processes: Every step of the process was examined to recognize the problems and identify the main difficulty to make feasible enhancements of the process and get higher production.

8. Create new Value stream mapping and record the Optimized Process: Based on the improvement ideas observed, presenting the ideal future state map of the selected model shoe production process.

9. Standardize the work: This needs choosing the best method to complete the task, maintaining uniformity of the methods, and management of variations from the standard.

10. Measure the result: The work needs to be put in points to measure and evaluate whether the approach of goal or the end result have been met up or not.

12. Propose the company to use the new method: The Company can apply the selected footwear model or the approach for any type of footwear as well as footwear family and gain fruitful benefits. Advantageous methods are suggested to the company to maximize its benefits.

13. Future result area: In order to extend the research project to a wide-ranging value stream mapping other factors need to consider.

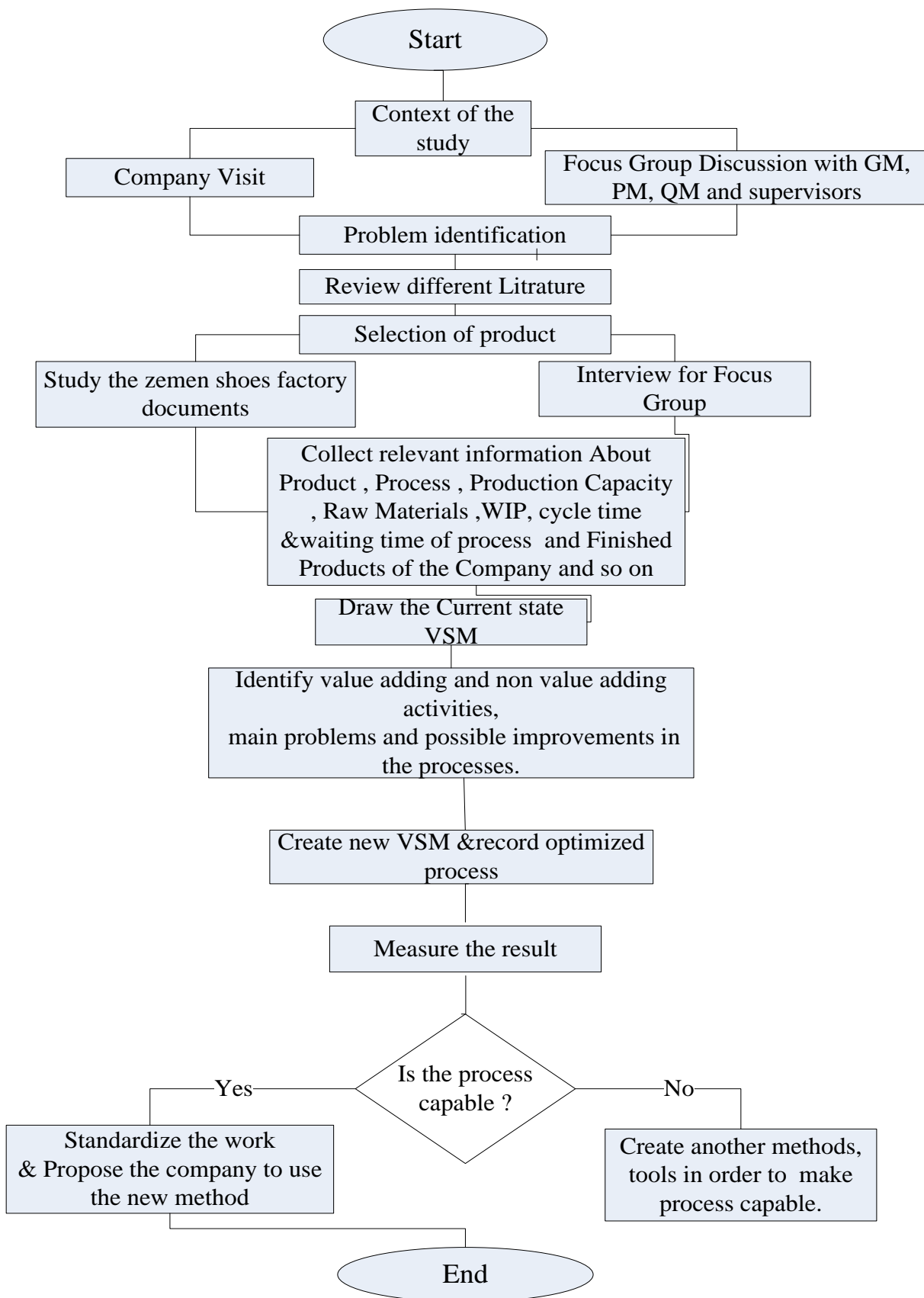


Figure 3. 1: Method of the study

3.3. Literature Survey

A review of previous studies has been conducted in order to get detailed insight and knowledge about concepts of production process, VSM, standardization and the relation between the three perceptions and how they affect productivity. The review includes the concept of productivity and productivity measurement factors, methods of productivity improvement, concept and application of VSM for concept of process optimization, different methods of process optimization lean manufacturing in order to enhance productivity and different findings in the area of the study.

3.4. Method of Data Collection

The process of data collection is fundamental activity that enables the study to be successful. Those different methodologies will be used to highlight the approaches that can be utilized to conduct a study. Both the primary and secondary data collection methods will be used.

3.4.1. Primary Data Collection Methods

In order to assess the current situation of the company and reason related to low productivity, different primary data collection was used. Some of them are guided interviews, recording time, telephone conversations, direct physical observations and feedback, a well-structured questionnaire were used.

3.4.1.1. Direct Physical Observation

To see and gather some relevant information, physical observation provides a wide opportunity for the study. The observation helps to assess at what is actually done and find better ways to complete tasks. Besides, direct observation is critical to determine the types of measures can be taken to improve the current situation.

It is important to visit the company directly to observe and record different production sectors of the company, the diverse features of products, machines types, sections, information flow and material flow, steps of manufacturing, machines numbers, space between work stations, product storage systems, production capacity, raw materials, WIP, and finished products of the company.

3.4.1.2.Focal Group discussion

Focal group discussion is a technique to gather people from similar experiences and background to discuss the lower productivity of Zemen factory. It is a form of qualitative research in which question are asked about their perceptions, attitudes, opinions, and beliefs in order to get depth understanding of the lower output. For the purpose of the study there was three (3) times focal discussion with production head, secretary, designing & quality manager's. It also helps in getting information about their views and experiences at difference spots in the factory.

3.4.1.3.Sampling Technique

There are different SMEs that are found in Arada sub city Addis Ababa, Ethiopia. This study conducted on Zemen Shoe Factory. The sampling technique is whole sampling because there are small numbers of employees in Zemen Shoe Factory. The total number of the workers beginning from the feeder of raw material is 48.

3.4.1.4. Questionnaire

Questionnaire is designed to have both close and open ended inquiries. It is also useful for the analysis of qualitative and quantitative data in order to determine the respondents' outlook on the research topic. The questionnaire contains 2 parts. The first part contains general questions which are asked to all of the interviewees; the second part contains questions that are specifically prepared for respondents in different departments of the company.

3.4.1.5. Interview

This study needs more resources to address information to all the persons, stations, and departments to whom this issue may concern. Therefore, formal and informal interview was prepared for the production manager of each section, production heads and also for some of the employee. The interview is prepared to different departments of managers, heads and some of the employees five time to collect some relevant information. It was cross checked to confirm the reliability of the responses and to get more detail and broad ideas.

3.4.1.6. Recording Time

Recording time is one of the primary methods to gather the data used for the aim of this study. To measure the duration of the processes, evaluate the work and activities involved in each step stopwatch

time recording was performed five (5) times. In addition to direct observation, using a stopwatch to time the employees' activities was relevant. Stopwatch allows to record and collected real time, the time of operator for a task, data for the cycle time, waiting time and transportation time. It was important to make sure the operators did not know that they were being timed by the researcher to prevent nervousness and anxiety.

3.4.2. Secondary Data Collection Method

With respect to purpose of the study several significant documents of the company such as previous research works, literature reviews, articles, Small and medium enterprise company data were reviewed. Zemen Shoes Factory data and related web sites were also used for the secondary data collection.

Those referred documents include the production report, current number of work force on the company, the annual production plan and sales volume since the year late of 2010E.C. Also several papers from different department were revised to know the process in each section of the company, the total product types based on past record of the company, and total production per day from year 2011-2012 E.C data's. The data collected is used to develop a value stream map to the manufacturing process for the selected model of the footwear. VSM makes use of identifying the possible wastes during process of manufacturing a product. This includes activities that do not contribute to the customer value and importance.

3.4.3. Product Selection Methodology

This paper is about enhancing productivity of Small and Medium Enterprise through Value Stream Mapping in the case of Zemen Shoe Factory in Addis Ababa Arada Sub city. In order to conduct the study, it's better to select a single product which is been manufactured by Zemen Shoe Factory, because it is very hard to concentrate on every single of the product kinds due to source and time constraint. There are different points to make out critical product. By watching the company records and interviewing managers, supervisors the data was gathered which is important for selection of the product. The shoes model was selected by considering higher ordering demand of customer.

3.4.4. Method of Data Analysis and Presentation

3.4.4.1. Method of Data Analysis

The data collected is used to develop a value stream map to the manufacturing process for 23 model footwear. VSM is used to identify the potential wastes during the manufacturing process of the product. This includes activities that do not contribute to the customer perception to value. To analyzing the data of value stream mapping there are tools that's used in common that are process flow diagram, cause and effect diagram, Pie chart and histogram.

As mentioned above in the literature, during manufacturing of product value stream mapping is used to recognize the possible wastes. Those wastes are activities that do not add any value to the customer view. To construct value stream map to the process of manufacturing the data has to be collected for shoe model 23 of footwear. Histogram is used for ordering and prioritizing the shoes by considering consumer demand and number of productions. To remove the recognized wastes, root cause of the problem is evaluated by using cause and effect diagram.

3.4.4.2. Method of Data Presentation

In order to present data, records in the pie charts, bar graphs, MS-Word and MS-Excel are used and applied. To optimize the whole process of Zemen Company by eliminating waste, it is required to illustrate in state maps that is, the current value stream mapping and future state map of the process. MS-Visio is used to show the state maps and to draw of essential diagrams that are used for the study (i.e. process flow chart, framework, etc.).

3.5. Ethical Consideration

The safety of research participants is ensured; all the collected data is not given to a third party & will not be used for any other purposes. Therefore, participants' privacy and the administration's collaborations are safeguarded. Also, any kind of communication in regard to the analysis ought to be through with truthfulness and clearness. There is enough degree of confidentiality of the lookup records ought to be guaranteed.

3.6. Research Dissemination

The study is going to share or disseminate for publication as well as the industry by giving to them the final results.

Chapter Four

4. Data Presentation and Discussion

4.1. Introduction

This chapter presents the data collected and the analysis carried out based on the methodology described in Chapter Three. Based on the research methodology, the data were collected from primary and secondary sources. And the data analysis mainly consists of the selection of product family, quality problem that occurred on model 23, major causes for lower productivity and waste types, possible solution for the improvement of production for the selected product and its overall success as rated by the participants. The questionnaire was distributed for all workers in Zemen Shoes Factory and the numbers of respondents are 48.

4.2. Quantitative data analysis

4.2.1 Questionnaire Data Analysis

The analysis of responses to questionnaire is presented in different classifications. Demography, common influences of productivity of Zemen shoe, awareness and knowledge that influences productivity of Zemen shoe, quality concerns that have impact on production process were considered in addition to the all-purpose questions associated with the study.

Those variables are discussed so that the researcher would apply the outcome of the proposed solutions and description of the current situation of productivity state in circumstance of Ethiopian small and medium enterprises.

4.2.2 Demographic Analysis

Table 4.1 shows the distribution of respondents in terms of age, gender, education level, experience, and position.

Table 4. 1: Demographic Profile of participants during study period

Characteristics (Demography)	Categories (Grouping)	Frequency	Percentage (%)
Age	20 - 25	10	20.83%
	26 -30	19	39.59%
	31 - 35	13	27.08%
	36 - 40	4	8.33%
	41 - 50	2	4.17%
	Total	48	100%
Gender	Male	37	77.08%
	Female	11	22.92%
	Total	48	100%
Education level	Primary level	25	52.08%
	Certificate or diploma	18	37.5%
	First degree	5	10.42%
	Second degree	0	0
	Total	48	100%
Experience	1-5 years	39	81.25%
	6-10 years	7	14.58%
	Over 10 years	2	4.17%
	Total	48	100%
Position	Managerial level	6	12.5%
	Only supporter	12	25%
	Other	30	62.5%
	Total	48	100%

4.2.3 Awareness and knowledge that influences Productivity of Zemen shoe

In order to arrive at the objective, it's better to dig out factors that influence SMEs Productivity. 8 questions were distributed to respondents to examine general information about the awareness and knowledge that influences the Productivity of Zemen shoes.

Table 4. 2: Awareness and knowledge that influence Productivity of Zemen shoe

List of items	Items	Frequency	Percent
Zemen company has a productivity strategy.	Strongly agree	10	20.83%
	Agree	18	37.5%
	Disagree	12	25%
	Strongly Disagree	2	4.17%
	Neutral	6	12.5%
	Total	48	100%
Your company has methods that are used to analyze productivity.	Strongly agree	17	35.42%
	Agree	15	31.25%
	Disagree	6	12.5%

	Strongly Disagree	3	6.25%
	Neutral	7	14.58%
	Total	48	100%
There is a good communication on production department.	Strongly agree	24	50%
	Agree	18	37.5%
	Disagree	2	4.17%
	Strongly Disagree	1	2.08%
	Neutral	3	6.25%
	Total	48	100%
You able to improve the production process of model 23 shoe.	Strongly agree	5	10.42%
	Agree	9	18.75%
	Disagree	22	45.83%
	Strongly Disagree	10	20.83%
	Neutral	2	4.17%
	Total	48	100%
There are different causes for low productivity in your company.	Strongly agree	18	37.5%
	Agree	23	47.92%
	Disagree	3	6.25%
	Strongly Disagree	4	8.33%
	Neutral	0	0%
	Total	48	100%
Immediate superior support you by fulfilling materials, information, and other things that are used for the production process.	Strongly agree	22	45.83%
	Agree	21	43.75%
	Disagree	2	4.17%
	Strongly Disagree	1	2.08%
	Neutral	2	4.17%
	Total	48	100%
There is an appropriate and suitable condition or environment for the process to do tasks in the production department.	Strongly agree	5	10.42%
	Agree	7	14.58%
	Disagree	26	54.17%
	Strongly Disagree	12	25%
	Neutral	10	20.83%
	Total	48	100%
There is a possible solution for the improvement of production for the selected product.	Strongly agree	16	33.33%
	Agree	21	43.75%
	Disagree	3	6.25%
	Strongly Disagree	0	0%
	Neutral	8	16.67%
	Total	48	100%

4.2.4 Quality concerns that have impact on production process

The effect of quality is the major reason or for increasing or decreasing the production process. In manufacturing industries to understand their collaboration, it's better to see the responses that are listed in the table.

Table 4. 3: Quality concerns that have impact on production process

List of items	Items	Frequency	Percent
Mostly there is non-conformable product on Zemen Shoe Company.	Strongly agree	14	29.17%
	Agree	19	39.58%
	Disagree	8	16.67%
	Strongly Disagree	5	10.42%
	Neutral	2	4.17%
	Total	48	100%
There are major quality problems that occur on the model 23.	Strongly agree	18	37.5%
	Agree	12	25%
	Disagree	8	16.67%
	Strongly Disagree	6	12.5%
	Neutral	4	8.33%
	Total	48	100%
There are different categories (types) of wastes that are observable exceedingly on production process and leads problems of quality.	Strongly agree	20	41.67%
	Agree	16	33.33%
	Disagree	5	10.42%
	Strongly Disagree	4	8.33%
	Neutral	3	6.25%
	Total	48	100%
There is quality problem or defect occurring repeatedly (frequently) on model 23 shoe.	Strongly agree	25	52.08%
	Agree	18	37.5%
	Disagree	3	6.25%
	Strongly Disagree	0	0%
	Neutral	2	4.17%
	Total	48	100%

4.2.5 All-purpose questions allied to the study

Basic general questions were asked to recognize the study objective well so; the employees were asked three questions below.

