

**Addis Ababa University
School of Graduate Studies
Institute of Technology
Mechanical Engineering Department**



Productivity Improvement through Work Study

The Case of Peacock Shoe Factory

By

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*A Thesis Submitted to School of Graduate Studies of Addis Ababa University in Partial
Fulfillment of the requirement for the Degree of Masters of Science in Mechanical Engineering
(Industrial Engineering Stream)*

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September, 2011

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Declaration

I, the undersigned, declare that this research work entitled “Productivity Improvement through Work Study a Case of Peacock Shoe Factory” is the result of my own research carried out under the supervision of Dr-Ing Daniel Kitaw and Mr. Amare Matebu. It has not been presented as a thesis in any other university and all source of material used for this thesis are duly acknowledged.

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This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

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Dedicated to my parents for their unending love and support

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Abstract

As global competition become tightens every day, there is an urgent need for manufacturing operations to continually striving to increase productivity and output of their operations. Productivity improvement should be a concern of every industry regardless of the type of production, economic or political system. Productivity can either be improved through increasing the output value by increasing the quality or quantity of products, or through decreasing the input value by utilizing the resources effectively & efficiently. Well-organized use of available resources is one way of improving the productivity through capital resources of the company.

The productivity improvement has a great significance for Ethiopia footwear industries. In this country there are limited resources which should be used to get the maximum output i.e., there should be attempts to perform a job by cheaper, safer and quicker ways. The aim should be optimum utilization of resources, so as to provide maximum satisfaction.

The paper has examined how proper utilization of available resource improves the productivity of footwear industries that is demonstrated by taking peacock shoe factory as a case study. Footwear industry, as it is one of the potential economic sectors, it should be given proper attention for sustainable development of the country. Thus, the purpose of this paper is to find out improvement areas in resource utilization activities that are considered as an immense factor for performing under.

The productivity improvement in footwear industry can be approached by different methods. On this thesis productivity improvement through work study are done, because footwear garment work is labor-intensive and largely depends on the skills and sensibility of the operator. The productivity of a factory is adversely affected by the advantage of the operators.

The topic of this master thesis originates from the practical problem that the company faced; the main intention of the thesis to show how productivity improvement can be achieved by analyzing operation, process, time study, process organization (line balancing) and lay out.

Through balancing the production line, the line efficiency of peacock shoe factory can be improved from 44% to 81%. Finally by analyzing the results obtained framework for implementation had formulated.

Table of Contents

Acknowledgements	I
Abstract	II
List of Figures	VI
List of Tables.....	VII
List of Appendixes	VIII
Accronyms	IX
Chapter One	1
Introduction	1
1.1-Background of the research	1
1.2-Statement of the Problem.....	3
1.3-Objectives of the research.....	4
1.4-The research methodolgy and approach	5
1.5-Selection of case manufacturing firm	8
1.6-Significance of the research	8
1.7-Research organization.....	9
Chapter Two	10
Literatures review	10
2.1-Introduction to productivity	10
2.2-Introduction to work study.....	12
2.2.1- Definitions of work study.....	12
2.2.2- Objectives of the work study.....	13
2.2.3- State-Of -The Art of work study	13
2.3-Recent advancements of work study.....	15
2.4-Components of work study	15
2.5-Time study	18
2.6- Work Sampling	19
2.7- Performance Rating and Fractional allowances determination	20
2.8- Prerequisite of conducting a work-study	21
2.9- Why Is Work Study Valuable?	21

2.10- Work Study and Productivity	22
2.11- Manual Assembly Lines and Line balancing.....	26
2.11.1- Fundametals of Manual Assembly Lines (MAL)	26
2.11.2- Line Balancing	27
2.12- Review of past research works	28
Chapter Three	32
Background of the footwear subsector	32
3.1- History of the Footwear Sub-Sector in Ethiopia.....	32
3.2-The development oportunities of leather footwear subsector in Ethiopia	33
3.2.1- Impacts of chinese imports and coping strategies of small scale footwear producers	33
3.2.2- Competition in the third market	33
3.3- Comparative Perspective	34
3.4- Value-added and Gross Output Measures: Ethiopian Manufacturing Firms.....	35
3.5- Overview of the footwear subsectors in Ethiopia	42
Chapter Four	48
Case Study: Peacock shoe factory	48
4.1-Company profile	48
4.2-Vision, Mision, and Objective of the company	48
4.3-Types of products and inputs of the company	49
4.4-Production process and production facilities description	49
4.5-Organizational structure of the company.....	57
4.6-Overall outline process chart	58
Chapter Five.....	65
Analysis, Discusion and Findings	65
5.1-Case study approach	65
5.2-Specific objectives for the case compnay	66
5.3-Method study	67
5.3.1-Developing the flow diagram for the selected product	67
5.3.2-Existing work stations arrangement	67
5.3.3-Developed the improved method	74

5.4-Non-value adding activities in the case company	80
5.5-Standard time setting.....	82
5.5.1-Existing practice of the company	82
5.5.2-Determining Labor Standards from Time Studies	83
5.5.3-Work Sampling for Cutting Department.....	90
5.5.4-Time study for stitching and lasting department.....	94
5.6- Overview of the Manual Assembly Line	99
5.6.1-Capacity determination of each station	100
5.7- Balancing the production line (Work organization)	105
5.8- Total line efficiency Calculation.....	118
5.9- Comparison of the case company wiith and without workstudy application.....	119
5.10- Means of Reducing the Number of Bottleneck Process	120
Chapter Six	121
Improvement areas in the case company	121
Chapter Seven	127
Implementation framework	127
7.1-Introduction.....	127
7.2-General implementation framework	127
7.3-Management Commitment.....	128
7.4-Project team Organization.....	129
7.5-Activities and scope of the implementation framework	129
Chapter Eight	133
Conclusions and Recommendations	133
8.1-Conclusion	133
8.2-Recommendation	135
References	137
Appendix 1	139
Appendix 2	143
Appendix 3	147

List of Figure

Figure 1.1: Framework of the research	5
Figure 2.1: The relationship between work study techniques	23
Figure 2.2: Configuration of an n -workstation manual assembly line	27
Figure 3.1: Percentage distribution of value added by major industrial group 1996 EFY	36
Figure 3.2: Percentage distribution of value added by major industrial group 2001 EFY	36
Figure 3.3: Summation of individual ratios of value addition to GVP	40
Figure 3.4: Summation of individual ratios of labor cost to value addition	41
Figure 3.5: Ratio of value addition to GVP	46
Figure 4.1: Components of bades shoe and bades shoe model	50
Figure 4.2: Organization structure of the case company.....	57
Figure 4.3: Overall outline process chart	61
Figure 4.4: Outline process chart of cutting department.....	62
Figure 4.5: Detailed outline process chart of major activities of the stitching assembly line...	63
Figure 4.6: Detailed outline process chart of major activities of the lasting assembly line.....	64
Figure 5.1: Existing work stations arrangement of cutting and stitching department.....	69
Figure 5.2: Improved work station arrangement (layout) of peacock shoe factory	75
Figure 5.3: Conversion of observed time to standard time	83
Figure 5.4: Variation in each process capacity per day compare to bench mark target/day ...	106
Figure 5.5: Variation in each process capacity per day compare to bench mark target/day ...	111
Figure 5.6: Variation in each process capacity per day compare to bench mark target/day ...	113
Figure 5.7: Variation in each process capacity per day compare to bench mark target/day ...	117
Figure 5.8: Comparison of the case firm with and without work study application	119
Figure 7.1: General implementation framework	127

List of Tables

Table 2.1: Direct means of raising productivity.....	24
Table 3.1: Total industrial and non-industrial costs.....	37
Table 3.2: Gross Value of Production by Industrial Group	38

Table 3.3: Ratio of Value Added* To Gross Value of Production by Industrial Group.....	39
Table 3.4: Ratio of Value Added* To Gross Value of Production by Industrial Group.....	41
Table 3.5: Actual Value of Production of footwear as Percentage of Yearly Capacity.....	43
Table 3.6: Export performance of the footwear sector.....	44
Table 3.7: Gross Value of Production by Manufacture of Footwear - Public and Private	45
Table 3.8: Cost of Raw Materials and Energy Consumed By Manufacture of Footwear.....	45
Table 3.9: Value Added by Manufacture of Footwear.....	46
Table 5.1: Standard shoe production in pairs per shift per day.....	85
Table 5.2: Daily production plan of all departments of peacock shoe factory.....	86
Table 5.3: A System of Rest Allowances Given As Percentages of Basic Times	88
Table 5.4: Allowance determination for cutting department	89
Table 5.5: Allowance determination for stitching department.....	90
Table 5.6: Work sampling sheet for cutting department.....	93
Table 5.7: Standard time determination	94
Table 5.8: Capacity determination of stations.....	101
Table 5.9: Bench mark Target, Labor productivity and Line Efficiency before line balancing. [Stitching dept.].....	106
Table 5.10: Proposed capacity per day for each process and proposed manpower	107
Table 5.11: Balancing processes to equalize bottleneck processes.....	109
Table 5.12: Bench mark Target, Labor productivity and Line Efficiency before line balancing. [bades shoe].....	111
Table 5.13: Bench mark Target, Labor productivity and Line Efficiency before line balancing. [Lasting].....	112
Table 5.14: Proposed capacity per day for each process and proposed manpower	114
Table 5.15: Balancing processes to equalize bottleneck processes.....	115
Table 5.16: Bench mark Target, Labor productivity and Line Efficiency after line balancing. [bades shoe model].....	117

List of Appendixes

Appendix 1 – Action plan for peacock shoe factory

Appendix 2 – Interview Questions

Appendix 3 - Cutting Machine and Preparation Operations

Acronyms

CSA	Central Statistical Agency
TQM	Total Quality Management
CIM	Computer Integrated Manufacturing
MBO	Management by objectives
LIDI	Leather Industry Institute Development
TFP	Total Factor Productivity
NECA	Nigerian Employers Consultative Association
PMTS	Predetermined Motion Time Systems
P.A	Personnel Administration
MAL	Manual Assembly Lines
CT	Cycle time
NLSC	National Leather and Shoe Corporation
SOE	State-Owned Enterprises
ESI	Export Similarity Index
GVP	Gross value of production
MOLSA	Ministry Of Labor and Social Affairs
ETA	Ethiopian Tanners Association
PDC	Product Development Center
CAD/CAM	Computer Aided Design/Computer Aided Manufacturing
BMAL	Batch model assembly line
S.A.M	Standard Allowable Minute
B.P.T	Basic Pitch Time
S.P.T	Standard Pitch Time
WIP	Work in Process
JIT	Just In Time

CHAPTER ONE

INTRODUCTION

1.1 Background of the research

The leather sector is the second largest component of Ethiopia's export earnings after coffee; representing 12% of total earnings. Within the manufacturing sector, the leather industry comes as the leading exporter accounting for, on the average, up to 67% of the total manufactured exports [1]. The leather and leather products sub-sectors produce a range of products from semi processed leather in various forms finished consumer goods of leather garments, stitched upholstery, shoe uppers, handbags, industrial gloves, school bags and finished leather. The country is exporting these products mainly to markets in Europe, Canada, Japan, the Far East and the Middle East countries.

Footwear industry is one of the manufacturing industries of leather sector that plays a role in the economic development of a country. This industry produces products of different shoe models. The shoe and leather products industry has reached a relatively high stage of development and now enjoys a reputation as a producer of good quality leather, recognized in international markets. However, since the year 2000 there has been a steady decline in the export performance of this sector. Though, Ethiopia has a comparative advantage in producing shoe and leather products due to its abundance livestock resources. The largest number of livestock in Africa and the tenth largest in the world are found in Ethiopia.

According to a report from the US International Trade Commission, Ethiopia is emerging as one of the leading sub-Saharan footwear exporters, along with South Africa, Kenya, Zimbabwe and Cape Verde. These 5 countries amount for 80% of the shoe exports from the region. The development comes on the eve of substantial private investment in shoe production in Ethiopia, and exports are also benefitting the country's trade balance. [2]

There was the study on Productivities in the footwear sub-sector; for the study 15 footwear enterprises were selected, and for ease of comparison, the same period of time, 1995–1999, is taken. Most of the footwear establishments are very small in size employing very crude

technology. As a result, total factor productivity in the Ethiopian footwear industry remained quite low. According to Berhanu Nega and Kibre Moges's research entitled (2001) *"Productivity and Competitiveness of the Leather Sector in Africa: Findings from Four Countries Case Studies"*, the five years average was only 1.58. For instance, for the Turkish footwear sub-sector, way back in the 1970s, the respective ratios were just above 2. What can be drawn from the footwear industry in Ethiopia is that most firms not only have low total productivity, but also show a declining trend over the years, implying deterioration in the capacity of the footwear sub sector to compete.

A large proportion of the deterioration in productivity is a result of worsening total factor productivities in most of the firms, that is, lack of improvement in the management of the firm, suffering from the way they perform tasks and long lasting of operations, lack of timely maintenance provision, efficiency in the supply and stock holding of raw materials, supply of utilities, etc. All these affect, primarily, the degree of capacity utilization of production, thereby the productivity level. Furthermore, these factors significantly and adversely affect unit cost of production, and hence the competitiveness of firms.