Table 4. 4 All-purpose general questions

List of items	Items	Frequency	Percept
Frequently model 23 shoes are ordered from customer.	Strongly agree	19	39.58%
	Agree	26	54.17%
	Disagree	2	4.17%
	Strongly Disagree	0	0%
	Neutral	1	2.08%
	Total	48	100%
The employees can make all types of product that found in Zemen company.	Strongly agree	10	20.83%
	Agree	16	33.33%
	Disagree	9	18.75%
	Strongly Disagree	7	14.58%
	Neutral	6	12.5%
	Total	48	100%
Your firm has knowledge of activities of value adding and non-value adding activities on the production process.	Strongly agree	6	12.5%
	Agree	9	18.75%
	Disagree	16	33.33%
	Strongly Disagree	7	14.58%
	Neutral	10	20.83%
	Total	48	100%

4.3. Qualitative data analysis

4.3.1. Data analysis for interview

Interview questions are crucial to analyze data about the Zemen Shoe Factory. This study needs more resources to address information to all the persons, stations, and departments to whom this issue may concern. Therefore, formal and informal interview was prepared for the production manager of each section, production heads and also for some of the employee. The interview is prepared to different departments of managers, heads and some of the employees five time to collect some relevant information. It was cross checked to confirm the reliability of the responses and to get more detail and broad ideas.

In general, based on the interview responses, they are facing challenges to improve productivity. The interview questions were as followed. In your organization, what is the most challenging thing that resulting in poor productivities? What factors help your organization to increase productivity? Finally, about the improvement mechanisms that used to enhance productivity.

The interview questions highlight the status of productivity on Zemen Shoes. In this factory, the researcher found that there are little or no written documents and set aside or kept by organizing them. They don't have a trend for production-related training, creation of awareness, discussion at some time of interval, production strategies, and responsibility for knowledge dissemination. The employees, as well as managers, answer the question of what has to be done to improve productivity. Most of them have the same opinion and agreed about giving training; the building of knowledge, awareness creation, discussion, and sharing experience is one of the essence points for improvement. Employees are complaining about companies are not giving training, manuals for the job, and other outlooks.

Table 4.5 shows the response of the interview by answering yes or no for the asked questions.

Table 4. 5 interview response related to productivities

Question items for interview	Yes (%)	No (%)
Is there continuous training and assessments that are used to upscale employees' performance?	8.23%	91.77%
Do you know factors that help your organization to increase productivities?	79.34%	20.66%
Do you have good workplace situations in your company?	18%	82%
Do you think there are different challenging thing that resulting poor productivities?	91%	9%
Do you have some improvement mechanisms that used to improve productivity?	55.78%	44.22%

4.3.2. Field observation data analysis

Observation of Zemen Shoes Factory showed that the owner and managers of company are more concerned on the profit and minimization of cost rather than optimization of the process. Also, there are no written documents found, manuals for trainings, periodic assessments for the performance of employees and strategies to be followed.

4.4. Factor Analysis for Productivity

The data analysis mainly consists of the product selection of manufactured goods in Zemen shoes, the production process of the selected model which is model 23 shoe, the existing state of value stream mapping, source of known wastes from the root for the identified wastes, endorse practice used for the recognized wastes in order to reduce non-value adding activities and optimize the value-adding operations, Standard working procedure (SOP) for stitching section of 23 shoe model, VSM for the

future states, improve and optimize the productivity of small and medium enterprises of Zemen Shoe Factory.

4.4.1. Inputs for the Shoe

For the manufacturing of diverse footwear types, the use of different consumption of supplies as a resource is required. Different leather inputs that are used for shoe making are comes from the suppliers Mojo and Elico factory. The principal and frequently used inputs for the manufacturing shoe are cow and sheep leather, glue, sole, insole and different fittings and stuffs. Others materials such as sole, insole, rivet, shoelace etc. are imported.

4.4.2. Product Family Selection

Zemen Shoe Factory has 68 different kinds of products for the market. However, the purpose of this research is to find out about a single product which is primarily is the base for the chosen VSM strategy. It is better to select one shoe model for the purpose of the study by considering families of product by observing the manufacturing process steps, which may serve many families of products& higher demand or which model is ordered frequently from customers.

Table 4. 6 Number shoe type and shoe model of Zemen factory (Author)

No of shoe model	Shoe type	No of shoe model	Shoe type	No of shoe model	Shoe type	No of shoe model	Shoe type
01111	Model 01	18	Model 18	35	Model 35	52	Model 52
2	Model 02	19	Model 19	36	Model 36	53	Model 53
3	Model 03	20	Model 20	37	Model 37	54	Model 54
4	Model 04	21	Model 21	38	Model 38	55	Model 55
5	Model 05	22	Model 22	39	Model 39	56	Model 56
6	Model 06	23	Model 23	40	Model 40	57	Model 57
7	Model 07	24	Model 24	41	Model 41	58	Model 58
8	Model 08	25	Model 25	42	Model 42	59	Model 59
9	Model 09	26	Model 26	43	Model 43	60	Model 60
10	Model 10	27	Model 27	44	Model 44	61	Model 61
11	Model 11	28	Model 28	45	Model 45	62	Model 62
12	Model 12	29	Model 29	46	Model 46	63	Model 63
13	Model 13	30	Model 30	47	Model 47	64	Model 64
14	Model 14	31	Model 31	48	Model 48	65	Model 65
15	Model 15	32	Model 32	49	Model 49	66	Model 66
16	Model 16	33	Model 33	50	Model 50	67	Model 67
17	Model 17	34	Model 34	51	Model 51	68	Model 68

From the total production of 27065 products, 5 footwear model types cover 52.07% of

customer demand by the year 2011 E.C.

In the year 2012 EC the production of this footwear types holds 54.85 % of the total production volume of 27380 pairs as indicated in table 4.7.

Total production of 54445 products, 5 footwear model types cover 53.47% of customer demand by the year 2011 and 2012 E.C.

These five shoe models are prioritized according to the customer demand and comparison of production process so as to pinpoint the severely product.

Table 4. 7: Product Prioritization with different families and their percentage share (Author)

No.	Types of shoe model	Production Volume		Total	Percentage share
		2011E.C	2012E.C		
1	Model 23	5150	6756	11906	21.87
2	Model 32	3522	3482	7004	12.86
3	Model 31	2236	1956	4192	7.70
4	Model 47	1664	1612	3276	6.02
5	Model 42	1522	1214	2736	5.03
Total		14094	15020	29114	53.47
Percentage share		52.07	54.85	53.47	53.47

4.4.3. Zemen shoe Manufacturing Process

There are different types of process for manufacturing shoe in Zemen factory. All of different models of the shoe have disparate manufacturing process. There are different parts of materials and shoe, also manufacturing process have many steps. The main manufacturing processes are the cutting, preparing, stitching, lasting and finishing process, finally to packing process. Mostly as elementary parts to complete shoe consists of sole, insole, outsole, midsole, heel counter and upper, shoelace lining and tongue.

After preparing design for the definite shoe model, cutters are designed according to the pattern drawn on the leather subsequently. The leathers are cut by man by marking and using cutters. Insole is coming from China. Next to the cutting section it goes to preparation section. The fundamental use of this sector is preparing the material needed to be stitched.

After the constituents are brought together in order to assemble in the stitching section. At last, the footwear is transported to the lasting and then finishing process. At the end it goes to packing section to be ready for stored and for selling. As summary the general process is

shown in the Figure 4.2.

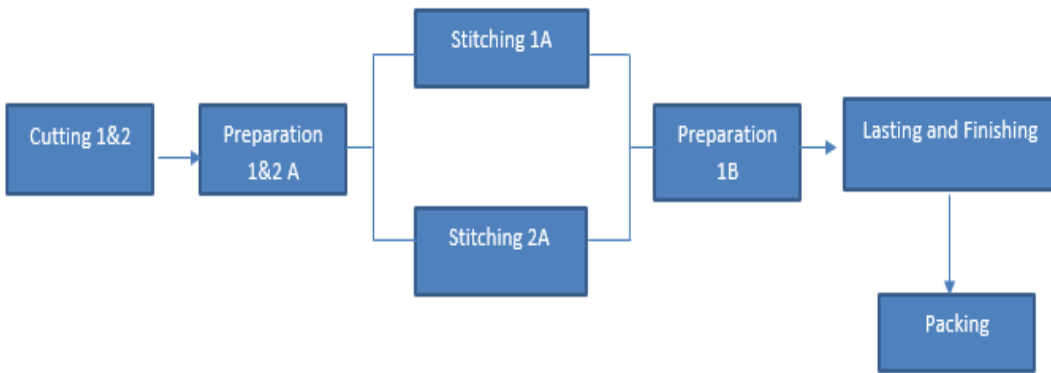


Figure 4. 1: Major Sections of the Company (Author)

4.4.3.1. Cutting Section Operations

Different footwear materials are cut in section based on the requirement of the design. Cutting all pieces of the shoe is done in this section. There are 2 places arranged for cutting section in Zemen Shoe Factory, there is no leather cutting machine in the company so, all parts are done manually. Therefore, the workers have to do their tasks attentively and in carefully to reduce redundant wastes in cutting process

There are different processes in cutting section. The cutting operation could be affected by altered factor such as blade quality, leather quality, worker skill, material quality.

Lining Cutting: The action mainly involves the cutting of linings for part of the shoe

Leather Cutting: It mostly cutting of various leather types like sheep and cows by using cutting tools.

Material Cutting: In this operation foam, textile fabrics and plastic materials are to be cut.

4.4.3.2. Preparation 1 Section Operations

Next to the cutting section preparation section is found. The main purpose of this section is preparing the upper part or Tommie for sewing. This process includes different activities such as marking, pasting glue and trimming after stitching, pairing different parts of Tommie that is needed for stitching operation, attaching foam and so on.

✓ **Marking:** Is the action of giving mark or spot for labelling the area of sewing that

aimed to workers at the sewing section by the help of different forms. In this section the marking of the eyelet, for stitching edges, hole making points are some of the marked points by using a marking pen.

- ✓ **Glue Pasting:** Is a process of pasting glue on different parts on the shoe. This includes attaching different strengthening and giving comfort materials on the upper part or Tommie of the footwear.
- ✓ **Hammering:** Is the process of beating or hitting the Tommie by using a hammer. This helps the upper to have a smoothly and good-looking finishing.
- ✓ **Trimming:** Trimming is the process of reducing or cutting, removing, cleaning excessive (additional) and unnecessary fragments like treads after sewing operation performed.

4.4.3.3. Stitching Section Operations

Stitching operation is the section in which the assembly operation is done. Sewing by making together different parts of Tommie that are received prepared components from preparation section such as stitching the tongue, vamp, quarters, liaising (it looks like back strap), back part, etc. In this section all the sewing processes are completed by using machines called singer.

Stitching: The operator stitches the different upper parts by the aid of the marks applied by the preparation section workers. The parts assembled include stitching front stripes, circle stitching on different edges like top line, tongue stitching, quarters stitching, stitching collar facing stitching, stitching vamp and facing, stitching collar with quarters, vamp stitching, with stripes and lining with upper stitching.

Upper Stitching with Tongue: This is the operation of assembling the Tommie and the tongue together.



Figure 4. 2 Stitching section: (Captured photo)

4.4.3.4. Preparation 2 Section Operation

Hole Making Process: In this section after the upper and the tongue is sewed it is brought here to pierce a hole on the edge of the upper part. This operation is made by hand.

Eyeleting: The procedure of attaching eyelet for the shoelace.

Cleaning: is the process of checking all operations done before this section and trimming if there are excessive threads that come from stitching section.



Figure 4. 3: Preparation 2 Section. (Captured photo)

4.4.3.5. -Lasting and Finishing Section Operations

In lasting section different operations are performed some of them are: -

Lasting: Mold is inserted manually into the shoe in order to make it to have its designed shape.

Tommie with Sole: This is the stage of assembling the completed upper part with the sole.

Different types of soles are used for the consumption of the company. The company does not produce any types of soles by itself; they are outsourced soles from china.

Heating: The shoe passes through a heat setter machine in order to have a good outer texture. The heat eliminates any shrinkage on the upper part, and it makes it easy to gain a shape of the mould easily while hammered.

Hammering: Is the process of hitting the upper part by using a hammer. This helps the upper to have a smooth and shiny finishing. In this section hammering is done both manually and by using a hammering machine.

(Polishing) Brushing Pasting: A prepared shoe cream is pasted on the shoe according to the color of the shoe.

De-lasting: Is the process of detaching the mould from the shoe.

Inserting Insole: Insole is attached on the inside of the shoe.

Attaching Shoelace: The shoe lace attached to the final shoe lace so as to make it ready for the customer.

Stamp number: Imprint the shoe number by pairing with same size of the shoe



Figure 4. 4 Lasting and Finishing Section (Captured photo)

4.4.3.6. Packing section

Packing: The assigned operator will check any deviation from the requirement and pack in pair of shoes.



Figure 4. 5: Packing section (Captured photo)

4.5. Creating the Current State Map

4.5.1. Production Process Description of Model 23

There are five major sections of production department in Zemen Shoe Factory. Those 5 predominant or vital sections that exist in the factory are cutting, preparation, stitching, lasting and finishing. The flow chart in Figure 4.8 indicates the overall flow procedure for model 23 shoe over these 5 main sections of production. The process starts from where other inputs are placed which is inside raw material store and ends at lasting and finishing.

Table 4. 8 Explanation for Activities Involved in Process for Production (Author)

No	Symbol	Name	Actions	Explanation
1	○	Operation	Adds value	Where the part, material of model 23 shoe is changed of modified or changed.
2	□	Inspection	Checks for defect	Occurs when model 23 shoe is examined for quality and quantity compared with standard.
3	⇒	Transport	Moves some distance	Shows a movement of component, materials or equipment of model 23 shoe from one place to another.
4	▽	Storage	Formal warehousing	Denoted when model 23 shoes is kept in stores to be dispersed to several work.
5	D	Delay or Temporary storage	Hold (Temporary delay)	Delay in the process, or model 23 shoes laid aside until required.

The production process of model 23 footwear covers different process steps (including the value and non-value adding processes). These steps are the one on which continuously accomplished for each pair of shoes. Through the steps of the production, it is important to identify the major wastes on the process, eliminate them and set standards for the value adding activities. Henceforth this approach can be significant to the company since it will: Better utilization of workers, Enhance the productivity, the work standardization to become a basis for continuous improvement.

Accordingly, before understanding and identifying wastes on a process there are two basic initial steps to be carried out in this study that are identify customers and define value to the customers.

These steps cover the way to easily define what the customer requirement and to eliminate or minimize any activities performed other than the one that bring values from the customer point of view.

4.5.2. Define customers of Model 23 Shoe

The production of this type of shoe started from the establishment of the company and it is known as an icon for the company. The customers of model 23 shoe type are the young people with estimated age range of 16- 45. The customers of this type of footwear could be divided into two.

- A, Retailer shops of the company: - 8 retailing shops owned by the company. Especially, the retailer shops on Addis Ababa region are in Merkato, Piassa, Mexico, Megenagna, Gergi, Ayertena, Bole
- B, Private retailer shops: - Different private retailer shops all over Ethiopia e.g. Butagira, Bahirdar etc.

4.5.3. Defining Value to Customers of Model 23 Shoe

For a company to be competitive, it must give great emphasis to value since competitiveness level is dependent on offering what the customer actually wants. Value determines the price which the customer is willing to pay for (Rother, 2008). Value added activity is the one that brings a change in the product in a way that the customer is willing to pay for. While non-value adding activity is the one that consumes time, energy, and other resources but the customer does not actually want to pay for it.

The main customer requirements of model 23 type of shoe are comfort, the perfect alignment of the vamp (upper) and the sole, keeping delivery promises, flexibility if upper and shoe element,

stretching ability, abrasion (scratch) resistance, availability of different choices in color and size and the sole quality. In order to have the above-mentioned values in model 23shoe, the main requirements are the quality of raw material and the quality of the process.

4.5.4. Components of Model 23 Shoe

The components for the shoe are mudguard lining, apron lining, quarters I-upper, quarters II upper, Facings-Upper, collar-upper, mudguard upper, counter patch–upper, counter-upper, apron-upper, eyelets. Figure 4.7 shows the main components of model 23 shoe.

























































































Figure 4. 6: Major Components of Model 23 Shoe (Author)

4.5.5. Activities Involved on the Production of Model 23 Shoe

In order to identify wastes, it is important to find out operations involved in the existing production process. For the production of 23 model shoe diverse activities are performed. Table 4.8 shows the material type flow sequence of the process from material store to finishing operation. It also shows the flow of process introduced for model 23 shoe below. The table displays the familiar notion of what the model 23 shoes method passes through.

Table 4. 9 : Flow Process Chart for model 23 (Author)

No.`	Activities performed for one pair of Model 23 production	Operation	Inspection	Transportation	Delay	Storage	By	Man power	Distance(m)	VAT(sec)	NVAT(sec)
1	Raw material storage	○	□	⇨	⏸	▽	Man				10800
2	To cutting	○	□	⇨	⏸	▽	Man	1	24		240
3	Waiting	○	□	⇨	⏸	▽					420
4	Marking and cutting	●	□	⇨	⏸	▽	Man	3		360	
5	Inspection & Temporary storage	○	■	⇨	⏸	▽	Man				450
6	To preparation 1 section	○	□	⇨	⏸	▽	Man	1	6		60
7	Waiting	○	□	⇨	⏸	▽					30
8	Matching Quarter	●	□	⇨	⏸	▽	Man	1		9	
9	Waiting	○	□	⇨	⏸	▽					32
10	To stitching	○	□	⇨	⏸	▽	Man		1		1.5
11	Stitching Quarter	●	□	⇨	⏸	▽	Machine	1		55	
12	To preparation 1 section	○	□	⇨	⏸	▽			1		1.5
13	Attaching Tommie with Quarter	●	□	⇨	⏸	▽	Man	1		78	
14	Waiting	○	□	⇨	⏸	▽					5
15	To Stitching section	○	□	⇨	⏸	▽			1		1.5
16	Stich round the Throat	●	□	⇨	⏸	▽	Man	1		72	
17	Waiting	○	□	⇨	⏸	▽					320
18	To preparation 1 section	○	□	⇨	⏸	▽			1		1.5
19	Glue pasting around Throat edge.	●	□	⇨	⏸	▽	Man	1		157	
20	Waiting	○	□	⇨	⏸	▽					530.8
21	To Stitching section	○	□	⇨	⏸	▽			1		1.5

22	Stich Tommie with Quarter						Man			75	
23	Waiting										410
24	Insert foam then glue paste between Tommie & Quarter						Man	1		119	
25	Waiting										5
26	To preparation 1 section								1		1.5
27	Hammering						Man	1		197	
28	Waiting										4
29	To Stitching section								1		1.5
30	Stitching Tongue						Man			53	
31	Stitching Tongue with Tommie						Man			45	
32	Marking						Man	1		8.3	
33	Waiting										220
34	Stich side stripes						Man			340	
35	Waiting										1800
36	To preparation 1 section								1		1.5
37	Trimming & Hammering then Glue paste on Lising						Man	1		267	
38	To Stitching section								1		1.5
39	Stitching Lising						Man			34	
40	To preparation 1 section								1		1.5
41	Glue paste to attach Collar then Hammering						Man			205	
42	To Stitching section								1		1.5
43	Stich Collar						Man			24	
44	Inspection & temporary storage						Man	1			2200
45	To preparation 2 section						Man		2		3.2
46	Making hole & attaching Eyelet						Man	4		332	

47	Inspection & temporary storage	○	■	⇒	D	▽	Man	2			1870
48	To Lasting & Finishing Section	○	□	⇒	D	▽	Man		8		12
49	Clear pucker (using Tenalia)	●	□	⇒	D	▽	Machine	1		5	
50	Temporary storage	○	□	⇒	D	▽	Man				110
51	Insert shoe last, Fold & pull by Pinsa	●	□	⇒	D	▽	Man	2		376	
52	Piercing around by nails and Hammering	●	□	⇒	D	▽	Man	2		285	
53	Waiting	○	□	⇒	●	▽					180
54	Trimming & Marking sole	●	□	⇒	D	▽	Man	1		27	
55	Waiting	○	□	⇒	●	▽					36
56	Hammering & removing nails	●	□	⇒	D	▽	Man	2		220	
57	Waiting	○	□	⇒	●	▽					26
58	Scrap with Freza	●	□	⇒	D	▽	Machine	1		13	
59	Waiting	○	□	⇒	●	▽					17
60	Glue pasting the upper & sole then put in to oven	●	□	⇒	D	▽	Man	2		89	
61	Waiting	○	□	⇒	●	▽					54
62	Press upper and sole	●	□	⇒	D	▽	Machine	1		7	
63	Waiting	○	□	⇒	●	▽					40
64	Inspection and Temporary storage	○	■	⇒	D	▽	Man	1			2400
65	To Polishing (Brushing)	○	□	⇒	D	▽			4		6
66	Waiting	○	□	⇒	●	▽					13
67	Polishing & Removing shoe last by Ganja	●	□	⇒	D	▽	Machine	1		26	
68	Inspection & temporary storage	○	□	⇒	D	▽	Man	1			771
69	To finishing	○	□	⇒	D	▽	Man				15
70	Insole	●	□	⇒	D	▽	Man	2		8	
71	Waiting	○	□	⇒	●	▽					11

72	To Packing	○	□	→	D	▽	Man		10		58
73	Clearing pucker& Entering shoe lace	●	□	→	D	▽	Man	1		424	
74	Waiting	○	□	→	●	▽					242
75	Stamp number	●	□	→	D	▽	Man	1		53	
76	Waiting	○	□	→	●	▽					150
77	Checking and Packing	○	■	→	D	▽	Man	1		468	

Table 4.9 classifies activities according to the two types of operation (VA.NVA). It shows the time taken and number of workers involved for performing a certain task. The chart describes the operations in five symbols. The description of the symbols used for the flow process chart is presented in the table 4.8. According to the chart the present process breakdown has total operation (30), inspection (5), transportation (18); Temporary storage (delay) is (21) and Storage (3).

4.5.6. Takt Time Calculation

Model 23 shoes follow a make to stock type of production approach. The company places a yearly production plan based on forecasted demand whereas the production department tries to achieve the target. Currently, Zemen has only one production shift per day. The total available time in the shift is 9 working hours. In order to calculate the customer takt time, a certain assumption is presented as below,

Where: TT is a rate of available production time in order to meet the customer demand. TT is matching actual production to customer demand. (Abrham, 2016).

- Total working days available in the year 2011/12 = 303 days
- The total available working time in the shift = 9 hours
- Total working days within a week= 5.5 days (including Saturday half working day)
- Number of cutting line= 1line
- Number of preparation line=3lines
- Number of stitching lines= 2 lines (For the production model 23 footwear the company use only the 2 lines)
- Number of lasting and finishing line = 1line

- Number of packing line =1 line
- All weeks has equal number of working days.
- Number of Shift = 1 working shift

$$\text{Total available time} = 9 \text{ hours} * 60 \text{ min} = 540 \text{ min per day}$$

$$\text{Lunch time} = 1 \text{ hr.} * 60 \text{ min} = 60 \text{ min}$$

$$\text{Tea break} = 15 \text{ min}$$

$$\text{Another allowances} = 15 \text{ min}$$

$$\text{Net operating time} = \text{Total available time} - \text{Planned downtime} = 540$$

$$\text{min} - 60 \text{ min} - 15 \text{ min} - 15 \text{ min} = 450 \text{ min/shift/day} =$$

$$\text{Net operating time} = \underline{27000 \text{ sec/shift (day)}} (450 * 60 \text{ sec})$$

Takt time is calculated by identifying the available production time of the company.

$$\text{Takt time} = \frac{\text{Total available time for production per shift}}{\text{Customer demand per shift}}$$

The total quantity of planned production is 11906 pairs of models 23 in 2011 and 2012. Per year on averages 5953 pair of shoes are needed. The takt time for each section is shown in Table 4.10

Table 4. 10: Takt Time Calculation for 1-line

No	Section	Yearly plan in pairs	Monthly plan in pair	Weekly plan in pair	Daily plan in pair	Daily plan/ line	Takt time
1	Cutting	5953	496	125	23	23	1173.9 sec
2	Preparation	5953	496	125	23	8	3375 sec
3	Stitching	5953	496	125	23	12	2250 sec
5	Finishing & Lasting	5953	496	125	23	23	1173.9 sec
6	Packing	5953	496	125	23	23	1173.9 sec

$$\text{Available time} = 7.5 \text{ hrs.} * 60 \text{ min} * 60 \text{ sec} = 27000 \text{ sec/day}$$

$$\text{Customer demand} = \underline{23 \text{ products per day}}$$

$$= (7.5 \text{ hrs}) 450 \text{ min} / 23 = 19.56 \text{ min} * 60 \text{ min} = 1173.9 \text{ sec}$$

$$\text{Takt time} = 1173.9 \text{ sec}$$

In case of preparation section, there are 3 lines for the production of model 23 shoe hence the daily production plan per line is; is (27000sec /3 lines) (27000sec /8) which is 23/3 = around 8 So, the

Takt time is 3375 sec.

Also, in case of stitching section there are 2 stitching lines for the production of model 23 shoe hence the daily production plan per line is $(27000\text{sec} / 2 \text{ lines}) (27000\text{sec} / 12)$ which is $23/2 =$ around 12 So. the takt time is 2250sec.

The takt time calculation shows an average production of 23 pairs are needed per day to fulfill the customer demand. The production department has to produce a pair every 3375 sec for preparation sections, 2250 sec for stitching sections and 1173.9 seconds for the other departments in order to be able to satisfy the customer demand. Preparation and Stitching section has a greater takt time relative to others. The company is currently using two stitching lines to produce model 23 footwear types while other sections have one and three line for production of model 23. The greater takt time implies better available time for fulfilling the demand on the other hand less takt time infers less available time for doing the task.

4.5.7. Current State Value Stream Mapping

The main data gathered for the current state value stream mapping is beginning from raw material storage and throughout all the operations carried out for the production of model 23 footwear. It includes the collection of data about the inventory level, process cycle time, number of workers involved, value added cycle time and number of scrap and rework. The data for the cycle time, transportation time and waiting time are collected by using stopwatch. The number of works in process is recognized by counting the number of inventories besides considering an average number of inventories (Taylor, 2009).

Work Standardization is necessary to achieve smooth flow and reducing inventory to the minimum level. In the case company of most stations there is one work in process (WIP) stock holding in between each process steps of different sections, which is represented by a triangle. The inventory level is considered only for model 23 shoe without considering variety product inventories. Abrham (2016) states that process boxes in the map represent the procedure followed by the product as well as the number of workers for accomplishing the task in each section. The process is considered for the case of Model 23 production. The data table shows the data gathered with respect to the production process of model 23. Each process has description of process cycle time (CT), rework rate, changeover time (C/O), transportation time (Tt), available time (AT) and value-added time (VA). The timeline segment displays the cycle time for a single product and the lead time in order to produce the order quantity. The lead time in the bottom of

the VSM is calculated by dividing the inventory quantity into the customer requirement. Little's law describes Lead time as: -

$$Lead\ time = \frac{WIP}{Throughput}$$

For example, the lead time of cutting which is 2.4 day is calculated by dividing number of inventories (56 pairs) by the daily plan (23 pair of footwear /day). The yellow stars are known as kaizen burst which refers to the major problematic area which needs to be improved. For example, within each station there are waiting and inventories which needs strong eye for improvement since they have greater influence on the rise of the cycle time and the lead time. Also, production interruption arises when an urgent order intervenes on the process before the production of an order quantity is over. In this situation the existing production will stay on the queue until the urgent order is completed. It makes the process flow to be unlevelled and it becomes difficult to record, recognize and control wastes.

The total lead time is 8.2 day (708,480sec); the total cycle time is 16488.1 sec (4 hrs. & 58 min) while, value adding cycle time is 3963 sec (1 hr. & 10min). Cycle time (Total) is the total time taken from the start of the production of a product or service to its completion. In this study it only means the summation of processing time plus, move time within the station, inspection time, changeover time and waiting time.

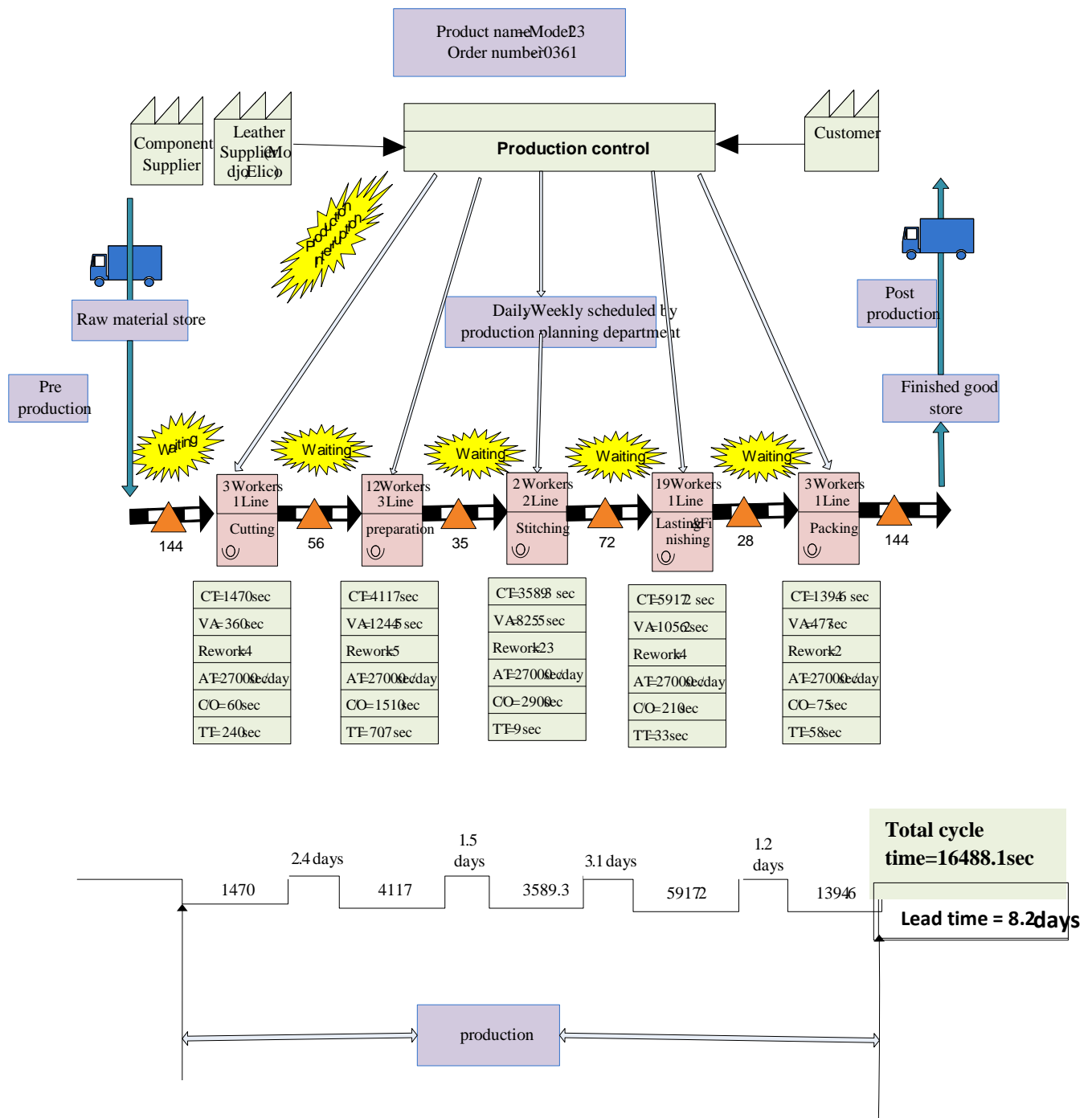


Figure 4. 7 show the current state value stream map (Author).

4.6. Percentage of Value Adding Time

In order to dignify the existing situation clearly, it is important to summarize the information gained from the CVSM and the material type flow process chart. The summary of the flow process chart and the VSM with respect to cycle time, available time and value-added time of one pair of shoes is presented in the table 4.4.

Table 4. 11: Summary of the Flow Process Chart and CVSM (Author).