By undertaking these under problems, the present research is an attempt to study productivity improvement, in Ethiopia footwear industries. Productivity improvement can be done by many ways, by improving facility layout, by implementing TQM, by using state of art of technology, by designing the job that the workers perform and by suing method study and other mechanisms. The thesis is focused on detail productivity improvement of footwear industries through work-study. It comprises of method study and work measurement. Method study aims at determining the most effective method of performing the job. The most logical layout for manufacturing facilities, uninterrupted flow of materials through the organization, will help to complete the job in the least possible time and optimum cost. Work measurement on the other hand determines the time required by an operator to complete the operation or job for the standard method at the defined level of performance.

Almost all of Ethiopian footwear industries are suffering from the way they perform tasks and long lasting of operations. Time plays a very important role in our everyday life. And in industries job times are vital inputs for manpower planning, estimating labor costs, scheduling, budgeting, and designing incentive systems. In addition, from the workers' standpoint, time

standards provide an indication of expected output. The production of high-quality and differentiated products requires the use of high-quality and specially designed parts, and higher production efficiency also requires the timely delivery of such parts.

Every members of the management team must be able understand the work-studies. Department must be able to use the simplest techniques in order to do their own job better.

1.2 Statement of the problem

In Ethiopia, regardless of the stern global competition in modern business, most industries are still very inefficient and are competing under suboptimal conditions. Reports from different production and service organizations (Central Statistical Authority) in the country reflects most industries are characterized by low profit, waste of resources, poor and unsafe working environment (report from safety and occupation department under Addis Ababa city administration; the department indicates 51% of Ethiopian manufacturing industries are found in A.A.), high employee & customer dissatisfaction, high labor turnover, long delivery time, inefficient management system, higher production cost etc. These parameters were measured with the help of one or more of the different types of performance measurement technique. However, one key issue has to be overlooked. That is for anything to measured, there need to have a standard reference or bench mark based on which proper judgment can be made to see if the performance is good or bad. This is a serious problem of peacock shoe factory which was established in 1994 (E.C) with the intention of substituting the imported readymade shoes and to save some foreign exchange by substitution.

Accurate standard times are the base of a footwear factory, but the factory must first specify the method very clearly before establishing a time. One of the great worries in the industry is that old fashioned time study techniques may include timing operations in which the method of doing the operation is not clearly specified and in fact the operator is timed using a method that is not economical and that has too many extra motions that are totally unnecessary. This will mean that the time for the operation is wrong! Thereby it cannot be guarantee for smooth flow of production (proper work organization). This is factual in peacock shoe factory.

As described above, in this factory there is no such a sound and detail study which considers factors like methods of doing jobs, standard times to perform the duty, proper layouts, proper

working environment, good work organization (balanced line) and other factors. Rather standard times are set for some jobs with the help of personal judgment thereby the production line is not balanced resulted from bottleneck stations. Therefore, definitely measuring performance based on such standards would lead to wrong conclusions or work standards. And ultimately could result customers and employees dissatisfaction due to late delivery of products.

Measuring performance without setting the standards don't reveal anything other than simply stating the existing poor conditions like low productivity and so on of the industries in the country. Therefore, the research will focus on effective ways of performing tasks by eliminating ineffective motions, based on this effective way setting standard times using the appropriate work measurement techniques and balancing the line by studying the operation capacity of the work places in terms of operators who work there.

1.3 Objectives of the Research

General objectives

It is to show the way how to study the work using work study principles & procedures, work organization and analyze its values in order to make the factory go towards higher productivity.

Specific objectives

- To see the existing system of controlling resource utilization by evaluating the methods used in the company for doing jobs and standard time settings;
- To improve operational efficiency by eliminating wasteful and inefficient motions or to find the best way of doing a job
- Setting a standard time for a selected shoe model
- Balancing the line for streamlining the process through detecting bottleneck stations (stations that have a higher workload) to create even flow of production from one work station to the next so that there will not delays at any station
- To improve labor utilization by minimizing slack times
- To calculate exact delivery time of the product to be studied

1.4 The Research Methodology and Approach

The approaches chosen for this study are the case study approach. The case study provides insight into firm-level mechanisms. This research study employs primary data from case firm; secondary data's from Leather Industry Development Institute, Central Statistical Authority and from past research works to investigate issues and problems of performance improvement in the case company.

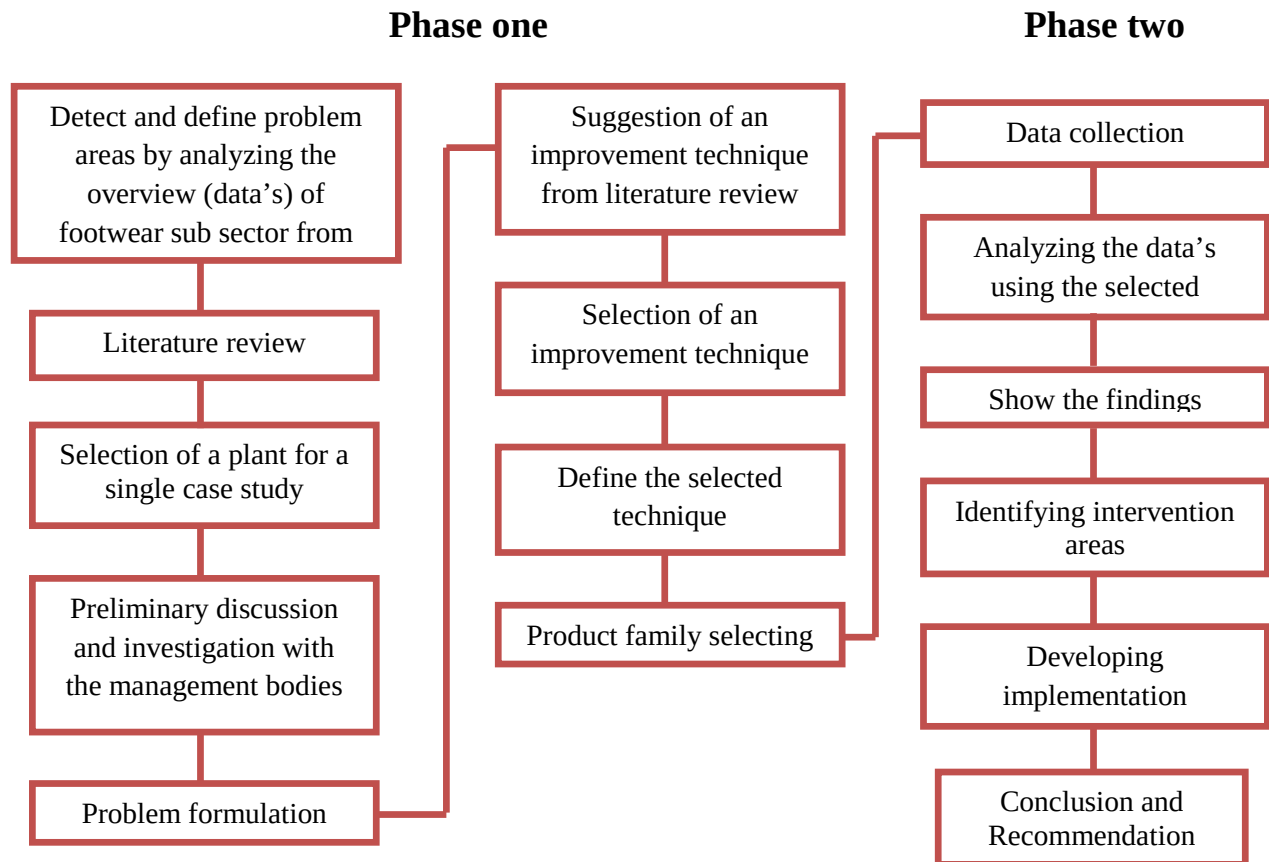


Figure1.1: Framework of the research

A. Literature Survey: - The main sources of information especially for compiling the theoretical background are different reliable books and Internet websites. One good local source of information used by the study is the work of past graduates of Post-graduate program of the University. Different printed materials including journals and achievement reports which are related to work study have also been used. The review will cover documents related to:

- Productivity, work study and their interrelation
- Work measurement
- Method study
- Layout
- Work organization (line balancing)
- Human resource factors

B. Selecting the product family: for the research work it is well-situated to select a product family. One point to understand clearly before starting the data collection is the need to focus on one product family/model. Identify product families from the suggestions from production manager. A family/model is a group of products that pass through similar processing steps and over common equipment in downstream processing. In addition, the article which has been on the production line for the recent past years (a product with high demand).

Data needed for the selected shoe model is mainly the five different day's observation times of each process and all of the process steps through which the selected article go.

C. Data Sources and Collection: Both primary and secondary data which were found to be essential for the research work have been collected from different sources. The data collection process has comprised principally two phases. The first phase was carried out at macro level to identify intervention area for productivity improvement and analysis system problems associated with the Ethiopian manufacturing firms in general and Ethiopian leather footwear firms in particular as presented in chapter three of this research. For this, both qualitative and quantitative data were collected from various data sources mainly from Central Statistics Authority (CSA) and post graduate students research works.

The second phase in the data collection process was carried out at company level after Case manufacturing firm had been selected. The data's that would be collected are qualitative and quantitative. Methods that will be used in collecting data needed are direct observation to the activities that are performed in the production shop floor thereby identify each operation process involved from raw materials to finished goods, identify all the places where inventory is stored

between the processes, and observed how the material flowed from one operation to another. Researcher will use a well-prepared templates, note pad, pencil, eraser and stop watch (time measuring equipments) as the tool to collecting data from the field. Another method for collecting data is direct data intake from production shop floor and internal company documentation, and pulled up data from company's database. Researcher will also perform structured interview and brainstorming with production teams. Line workers will be asked to participate in a survey during their planning time or anytime that is convenient to them. In parallel, number of field visits was taken place to have a methodical understanding of the process for the manufacturing, to know the practical problems faced for time utilization and to observe the existing layout and to record a time spent by employees at job. The survey will help in obtaining information on the physical conditions of the factory as well as their surroundings; and any available recorded data's will be examined to use them as secondary sources.

D. Analysis: the data's has been analyzed using work study techniques and thereby identifying bottleneck processes. The productivity improvement approaches are limited in their abilities to provide a pragmatic tool to monitor productivity changes. The improvement techniques are various and can be classified into five basic categories (Sumanth, 1984):

- a) Technology-based techniques, such as computer integrated manufacturing (CIM),
- b) Employee-based techniques, such as Management by objectives (MBO),
- c) Product-based techniques, such as Advertising and promotion,
- d) Task-based techniques, such as Job design,**
- e) Material-based techniques, such as inventory control. [3]

It is desirable to determine which of the improvement techniques should be used, so that the total productivity of an organization is optimally improved. The technique to be used is task based. Among this productivity improvement tools:

- Methods study (outline process chart, flow process chat and flow diagram) and work measurement (specifically time study and work sampling) are the promising techniques and others like line balancing and layout will be considered.

- The footwear productivity can be improved by studying the operation capacity of the work places.

E. Conclusion and Recommendation

At the final phase of this research, the researcher concluded the research work that relied on results from data processing and analysis at previous phase. Researcher will also give some recommendations for the company that can be followed up for plant improvement.

1.5 Selection of Case Manufacturing Company

Ideally, most manufacturing plants would like to find the method for the overall productivity improvement strategy. However, manufacturing plants that are searching for improvement strategies are still likely to find that they are unable to take full advantage of the modern methodologies and techniques.

To this end, to analyze productivity of production system, a case manufacturing system from the country footwear industries, Peacock Shoe Share Company, has been selected. Peacock Shoe Share Company is currently a private owned firm in which a relatively plentiful data required for this research purpose is available. Ease of accessibility for frequent data collection is attributed to the firm with respect to the researcher. It is also a representative firm for large to medium sized footwear firm and it is a major shoe exporter in Ethiopia having 58% Export performance as per the 2009 report from Leather Industry Institute Development (LIDI). The company is also thriving to implement different modern management tools and systems including benchmarking.

1.6 Significance of the Research

As a research thesis, the primary merits of the study goes to the university academics. Since there are few and shallow studies in the area, the research shall offer a comprehensive starting point for more specific productivity researches for Ethiopian footwear Industries. Organization, which is taken up as a case study, can get some idea on what of productivity is and its benefits. Hopefully, this motivates the organization to improve their productivity perception & activities and can be benefited through balancing the line for streamlining the process by detecting bottleneck stations (stations that have a higher workload) to create even flow of production from one work station to the next so that delays can't be existed at any station. Leather Industry

Development Institute (LIDI), formerly Leather and Leather products Technology of Institute (LLPTI), and other interested organizations participating in the sector can get important concepts on the overall productivity improvement. Finally, anybody who is interested in productivity especially in leather products can get good ideas from this thesis.