Process name	Manual CT (sec)	Machine CT (sec)	No of workers	WIP	Change over time (sec)	Inspection (sec)	Transportation	
							Dist. (m)	Time (sec)
Cutting	1470	-	3	56	60	450	24	240
Preparation	4117	-	11	35	1510	2200	13	70.7
Stitching	3589.3	-	2	72	2900	-	6	9
Lasting & finishing	5917.2	51	19	28	210	3970	13	33
Packing	1394.6	-	3	-	75	468	10	58
Total	16437.1	51	38	224	4755	7088	66	410.7

From the shown flow process chart, all the Value adding and non-value adding time, total manpower involved in the production process as well as the transportation distance are analyzed and summarized.

As identified by (Islam and Khan, 2013), value added and non-value adding activities are crucial factors in investigating which stations needs action for improving productivity.

Table 4. 12: Summary of the Flow Chart (Author).

No.	Time	Summary (sec)	percentage value-added time
1	VA time	3963	24%
2	NVA time	12526	76%
3	Total	16489	100%

As it is seen from the table, the value adding times which are the actual operations on the cutting, preparation, stitching, finishing & lasting, and packing sections have the lowermost share which is 24% of the total time while, the non-value adding time which comprises

waiting, inspection and unnecessary transportation covers 76%. The result clearly indicates that there is a high unproductively rate of the workers that need to be improved or eliminated. In other words, the much time had been spent on the non-value-added activities while a lower time is spent on the value-added activities. The non-value-added activities include both the NNVA and NVA. The Company currently uses one-piece flow production system.

4.6.1. Cycle Time Loss

Before improving the process, it is important to find out the cycle time loss. Cycle time loss is measured as the difference between the actual cycle time and ideal cycle time for each piece manufactured (Meteken, 2013). The ideal cycle time is the theoretical minimum time to produce Model 23 type of shoe. By assuming the flow for a single product, let's say a single pair of shoes is ordered by the customer thus the ideal cycle time is the summation of the time the product spent with in each section.

$$\text{Run time} = 16488.1 \text{ sec} * 1 = \underline{16488.1 \text{ sec}}$$

$$\text{Ideal cycle time} = 360 + 1244.5 + 825.3 + 1056.2 + 477 = 3963$$

$$\begin{aligned} \text{Cycle Time Loss} &= \text{Run Time} - (\text{Total parts} * \text{Ideal cycle time}) \\ &= 16488.1 \text{ sec} - (1 \text{ pair} * 3963 \text{ sec}) \\ &= 16488.1 \text{ sec} - 3963 \text{ sec} \\ &= \underline{12525.1} \end{aligned}$$

To determine the run time, compare how fast the company could have manufactured Model 23 type footwear under ideal circumstances (one pair multiplied by ideal cycle time) to how fast actually foot wears are manufactured (run time). The difference between the two is cycle time loss of the company. As a result, if Zemen Shoe Factory produces products at ideal circumstances or in a flow which is free from wastes, 12525.1 sec could be saved on the quantity from production.

Cycle time loss is considered as the difference between the Actual Cycle Time and Ideal Cycle Time for each quantity that manufactured (Ideal Cycle Time is the imaginary minimum time to produce single or one shoes).

4.6.2. Cycle Time Efficiency

As the cycle time efficiency stated is to reason that for value added ratio. Cycle time efficiency is applied to, measuring how match time is added value on the process (Meteken, 2013).

The process Cycle efficiency is calculated including the waiting time in line also in the storage. In all section the product is produced accordingly one-piece flow (from one product within the process passes to the next process)

Process Cycle Time Efficiency (PCE) = Value added time /Actual cycle time

PCE cutting =Cutting value adding time/cutting actual cycle time

$$360/1470 = \underline{24.5\%}$$

Calculated the same as others on their section:

$$\text{PCE preparation} = 1244.5/4117 = \underline{30.2\%}$$

$$\text{PCE stitching} = 825.3/3589.3 = \underline{23\%}$$

$$\text{PCE Lasting \& finishing} = 1056.2/5917.2 = \underline{17.8\%}$$

$$\text{PCE packing} = 477/1394.6 = \underline{34\%}$$

As we can see from manipulation 34%PCF for packing which is the largest the number shows that the more efficient in the process. This means achieving more productivity with minimum waste. And Like wise for stitching, lasting and Finishing the lower efficient in the process.

4.6.3. Comparing Takt Time & Actual Time

By taking the three findings as a baseline the gap between takt times, actual cycle time and value-added cycle time is observed in order to match the customer demand with the actual cycle time. Although it is ideal or needs huge effort to achieve, it is preferable if these three “times” (TT, CT, and VAT) and LT become nearly equal with a little bit higher takt time.

A higher takt time (TT) than the cycle time (CT) implies that there is free time for the workers in addition to the actual cycle time. On the other hand, lower takt time implies that the company should think of other methods like overtime, adding machineries and adding man power to enhance the production.

Table 4. 13: Comparison of the Actual Cycle time and Takt time

No.	Operation	Takt time (sec)	Actual Cycle time(sec)
1	Cutting	1173.9 sec	1470 sec
2	Preparation	3375 sec	4117 sec
3	Stitching	2250 sec	3589.3 sec
4	Lasting and finishing	1173.9 sec	5917.2 sec
5	Packing	1173.9 sec	1394.6 sec

When manufacturing lower than takt time consequences bottleneck and creates delay also have an effect on customer orders which cannot be satisfied or pleased on time.

By simply observing the numbers all the cycle times in each department are much higher than the takt time which shows a higher gap in between the actual cycle time and the takt time that needed to be filled.

So, from the figure shown above stitching and lasting & finishing operation results bottleneck which slows down the process by different kinds of wastes. Where packing is the more pleasant process and have lower wastes occurred as compared to other section processes.

4.6.4. Categorizing Waste

As expressed above the production process of the selected shoe passes through five stations. The actual value-added time is 3963 sec. On the other hand, it takes more than 9 days to finish the production through one-piece flow. Generally, the takt time is much lower than the actual cycle time. This is mainly an impact of having lower time productivity rate. As it is expressed earlier the factor that leads to having a decrease in productivity is the presence of non-value adding activities within the process. The major wastes are discovered by VSM and method study techniques. Those major types of wastes are: transportation wastes, inventory wastes waiting waste, motion wastes, over processing, over production and defect (rework) wastes (Dennis, 2008).

Transportation and waiting time are summarized by recording the actual time spent on the waste and summarizing all the transportation and waiting wastes in each section. The changeover time refers to the period required to prepare a device machine, process, or a system for it to change from producing good piece of the order. In order to compute the time spent on rework, frequently occurring rework type is considered Wavy and tortuous when stich round the throat. This type of rework covers the highest percentage of the rework types on model 23 shoes. Thus, by assuming all the rework which occur in model 23 type of footwear are tortuous stitching round the throat, the correction of this type of rework takes on average 822 sec (around 10 min) while the number of reworks is 4 shoes when producing 12 pair of shoes (which is a ratio of one & third from the production quantity when making 12 pair).

Table 4. 14: Time taken for Wastes

No.	Type of Waste	Time taken (sec)	Percentage Value (%)
1	Transportation	410.7 sec	3%
2	Waiting	5026.8 sec	33%
3	Changeover time	4755 sec	31%
4	Rework	4932 sec	32%

As it is observed from table the waiting time which includes waiting within the process of Production and temporary storage of waiting time has the largest percentage share from all of the wastes. The time spent on reworking tortuous stitching round the throat also had the second largest share on having lower labour productivity.

4.6.5. Analysis of Wastes for the case company

The waste described above has different indications with each section. The wastes should be discovered before finding a solution to the problems. These wastes are visible based on the 7 wastes described above. Inventory waste includes components waiting to be taken by the next operation including upper, insole and other semi-finished components inventory. Transportation waste includes movement from one department to another and also transportation within the department. Motion also includes the unnecessary movement of the workers due to Poor ergonomic conditions and poor workplace arrangement. As discussed above the rework waste in model 23 shoe is tortuous stitching round the throat. This type of waste is a cumulative of the actions within each section. For example, there is no marking operator on the sewing area of the throat to stitch it accurately, so that the sewing operator will create a rework of tortuous stitching round the Throat due to lack of marked guiding line. Table 4.8 shows the wastes indicators within each production sections.

Table 4. 15: Each section of waste indicators (Author).

Waste Type	Department				
	Cutting	Preparation	Stitching	Lasting and finishing	Packing
Inventory	Different parts waiting for next operation after marking & cutting	Parts are ready waiting for stitching after matching & attaching different parts also glue pasting, and attaching eyeleting.	Parts come from preparation waiting for stitching	Parts waiting for different machine e.g. Shoes place on oven (heater), sole then waiting for polishing and Freaza machine.	Shoes waiting for numbering, packing finished goods
Transportation	Transporting raw material from store to cutting& cutting to preparation.	Manual raptly movement for processes from preparation to stitching	Operator performing various tasks & Manual repeatedly movement for processes from stitching to preparation.	From stitching to lasting &From Lasting to finishing	☐ Longer distance from lasting and finishing to packing
Defect	Operation is made by man and using blunt, dull Cutters, not clear marking	Matching, attaching improperly	Tortuous stitching round the throat. They sewed without marking guidance &have work load.	Forgot to insert insole, improper fitting of upper and sole.	Variation of number when packing
Motion	Poor ergonomic conditions	Manual movement from process to process	Motion due to poor organization of workplace	Motion due to poor workplace organization Motion to pick, place, take materials	Ergonomic condition is poor

A. Over Production

ZSF demand varies on between 46 up to 144pairs of shoes. Over production is occurred when producing more products than needed, but in ZSF their productivity is according to their demand plus to accommodate they produce on tolerable range as company standard which is 10% so that, occurrence of over production is almost not a bit.

B. Waste of Inventory

Unnecessary inventory is considered as waste since it cannot be sold to the customer directly and it also holds space. WIP is one of the types of inventory. The inventory of the company is found in various places including the finished goods store. But while speaking about labour productivity within the process, the main concern is the WIP. In order to compare the departments based on WIP, The work in process rate for a period (t) (WIP t) is given by: -

$$\text{WIP}_t = \text{Number of WIP} / \text{Total Number of Input}$$

$$\text{WIP cutting} = 56/144 = \underline{38.8\%},$$

$$\text{WIP preparation} = 35/144 = \underline{24.3\%}$$

$$\text{WIP stitching} = 72/144 = \underline{50\%}$$

$$\text{WIP lasting \& finishing} = 28/144 = \underline{19.4\%}$$

Figure 4.12 shows that, the WIP rate of cutting section, preparation, stitching section, finishing &lasting section.

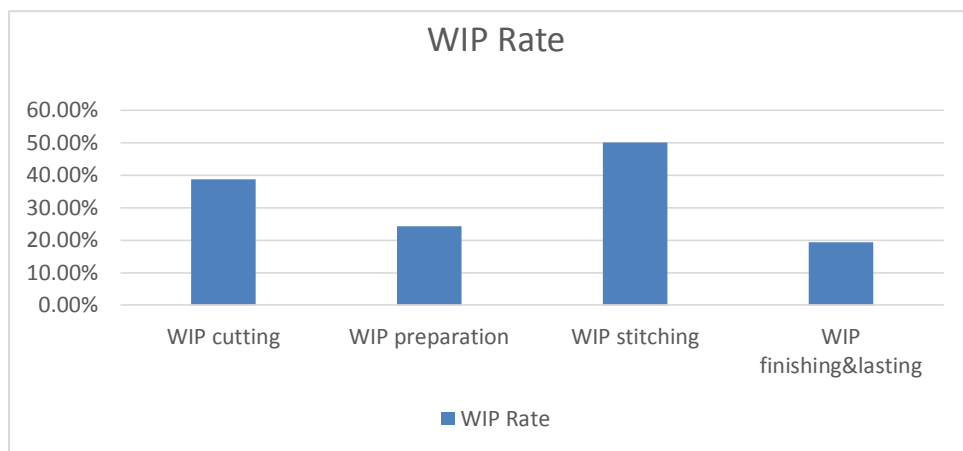


Figure 4. 8 WIP rates of different sections

As presented in the figure in Stitching section there is the highest inventory of work in process, it is 50%. So that it leads to difficult visual management, increasing processing time and losses of quality of production.

C. Over Processing

There is no more works, adding additional or more components in ZSF. The steps or procedures of product are as required by customers. Such as they do not run more analysis, using components what is needed.

When coming to they are using components with capacities, not using beyond the required. Also there is no double entry of data is occurred.

D. Waiting Time

Waiting refers to the time spent on waiting the component or material to come. The waiting time in each section is listed on the figure in second. Waiting time for stitching section is the longest time spent on waiting which is 2755 sec. by the standard of the company more than 5% of time of waiting is not acceptable. so it should need word in order to minimize this NVA activity waste.

Figure 4.10 shows that the waiting time for cutting section, preparation, stitching section, finishing & lasting packing and packing section.

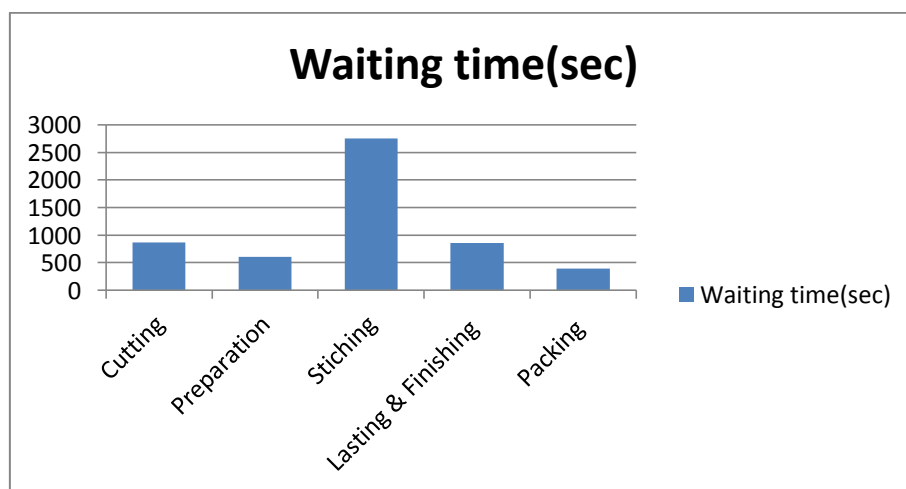


Figure 4. 9: Waiting time Comparison(Author)

As seen on Figure the waiting time in second of all section is mentioned those are waiting time for cutting is 870 Sec, whereas waiting time for preparation is 601.8 sec and Waiting time for stitching is 2755 Sec; waiting time for lasting & finishing is 858 Sec and finally waiting time for packing is 392 Sec the more waiting time spent is in stitching section.

Changeover Time

A changeover time is shown in the CVSM and it is seen that the stitching section has a high changeover time. The Changeover in Zemen Shoes Factory includes dispatch (communication), reshuffling line (rearranging the line for the plan that is given) and also workers.

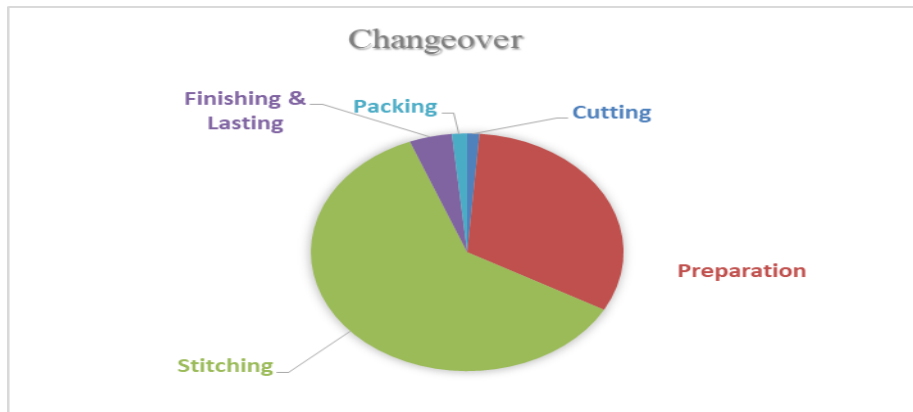


Figure 4. 10: Changeover Time Comparison (Author)

As seen Changeover Time Comparison in the figure above change over time in stitching section shares the largest percentage from other sections. And cutting is the lower one.

E. Waste of Transportation

Transportation waste is the unnecessary movement of parts and sub assembled components within different workstations. The time for transportation waste can be seen from activities flow process chart as shown before. In case of ZSF there is one-piece flow of production process. There are major long-distance(66m) transportations on the production process such as movement from temporary store to the cutting section has long distance, from cutting section to the preparation also. Especially from preparation to stitching and vice versa has a redundant movement of parts. And from preparation to lasting & from lasting to packing section have

long distance. The total transportation for the product to become a complete shoe, it travels a total distance of 66 meters and total time of 410.7 seconds.

F. Waste of Defect

Rework in case of model 23 shoe is Tortuous stitching round the throat. It is found on the upper part of shoe. The figure shows that 74% of model 23 products pass without rework whereas 26% is rework. When it is compared by departments, stitching section rework is very high and covers 16% of the rework rate due to tortuous stitching round the throat. The rework is seen in this section has an increasing impact of other sections problems.

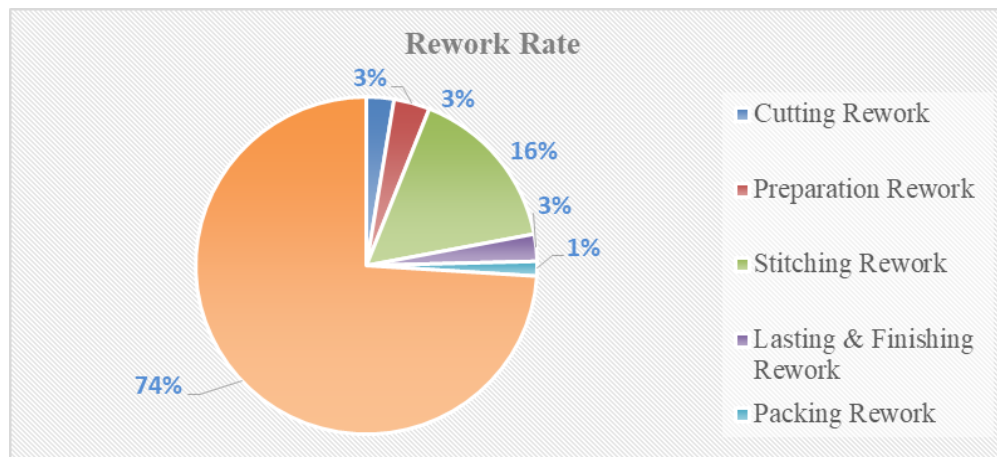


Figure 4. 11: Rework Rate Comparison (Author)

G. Waste of Motion

Waste of motion refers to the time spent for human actions that does not add value to the customer. Identifying waste of motion is a step-by-step approach. Those listing down show the general methodology for identifying motion waste.

1. Identify the area of the study
2. Identify the process
3. Identify motion element on the process
4. Record time taken for each motion element
5. Separate VA and NVA motion elements
6. Eliminate NVA activities

Motion is a broader concept which needs detailed study and analysis therefore it is difficult to address all the departments by a motion study nevertheless for the case of this study stitching

Section is selected to demonstrate how to identify motion wastes within a process. Stitching the section is suitable for motion analysis since it has the highest WIP rate. It is also one of the bottleneck departments that are holding up the process, in this section on which operations are performed by a full deal of labour without the help of semi or fully automatic machines. It is a section which blamed to run for a long time per single pair. Additionally, in this section, the largest rework rate on Model 23 footwear is observed which a 16% rework rate is.

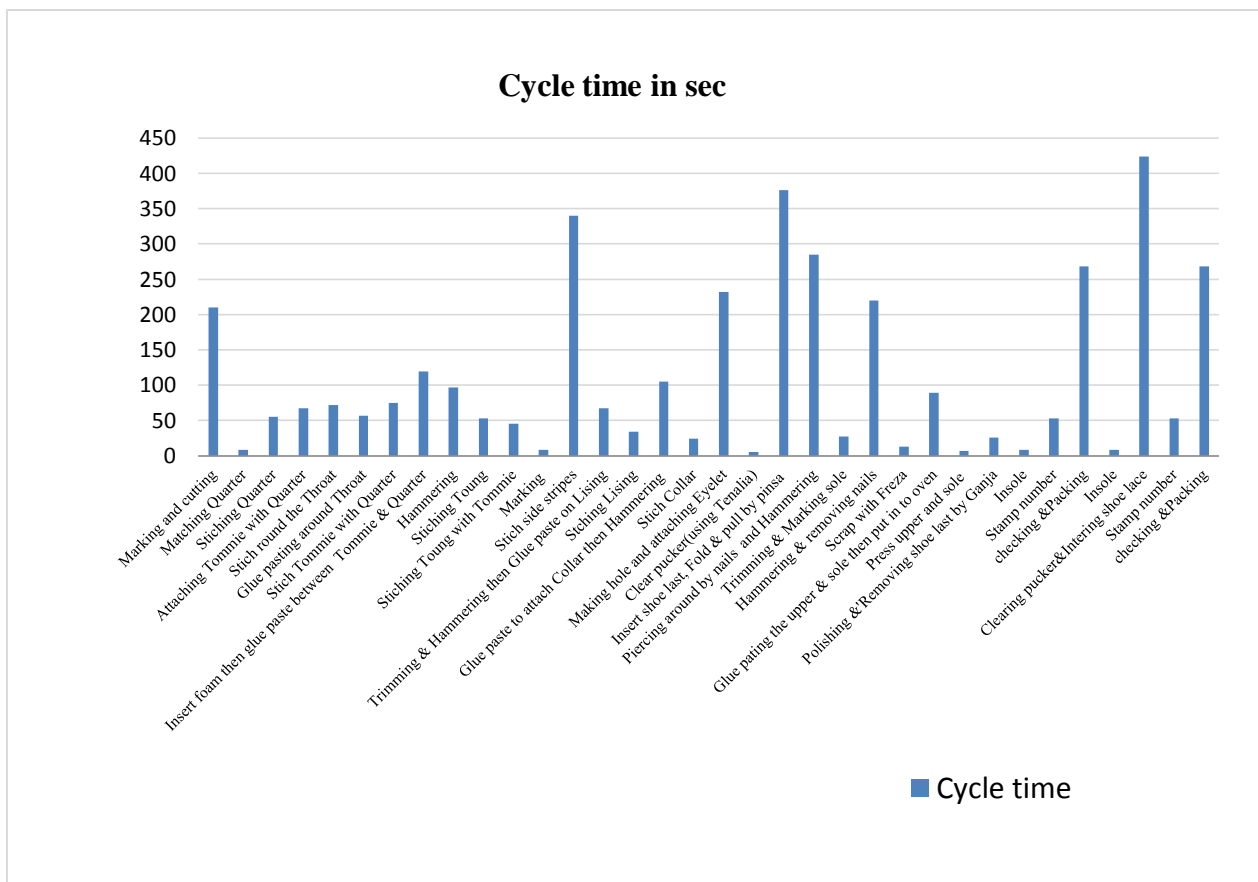


Figure 4. 12: Cycle Time of Production Process of model 23(Author)

Figure 4.13 shows the cycle time of operation for the production of model 23 footwear. Stitching side stripes, clearing pucker & interring shoelace, piercing around by nails and hammering are the top three cycle time of operation on the production of model 23 type of footwear.

Stitching workers have the largest cycle time of all. Even if other stations have larger cycle time, they perform different tasks also make more than single pair. At a minimum, they work on 2 or more tasks while the stitching section takes a long processing time to do one specific task. In consequence, detailed motion analysis would help to find out wastes within the activities of the workers of the stitching section.

1. Motion analysis (work element identification)

In order to find out motion wastes, detail motion elements on each operation need to be studied and they need to be observed according to value they contribute to the final output of model 23 shoe here the customer need should be taken into account.

Table 4. 164: Identification of Work Element (Author)

NO.	Work element
1	Stitching Quarter
2	Stitch round the Throat
3	Stitch Tommie with Quarter
4	Insert foam then glue paste between Tommie & Quarter
5	Stitching Tongue
6	Stitching Tongue with Tommie
7	Marking
8	Stitch side stripes
9	Stitching Lising
10	Stitch Collar

2. Waste Identification to Work Element

Each work element takes its processing time when performed by the operator but all of the elements might not be value adding activities. Some of them might be necessary due to current working condition others could totally be eliminated without experiencing any additional cost and effort by the company. Each work element is identified in the stitching section with the corresponding time taken by dividing into value added motion time (VAMT) & non-value added motion time (NVAMT). Table 4.17 shows waste identification in the motion elements.

Table 4. 175: Waste identification by Motion Analysis (Author).

No.	Work element	VAT (sec)	NVAT (sec)	Total
1	Picking up the matched Quarter which comes from the preparation section		12	12
2	Preparing the thread to sew		10	10
3	Stitching the left and the right-side Quarter	55		55
4	Placing the sewed component on the front for preparation section to be continue for next process		8	8
5	Picking up the “Tongue” which comes from the preparation section		8	8
6	Preparing the thread to sew		10	10
7	Stitch round the Throat edge	72		72
8	Placing “Tongue” on the front side of the preparation table		9	9
9	Picking up the Attaching Tommie with Quarter		8	8
10	Preparing the thread to sew		10	10
11	Stitch Tommie with Quarter(upper)	75		75
12	Insert foam then glue paste between Tommie & Quarter		319	319
13	Placing the tongue and the upper part in the front		8	8
14	Preparing the thread to sew		10	10
15	Picking the upper		5	5
16	Picking the tongue		5	5
17	Stitching the upper and the tongue	53		53
18	Placing the sewed component and marking for side stripes		8.3	8.3
19	Preparing the thread to sew		10	10
20	Stitch side stripes	240		240
21	Placing upper on the front side of the preparation table		8	8
22	Preparing the thread to sew		10	10
23	Stitching Lising	34		34
24	Placing upper on the front side of the preparation table		10	10
25	Preparing the thread to sew		10	10
26	Stitch Collar on the upper	24		24
	Total	553	479	1032

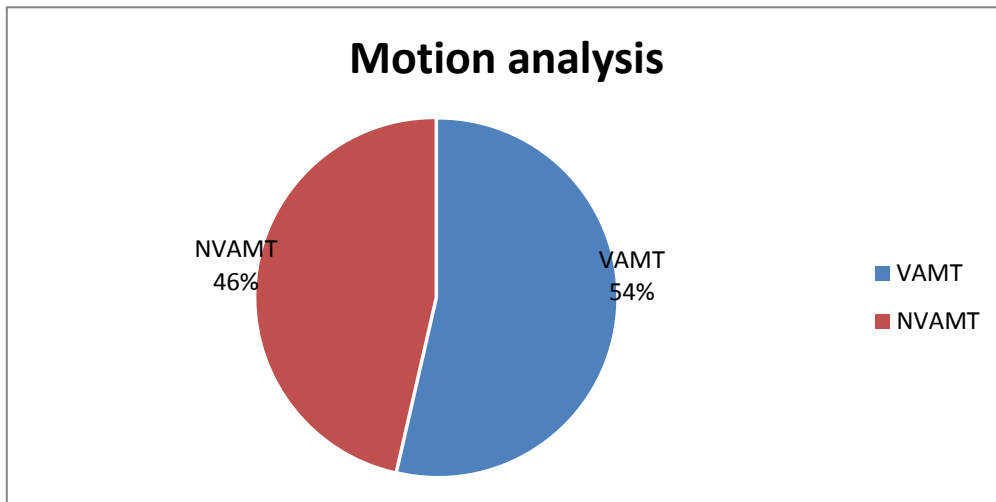


Figure 4. 13: Motion analysis (Author)

VAMT is 54% of the total time while the NVAMT covers 46% of the total time per single pair. Here the NVAMT could not be totally eliminated since it includes necessary non-value adding motion elements nevertheless it can be optimized to the minimum possible time.

4.6.6. Identifying the General Factors for Lower Labour Productivity

As a result of the VSM and process flow diagram the main types of wastes are exposed as seen above. The major root causes for the occurrence of these wastes are presented on the fishbone diagram shown below.

Figure 4.19 shows the main causes for the existence of the wastes within the process. The root causes are categorized into six which are motion waste, transportation waste, waiting waste, rework waste, excess inventory and factors related to equipment. The root cause analysis considers the major causes related to the production of model 23 shoes but the improvement of these factors would have an advantage for the enhancement of production process of all the products.

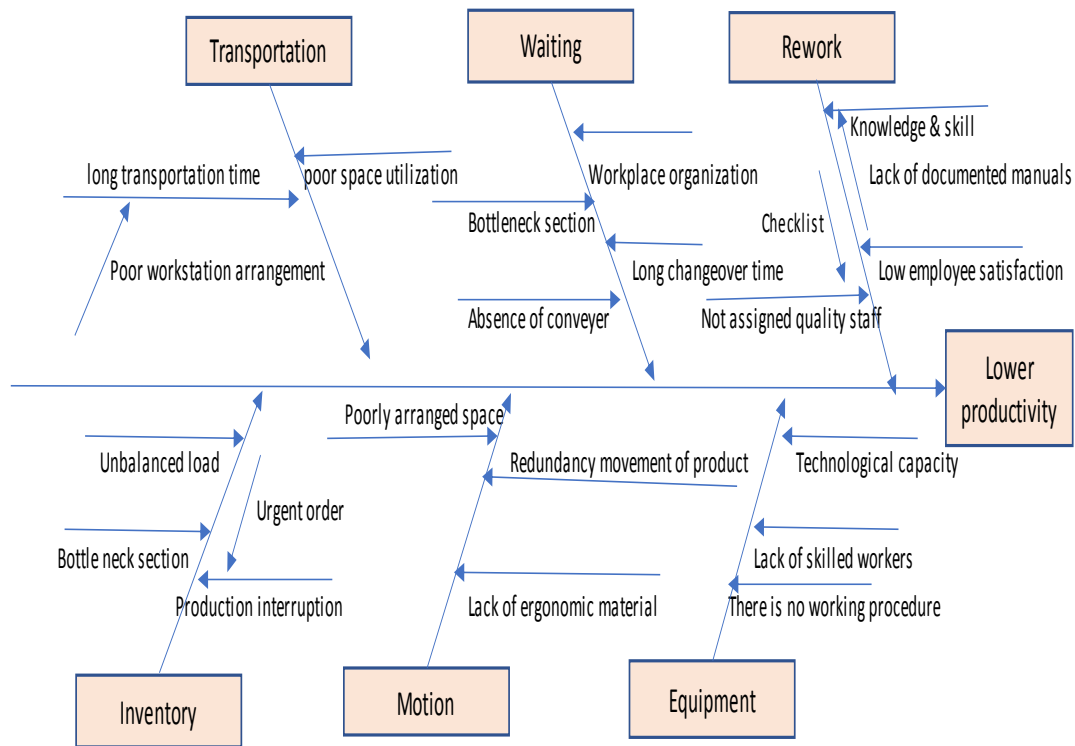


Figure 4. 14: Analysis of Root Cause for lower productivity(Author)

The detail description and the impact of the causes in the process time efficiency are:

Transportation - is unnecessary movement of parts, equipment and material from one place to another. Material Transportation does not add any kind of value to the product (Janne, 2018). It has Impacts on the process by longer cycle time due to poor workstation arrangement of production process & redundancy movement of products.

Space utilization – is how well you are consuming your space in order to make productive work. Weak scheme of arrangement can lead to have Poor space utilization.

Bottleneck section- is a section of function with the lowest capacity, usually the operation with the lengthiest cycle time per unit (Abrham, 2016). Has Impacts on the production process operation slower than the average due to un-evenly distributed load of operators. Also, there is no system of measuring operator’s capability (CAPA) in Zemen Shoe Factory.

Absence of conveyer- the main use of conveyer system is to move objects, property from one

place to another place by using an endless belt moving. In Zemen factory there is no conveyer for production process. They do all their works manually.

Changeover time - there are activities necessary to prepare an operation or process for another type of product. The time allocated for this is called changeover time or setup time.

Knowledge and skill –it developed or acquired through experience which is shown by the ability or to do something well. Higher rework rate and slower operation than the average time occur due to lack of skill and knowledge.