1.7 Research organization

This thesis is divided in to eight chapters. The first chapter is the introduction part which includes the background of the research, statement of problem for the study, objectives of the study, the research methodology & approach, selection of case manufacturing firm, significance of the research. In the second chapter the literatures are surveyed. Chapter three is concentrated on background of the footwear subsector; it described history of the footwear sub sector in Ethiopia, the development opportunities and overview by means of the data's gathered from CSA. The case company's information is designated in the fourth chapter. In the fifth chapter the data's gathered are analyzed using work study components; and held the discussion on the findings. After conducting the analysis, the intervention areas are identified in the sixth chapter. The implementation framework and conclusions & recommendations are the next succeeding two chapters.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction to Productivity

The key to growth is an increase in productivity (Wonnacott, 1986). Productivity has become a household word as almost everyone talks about it. Yet, the term ‘productivity’ means different things to different persons. As phenomenon, it ranges from efficiency to effectiveness, to rates of turnover and absenteeism, to output measures, to measure of client or consumer satisfaction, to intangibles such as disruption in workflow and to further intangibles such as morale, loyalty and job satisfaction. [4]

2.1.1 Definitions of productivity

The least controversial definition of productivity is that it is a quantitative relationship between output and input (Iyaniwura and Osoba, 1983, Antle and Capalbo, 1988). This definition enjoys general acceptability because of two related considerations. One, the definition suggests what productivity is thought of to be in the context of an enterprise, an industry or an economy as a whole.

Eatwell and Newman (1991) defined productivity as a ratio of some measure of output to some index of input use. Put differently, productivity is nothing more than the arithmetic ratio between the amount produced and the amount of any resources used in the course of production. This conception of productivity goes to imply that it can indeed be perceived as the output per unit input or the efficiency with which resources are utilized (Samuelson and Nordhaus, 1995).

By way of analogy, Amadi (1991) explained that an example of productivity ratio is kilometers driven per gallon of petrol where petrol is the input and kilometers covered constitute the output. However, input measure of petrol is not used to determine the efficiency of the car’s performance. Other related factors such as speed, traffic flow, the engine’s efficiency and the fuel’s efficiency are equally involved in the computation of the input index. The output measure

of kilometers driven therefore becomes a gauge of the magnitude or effectiveness of the results achieved. Expressed simply:

Productivity = total output/total input = total results achieved/total resources consumed or effectiveness/efficiency.

In effect, productivity becomes the attainment of the highest level of performance with the lowest possible expenditure of resources. It represents the ratio of the quality and quantity of products to the resources utilized. It is evident in the literature on productivity that almost all the definitions of productivity centre on ‘outputs’ and ‘inputs’. Unfortunately, definition of either output or input or both may sometimes pose more difficulty to the understanding of what productivity is. For output, it is in the form of goods if visible and services if invisible. Input on the other hand is less easily defined. Since production (creation of goods and services) is a team effort thereby making the demand for inputs to be interdependent, various elements (inputs) are involved in the production of output. This makes the definition of input more complex than that of output. To ease this problem of defining inputs, it is common a practice to classify inputs into labour (human resources), capital (physical and financial assets), and material. Again, in an attempt to circumvent the difficulty of defining inputs, productivity is sometimes defined as goods and services produced by an individual in a given time. In this sense, time becomes the denominator of output with the assumption that capital, energy and other factors are regarded as aids, which make individuals more productive.

Olaoye (1985) observed that productivity as a concept can assume two dimensions: namely total factor productivity (TFP) and partial productivity. The former relates to productivity that is defined as the relationship between output produced and an index of composite inputs; meaning the sum of all the inputs of basic resources notably labour, capital goods and natural resources. Eatwell and Newman (1991) captioned total factor productivity as ‘multi-factor productivity’. For the latter, output is related to any factor input implying that there will be as many definitions of productivity as inputs involved in the production process whereby each definition fits a given input. For example, when output is associated to per man-hour or per unit of labour, this definition of productivity is a partial one and it relates to labour productivity. Partial factor productivity is equally known as average product. Symbolically, if Y stands for output, and F_i for any individual factor, we have $APF = Y/F_i$ where APF is the average product. It only

measures how the output per unit has changed over time, ignoring the contributions from other factors to the detriment of production process reality.

NECA (1991), Nigerian Employers Consultative Association, observes that it is more common in productivity studies to see emphasis placed on labour productivity. By coincidence, at the national level, labour productivity translates to what is known as human productivity. It is the type3 of productivity that affects directly the purchasing power of the population since: [4]

$$\text{National productivity} = \frac{\text{Gross National product}}{\text{Working Population}}$$

2.2 Introductions to Work study

Work study is a generic term for techniques used for the examination of human work and systematic investigation of all the factors which affect the efficiency of the process, in order to seek improvements. It investigates the work done in an organization and aims at finding the best and the most efficient way of utilizing the available resources (man, material, money and machinery) to achieve best possible quality work in minimum possible time which involves least possible time and causes least possible fatigue to the worker. Work study divides into two complementary areas; method study and work measurement.

2.2.1 Definitions of Work Study

- It is a means of raising the productive efficiency (productivity) of a factory or operating unit by the reorganization of work, a method which normally involves little or no capital expenditure on plant and equipment.
- It is systematic. This ensures that no factor affecting the efficiency of an operation is overlooked, whether in analyzing the original practices or in developing the new and that all the facts about that operation are available.
- It is the most accurate means yet evolved of setting standards of performance, on which the effective planning and control of production depends.
- The savings resulting from properly applied work study start at once and continue as long as the operation continues in the improved form.

- It is a "tool" which can be applied everywhere. It can be used with success wherever manual work is done or plant is operated, not only in manufacturing shops, but in offices, stores, laboratories and service industries such as wholesale and retail distribution and restaurants, and on farms.
- It is one of the most penetrating tools of investigation available to management. This makes it an excellent weapon for starting an attack on inefficiency in any organization, since, in investigating one set of problems, the weaknesses of all the other functions affecting them will gradually be laid bare. [7]

2.2.2 Objectives of Work Study

- The standardization and improvement of the working process.
- Less fatigue to operators and workers.
- Better product quality.
- Effective utilization of man, machine and material.
- to increased efficiency
- To determine the time required to-do a job; thus it helps to choose the fastest method.
- To decide the required man power to do a job.
- To decide realistic labor budgeting.
- Effective labor control.
- To aid in calculating exact delivery time.

2.2.3 The Development of Work Study

A. Early history of work study

The pre historic man who for the first time took up a stone to use as a hammer in his primitive and sporadic activities had successfully carried out a sort of work study. The first man who succeeded in simplifying his job by use of his reason can be considered the unconscious founder of work study. Until very recently work study remained an unconscious tool of management. It was practiced not as a regular feature of industry but as an unconscious art. The earliest attempt at timing production was made in 1760 by a French man called Parronet. He made overall

timings of the complete cycle of operations in the manufacture of Pins. He found that 12000 numbers of pins took 24.3 hours to manufacture.

An American Engineer Frederick Winslow Taylor (1856-1915) has been called the father of Scientific Management. He lay in introducing scientific methods of thinking and working in all tasks. He realized the value of complete work study but the bulk of his practical work was directed at time study, the price form of work measurement.

Next to Taylor, Frank Bunker Gilbreth [1868-1924] is considered the founder of modern work study. He developed motion study; it is the system of recording the workers movement and even the movement of individual parts of his body. Gilbreth started as brick lay and become a successful contractor. When he tried to learn to lay bricks, he discovered that no two operatives used the same technique. Furthermore he noticed that a brick layer used one set of motions when he worked slowly and another when he worked fast. This started Gilbreth thinking. While him learning the craft as best he could, Gilbreth determined to work out the most efficient method of laying bricks by studying the motions of the individual brick layer. This was the beginning of “motion study”. He studied the problem of laying bricks. He ascertained that the 18 seaport movements were made in laying each brick. By analyzing these movements, he was able to recognize the pattern of work so that the movements were reduced to 5 per brick.

In addition to motion study Gilbreth developed the technique known as micro motion study. It is the application of cameras for motion which are not possible to observe by human eyes. [8]

B. Time Study and Sampling Software

Work-study is the most sophisticated work measurement capture tool. It is ideal for any time study, work sampling or random sampling projects. With its easy to use and intuitive interface, customizable design and powerful features, it is the right tool for industrial engineering in the areas of logistics, manufacturing, healthcare, military, public service and entertainment. The solution runs of handheld devices (Palm OS or Pocket PC) which allow the industrial engineers and time study practitioners to become more efficient. The complete portable solution for performing time study and sampling study projects that does all the tedious work of data transfer and analysis for you. With Work-study you will never have to use paper and stopwatch to do your studies again - everything you need fit right into your pocket. [9]

C. Computerized Work Sampling

A number of software packages with a variety of features are available for work sampling. Application of these packages saves the clerical time associated with recording and summarization of sampling data. The well-known ones among them are WorkSamp, by the Royal J. Dossett Corp.; CAWS/E, by C-Four; and PalmCAWS, by C-Four. These software packages reduce time for the clerical routines of work sampling and allow faster processing with greater accuracy. Use of computers may save about 35% of total work sampling study cost (Niebel and Freivalds, 2003) by eliminating the clerical work time, which is comparatively high relative to actual observation time. [9]

2.3 State-Of-The Art of work study

- Total Quality Management
- Six Sigma
- Just In Time
- Lean manufacturing
- Agile manufacturing
- Business Process Re-engineering

2.4 Components of work study

It has two broad components: Method Study: It is also called methods engineering, or work methods design and Work measurement

2.4.1 Method Study

Method study is a critical study and analysis of method of doing a work and bringing out improvement in method and operation in order to increase the productivity. It is clear that method study is concerned with the development of efficient and economical work methods. Proper development of these methods call for the co-operative efforts of the design engineer, process engineer, and method analyst; There is a continuing need for analyzing existing methods even in the case in which special efforts are made to develop efficient original work method. The reason for this is that the best methods today may not necessarily remain the best method after

some period. Subsequent investigations may reveal the more economical materials are available, more efficient machines, tools, jigs and fixtures have been designed, better inspection methods have been evolved, more satisfactory material handling equipment can now be procured; the existing plant layout is obsolete because of change in the product design and so on. Therefore, opportunities to improve upon existing methods always exist because of technology developments. The performance of work by man or machine is usually accomplished by movement. The effectiveness of this movement in terms of both accuracy and time is determined by the distance moved, the control exerted, and the conditions under which the movement is made.

Steps involved in Method Study

The method study approach of “SREDIM” can be a very practical approach to total quality. The phrase acts as a reminder of a systematic approach to improving performance in the workplace:

- **Select** a specific area of work or process in order to improve it.
- **Record** all relevant facts of the particular area or process.
- **Examine** all factors in the present process.
- **Develop** a better approach or process.
- **Install** the new method as a standard of excellence.
- **Maintain** this new standard as the minimum while actively seeking for further improvements on a continuous basis.

The SREDIM approach acts as a “closed loop” management system and has much to offer. In the “select” stage a “problem-solving” focus group (or quality circle) will hone in on a specific area; the next stage is to “record” – all facts will be recorded in order to measure process performance *as it is* – this recorded information has to be exhaustive, relevant and applicable; the “examine” and “develop” stages tie closely together and provide front-line personnel the opportunity to brainstorm for areas of improvement and, in this way, ownership of change is gained and created by the group; in the “install” stage new methods are used as the new process “standard”. Finally, the “maintain” factor allows the change to be monitored and controlled continuously. This provides a disciplined and focused approach to the continual management of quality. In applying the SREDIM approach, therefore, work study offers sound, practical tools and techniques which

help to make plant layout improvements become a reality in the organization. Typical result categories are given as: Eliminate avoidable delays, reduce the processing times, eliminate delays, reduce fatigue, reduce idle time by eliminating or combining tasks and simplifying methods, reduce travel time and distance. The five symbols used in method study can serve as a simple, yet powerful, approach to measuring current processes, in terms of time and other factors in order to make improvements:

- O: Operation.
- D: Delay.
- □: Inspection.
- ▽: Controlled storage.
- ⇨: Transport.

Obviously, the aim is to have as much pure “operation” activity as possible: this is the only activity which adds value; the others are, essentially, non-productive “cost” factors. The aim is to eliminate these “waste” factors in order to reduce costs and throughput times and to increase productivity and to improve the overall process flow, both in manufacturing and service settings. Using work study techniques – specifically the five symbols above – we can plot the process and we know that the only activity which truly provides value is the “O” (operation); none of the others add value. One of the major reasons behind Japan’s phenomenal success has been the obsession with quality – the ongoing and never-ending pursuit of producing at lower cost, at faster speeds and meeting customer needs through continuous improvement. Method study can benefit key areas such as: department layout; tools design; process design; workplace layout; product design; materials handling; quality standards.

2.4.2 Work Measurement:

Work measurement is defined as the application of techniques designed to determine the time required by a qualified and well-trained person working at a normal pace or defined level of performance to do a specified job [5].

In addition to method study the other ingredient to work study is work measurement. The British Standards definition of work measurement is: The application of techniques designed to establish the time for a qualified worker to carry out a task at a defined level of performance [5].

The human work is commonly measured in terms of time in almost all the industries. Work measurement is defined as analysis of a given operation to determine the time taken in the performance of elements or work. Work measurement is concerned with investigating, reducing or eliminating ineffective time. Basically time study provides reliable and consistent standards of performance [9].

Techniques of Work Measurement: The following are the principle techniques by which work measurement is carried out:

1. Time Study
2. Work Sampling (Activity Sampling or Ratio delay study)
3. Predetermined Motion Time Systems (PMTS)
4. Analytical Estimating
5. Synthesis from standard data.

2.5 Time Study

Time study is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions, and for analyzing the data so as to obtain the time necessary for carrying out the job at a defined level of performance.