Documentation- is a vital part in order to allow traceability (**Manning & Sorlin, 2017**). All the documentation associated with production should be prepared, reviewed, approved and distributed according to written procedures. In Zemen manufacturing there are no documented manuals for training, Standard Operation Procedures (SOP), Standard of quality and so on.

Satisfaction of employee – is the state of being gratified within different acts held on the company. Employee satisfaction can be a result of higher rework rate which also leads to a slower process of operation than the average.

Unbalanced load- when the load of work on employee is not fairly and equally distributed unbalanced load occurs. Due to this operator, may overwork which have burden to do their tasks and some others have free time.

Production interruption - an activity or event that causes the disturbance or stopping of production in Zemen Company. The production can be interrupts when urgent order comes and daily production plans stops.

Absenteeism – Is employees not being present on the place of work during working time. Bottleneck operation occurs due to the absence of operator in a station.

Technological capability - shows how a company is technologically capable to do the intended job. Unavailability of modern technologies to ease the process leads to downtime by incapable (unqualified) machineries, so that most of operation will have to be made by man in the company.

Employee benefit (Incentive) – employee benefit motivates or encourages workers. In case of Zemen, there is no system to give incentives to the workers. This leads to lower employee satisfaction and motivation.

Work instruction & procedures (standardized process) – is one of documentation in order to show work instructions given to the employees in written form. Due to absence of SOP in Zemen Shoes Factory longer cycle time and rework due to lack of standardized work.

Check list for quality – is an informational job aid used to check, verify and inspect. Because of absence of check lists, it is difficult to know the exact or precise information & what needs improvement.

Quality control (QC) – QC is a process which gives to review, checks the quality of all aspects in production process. Defects occurred in redundant due to not assigned quality control staff in Zemen factory. The qualities of manufacturing goods are checked by production operators.

Workplace organization (5s) - The aim of 5S is to make a visible work area so that the workers can be more effective and facilitating identification of problems (Khan, 2019). In Zemen Transportation, there is back tracking due to unorganized workplaces. The necessary and unnecessary items are put together due to poor organization.

Ergonomics – is used to show whether the workplace is suitable for the workers to their job. Absenteeism and less output due to the presence of ergonomic risk factors.

Table 4. 18: Explanation of the Root Cause (Author)

Factors related to the transportation, waiting, motion, rework, inventory, and equipment		
No.	Factors	Impact on the process
1	Transportation	Longer cycle time due to poor workstation arrangement of production process & redundancy movement of products.
2	Space utilization	Poor space utilization due to weak scheme of arrangement.
3	Bottleneck section	Operation slower than the average due to un evenly distributed load on operators. Even there is no system of measuring operator’s capability (CAPA)
4	Absence of conveyer	They don’t have conveyer for production process. They did by manual works.
5	Changeover time	Larger rate of change over time due to Summation of machine set up and starting time.
6	Knowledge and skill	higher rework rate due to lack of skill, knowledge also Operation slower than the average

7	Documentation	There are no documented manuals e.g. training and so on
8	Satisfaction of employee	Process of operation slower than the average and due to satisfaction factors, it will be occurred higher rework rate.
9	Unbalanced load	The load of workers not evenly distributed. Some operators may overwork which have burden to do their tasks and some others have free time.
10	Production interruption	When urgent order comes daily production, plans stops.
11	Absenteeism	By the absence of operator in a station Bottleneck operation.
12	Technological capability	Unavailability of modern technologies to ease the process. So that Downtime by incapable (unqualified) machineries due to technology, Most of operation made by man.
13	Employee benefit (Incentive)	There is no incentive system it Leads to lower employee satisfaction and also motivation.
14	Work instruction & procedures (standardized process)	Longer cycle time and rework due to lack of standardized work. They don't have standard operational procedure (SOP)
15	Check list for quality	Difficulty to know the exact or precise information & what needs improvement due to improper using of quality sheet papers.
16	Quality control	Defect due to not assigned quality control staff. Quality is checked by production operators.
17	Workplace organization (5s)	Transportation, back tracking due to unorganized work places, the necessary and unnecessary items are put together.
18	Ergonomics	Absenteeism and less output due to the presence of ergonomic risk factors.

4.7. Adapted Future State Value Stream Map

The future state map is a visionary map drawn to propose suggestions for the Formwork product only by considering the proposed improvement ideas. Numerous lean manufacturing methods are adopted to decrease lead time, cycle time and increase output. As explained in the literature review for manufacturing cycle time the clock starts when work begins on request and finishes when the piece is complete for delivery. Setup time is the summation of the times expended setting up entirely workstations vital to process the part through the production

scheme. Transportation time is the summation of times expended moving a part among each workstation in the production directing for the part. Waiting time is the sum of the queue waiting at all workstations in the production routing for the part. Waiting time is usually the largest of all wastes likewise to this study. Thus, in order to minimize and eliminate wastes in Zemen Shoe Factory some of the major countermeasures or improvement opportunities are:

Table 4. 19: Opportunities for the improvement

No.	Waste Type	Improvement Opportunity
1	Additional motion	<ol style="list-style-type: none"> 1. Identifying and then removing redundant motion. 2. Use materials that ease the production at the stitching section (in preparation after done their task they put it on their table, and give the upper parts for the stitching section when they requesting to give some parts on hand.)
2	Waiting (delay)	<ol style="list-style-type: none"> 1. Set standard time using CAPA (capacity) measuring. 2. Maintenance for rework at the stitching section. 3. 5S implementation (Visual management). E.g. using different boxes to identify the material and easy to get them. 4. Minimize changeover time by implementation 5S (Visual management). 5. Starts using conveyors.
3	Transportation	<ol style="list-style-type: none"> 1. Change work place arrangement. 2. 5S implementation (Visual management).
4	Rework	<ol style="list-style-type: none"> 1. Using Standard procedure 2. Developing first product check in order to reduce the existence of defects and reworks that comes by group.
5	Excess Inventory	<ol style="list-style-type: none"> 1. Prepare standard WIP

4.7.1. Standard WIP calculation

As observed the production of 23 model shoe takes high level of inventory. Thus, standard work in process inventory is necessary. Standard work in process (SWIP) is the minimum necessary process inventory to maintain single piece flow.

As it is discovered overhead, the takt time of the model 23 shoe production process is **1173.9sec**. Based on that the SWIP, calculation is presented below. This calculation shows the optimum number of WIP which should be within the process. These limits should not be

passed by the operators. A standard work in process can be calculated by the formula thus the maximum WIP with in the process would be calculated as follows:

$$\text{SWIP} = \text{Cycle Time} / \text{Takt Time}$$

$$\text{CT cutting} = 360\text{sec}$$

$$\text{SWIP cutting} = 360/1173.9 = 0.3$$

$$\text{CT preparation} = 1244.5\text{sec}$$

$$\text{SWIP} = 1244.5/ 1173.9 = 1.06$$

$$\text{CT stitching} = 825.3 \text{ sec}$$

$$\text{SWIP} = 825.3/ 1173.9 = 0.7$$

$$\text{CT lasting \& finishing} = 1056.2 \text{ sec}$$

$$\text{SWIP} = 1056.2/1173.9 = 0.9$$

$$\text{CT packing} = 477 \text{ sec}$$

$$\text{SWIP packing} = 477/ 1173.9 = 0.41$$

4.7.2. Maintaining Marking lines at the Cutting Section

The availability uncertain or blurry marking area at the process leads the company to have two extra workers with two extra process steps on the production of model 23. These workers are the two Tommie or upper makers found at the stitching section.

For one employee to make marking in one pair of shoe takes 360 sec. This process can be done at the cutting section without adding any workload by giving them appropriate pattern. When rework is done loosen tread and try to re correct it again took more than four times of making it which is around 310 sec. any. This problem should be given emphasis by the company since it occurs in most demanded footwear types. It also brought significant result through reducing waiting time for its order.

4.7.3. Organization of workplace

5s activity implementing is also functioning for reducing time of searching and time of waiting. Workplace organization can also contribute to worker's satisfaction by creating a comfortable area of working which is free from dangers, risks and hazards. For example, in order to search for an upper, it takes more than 8 minutes for a worker but by using visual management or by separating the box or cart which have different colors in order to get Tommie parts speedily which has the capacity of holding more than 120 uppers, upper searching time can be minimized to 3 seconds.

And also, arrangement of workers and balancing quantity of workers in different station as needed based on measuring their capacity is crucial in order to reduce cycle time while reducing non value adding activities and improve productivity.

While rearranging the staffs it is going to considering the unnecessary movements of materials as well as man,so it is better to minimizes the transportation because transport waste comes by material movement that is not directly associated with a value adding process.

First, cutting station must be closer to ware house and designing area simultaneously because, those three areas works are much related and need more communication to do some task. By this phase it can reduce around 8.5 meters

Secondly, the cutting and preparation stations needs to be more closer because most of shoe models processes including model 23 is, the preparation section commonly receive the materials from cutting section. By this phase it can reduce around 5 meters. While the preparation and stitching section also lasting and finishing sections have the most optimum arrangement, so no need of re arranging.

Finally .from Lasting to packing it has long distance so, re arrangement needs and by formation a new path it will reduce the moving around 3 meters.

4.7.4. Standard Quality Control Format with staffs

In all station quality staffs with Standard Quality Control Format must checked and kept in place for collecting rejection, rework and product quality for all sections. Because of non-conforming materials and parts must be known in early stage without passing any further steps. Also, before all stations IQC incoming quality control staff is needed to check each batch by examining the incoming raw materials before they pass through any next steps. Also, this helps to communicate and deal with suppliers and makes it easier to identify the quality of materials before they are stored. The new organized quality staffs are incoming quality control (IQC) in line, quality control (QC) checks on processing shoes, quality assurance (QA) which checks sample by batch after assembling before packing and Overall Quality control (OQC) is quality staffs that see and give confirmation of the packed shoes, and OQC check the shoes as customer for production lines.

4.7.5. Future State Map

Based on the improvement ideas observed above, the ideal future state map of model 23 shoe production processes is presented in figure 4.16

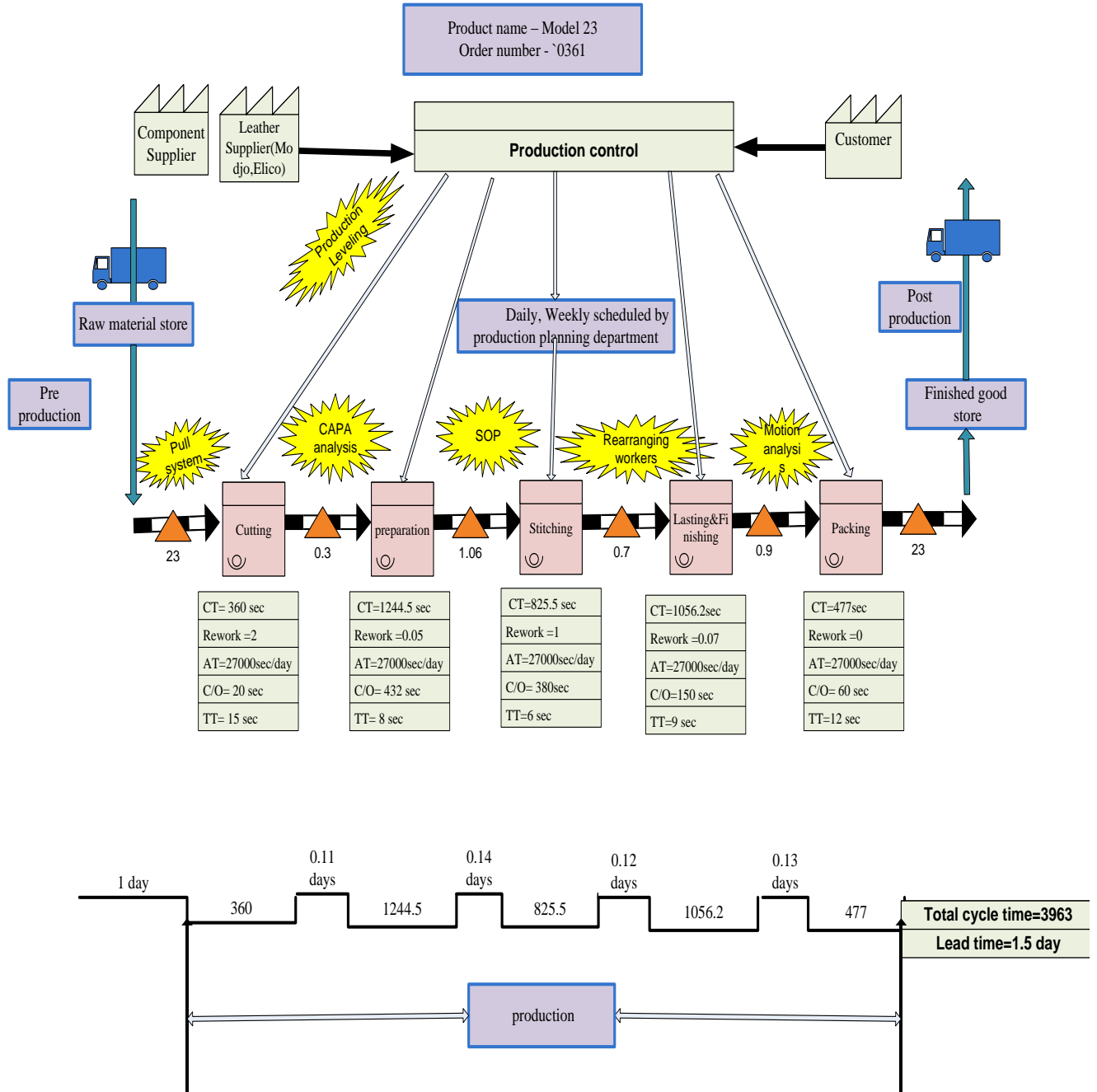


Figure 4. 15: Future State Value Stream Map

4.8. Work Standardization

4.8.1. Standard Time for Each Process Steps

The standard time for period (t) (Z t) is given by:

$$Z t = \text{Normal time} + \text{Allowances}$$

Where normal time = Average value of observed time

Based on ILO recommendation of the allowances of relaxation as the percent of the basic time, the constant allowances are 5% for the personal need allowance, 4% for the basic fatigue allowance for men, 7% personal need allowance and 4% basic fatigue allowance for women. Thus, for the case of the study 9% allowance is preferred since there are more male workers at the company than female workers which is more than 73% male workers.

Table 4. 20: Standard Time for the Process in all sections: (Author)

No.	Operation	Normal time (sec)	Allowances (%)	Standard time (sec)
1	Marking and cutting	210	0.09	210.09
1	Matching Quarter	8	0.09	8.09
2	Attaching Tommie with Quarter	78	0.09	78.09
3	Glue pasting around Throat	56.5	0.09	56.59
4	Hammering	97	0.09	97.09
5	Trimming & Hammering then Glue paste on Lising	67	0.09	67.09
6	Glue paste to attach Collar then Hammering	105	0.09	105.09
7	Making hole and attaching Eyelet	232	0.09	232.09
1	Stitching Quarter	55	0.09	55.09
2	Stitch round the Throat	72	0.09	72.09
3	Stitch Tommie with Quarter	75	0.09	75.09
4	Insert foam then glue paste between Tommie & Quarter	119	0.09	119.09
5	Stitching Tongue	53	0.09	53.09
6	Stitching Tongue with Tommie	45	0.09	45.09
7	Marking	8.3	0.09	8.39
8	Stitch side stripes	340	0.09	340.09
9	Stitching Lising	34	0.09	34.09

10	Stich Collar	24	0.09	24.09
1	Clear pucker (using Tenalia)	8	0.09	8.09
2	Insert shoe last, Fold & pull by pinsa	26	0.09	26.09
3	Piercing around by nails & Hammering	7	0.09	7.09
4	Trimming & Marking sole	89	0.09	89.09
5	Hammering & removing nails	13	0.09	13.09
6	Scrap with Freza	220	0.09	220.09
7	Glue pasting the upper & sole then put in to oven	27.2	0.09	27.29
8	Press upper and sole	285	0.09	285.09
9	Polishing & Removing shoe last by Ganja	376	0.09	376.09
10	Insole	5	0.09	5.09
1	Clearing pucker & Entering shoe lace	24	0.09	24.09
2	Stamp number	13	0.09	13.09

As observed in the current state value stream mapping CVSM of total cycle time for the process was 16488.1 sec. The proposed standard time (optimized cycle time) has reduced to 2774.79 seconds per single pair model 23 footwear. This cycle time could be achieved if the preconditions such as the workplace organization by 5S, and SWIP, Standard Quality Control Format with staffs are fulfilled. Based on the standard the comparison between the actual cycle time, takt time and value adding cycle time is presented in figure 4.17 below. As it is shown in the figure FVSM shows the reduction of cycle time of the process.