The equipment required for time study consists of::

1. Stop Watch
 - a. Non-fly back stop watch-- continuous timing
 - b. Fly back stop watch- When two elements are to be timed
 - c. Split hand or split second type stop watch-- to get greater accuracy
2. Time study board
3. Time study forms

In addition: a small calculator, reliable clock with a seconds hand measuring instruments such as a tape measure, steel rule, micrometer, spring balance etc.

The Steps in Making a Time Study [7]

Once the work to be measured has been selected the making of a time study usually consists of the following eight steps:

1. Obtaining and recording all the information available about the job, the operator and the surrounding conditions, which is likely to affect the carrying out of the work.
2. Recording a complete description of the method, breaking down the operation into "elements"
3. Examining the detailed breakdown to ensure that the most effective method and motions are being used.
4. Measuring with a timing device (usually a stopwatch) and recording the time taken by the operator to perform each "element" of the operation.
5. At the same time assessing the effective speed of the working of the operative in relation to the observer's concept of the rate corresponding to standard rating.
6. Extending the observed times to "basic times"
7. Determining the allowances to be made over and above the basic time for the operation.
8. Determining the "standard time" for the operation.

2.6 Work Sampling

Before setting the standard time for an activity it is necessary to make allowances for delays. Continuous stop-watch time study is generally used for obtaining complete information about the activities of a man, machine or process equipment particularly delays and interruptions. These studies are made to minimize chance fluctuations on a number of operators, machines or process equipment doing the same or similar work which is a time consuming and costly affairs and more so when the work follows long and irregular cycle. To get rid of this difficulty L.H.C Tippet of British Cotton Industry Research Association in 1934 developed the idea of work sampling technique which enables the analyst to obtain the information about an activity, machine or process equipment by simply making random observations of the worker, the machine or the process without the use of a stop-watch. [12]

Activity sampling is a technique in which a large number of instantaneous observations are made over a period of time of a group of machines, processes or workers. Each observation records what is happening at that instant and the percentage of observations recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs. It is extensively used in the textile industry, for which it was developed, and also in other industries **where large numbers of similar machines and workers engaged on similar tasks are employed**. It can also be used in the determination of workloads in large offices. [7]

We may also be interested in the percentage time spent by a worker or groups of workers on a given element of work. If a certain job consists of ten different elements, by observing a worker at three defined points in time we can record on which element he is working and therefore arrive at a percentage distribution of the time he has been spending on each element. [12]

2.7 Performance Rating

When number of qualified operators is performing the same activity, their output will not be same. Some operators will definitely be producing more than what others are producing, while it is assumed that all operators are following the same method and working under the same conditions. As such it is really a problem whose work should be considered as fair day's work. If the slowest worker is considered as standard then the efficient worker will be considered very fast and ultimately there will be lot of difference between their earnings and thereby it will cause dissatisfaction among the workers. As such there should be standard of performance for all the processes and should satisfy the group of workers.

For instance, most people would be able to judge the rate at which a man is walking. They would start classifying rates of walking as slow, average or fast. With a little practice they would be able to say: "About 3 miles an hour, about 4 miles an hour, or about 5 miles an hour" (or of course the equivalent rates in kilometers if they are more used to kilometers). If, however, a reasonably intelligent person were to spend all his time watching men walking at different speeds he would soon reach the point where he could say: "That man is walking at 2 V2 miles an hour and this one at 4 ' / miles an hour", and he would be right, within close limits. In order to achieve such accuracy, however, he would need to have in his mind some particular rate with which to compare those which he sees. **That is exactly what the work study man does in rating.** [7]

2.8 Prerequisite of conducting a work-study

If work study is to contribute seriously to the improvement of productivity, relations between the management and the workers must be reasonably good, and the workers must have confidence in the sincerity of the management towards them. The type of relationship is often determined by the working conditions and environment provided by the management. Good human relations and working conditions are thus the two important prerequisites for successful application of work study.

- **Human factor:** Successful application of any technique, in general, is dependent on the people who apply them also on those for whom they are applied. This is particularly true for work study where the major focus is the investigation of human work with an aim to improve the efficiency of the same. Thus, the human factor plays a very important role in the successful conducting and implementation of work study in organizations. The management who is responsible for spelling out the objectives and planning of work, the supervisor who translates these plans into day-to-day operations and continuously monitors them, the worker who carries out the operations and the work study man who conducts the study. All of them have to contribute positively if the study has to succeed. The supervisors act as the liaisons between the management and the worker since supervisors' jobs are translating the tasks planned by management into day-to-day operations and monitor the progress by ensuring that the workers perform the work as designed.
- **Working conditions:** The unfavorable working conditions like occupational safety and health elements, layout and housekeeping elements, ergonomic elements, arrangement of working time etc may lead to creation, sustenance and regeneration of dissatisfaction which ultimately get manifested in the form of reduced labour productivity, increased rejections, reduced overall economy through increased turnover and absenteeism. [12]

2.9 Why Is Work Study Valuable?

There is nothing new about the investigation and improvement of operations in the workshop or elsewhere; good managers have been investigating and improving ever since human effort was first organized on a large scale, which must have been long before the Pyramids were built in Egypt. Managers of outstanding ability and genius have always been able to make notable advances.

Work study succeeds because it is systematic both in investigation of the problem being considered and in the development of its solution. Systematic investigation takes time. It is therefore necessary, in all but the smallest firms, to separate the job of making work studies from the task of management. The factory manager or shop foreman, in his day-to-day work, with its many human and material problems, is never free from interruption for long. However capable he may be, a manager can rarely afford to devote a long time, without interruption, to the study of a single activity on the factory floor. This means that it is almost always impossible for him to obtain all the facts on what is happening in the course of that activity. Unless all the facts are known it is impossible to be sure that any alterations in procedure which are made are based on accurate information and will be fully effective. It is no use relying on the word of operators or foremen, because it has been proved again and again that they do not always know what is really happening. Only by continuous study at the workplace or in the area where the activity is taking place can the facts be obtained. This means that work study must always be the responsibility of someone who is able to undertake it full time, without direct management duties: someone in a staff and not a line position. Work study is a service to management and supervision.

2.10 Work Study and Productivity

There is a body of knowledge which has evolved over the years that is designed to increase the productivity of an organization and of the individuals who make up the organization. Work Study has as its objective the elimination of unnecessary work, the design of methods and procedures which are most effective, which require the least effort, and which are suited to the person who uses them. Moreover, it provides methods of measuring work for determining a performance index or productivity index for an individual or for a group of workers, a department, or for an entire plant.

Although industrial engineers and staff specialists ordinarily perform work in this field, there is a trend toward developing forms of work organization in which work study and the problem-solving process are used directly by the managers, supervisors, and the employees themselves.

[9]

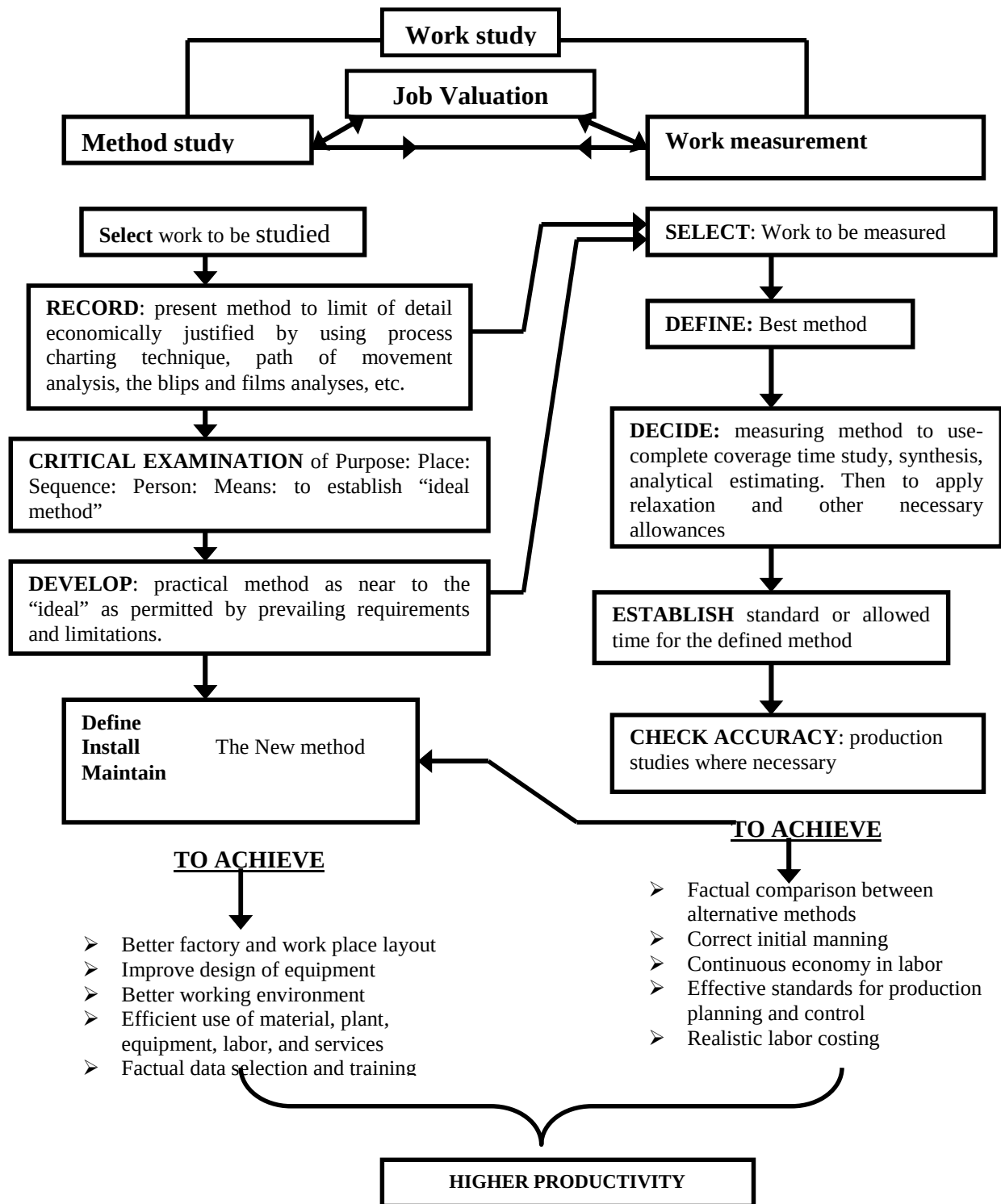


Figure 2.1: The relationship between work study techniques (Modified from Larkin, 1969, p.20; International Labor Office, 1964, p. 42)

2.10.1 Work Study: A Direct Means Of Raising Productivity

It has been assumed that productivity would be raised by using existing resources. Productivity can almost always be greatly increased by heavy investment of money in new and improved plant and equipment. How much can we expect to gain through the use of management techniques, and especially work study, to improve the use of existing resources as against investing capital in new plant? Any comparison made in general terms will only be a rough guide. It is convenient to do this in the form of a table. It will be seen that the most effective way of raising productivity in the long run is often the development of new processes and the installation of more modern plant and equipment. This, however, is only true of those industries where production is dependent mainly on machines and plant rather than on human labor. Continuous chemical processes and also many textile processes are of this kind.

Work study, being a management technique, shares the characteristic of all management techniques mentioned in the last chapter, namely that of being a systematic procedure. That is its strength as a "tool" of investigation and improvement. [7]

Table 2.1: Direct means of raising productivity [7]

Approach	Type of improvement	Means	Cost
Capital investment	Development of new basic process or fundamental improvement of existing ones	Basic research Applied research Pilot plant	High
	Install more modern or higher-capacity plant or equipment or modernize existing plant	Purchase Process research	High
Better management	Reduce the work content of the product	Product research Product development Quality management Method study Value analysis	Not high compared With 1 and 2
	Reduce the work content of the process	Process research Pilot plant Process planning Method study	Low

2.10.2 Factors Tending To Reduce Productivity

A. Work Content Added Due to the Product

- The product and its components may be so designed that it is impossible to use the most economical processes or methods of manufacture. Components may not be designed to take advantage of high-production machinery
- Excessive variety of products or lack of standardization of components may mean that batches of work have to be small and cannot be put on special-purpose high-production machines but have to be done on slower general-purpose machines
- Incorrect quality standards, whether too high or too low, may increase work content.

B. Work Content Added Due to the Process or Method

- If the wrong type or size of machine is used, one which has a lower output than the correct one (examples: small capstan work put on a turret or centre lathe; narrow cloth put on too wide a loom).
- If the process is not operating properly, that is at the correct feed, speed, rate of flow, temperature, density of solution or whatever conditions govern its operation, or if the plant or machine is in bad condition.
- If the wrong hand tools are used.

C. Ineffective Time Due to the Management

- By failing to ensure that designs are properly developed or that customers' requirements are met from the beginning. This results in changes of design causing stoppages of work and loss of machine- and man-hours as well as waste of material.
- By failing to plan the flow of work and of orders, with the result that one order does not follow immediately on another and plant and labour are not continuously employed.
- By failing to maintain plant and machines properly. This leads to stoppages due to machine breakdowns.

D. Ineffective Time within the Control of the Worker

- By workers taking time off work without good cause: by lateness, by failing to start work immediately after clocking in, by idling at work or by deliberately working slowly.
- By careless workmanship causing scrap or making it necessary for work to be done again. Work which has to be done again means wasted time, and scrap means wasted materials.

In general, far more ineffective time is due to management shortcomings than to causes within the control of workers. In many industries the individual worker has very little control over the conditions under which he is required to operate. If all the factors enumerated under the four heads above can be eliminated (the ideal case which, of course, never occurs in real life), the minimum time for the production of a given output and hence the maximum productivity is achieved.

2.11 Manual Assembly Lines and Line balancing

2.11.1 Fundamentals of Manual Assembly Lines (MAL)

Most manufactured consumer products are assembled. Each product consists of multiple components joined together by various assembly processes. These kinds of products are usually made on a manual assembly line. MAL are work systems consisting of multiple workers organized to produce a single product or a limited range of products. Assembly workers perform tasks at workstations located along the line-of-flow of the product: Usually a powered conveyor is used and some of the workstations may be equipped with portable powered tools. [2]

The basics of MAL are a production line that consists of a sequence of workstations where human workers, as depicted in figure below perform assembly tasks [2]. Products are assembled as they move along the line. At each station, a portion of the total work content is performed on each unit. Base parts are launched onto the beginning of the line at regular intervals (cycle time). Each base part travels through successive stations and workers add components to progressively build the product.

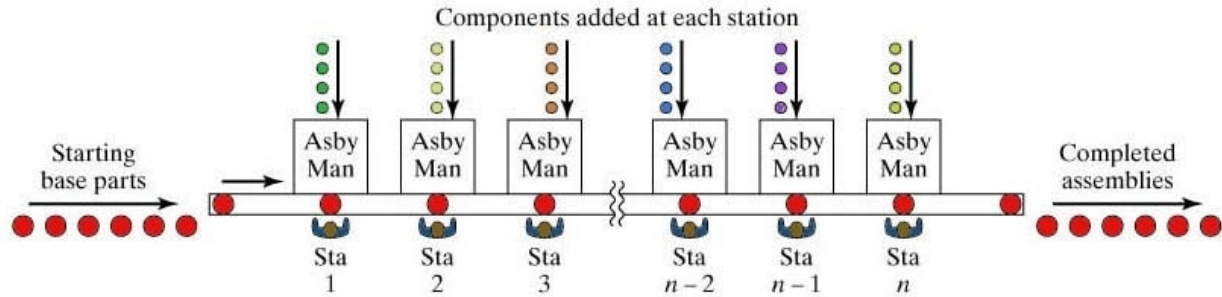


Figure 2.2: Configuration of an n -workstation manual assembly line [Groover 2001]

The production rate of an assembly line is determined by its slowest station. Stations capable of working faster are ultimately limited by the slowest station.

2.11.2 Line balancing

It is arranging a production line so that there is an even flow of production from one work station to the next i.e. so that there are no delays at any work station that will leave the next work station with idle time. Line balancing is also defined as “the appointment of sequential work activities into work stations in order to gain a high utilization of labor and equipment and therefore minimize idle time”. Balancing may be achieved by rearrangement of the work stations or by adding machines and workers at some of the stations so that, all operations take about the same amount of time. In many industries, in particular automotive, the product being assembled is sufficiently voluminous to allow several operators to work on the product at the same time. Since that possibility does exist, not exploiting it would lead to unnecessarily long assembly lead times, implying a reduced productivity. It is therefore often the case that several operators are active on the product simultaneously. Once a workstation features more than one operator, the workstation’s lead time ceases to be a simple sum of durations of all operations assigned to it. First of all, the workstation as a whole will need the time equal to the lead time of its “slowest” operator to complete all operations assigned to the workstation. Needless to say, since operations are indivisible chunks of work, this is certainly not equal to the sum of durations divided by the number of operators.

More importantly though, the precedence constraints that nearly always exist among the operations assigned to a workstation, may introduce gaps of idle (waiting) time between operations, whenever an operator needs to wait for another one to finish a task. These gaps

significantly reduce the efficiency of the workstation and must obviously be reduced as much as possible. This transforms the initially trivial computation of a workstation's lead-time (i.e., a simple sum of operation durations) into a full-fledged scheduling problem. The problem is further significantly more complicated in presence of multi-operator operations and/or ergonomic constraints, as described below. [13]

2.12 Review of past research works

2.12.1 Productivity Improvement Using Work Study for Automotive Vendor

The study was conducted by Ahmed Fadzadi Zakaria. It is to establish more efficient and manageable production inside a plant or factory, manufacturing systems play an important role and have to be practiced frequently to encounter unstable market demands for products, and introduce better innovation. This final year project is to determine and propose new solutions on methods design for TRM Door Outer product in finishing department at Sri Kota Rubber Manufacturing Sdn. Bhd. The new methods is highly important to reduce the cycle time to finish the product in order to improve the productivity as well as achieving the target and fulfill the demand of customers, especially from Proton. To achieve this purpose, Work Study method is studied and used in this project, which the research is divided into the two main categories consist of Method Study and Work Measurement. The main finding for this project is the process cycle time data of the operators to finish the products including the number of pieces done and the elements of work. Before this study is conducted, the process is done manually and in a tedious work where the time needed to finish the product is too long. The other findings in this study also involve in proposing suggestions to improve the work done in term of time and methods used.

2.12.2 Modeling Productivity Improvement with Work Study Approaches for Ethiopian Garment Industries

It is a master's thesis work done by Negus Sisay in 2006. The productivity improvement in garment industry can be approached by different methods. On this thesis productivity improvement through work study are done, because sewing work is labor-intensive and largely depends on the skills and sensibility of the operator. The productivity of a factory is adversely affected by the advantage of the operators. The specific motion and time study are done in

Gullele Garment Factory, by analyzing the result model had formulated to all Ethiopian garment industries.

Most Far East countries enterprises, highly utilize the scientific method of work study application. However, In domestic company government owned like Gullele factory the awareness of different method and poor working culture have developed during command economy period but the new private company is looking forward to follow the best practice to improve productivity. The main intention of the thesis to show productivity improvement which can be achieve by analyzing operation, process, motion study, time study, process organization (line balancing) and lay out in Ethiopian garment industry sector at large.

2.12.3 Method Study for Productivity Improvement: a case study in SUR Construction Plc.

The thesis was conducted by Goitom Birhane for the partial fulfillment of the requirement for the degree of masters of Science in Mechanical Engineering specialized in Industrial Engineering in Addis Ababa University.

The objective of this thesis is to improve the productivity of SUR construction plc on the basis of method study. The study has been focused on the equipment management department, (i.e. Equipment maintenance, and Equipment Administration division), where most of the resources of the company are located (machinery and Manpower); however, the unit is mentioned to be a problem area and these resources are always stated to be under managed.

The raw data has been purified to increase reliability and then analyzed to identify the barriers for higher productivity. Finally, it is found that the equipment management department is characterized by low productivity, high down times, traditional way of doing jobs, no standard methods and times set based on proper method study and work measurement techniques respectively, subjective way of measuring performances of the labor and machines under the unit, etc. In short, there is no positive result obtained as compared with the plan for any criteria taken to consideration while evaluating the system based on the data gathered.

The existing system/procedure of the equipment management department is also evaluated to be poorly designed and has contributed to the poor results of productivity of machines (the actual productivity of the machines is found to be 0.6 while the plan was 0.9). Moreover, a thorough

assessment of the Equipment Maintenance Department (EMD) in relation to the other departments indicated that the integration is very poor and has a negative influence over the productivity of the unit under consideration. Hence proper method study was conducted to eliminate the inefficiencies due to traditional way of doing jobs, unsafe working conditions, subjective means of measuring performance, etc.

2.12.4 Productivity Improvement through Line Balancing In Small and Medium Industry

(By Hazmil Bin Hapaz, Report Submitted In Partial Fulfillment of the Requirements for the Award of the Degree of Bachelor of Mechanical Engineering at Universiti Malaysia Pahang, November 2008)

Poor layout design is determine as a major problem contribution in small and medium industry. These particular problems thus affect the productivity and the line efficiency as well. Throughout the study, the aim is to proposed new layout to the related company to increase their productivity. The major step is to identify a bottleneck workstation in current layout. After identify related problems, the current layout is redesign by computing the standard time and processing time in each workstations. In each workstation the processing time is different and the longest time consumption is workstation will be identified as a bottleneck workstation. This related line is studied by time study techniques. The time is taken by stopwatch. In this study, application of Computer Aided tools is introduced which in this study is WITNESS SOFTWARE. The related inputs are going to be simulated with this software. The manual calculation also included especially in line balancing algorithm. The goal of the thesis is to seek the best layout in terms of line efficiency and productivity rate hence proposed to the company. Throughout the study, 3 layouts have been achieved. Among 3 layouts only one will be propose to the company. This layout has better line efficiency and rate of productivity.

2.12.5 Productivity Improvement through Line Balancing in Apparel Industries

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The apparel industries must produce momentous quantities in shorter lead times. Apparel product is highly correlated with high level of productivity; sewing line should be balanced in

shorter possible time and effective way for each style and quantity. The focal constraint against the higher productivity is the difference in individual capacity which is the mode of improper line balancing and bottle neck process. This paper is based on an effective layout model where to hit upon the bottleneck process through benchmark capacity and led us to use balancing process using two separate concept of manufacturing processes- modular line and Traditional system both together. The research shows that this balanced layout model has increased the efficiency by 21%, and labor productivity by 22%.

Evaluating the research works

Comparing the research works the second one considers different dimensions to improve productivity. The main finding of the first one is the process cycle time data of the operators to finish the products including the number of pieces done and the elements of work by using only Method Study and Work Measurement. It doesn't say anything about the bottleneck operations; that means work organization (line balancing) is not the concern of the project work though it has a great benefit in identifying bottleneck operations thereby the line will be balanced to create even flow of production from one work station to the next without any delays and idle times. On the other hand the third research has been focused on method study on equipment management department. The fourth and the fifth have similar findings of proposing the best layout in terms of line efficiency and productivity rate. Comparing with the other works, the second research seems good as it considers different dimensions for analysis like analyzing the operation, process, motion study, time study, process organization (line balancing) and lay out. These parameters will be considered in this research work.

CHAPTER THREE

BACKGROUND OF THE FOOTWEAR SUB SECTOR

3.1 History of the Footwear Sub-Sector in Ethiopia

The production of leather shoes in Ethiopia dates from the late 1930s when Armenian merchants founded two shoe factories in Addis Ababa. These factories nurtured a number of shoemakers, who opened their own factories in Addis Ababa and trained their workers. Today, the neighborhood of Merkato, a huge marketplace in the city, swarms with shoemakers, wholesale shops dealing in leather, soles, and shoe accessories, and shoe retail stores. [6]

The growth of industries was clearly stunted by policies, in particular that of the nationalisation of private enterprises by the Derg regime. The sector was in the middle of the 1990's still dominated by the large numbers of cottage and handicraft establishments, surpassing even the employment created by the medium and large-scale establishments (the 10+ category). Nevertheless, these leather establishments account for about 8% of the total registered employment in the entire manufacturing sector in Ethiopia. Despite a decade of liberalisation policies, the public sector is still very important with 13% of establishments and 58% of employment. Geographically, the 10+ establishments were concentrated to a large extent (over two-thirds) in the capital city of Addis Ababa. [14]

Until recently, state-owned leather products enterprises were largely controlled by the National Leather and Shoe Corporation (NLSC), which administered six shoe manufacturing enterprises and one leather good producing enterprise. In addition, there were several private sector workshops manufacturing leather products. The leather product lines produced include leather shoes, shoe uppers, leather garments, bags and stitched upholstery. Through joint ventures and other contractual arrangements, further rapid progress is expected. The Ethiopian leather industry initially developed in the context of an import-substitution programme and was highly protected from import competition, particularly in the leather footwear products for the domestic market. This policy has enabled the sub-sector to expand rapidly although at the expense of paying scant attention to quality considerations. The sector has diversified into the production of shoe components and auxiliaries.

3.2 The development opportunities of leather footwear sub-sector in Ethiopia

3.2.1 Impacts of Chinese imports and coping strategies of small scale footwear producers

The forgoing has provided a general perspective on the overall impacts of China and India on Ethiopia. China seems to have a larger impact than India particularly in the sphere of trade relations. One of the consequences of trade relations is its impact on local producers. The following closely examines such impacts with the view of understanding the extent of the impact and how local producers cope up with such influences.