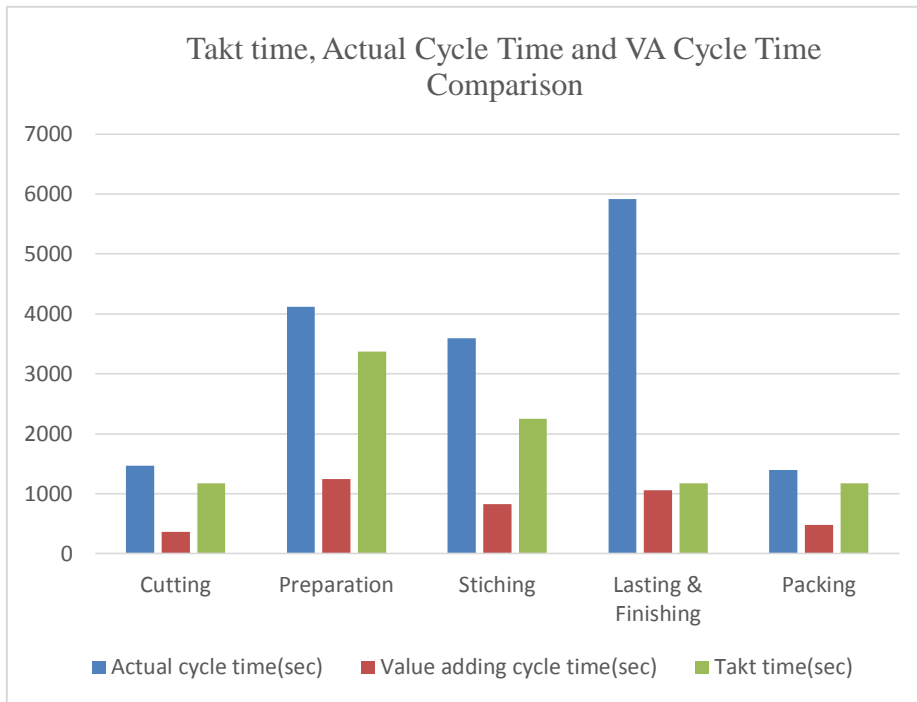


Figure 4. 16 Takt time, Actual Cycle Time and VA Cycle Time Comparison

In order to understand the productivity improvement, by taking one-piece flow as a total output of daily plan is 23 pairs with 48 workers before and after implementation of VSM and by 8.2 days(708.780sec) before and 1.5 days (129,600) after implementation of VSM.

4.8.2. Sustaining Standard

Based on the data investigation known above, the method has a great benefit for the improvement of cycle time and productivity. If there is development needed to be relevant for other shoe models and if the outcomes are required to be sustainable or maintainable for the long run, it is significant to have a standard framework for the process to be followed. The all-purpose approach for VSM application is reducing cycle time and generating a standardized work in a company as shown on Figure 4.18

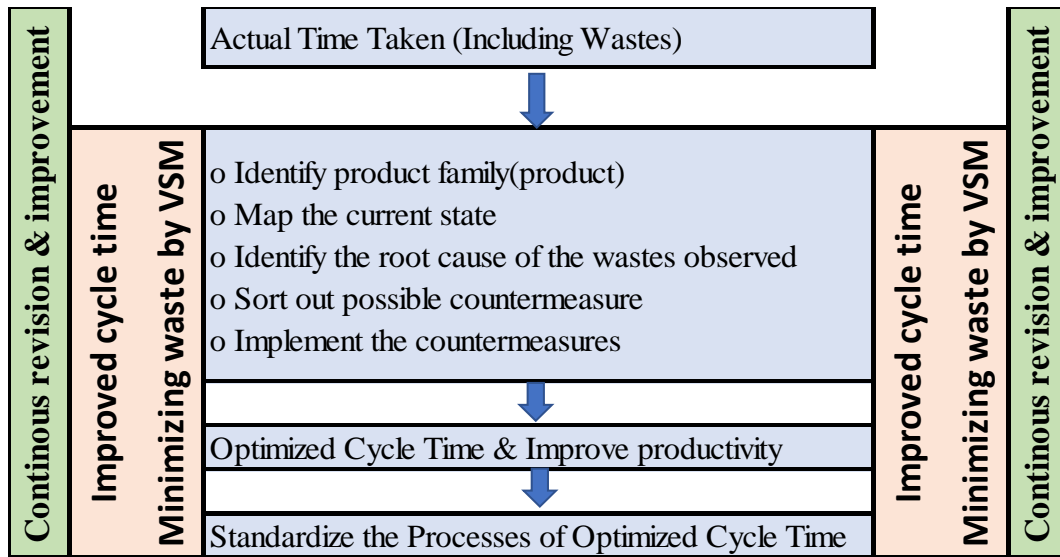


Figure 4. 17: Model for Standardized Process

For the standardizing to be more effective company has to improving

- The important fundamental items,
- Fulfilling requirement prerequisite for basic skill,
- Deciding the conditions of working and
- Giving theoretical & practical training for each section of processes should be continually working on.

1-Important Fundamental Items The basic fundamental items include working on team, implementation of 5s and following working instructions standards.

Implementation of 5s: Organizing the workplace helps the company to minimize wastes and to have more efficient time utilization. 5s implementation should be the basis for every section on the company. It utilizes workplace organization and work simplification techniques to make work easier, faster, cheaper, safer and more effective. But before implementing 5S top management understands, commitment and positive involvement in the program is required.



Figure 4. 18 Importance of implementation of 5s

- ✓ **Teamwork:** Workers should collaborate with each other towards the development of a company. Thus, teamwork is when colleagues work together well, try their best in any circumstances, cooperate using their individual skills and providing constructive feedback to each other towards a common goal.
- ✓ **Following Working Rules and Standards:** In order to sustain any activity rules and procedures should always be followed by all employees at any time. Following working rules and standards reduces differences and encourages goodness through constant implementation of procedure within the organization, even if there are temporary or permanent personnel changes.

2-Fulfilling Requirement for Basic Skill

Preparing manuals for training systems and job instruction guide is one of the helpful methods for employees to grasp the work content easily and to standardize fulfilling requirement of basic skill. After this it's better to know their performance by giving continuous assessment and know their working performance, in order to rearrange them by their working ability. Standardizing a certain activity is used for the company to have a consistency of work. It is used to carry out the operations correctly and always in the same manner. The objective of this module is to help supervisors develop a well-trained workforce who have the required skill and follow the standard incessantly. Should be reviewed (validated) by one or more individuals with appropriate training and experience with the process. Also, it could be upgraded when needed. A good standard work sequence (SOP) needs to have the following qualities that are

listed below.

- Should provide model information & all the information necessary to perform a task
- Is usually specific to the equipment used for the procedure
- Should be detailed
- Should provide Quality Control information
- Should list materials that they use

3-Decide the Working Conditions

Setting standard for the operations and controlling and periodically observing the process (process conditions quality check sheet, productivity check sheet etc.). These types of standards help the company to pinpoint weaknesses and strengths easily. For example, in case of Zemen Shoes Factory currently there is no standard quality recording format. If this format is prepared, the company would be able to get insight into the occurrence of waste or rework. Besides it would be helpful for identifying the main rework generating department, the impact it had on the company productivity and ways to minimize or eliminate the problem. Based on this, standard quality recording sheet can be prepared as seen in Annex III.

4-Theory & Practical Training for Element Operations (Job Methods Training)

On Job method training has the objective of helping the supervisors to produce greater quantities of quality products in less time. By coaching and training through on job step by step working out to make the best use of the manpower, machines, and material available at hand. For instance, it's easy to understand for step-by-step training using sop with its quality control points.

5-Standardize the Work

Standardized work should be performed in a cyclic manner. While the company standardizes a work, the following concepts should be given attention **Always check the control points of quality before starting operation:** The production process to go according to the customer demand thus the company needs to revise the customer specification frequently. Also, before starting producing it's better to know quality control points in order to minimize the defect occurrences. **Decide the sequence of operation:** The sequence of operation can be revised by

continuously reviewing the existing process and finding better improvement ideas. Due to various changes through time, it is necessary to continuously assess the working process according to purpose, place, and sequence.

The critical examination for recording the workers capacity is important and to measure & improve CAPA those 3 listed points are important

1. Optimize SOP
2. Train staff improve skill of staff and
3. Arrange staff reasonably according to their skills.

Therefore, it is important to check the worker capacity (CAPA) of Stitching section and know Neck bottle Station, which has the longest operation time. And neck bottle time is the operation time of neck bottle station and it is shown on Annex IV.

Decide the number of in process parts: The number of in process parts should be decided in order to eliminate and minimize the number of inventories within the process. Generally the standardization of work implies an iterative, cyclic continuous improvement which doesn't have an end. There would always be an improvement for the process. An optimized process would be reviewed, and it could be improved further in changing situation.

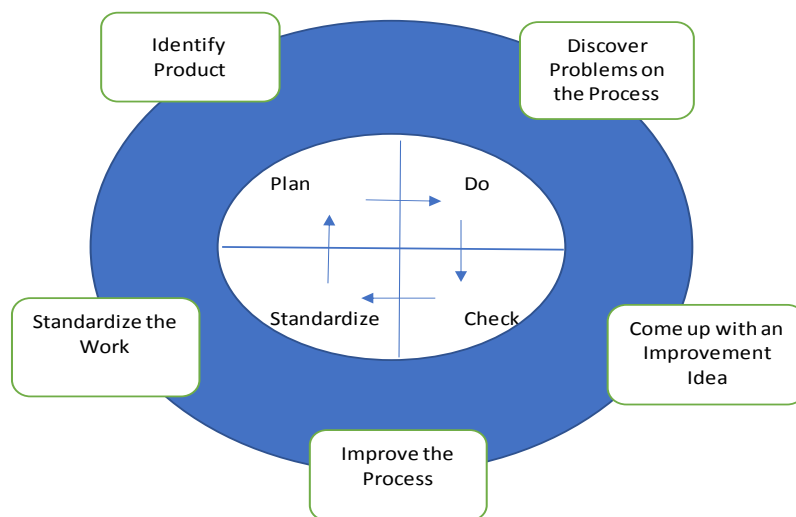


Figure 4. 19: Continuous Improvement to Standardized Work

4.9. Results obtained from the Future State Value Stream Map FSVSM

The FSVSM is prepared for the Formwork product only by considering the proposed improvement ideas. In the FSVSM, the problems seen in the CSVSM are recovered by reducing the non-value adding activities by using both the quantitative and qualitative methods. The finding of the study suggests that the existence of wastes in a production process has a great impact on the increase of cycle time and lead time of the production process (Kirubakaran & Selvan, 2018). These means the processing time of model 23 footwear was too much comprehensive (broad) which is more than 9 days due to transportation, rework, unnecessary motion, inventory and longer changeover time. The study demonstrates that the time can be minimized to 1.5days if the wastes are eliminated. Furthermore, the study shows that elimination of wastes will be helpful to match the customer Takt time with the cycle time.

Table 4. 21: Summary of Results Calculated from Survey, (2020)

Total	CVSM	FSVSM
Number of process steps	77 (including the NVA)	31
Cycle Time (sec)	16488.1	3963
Distance (m)	66	49
WIP (in pair)	48(average WIP)	4
Lead time	8.2days(708,480sec)	1.5days(129,600sec)

Productivity before FVSM is 0.31pairs/person/day and Productivity after FVSM is 4.2 pairs/person/day.

As the calculation has shown that the labour productivity has improved after feature value state mapping (FVSM), also using same amount of number of employees or workers.

Chapter Five

2. Conclusion, Recommendation and Future Work

5.1. Conclusion

Companies have a duty to optimize and improve their process by reducing as well as eliminating wastes so that any activity that doesn't add value should be removed. By evaluating the existing condition of Zemen Shoes Factory, the study showed that productivity of the company is highly affected due to the occurrence of wastes within the process. Thus, improving the process should be taken as a critical task in the company.

In this study all the processes starting from the cutting section up to the packing section are studied and current state map is drawn. VSM tool is selected since it is the most appropriate tool to find wastes in model 23 shoes of Zemen Shoes Factory which is known as an icon for the company. The major types of wastes which are identified in the process are waiting time waste, motion waste, transportation waste, rework, changeover time, and inventory. The study generally has shown unnecessary waiting time and transportation is the major providers for the occurrence of wastes.

Number of process steps 77 (including the NVA) has reduced to 31 (VA operations). The average WIP was 48 pairs, by setting SWIP it is decreased to 4 pairs. The cycle time was reduced from 16488.1 sec to 3963 sec the distance traveled by the product has decreased from 66m to 49m. The study demonstrates that other than reducing lead time, the VSM approach could be helpful tool to create standardized work which is free from wastes and measuring capacity of worker is improving the process and enhances the productivity. In addition, the study shows how VSM approach could be applied for a single product.

5.2. Recommendation

It is recommended that the company pays attention to the process optimization through VSM approach to improve the productivity and base the work on what the customers actually want.

The standard developed should be applied sustainably thus it is recommended that the method developed to sustain standard should be taken into consideration.

The study has analyzed seven wastes related to the process. The company should take initiatives to identify other types of wastes. Moreover the scope could be broadened on identifying and eliminate any wastes and non-value added activities across the company. Zemen Shoes Company should introduce other competitive production systems so as to improve the productivity and to become competitive in the world class manufacturing as well.

5.3. Future work

Realizing the possible benefits of the study, the research can go further to conduct an analysis on the whole production lines and product types on the company. The procedures which have been used on this study can be applied here. The study has been conducted for shoe model 23 process flows. In the future the study can be arranged for different models of shoe. VSM waste elimination in macro or higher level could also be done for the entire process by studying detail analysis of each station of standard operational procedure and giving training to develop their capacity. To extend the research project to a wide-ranging value stream mapping of the entire material and information flow and other inventory data should be considered. Only wastes related to the process are analyzed in the study. Likewise, the study can be broadened to the overall value flow chain beginning from the input to the output.

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Appendix I Survey Questionnaire



Addis Ababa University

Addis Ababa Institute of Technology

School of Mechanical and Industrial Engineering

Dear Sir/Madam,

My name is mister Binyamin am a student of Master of Industrial Engineering at Addis Ababa Institute of Technology. The Questionnaires developed as part of my research paper for the requirements of an MSc in industrial engineering is supposed to be distributed for you. The purpose of the questionnaire is to collect relevant information for the research. The research is entitled “**Enhancing Productivity of SMEs through VSM: A Case of Addis Ababa**”. This questionnaire is used for only academic purposes and will not be submitted to a third party or any other use. The questionnaire has three parts. The first part focuses on your and your firm's background. The second and third part addresses the required information to achieve the research objective.

Therefore, this is to request your kind cooperation to fill the questionnaires so that I will accomplish my research work plus I will present the finding to your organization for improvement in sight.

If you have any questions, you may direct it to me through my contact addresses given.

Thank You in advance for your cooperation!

Name -Mistir Binyam

Email – missibini@gmail.com

Address-Addis Ababa, Gulele sub-city

Telephone - 0911418682

Part 1: General questions / Information

These general questions are asked for all of the interviewees.

1. **Sex:** _____
2. **Age:** _____
3. **Level of Education:** _____
4. **Job Position:** _____
5. **Respondent position in the firm:** _____
6. **Work Experience:** _____

Part 2: Understanding the firm productivity

This part of the questionnaire is organized to be familiar with different general information about company productivity and to examine in general the information about the selected product (model 23), specifically to conduct the research.