In the early 2000s, China-made leather shoes flooded into the Ethiopian market plunging the local industry into a slump. Remarkably, however, the industry soon resumed vigorous growth, not only taking the market back but even finding its way into the international market. While the majority of Ethiopian factories sell their product to domestic markets, some are exporting shoes in bulk to Italy and other developed countries as well as neighboring African countries. These high-performing enterprises are not State-Owned Enterprises (SOEs) but private enterprises. They are building or planning to build new large factories to start mass production of high quality leather shoes for foreign markets. The leather-shoe industry in Addis Ababa is exceptionally successful in Africa. We believe that this is a case worth investigating since it is expected to provide an insight into the key to successful industrial development. A major finding is that the growth of this industry was driven initially by the massive entry of new enterprises established by former employees of the existing shoe factories but more recently by the growth in enterprise sizes due to improvements in the quality of products, marketing, and management. Such improvements were first made by highly educated entrepreneurs and subsequently followed by other enterprises. While the followers have grown in size, the leading enterprises have grown faster. Such a development pattern appears similar to the experience of successful cluster-based industrial development in China, Taiwan, and Japan, as is recently reported by Sonobe and Otsuka (2006a, b). [15, 16]

3.2.2 Competition in the third market

One way of looking at whether Ethiopia faces competition from China and India in the third market is to look at the export structure. Most of the Ethiopian exports are unprocessed agricultural products while most of the Chinese exports are manufactured goods. This suggests

that Ethiopia may not face a competitive threat in third market from China and India. This is further ascertained by the export similarity index between Ethiopia and China. Jenkins and Edwards (2006) computed ESI for 2003 between Ethiopia and China to be 4.3% while that of between India and Ethiopia for the same year was 9.3% in a scale range of 0-100% (Jenkins and Edwards, 2006). But ESIs or export structure may not clearly depict the level of competition because of differences in the scale of export between countries. Jenkins and Edwards (2006) identified an alternative approach that captures whether African countries are facing competition in products for which China and India are likely to be significant competitors. This revealed that the proportion of Ethiopian exports facing competition from China and India is 17.8 % and 7.6 % respectively. China thus seems to be presenting a higher threat to Ethiopian export than India. If one closely examines the Ethiopian export, some labor intensive products such as textile and footwear and leather products are given higher priorities as exportable items. These sectors are identified as priority sectors to spearhead industrialization and generate employment in the country. [16]

3.3 Comparative Perspective

One of the sectors that Ethiopia (and most African countries too) seems to have a clear comparative advantage in manufacturing is the leather sector. The major advantages that could give a competitive edge to the Ethiopian leather sector are its large livestock base. There is the largest livestock production in Africa and the 10th largest in the world. Ethiopia's livestock population is currently estimated at 35 million cattle, 21 million sheep and 16.8 million goats. Annually it produces 2.7 million hides, 8.1 million sheepskins and 7.5 million goatskins. This comparative advantage is further underlined by the fact that the cost of raw hides and skins constitute on average between 55 to 60% of the production of semi-processed leather (Kiruthu 2002).

The highly labor intensive nature of the industry, it's not too sophisticated technological requirements, combined with Ethiopia's large resource base for the raw material needs of the industry makes the leather sector a good candidate for a concerted effort to expand production and achieve competitiveness at the international level. However, maximizing the benefit from this resource requires expanding the leather products industries including footwear & accessories, leather garments, auto upholstery, etc, and fully integrating it into the domestic

upstream industry. This, primarily, necessitates establishing a tanning sub-sector that is capable of producing high-grade finished leather to feed the downstream industries. This is so because in this sector relatively higher value added can be attained by processing raw hides & skins to the finish and further proceeding to the leather product industry than being limited to semi-processing for export. It is this network, the linkage between the tanning and leather products industries, which is missing most in Ethiopia and also in many African leather sectors. As explained above, what is domestically supplied to the leather products industry is only the 14 percent of the total product of the tanning industry. The bulk of the tanning industry output is exported in semi-processed form, a testimony to the underdeveloped nature of the sector as a whole: inefficient tanning and infant leather products sub-sectors. On average, Ethiopia produces only 25 million dollars worth of footwear annually. But this is less than 50 percent of the tanning industry's output.

3.4 Value-added and Gross Output Measures

There are two types of output measures that can be used to calculate TFP growth. One is the value-added output, which is gross output corrected for purchases of intermediate inputs, and the other measure is gross output. Diewert (2000) noted that for comparing TFP growth at the industry level, it is best to use value-added output rather than gross output as the latter includes the purchase of intermediate inputs which may vary greatly among industries. In addition, the value added measure is best used for primary production and for comparing enterprises that produce different product mixes that are vertically integrated to different degrees, or produce outputs of different quality. The value-added output measure remains a useful concept, particularly for international comparisons of productivity, because it is simple, avoids the need for estimates of intra-industry transactions, and bears closer resemblance to primary statistics such as production census and representative firm data. [Renuka Mahadevan, New Currents In Productivity Analysis: Where to Now? 2003 Asian Productivity Organization]

Having these points about value added and gross output, the Ethiopia manufacturing firms has been analyzed using the ten years data's gathered from CSA. The analysis shows the Percentage distribution of Value added by major industrial group, the total industrial and non-industrial costs and its effect on the growth of value added, Gross Value of Production by Industrial Group -

Public and Private, Ratio of Value Added To Gross Value of Production by Industrial Group,
 Ratio of Cost of Labor to Value Added By Industrial Group public-private.

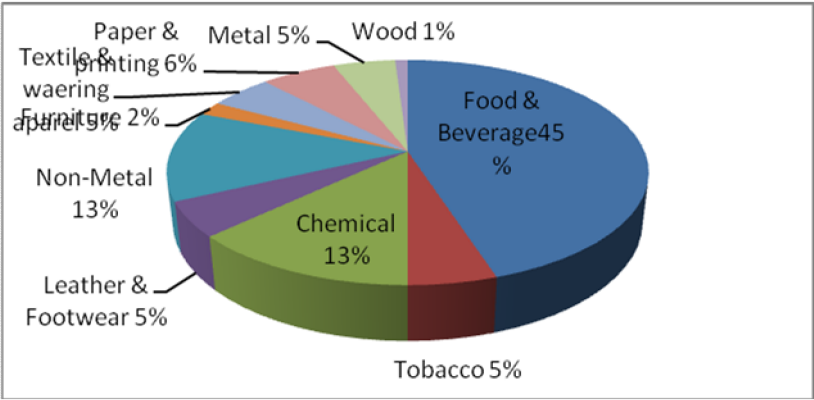


Figure 3.1: Percentage distribution of Value added by major industrial group 1996 EFY (2003/2004)

The figure depicts the percent share of the manufacturing subsectors in terms of value addition in the year 1996 EFY. Based on that, manufacture of food and beverage has a high percent share (45%), and manufacture of non-metal products and chemical and chemical products follows. On the reverse side Manufacture of Wood & Products of Wood, Cork & Manufacture of Furniture; Manufacturing N.E.C and the leather and footwear sectors have the lowest percent share of value added.

In the year 2001 EFY the percent distribution in value added among the sectors show variation as compared to the 1996th distribution. According to this percent distribution, manufacture of food and beverage lowered to 37.15%, manufacture of non-metallic mineral products 16.41%, manufacture of chemical and chemical products 8.89%.

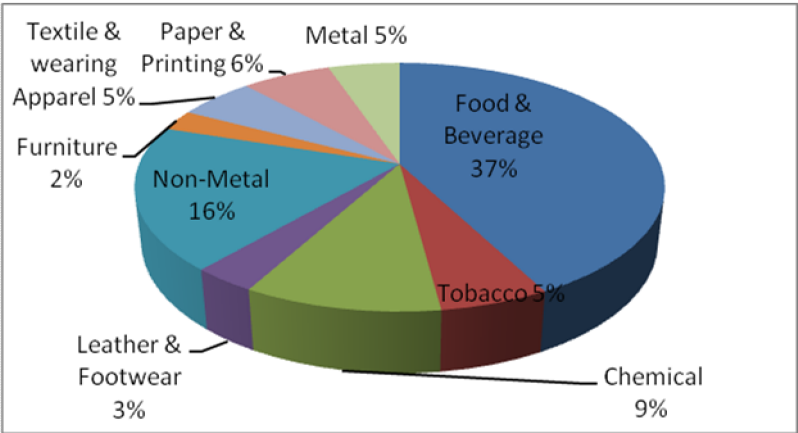


Figure 3.2: Percentage distribution of Value added by major industrial group 2001 EFY (2008/2009)

The percent distribution of food and beverage lowers from 45% to 37%, manufacture of chemicals also from 13% to 9% and that of manufacture of non-metal products rise from 13% to 16%. Though the percent share of food & beverage decreases by 8%, still this has a high percent share. The researcher concerns the leather and footwear sectors decrease its percent distribution by 2% becomes 3% share.

Table 3.1: Total industrial and non-industrial costs

Industrial Group	1996	2001
Food Products and Beverages	1,966,057	6,878,298
Tobacco Products	123,043	1,025,124
Textiles	717,559	898,864
Wearing Apparel, Except Fur Apparel	51,507	333,680
Leather; Manufacture of footwear, luggage and handbags	623,967	1,017,876
Paper, Paper Products and Printing	363,917	689,781
Chemicals And Chemical Products	467,178	1,686,110
Rubber and Plastic Products	309,982	1,210,962
Other Non-Metallic Mineral Products	675,817	1,800,598
Basic Iron and Steel	559,175	786,526
Fabricated Metal Products Except	185,163	1,079,996
Machinery and Equipment N.E.C.	10,338	13,692
Motor Vehicles	276,921	356,491
Furniture; Manufacturing N.E.C	94,898	401,986
Total	6,452,708	17,382,574

In this cost data cost of raw material consumed, cost of energy consumed, payment for industrial services, transport cost, payments for non-industrial costs are included. The total industrial and non-industrial costs depicts that the cost of industrial groups triple within five years.

Table 3.2: Gross Value of Production by Industrial Group - Public and Private
1999/2000 (1992 E.F.Y) - 2003/2004 (2001 E.F.Y)

INDUSTRIAL GROUP	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Food Products and Beverages	3,337,178	3,335,537	3,136,320	3,577,430	3,996,066	4,418,420	5,403,839	*5,975,876	8,751,377	11,596,305
Tobacco Products	261,542	250,417	256,768	256,768	364,046	324,563	415,218	467,320	568,662	630,019
Textiles	603,331	699,914	675,447	751,899	956,445	897,250	918,435	1,097,951	693,552	1,431,781
Wearing Apparel, Except Fur Apparel	62,660	55,721	57,565	73,119	86,511	62,612	80,516	273,249	388,351	409,329
Tanning and Dressing of Leather; Manufacture of footwear, luggage and handbags	591,316	840,039	825,313	790,492	813,127	984,678	1,022,744	1,213,791	1,447,236	1,332,345
Paper, Paper Products and Printing	344,234	379,180	431,230	433,684	612,908	780,213	795,933	964,807	1,236,481	1,281,657
Chemicals and Chemical Products	468,512	518,049	513,493	573,376	726,408	788,811	929,979	1,156,908	1,733,375	2,598,736
Rubber and Plastic Products	380,583	439,056	467,137	488,132	557,349	688,150	983,106	1,064,840	1,484,548	1,912,133
Other Non-Metallic Mineral Products	599,285	635,520	694,410	1,022,809	1,179,618	1,163,801	1,675,749	2,513,864	3,068,948	3,496,772
Basic Iron and Steel	235,494	403,739	454,473	382,701	761,825	1,085,284	1,374,069	1,473,048	1,081,328	1,204,310
Fabricated Metal Products Except	116,106	151,369	163,022	218,138	299,574	473,993	527,746	728,217	1,203,517	1,634,347
Machinery and Equipment N.E.C.	6,121	5,508	6,026	8,794	14,527	13,673	136,505	15,728	27,932	23,015
Motor Vehicles	965,004	567,502	228,586	189,990	275,270	243,227	422,851	1,237,412	789,883	511,494
Furniture; Manufacturing N.E.C	127,430	117,704	140,720	195,677	169,654	333,732	288,566	308,267	392,477	653,184
Total	4,761,618	5,063,718	4,914,190	4,362,770	5,637,644	12,234,723	14,975,256	18,491,278	22,867,667	28,715,377

The structure of total manufacturing production shows clear trends. The gross value of production was fluctuating from 1992-1996. But afterwards there is an increasing trend in gross value of production. From the above two tables we can compare the total cost and total gross value of production. In the year 1996 the total cost was 6.5 billion birr but in the same year the gross value of production was around 5.5 billion birr. It is the big clue that the industrial groups was not performing well.

Table 3.3: Ratio of Value Added* To Gross Value of Production by Industrial Group- Public and Private
1999/2000 (1992 E.F.Y) - 2003/2004 (1996 E.F.Y)

INDUSTRIAL GROUP	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Food Products and Beverages	.308	.361	.321	.337	.320	.297	.274	.301	.261	.249
Tobacco Products	.401	.261	.351	.351	.411	.318	.331	.301	.379	.607
Textiles	.221	.201	.162	.142	.126	.196	.136	.189	.131	.265
Wearing Apparel, Except Fur Apparel	.239	.244	.246	.317	.244	.258	.257	.218	.186	.164
Tanning And Dressing of Leather; Manufacture of Footwear, Luggage and Handbags	.175	.134	.182	.142	.175	.137	.157	.126	.179	.169
Paper, Paper Products and Printing	.385	.365	.337	.328	.288	.308	.247	.281	.261	.345
Chemicals and Chemical Products	.252	.212	.230	.256	.261	.206	.192	.207	.205	.266
Rubber and Plastic Products	.271	.307	.288	.315	.316	.244	.331	.211	.178	.240
Other Non-Metallic Mineral Products	.339	.322	.309	.346	.302	.240	.344	.434	.448	.365
Basic Iron and Steel	.206	.119	.150	.160	.137	.220	.105	.096	.135	.219
Fabricated Metal Products Except	.281	.255	.271	.228	0.258	.216	.211	.370	.194	.218
Machinery and Equipment N.E.C.	.351	.411	.263	.162	.179	.175	.085	.226	.215	.263
Motor Vehicles	.211	.178	.243	.217	.126	.063	.209	.159	.181	.239
Furniture; Manufacturing N.E.C	.317	.323	.322	.299	.333	.579	.309	.333	.315	.284
Sum	3.962	3.696	3.668	3.598	3.472	3.444	4.088	3.444	3.262	3.892

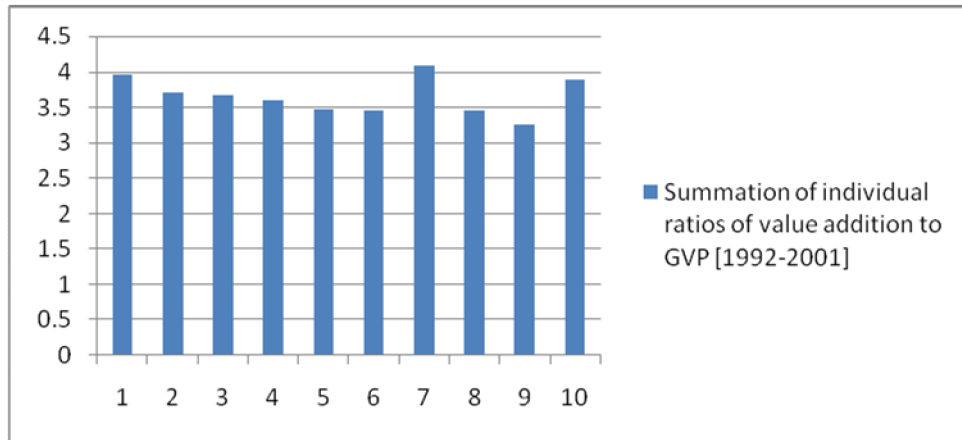


Figure 3.3 Summation of individual ratios of value addition to GVP

From the above table entitled Gross value of production we can see that the GVP has an increasing trend; but from this graph again we can see that the sum values of ratios of value added to GVP has a decreasing trend from 1992 to 1997 and show an increment in 1998 and again it declines. From this data it can be shown that the value addition decreased. In other word the industrial and non-industrial cost was increased which is reduced from the GVP to get Value added.

Table 3.4: Ratio of Value Added* To Gross Value of Production by Industrial Group- Public and Private 1999/2000 (1992 E.F.Y) - 2003/2004 (1996 E.F.Y)

INDUSTRIAL GROUP	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Food Products and Beverages	.192	.182	.268	.240	.238	.255	.264	.243	.258	.255
Tobacco Products	.094	.174	.152	.152	.087	.135	.168	.187	.285	.072
Textiles	.839	.807	1.092	1.081	1.226	.665	1.055	.644	1.074	.435
Wearing Apparel, Except Fur Apparel	1.019	1.209	1.181	.930	.990	.805	1.229	1.032	1.012	.914
Tanning And Dressing of Leather; Manufacture of Footwear, Luggage and Handbags	.512	.534	.406	.515	.381	.509	.460	.473	.340	.438
Paper, Paper Products and Printing	.319	.341	.361	.382	.345	.313	.434	.351	.431	.319
Chemicals and Chemical Products	.245	.278	.316	.301	.246	.350	.314	.367	.296	.164
Rubber and Plastic Products	.238	.210	.239	.229	.218	.283	.168	.280	.304	.271
Other Non-Metallic Mineral Products	.236	.236	.266	.201	.208	.285	.170	.102	.166	.193
Basic Iron and Steel	.243	.292	.247	.322	.205	.117	.214	.216	.189	.233
Fabricated Metal Products Except	.474	.504	.457	.533	.387	.332	.376	.167	.290	.245
Machinery and Equipment N.E.C.	.566	.441	.664	.794	.471	.562	.917	.450	.297	.339
Motor Vehicles	.074	.147	.235	.372	.565	1.172	.274	.233	.277	.344
Furniture; Manufacturing N.E.C	.539	.585	.561	.449	.509	.473	.395	.410	.442	.409
Sum	5.586	5.936	6.454	6.496	6.076	6.244	6.426	5.432	5.656	6.42

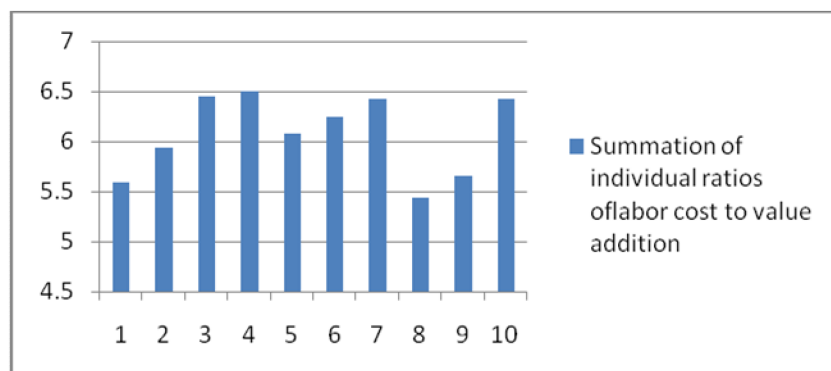


Figure 3.4: Summation of individual ratios of labor cost to value addition

It is obvious that every organization is aimed at generating profit by increasing its value year to year by increasing the production amount; decreasing the input factor costs is another means of generating profit with the same level of production; but it is not the case for manufacturing sectors of Ethiopia. From the graph we can see that the summation of ratios of labor cost to value addition is fluctuating; this shows that the footwear manufacture sector is not operating at a good performance due to the labor costs; but labor cost can be reduced by applying engineering methods.

3.5 Overview of the footwear Sub-Sector in Ethiopia

The leather footwear sub-sector accounts for 72 percent of all leather and leather products enterprises in Ethiopia, and is dominated by the MSEs. Merkato (Addis Ababa) leather footwear cluster, which has at least 600 registered and un-registered enterprises producing more than 6 million pairs of shoes annually, accounts for over two-thirds of all micro and small-scale footwear manufacturers in the country. The only way to survive this threat is through reducing the costs and improving the design, quality and marketing systems. Increased business as well as vocational skills, upgrading of technology, better designs, better shop floor practices, bookkeeping, improved working premises, easy access to credit, quality awareness and joint actions on the business operations of common interest will help the enterprises in becoming more competitive and thereby ensuring their survival and growth.

According to the central statistical agency (CSA) & ministry of labor and social affairs MOLSA research the enterprises in the Manufacturing industry in which the footwear sector is included comprise 42.07% of the informal sector enterprises,

In 1995/96 the various surveys of CSA gave a rather complete picture of the types of enterprises in the leather sector. It indicates clearly that in terms of numbers the cottage and handicrafts establishments in leather and shoe production dominate. Within the leather sector, the CSA distinguishes two broad categories. The first one is the tanning/dressing of leather, manufacture of luggage and handbags, while the second concerns the manufacture of footwear. The footwear enterprises are more numerous, but smaller in terms of employment than the former category. For example, in 1999/2000 out of 53 leather establishments, 38 (72%) were in footwear, employing only 49% of the total persons engaged (CSA 2002). Since the downfall of the Derg, a

rapid expansion has been taking place in the tannery sub-sector. In 1990 there were only eight tanners, consisting of six public and two private plants. In November 2002, 19 tanneries were registered with the Ethiopian Tanners Association (ETA): 15 private and 4 public ones; the latter are in the process of privatisation. Furthermore, six private tanneries are in development.

Table 3.5: Actual Value of Production of footwear as Percentage of Yearly Capacity by Industrial Group
Public and Private - 2003/2004 (1996 E.F.Y) and 2008/2009(2001 E.F.Y)
(In '000 Birr)

Year	Actual value of production	Value of production at full capacity (at market price)	Actual value of production as % of yearly capacity
1996	199,178	333,448	59.73
2001	403,405	655,302	61.56

Source: CSA, Survey of Manufacturing Industries

A common feature of the tanning sub-sector in Ethiopia, and in many African countries too, is the low level of capacity utilization [Berhanu & Kibre, 2001]. As per the data, footwear industry in Ethiopia operates, on average, below two-third of its full potential. Though various reasons are provided for this under capacity utilization, the major ones include too low level of domestic livestock production, the high traditional human consumption of hides and skins for traditional clothing, furnishing and handicrafts, low off-take rate and low recovery rate (damage) of hides and skins arising from the process of flaying and preservation, the poor quality of leather also contributed to this low capacity operation.

Table 3.6: Export performance of the footwear sector ('000 USD)

	1997		1998		1999		2000		2001		Average of the 5 years		
Shoe factories	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	%
Peacock shoe	167	163	1,000	1,526	2,600	3,967	9,800	2,843	5,616	2,613	3,837	2,222	58
Ramse shoe	427	56	540	8	1,951	602	5,880	2,414	11,000	911	3,960	798	20
Anbesa shoe	108	3	500	1	125	419	4,319	1,224	10,267	2,128	3,064	755	25
Kangaroo shoe	162		300		655		2,940	597	2,580	460	1,328	212	16
Walya shoe	12		100	7	14		3,528	532	2,246	262	1,180	160	14
Ras dashin shoe	7,523		1,000		2,402	26	2,940	859	3,370	343	3,447	246	7
Tikure abay shoe	2,204	219	1,824		694	339	1,960	1,143	4,493	303	2,235	401	18
Gelila shoe	-						2,940		1,797		947		
Valino francisco		126										32	
Tizal global			200								40		
Boatex PLC													
Others		2,879		27		188		260		153		702	
Total	10,604	3,446	5,464	1,569	8,441	5,541	34,307	9,871	41,369	7,174	20,037	5,520	28

Source: leather and leather products institute (2009)

The table depicts that the export performance is too much below from its plan for the five years. Especially in 2000 and 2001 the planned and actual export was highly vary. As can be calculated from table, on average, exports account for about 28 percent of planned export value. The general trend of export has a decline trend.

Table 3.7: Gross Value of Production by Manufacture of Footwear - Public and Private
1999/2000 (1992 E.F.Y) - 2003/2004 (1996 E.F.Y)

(In '000 Birr)

Year	Gross value	Industrial and non-industrial costs	Cost of labor	Ratio Of Cost Of Labor To Gross Value Production
1992	205,143		20719.44	.101
1993	214,993		21929.29	.102
1994	197,959		17420.39	.088
1995	188,042		21436.79	.114
1996	223,704	136,264	24607.44	.110
1997	243,216		28213.06	.116
1998	295,789		27212.59	.092
1999	330,063		28715.48	.087
2000	440,937		33070.28	.075
2001	513,763	353,234	41614.81	.081

Source: CSA, Survey of Manufacturing Industries

This data shows us that the gross value has an increasing trend; but the industrial and labor costs are increasing nearly proportionally to the gross value.

Table 3.8: Cost of Raw Materials and Energy Consumed By Manufacture of Footwear – Private and Public 2003/2004 (1996 E.F.Y) and 2008/2009(2001 E.F.Y)

(IN '000 BIRR)

Year	Cost Of Raw Material Consumed			Cost of energy consumed			
	Local	Imported	Total	Electricity	Wood and charcoal	Other fuels	Total
1996	54325	56349	110675	5012	-	419	5431
2001	99554	117139	216693	9381	92	2,223	11696

Source: CSA, Survey of Manufacturing Industries

From the above tables we can see that the cost of labor, cost of raw material consumed, cost of energy consumed and total value of fixed assets and new capital expenditure increased. And the level of production has an increasing trend. But it is due to the increment of input resources, the performance decreases. This is not guarantee for the productivity of manufacture of footwear in Ethiopia.

Table 3.9: Value Added (At Market Price and At Factory Cost) By Manufacture of Footwear - Public and Private 1999/2000 (1992 E.F.Y) - 2008/2009(2001 E.F.Y)

Year	Value Added In The National Account Concept (In '000 Birr)		% Distribution Of Value Added	Ratio Of Value Added To Gross Value Of Production	Value Added Per Person Engaged (In Birr)	Ratio Of Cost Of Labor To Value Added
	At Market Price	At Factor Cost				
1992	64,431	43,112	1.89	.210	12,562	.480
1993	65,192	45,653	1.93	.212	13,718	.483
1994	67,374	45,595	2.06	.230	14,493	.384
1995	66,059	46,784	1.82	.249	12,400	.460
1996	77,651	52,649	1.85	.235	13,208	.466
1997	87,240		1.96	.244	14,183	.474
1998	102,464		1.33	.165	12,476	.555
1999	109,374		1.53	.228	16,305	.380
2000	146,083		1.70	.229	20,408	.328
2001	160,528		1.33	.201	19,982	.404

Source: CSA, Survey of Manufacturing Industries

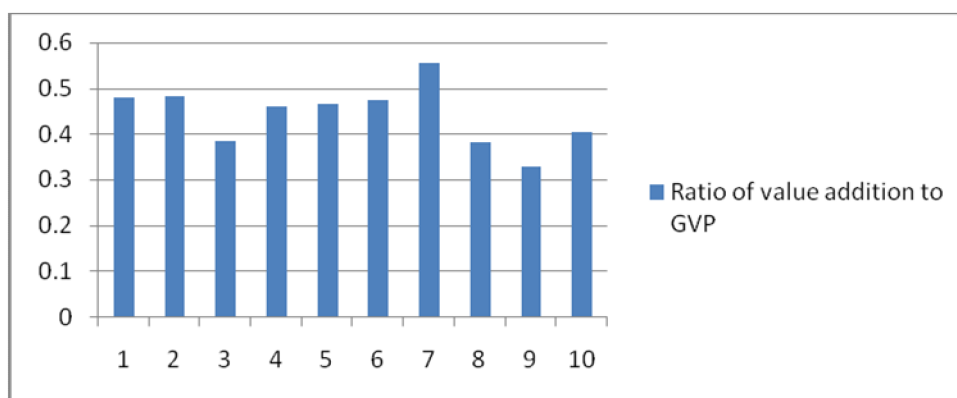


Figure 3.6: Ratio of value addition to GVP

N.B: as per the definition of CSA Value Added is the difference between Gross Value of production and Industrial & non-industrial costs. It is obvious that every organization is aimed at generating profit by increasing its value year to year. But from the data we can see that the % distribution of value addition in manufacture of footwear from 1992 to 2001 EC was fluctuating; in the year 2001 it is 1.33 which is the minimum of the ten years data. This shows that the footwear manufacture sector is not operating at a good performance.