Please mark \surd inside the rectangle box to answer the following questions for understanding about the productivity of the organization, degree measuring method using Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. Please rate your enterprise

No	Questions	Strongly agree	Agree	Disagree	Strongly disagree	Neutral
10	There is a good communication on production department.					
11	Mostly there is non-conformable product on Zemen Shoe Company.					
12	Immediate superior support you by fulfilling materials, information, and other things that are used for the production process.					
13	Zemen company has a productivity strategy.					
14	Frequently model 23 shoe is ordered from customer.					
15	There are major quality problems that occur on the model 23.					
16	You able to improve the production process of model 23.					
17	There are different categories (types)					

	of wastes that are observable exceedingly on production process.					
18	The employees can make all types of product that found in Zemen company.					
19	There are different causes for low productivity in your company.					
20	There is quality problem or defect occurring repeatedly (frequently) on model 23 shoe.					
21	Your firm has knowledge of value adding and non-value adding activities on the production process.					
22	Your company has methods used to analyze productivity.					
23	There is an appropriate and suitable condition or environment for the process to do tasks in the production department.					
24	There is a possible solution for the improvement of production for the selected product.					

Part three: Open Ended questionnaires

1. What are the most challenging in your organization resulting in poor productivities?
List out.

2. What are the factors help your organization to increase their productivities?

3. What do you think the improvement mechanism to be used to upscale productivity?

THANK YOU FOR YOUR COOPERATION!!!



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 አዲስ አበባ ቴክኖሎጂ ኢንስቲትዩት
 ADDIS ABABA UNIVERSITY
 አዲስ አበባ ዩኒቨርሲቲ

አዲስ አበባ ዩንቨርሲቲ

አዲስ አበባ የቴክኖሎጂ ተ(ም)

የመካኒካል እና ኢንዱስትሪያል ኢንጅነሪንግ ትምህርት

የ አነስተኛ እና መካከለኛ ኢንተርፕራይዞች ምርታማነትን ለማጥናትና በቫልዩ ስትሪም ማፒንግ በኩል ለማሳደግ የተዘጋጀ መጠይቅ

ውድ ሠራተኞች፣

ሚስጥር ቢኒያም እባላለሁ በአዲስ አበባ የቴክኖሎጂ ኢንስቲትዩት የኢንዱስትሪያል ኢንጅነሪንግ ማስተርስ ተማሪ ነኝ ። በኢንዱስትሪ ኢንጅነሪንግ ውስጥ ለማስተርስ መስፈርቶች ለምርምር ወረቀቴ አካል የሆኑት መጠይቆች ለእርስዎ ይሰራጫሉ ተብሎ ይገመታል ። የመጠይቁ ዓላማ ለምርምር ተገቢ መረጃዎችን መሰብሰብ ነው ። ጥናቱ “በ ቫልዩ ስትሪም ማፒንግ አማካይነት

የአነስተኛ እና መካከለኛ ኢንተርፕራይዞች ምርታማነትን ማሳልበት የሚል ነው ። ይህ መጠይቅ ለአካዳሚክ ዓላማ ብቻ የሚያገለግል ሲሆን ለሶስተኛ ወገን ወይም ለሌላ አገልግሎት አይሰጥም ። መጠይቁ ሶስት ክፍሎች አሉት ። የመጀመሪያው ክፍል በእርስዎ እና በድርጅትዎ ዳራ ላይ ያተኮራል ። ሁለተኛው እና ሶስተኛው ክፍል የምርምር ዓላማውን ለማሳካት የሚያስፈልጉትን መረጃዎች ይመለከታል ።

ስለሆነም ይህ መጠይቆቹን ለመሙላት የርስዎን ትብብር ለመጠየቅ ነው ፣ ስለሆነም የምርምር ሥራዬን አጠናቅቄያለሁ እናም ግኝቱን ለዕይታ ለማሻሻል ለድርጅትዎ አቀርባለሁ ።

ማንኛውም ጥያቄ ካለዎት ከታች ባለው አድራሻዎች በኩል ወደ እኔ መምራት ይችላሉ ።

ስለ ትብብርዎ በቅድሚያ አመሰግናለሁ!

ስም - ሚስጥር ቢኒያም
 ኢሜል - missibini@gmail.com
 አድራሻ-አዲስ አበባ ፣ ጉለሌ ክፍለ ከተማ
 ስልክ - 0911418682

ክፍል አንድ: አጠቃላይ ጥያቄዎች / መረጃ

እነዚህ አጠቃላይ ጥያቄዎች ለቃለ-መጠይቆች ሁሉ ይጠየቃሉ ።

1. ጾታ _____
2. ዕድሜ _____
3. የትምህርት ደረጃ _____
4. የሥራ ቦታ _____
5. በድርጅቱ ውስጥ ተጠሪ ቦታ _____
6. የሥራ ልምድ _____

ክፍል ሁለት: ጠንካራ ምርታማነትን ለመገንዘብ የቀረቡ ጥያቄዎች

ይህ መጠይቅ ክፍል ስለ ከባንያው ምርታማነት የተለያዩ አጠቃላይ መረጃዎችን በደንብ እንዲያውቅ እና በአጠቃላይ ስለ ምርቱ ምርት (ሞዴል 23) መረጃ ለመመርመር የተደራጀ ነው ፣ በተለይም ጥናቱን ለማካሄድ ።

ስለ ድርጅቱ ምርታማነት ፣ የዲግሪ የመለኪያ ዘዴን በተመለከተ በፅኑ እስማማለሁ ፣ አልስማማም ፣ ገለልተኛ ፣ እስማማለሁ ፣ እና በጣም እስማማለሁ የሚለውን ለመረዳት የሚከተሉትን ጥያቄዎች ለመመለስ እባክዎን በአራት ማዕዘን ሳጥኑ ውስጥ ምልክት ያድርጉ ። እባክዎ ለድርጅትዎ ደረጃ ይስጡ።

ቁጥር	ጥያቄዎች	በጥብቅ እስማማለሁ	እስማማለሁ	አልስማማም	በጣም አልስማማም	ገለልተኛ
7	በምርት ክፍል ላይ ጥሩ ግንኙነት አለ ።					
8	በአብዛኛው በዘመን ጫማ ከባንያ ላይ ጉድለት ያለበት ወይም የማይጣጣም ምርት አለ ።					
9	የበላይ ተቆጣጣሪ ለምርት ሂደት የሚያገለግሉ ቁሳቁሶችን ፣ መረጃዎችን እና ሌሎች ነገሮችን በማሟላት ፈጣን እና የላቀ ድጋፍ ይስጥዎታል ።					
10	የዘመን ከባንያ ምርታማነት ስትራቴጂ አለው ።					
11	በተደጋጋሚ ሞዴል 23 ጫማ ከደንበኛ የታዘዘ ነው ፡					
12	በሞዴል 23 ላይ የሚከሰቱ ዋና ዋና የጥራት ችግሮች አሉ ።					
13	የሞዴል23ን የምርት ሂደት ማሻሻል ይችላሉ ።					

14	በምርት ሂደት ውስጥ እጅግ በጣም የሚስተዋል የተለያዩ ለምርት ሂደት የማያስፈልጉ ነገሮች አሉ ።					
15	ሰራተኞቹ በዘመን ከባንያ ውስጥ የተገኙትን ሁሉንም የምርት ዓይነቶች ማምረት ይችላሉ ።					
16	በከባንያ ውስጥ ለዝቅተኛ ምርታማነት የተለያዩ ምክንያቶች አሉ ።					
17	በሞዴል 23 ጫማ ላይ በተደጋጋሚ የሚከሰት የጥራት ችግር ወይም ጉድለት አለ ።					
18	የእርስዎ ድርጅት በምርት ሂደት ላይ እሴት የመጨመር እና እሴት-አልባ እንቅስቃሴዎች ላይ እውቀት አለው።					
19	ከባንያዎ ምርታማነትን ለመተንተን የሚያገለግሉ ዘዴዎች አሉት ።					
20	በማምረቻ ክፍሉ ውስጥ ሥራዎችን ለማከናወን ለሂደቱ ተስማሚ ሁኔታ አለ ።					
21	ለተመረጠው ምርት ምርትን ለማሻሻል መፍትሔ አለ ።					

ክፍል ሶስት: በተሰጠው ክፍት ቦታ ተሰማሚውን መልስ ለማስፈር የተጠናቀቁ መጠይቆች

1. በድርጅትዎ ውስጥ ደካማ ምርታማነትን የሚያስከትለው በጣም ፈታኝ ችግር ምንድነው? ይዘርዝሩ ።

2. ለድርጅትዎ ምርታማነታቸውን እንዲያሳድጉ የሚረዱት ነገሮች ምንድን ናቸው?

3. ምርታማነትን ለማሳደግ የሚያገለግል የማሻሻያ ዘዴ ምንድነው?

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ለትብብርዎ እናመሰግናለን!!!

Appendix II: The severely product (2011 EC - 2012 EC)

No.	Types of shoe model	Production Volume		Total
		2011E.C	2012E.C	
1	Model 23	5150	6756	11906
2	Model 32	3522	3482	7004
3	Model 31	2236	1956	4192
4	Model 47	1664	1612	3276
5	Model 42	1522	1214	2736
6	Model 35	784	1470	2254
7	Model 08	938	1098	2036
8	Model 51	818	674	1492
9	Model 40	604	660	1264
10	Model 41	480	688	1168
11	Model 01	596	560	1156
12	Model 28	684	400	1084
13	Model 36	354	644	998
14	Model 10	440	498	938
15	Model 05	450	448	898
16	Model 57	340	488	828
17	Model 15	444	300	744
18	Model 25	354	368	722
19	Model 65	414	304	718
20	Model 04	344	370	714
21	Model 34	330	354	684
22	Model 29	424	240	664
23	Model 62	270	384	654
24	Model 18	387	240	627
25	Model 26	294	274	568
26	Model 55	230	314	544
27	Model 27	290	180	470
28	Model 68	304	160	464
29	Model 30	304	130	434
30	Model 20	350	80	430
31	Model 50	210	210	420
32	Model 44	250	160	410
33	Model 56	264	140	404
34	Model 38	200	170	370
35	Model 60	330	-	330
36	Model 33	140	160	300
37	Model 11	40	144	184
38	Model 14	120	50	170
39	Model 67	110	-	110
40	Model 13	80	-	80
Total		27065	27380	54446

Appendix III: Standard Quality Control Format

For collecting rejection, rework and product quality for different shoe models

Defect sheet	
Station -	Date -
Line -	Checked by-
Product type (Model) -	Signature -
Plan no -	
Color -	


No.	Defect type	Defect number	Total	Remark
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				


Appendix IV: Standard CAPA analysis Format


CAPA analysis				
Product type (Model) -				
Line -				
personal quantity -				
Neck bottle station -				
Neck bottle time -				
Average operational time -				
No.	Station	Personal Quantity	Operational Time	Average Time
1	Stitching Quarter			
2	Stitch round the Throat			
3	Stitch Tommie with Quarter			
4	Insert foam then glue paste between Tommie & Quarter			
5	Stitching Tongue			
6	Stitching Tongue with Tommie			
7	Marking			
8	Stitch side stripes			
9	Stitching Lising			
10	Stitch Collar			


Date -	
Checked by-	
Signature -	


Appendix V: Standard operational procedures for Stitching section SOP


Zemen Shoe Factory		
Sheet No. - 1		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Quarter Stitching
Operational procedure		Equipment used
<ol style="list-style-type: none"> 1.Pick the matched left and right Quarter 2.Align equally and make straight both Quarters 3. Pick the thread and needle 4.Start single line sewing it from the left to the end 		<ol style="list-style-type: none"> * Needle * Thread
		Control points
		<ol style="list-style-type: none"> 1.Correctly fit the tip of the needle to the equally aligned Quarter 2.Stop sewing when you observe any abnormality or any mismatch
Supervisor -		Made by - Mistir Binyam


Zemen Shoe Factory		
Sheet No. - 2		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stich round the Throat
Operational procedure		Equipment used
<ol style="list-style-type: none"> 1.Pick the and feed the Tommie 3. Pick the thread and needle 4.Start curved single sewing of Tommie from the left to end 		<ol style="list-style-type: none"> * Needle * Thread
		Control points
		<ol style="list-style-type: none"> 1.Correctly fit the tip of the needle to the Tommie 2.when sewing make sure the curve have stitching evenly & equally in dimension. 2.Stop sewing when you observe any abnormality or any mismatch
Supervisor -		Made by - Mistir Binyam


Zemen Shoe Factory		
Sheet No. - 3		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stich Tommie with Quarter
		Equipment used * Needle * Thread
Operational procedure		Control points
<ol style="list-style-type: none"> 1.Pick the Quarter 2. Pick the Tommie 3.Match It Quarter & Tommie based on guiding mark 4. Pick the thread and needle 5. Start sewing from the left to the end 		<ol style="list-style-type: none"> 1.before start sewing make sure whether the Tommie with Quarter are connected as marked. 2.Stop sewing when you observe any abnormality or any mismatch
Supervisor -		Made by - Mistir Binyam


Zemen Shoe Factory		
Sheet No. - 4		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Insert Foam then glue paste between Tommie & Quarter
		Equipment used * Foam * Glue * Brush
Operational procedure		Control points
<ol style="list-style-type: none"> 1.Pick the Foam 2.Pick Tommie & Quarter 3. Insert Foam between Tommie & Quarter 4..Pick the glue 5.glue paste between Tommie & Quarter 		<ol style="list-style-type: none"> 1.Insert Foam Correctly 2. Pasting Glue properly inside avoid observed outside
Supervisor -		Made by - Mistir Binyam


Zemen Shoe Factory		
Sheet No. - 5		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stitching Tongue
		Equipment used * Needle * Thread
Operational procedure	<ol style="list-style-type: none"> 1. Pick the tongue 2. Pick the thread and needle 3. Start sewing round of the tongue from the left to end. 	Control points <ol style="list-style-type: none"> 1. Correctly fit the tip of the needle to the edge of the tongue 2. Stop sewing when you observe any abnormality or any mismatch
Supervisor -	Made by - Mistir Binyam	

Zemen Shoe Factory		
Sheet No. - 6		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stitching Tongue with Tommie
		Equipment used * Needle * Thread
Operational procedure	<ol style="list-style-type: none"> 1. Pick the Tommie 2. Pick the tongue 3. Pick the thread and needle 4. Sewing tongue with Tommie part from the left to end. 	Control points <ol style="list-style-type: none"> 1. Correctly fit the tip of the needle to the Tommie and tongue 2. Stop sewing when you observe any abnormality or any mismatch
Supervisor -	Made by - Mistir Binyam	

Zemen Shoe Factory	
Sheet No. - 7	Section - Stitching
Date of Start using SOP -	Line - A1 ,A2
	Model - Model 23
Material image	Description - Marking
	Equipment used * Marker * Patern
Operational procedure 1.Pick the Marker 2.Pick the Patern 3. Place the pattern and mark based on direction of patern guidance on the side of upper 4.Marking Carefully &clearly	Control points 1.Make sure to sketch the marker neatly and clearly.the marker must be visible to stitch it.
Supervisor -	Made by - Mistir Binyam

Zemen Shoe Factory	
Sheet No. - 8	Section - Stitching
Date of Start using SOP -	Line - A1 ,A2
	Model - Model 23
Material image	Description - Stich side stripes
	Equipment used * Needle * Thread
Operational procedure 1.Pick the upper 2. Pick the thread and needle 3.Start single line sewing from the left to the end based on side marking stripes	Control points 1.Correctly fit the tip of the needle to the side of marking stripes 2.Stop sewing when you observe any abnormality or any misaligning with marking area
Supervisor -	Made by - Mistir Binyam

Zemen Shoe Factory		
Sheet No. - 9		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stitching Lising
		Equipment used * Needle * Thread
Operational procedure 1.Pick the upper with attached Lising 2. Pick the thread and needle 3.Start single line sewing from the left parallely to the edge of Lising		Control points 1.Correctly fit the tip of the needle to the edge of Lising and sew it in equal dimation 2.Stop sewing when you observe any abnormality or any mismatch
Supervisor -		Made by - Mistir Binyam

Zemen Shoe Factory		
Sheet No. - 10		Section - Stitching
Date of Start using SOP -		Line - A1 ,A2
		Model - Model 23
Material image		Description - Stitching Collar
		Equipment used * Needle * Thread
Operational procedure 1.Pick the Quarter 2. Pick the Collar 3.Attach Quarter with Collar 4. Pick the Thread and Needle 5. Start sewing the upper & collar from the left to the end		Control points 1.Correctly fit the tip of the needle to the Quarter edge of Collar& sew it in equal dimation 2.Stop sewing when you observe any abnormality or any mismatch
Supervisor -		Made by - Mistir Binyam