From the data's compiled from CSA, we can see that the input factors considered are material, labor, energy and capital. But from the last table we can see that the cost of labor has a

significant influence for the underperforming of the foot wear subsector. In the year 1998, the ratio of cost of labor to value added was 0.555 and the average for the ten years ratio was 0.44 which is high; that means cost of labor is a major factor so that this thesis work will try to reduce the labor cost by producing more products using the existing resources i.e. without expending more money for getting advanced machines. This can be done by improving methods of doing work, reducing ineffective motions, reducing work content, setting standard times for operatives to accomplish their tasks within a time limit and balancing the production line i.e. eliminating idle times and detecting bottleneck workstations so that with the existing labor force, machines and equipments more products and revenues can be generated. This indicates that work study enables every organizations be effective by the existing resources without investing huge amount of money to purchase well advanced machines and equipment. This will be demonstrated in the analysis part of the thesis work.

CHAPTER FOUR

CASE STUDY: PEACOCK SHOE FACTORY

4.1 Company History

Peacock Shoe Factory was established in 1994. For more than 15 years peacock Shoe Company is producing shoes either for the local or global market. It is mainly engaged in the production of quality dress casual men's shoes. The shoe factory has its own numerous shops. Peacock has a wide range of shoes in a variety of styles and colors. The shoe factory success has been its dedication to quality. The company has sister companies like Dire Tannery, Dire electronics and others. For the local market satisfaction, the company has one production site apart from the company under consideration, located around piazza. However, the company, which is located in saris area, is mainly focused on export.

For the first time in Ethiopia footwear history, the Peacock shoe company is the first to land on the export market. On April 19, 2005 at 4:45PM, the peacock shoe company sent its products with Messina shipping to the global market like Sergio (Italy), BZ moda (Germany), Mogocor (Spain), Alkahir (Jida), Brimac industries (Nigeria) etc.

4.2 Vision, Mission and Objective of the company

- **Vision of the Company:**

To be competent in the international shoe market in terms of competitive price and quality

- **Mission of the Company:**

To produce and sale quality shoes both in the local and foreign market, and maximize profit with customer satisfaction.

- **Objectives of the Company:**

- ✓ Contributing its share to the national economy through its quality products in the local markets
- ✓ Earning foreign currency through export opportunity
- ✓ Availing job opportunities

- ✓ Promoting economic ties with other stakeholders in the sector

4.3 Types of products and inputs of the company

- **Type of product:** The Company produces more than 50 models of shoe for local and export market.
- **Inputs:** it is difficult to list all inputs of shoe details and it is different from one shoe model to another, but the general inputs are: sheep leather, cow leather, re-enforcing material, sole, insole, adhesive (glue), accessories, different medallion (decoration).

Some of the materials are received from local companies and the rest from abroad. The main input for shoe manufacturing which is hide and skin comes from the local market and since peacock shoe factory owns its own tannery (Dire tannery and Modjo tannery) it gets its raw material from its own company but if there are some shortage in its own company, the factory buys from other local tanneries like Ethiopian tannery, Walia, and Batu tanneries. The different components and accessories imported from suppliers found in abroad for six month stock.

4.4 Production process and Production Facilities description

A. Cutting Section

The nature of the workstations is standing. The workers perform their job on standing on a concrete floor. But it is scientifically proved that a person can sit for about one hour and stand for half an hour before muscle fatigue and stress occurred. As a result of this the workers spent on standing for about eight hour per two shifts without rest performing their job. In addition to this, the cutting section room does not get natural light from the sun. The production equipments such as cutting dies, cutting board, and other necessary materials are not properly maintained and replaced on time. The productivity of the workers is shown as very low due to these equipments. And also the long standing situation of the worker needs great attention that concrete floor exerts reaction force against the operator's which in turn causes fatigue stress on him/her.

Cutting of leather to different shoe components is done by modern Hydraulic cutting machines. The working area is on a separate building which serves both for cutting and mucus preparation.

In this section there are about 27 cutting machine. Due to large number of the electrical fluorescent the temperature of the room is very high, especially in the afternoon.

The other problem in the cutting section is as the operator cuts the materials; the operator presses the machine against the cutting die. While he performs this activity due to the cutting die not properly grinded to make its blade sharp, they are forced to exert large force. Because the cutting dies sometimes stick to the cutting board called **mica**, the operators has to take time to remove the cutting die from the board. And also as a result of the cutting die is not sharp enough, it loses its function of cutting the pieces correctly. To alleviate this, the operators must waste time to cut the pieces using scissors. Consequently the effect of wastage of time on the daily productivity is observed by taking the average time the operator takes to produce one piece of product and the time he wastes to remove the die from the board and to cut with scissors is not part of the operation. The analysis is formulated as follows: the data is taken from one operator performance.



Figure 4.1: Components of Bades shoe and Bades shoe model

In the cutting department there are different types of operations. These are:

1. **Upper cutting:** its purpose is to form the upper leather components of a shoe.
2. **Lining cutting:** on the other hand the lining cutting's purpose is to form the inner side component of a shoe.
3. **Material cutting:** textile fabrics, nylon, plastic materials, sponge foam, and cloth are the materials cut that are to be attached with some of the upper components to avoid tiring while the leather parts are stitched and it helps the shoe to have strength and flexibility.
4. **Marking:** At this stage some of the upper components which go through stitching are marked by using silver pen. This activity is done in order to help the stitching activity of the workers to follow through the line of marking as a guide. Even though the components which have to be marked differ from model to model, more or less the following can take the marking activity: eye let, apron, vamp, sock lining, and upper components. The activity of marking is performed on standing. But the nature of the task does not require exertion of force or it does not require extreme accuracy.
5. **Skiving:** This operation is done to reduce the thickness of the upper leather components that under goes through stitching operation for ease of penetrating the needle of the stitching machine. The components which under go on skiving differs from model to model. The most common components that have to be skived are as follows: quarter lining, vamp lining, apron, eye let face, lining tongue etc. the nature of the job allows both sit and stand working condition but currently they are working standing.
6. **Re-enforcement material attachment:** Different types of re-enforcement materials are cemented with glue and attached with some of the upper components to avoid tiring while the leather parts are stitched and it helps the shoe to have strength and flexibility. The types of re-enforcement materials differ for different components, such as nylon, plastic materials, sponge foam, and cloth etc. the nature of the work is like the others does not require special skills and does not require force. Similarly the workers perform the activity by standing.

7. **Loading:** all components that are necessary for one complete shoe are counted and stored until it is loaded and distributed to the stitching department. It is assumed also as a starting point for the main line of stitching section as a whole. All the previous activities are considered as a preparation stage.

B. Stitching Section Operations:

Like the cutting room the stitching room also has problem of getting sun light. Relatively the sitting workstations are better than the other rooms. Stitching, trimming, hammering is among the seating workstations. The rest of the following workstations can be changed into sit-stand workstations to allow the workers have alternatives. These includes: Folding, Pulling and Burning threads, and Cleaning and Inspection. Workers assigned on hammering machine and trimming machine need to have ear muff and hand glove to protect them from hazards. Shortages of production equipments in this room are also clearly seen.

Upper, lining and re-enforced materials come in batch from cutting department to feed stitching department. One batch contains 10 components. Quality of components, quantity per one binding, size is checked while the batch arrive stitching department. In this section assembly of the different components of the upper parts of shoes is done by different types of flat bed, post-bed, zigzag, eyeleting machines and others; Parts of shoes referred as an upper are vamp, tongue, apron, toecap, counter, quarter, and mudguard, etc.

8. **Stitching:** The word stitching refers to many types of stitching. These stitching may be combining of two similar or dissimilar components. There are different types of stitching machines. To mention some of them are: Flat bed stitching machine used for zigzag stitching and post bed used for normal stitching. The different components that have to go through the stitching step may include the following: decorations, back strap, stitch and turn, top line stitch, lock stitch, stitch line, component to component (assembly). The operation is sitting work station. The only problem being observed is the chairs are not comfortable to the workers, it needs designing.

- 9. Trimming:** Trimming activity is done after stitching is accomplished. There are two trimming machines; trimming is very useful to remove the unnecessary parts of the edge of the upper components.
- 10. Folding and Hammering:** At this step the upper components are folded to inside side so that it can have good shape and appearance. Hammering is basically done for relieving (reduce) the folds around the surface area of all upper components.
- 11. Back Part Molding:** The heel side of the tomay is molded using mold machine to keep the shape of the tomay a heel shape.
- 12. Pulling and burning threads:** After respective operations have been completed, the threads left out from stitching operation are pulled out and burned and they are cleaned properly. The operation is very easy and standing work station. After completing this activity lacing (inserting shoe kir) activity is part of the workers responsibility
- 13. Fixing operation:** This activity is mainly concerned with joining of main assembled components. The main fixing activities include: Component to component, toe puff fixing, counter stiffness fixing, sub-assembled lining fixing and foam fixing
- 14. Cleaning and Inspection:** This work station is the end of stitching operation section. Finalizing the tomay (Italy name) as end products before it is shipped to the lasting section. The inspection is done without measurement; only eye inspection.

C. Lasting Section Operations

Comparing the lasting section with the other building; it is modern building purposely designed for lasting section with regard to lighting system. But the main problems of this section are the temperature of the room is very high especially in the afternoon; because there are a lot of machine which uses electric power which in turn produce heat, noise, and dust from the roughing machines due to failure of the dust sacker. Different production equipments are found there for lasting purpose like back part molding, upper prepare-hot, toe puff attaching-hot, seat lasting, seat and side lasting-hot, ironing-hot, sole press-hot, and other tools and fixture. Sole, tomay, insole and last (form) are the materials feed to the lasting department.

1. **Preparation stage:** This section uses the end products of stitching section as an input i.e. the tomay as well as the sole. The operators load pair of tomay together with pair of sole on upper and lower layer of the conveyor. The sole is washed using hydrogen liquid (priming) and then glue it to prepare for fixing with daban (local name).
2. **Manual Lasting:** In this station the tomay and Mucas are inserted to the form after the tomay is properly heated by heating machine to increase the elasticity of it for ease of insertion to the form. The operators performing this activity do not have protective tools such as hand glove and he inserts it using his hands exerting large force. To avoid such type of large force exertion the operator comments out it should be replaced by automatic insertion machine. The operator expresses that he has pain on his left hand and his neck during sleeping time.
3. **Hammering Nail:** The daban with the form and the tomay with the form are firmly attached with nail to avoid misalignment during the next steps.
4. **Pressing:** At this working area the mucus part/ lower part of the shoe is closed and made it to be pressed to have the right shape. This working station is very noisy resulted from the machine called (TKcKh). This machine is done by exertion of large force and it produces vibration. Even though the vibration produced is due to the nature of the machine the operator has not awareness of using ear muff or other protective material.
5. **Furnishing Mucus:** In this area the workers perform this task by standing the whole day. But the task can be done sitting and standing alternatively. As a result of long standing work station the worker explains that they have back and shoulder pain. Therefore I strongly believe that this can be changed to sitting and standing work station, so they need to have chairs.
6. **Closing/ folding:** The mucus surrounding edge is cemented with glue and heated, and then the process of folding the **tomay** to the surface of the mucus is done manually. But the back part of the heel is folded by parting machine because of its difficulty to perform it by hand. The nature of the job is standing workstation, because it needs large amount of force. So men are assigned in this work area. The problem observed here is that the

workers do not have tea time to take rest for a while so that they are subjected to back strain and mental retards.

7. **Heating:** The shoe at this step is properly heated in the heater machine to make it relaxed, so that it can have its natural elasticity and the nails are removed from its position as the mucus and the upper component of the shoe are now fixed together. The working condition is still not comfortable like the other stations.
8. **Grinding:** The nose part of the mucus and upper component together are grinded properly to bring the nose part of the shoe to the shape of toe. The nature of the job demands the operator to exert large amount of force and the grinder by itself has the effect of vibration nature. So the operator has to carry the shoe on his left hand side and the grinding machine on his right hand side. As a result of this the operator explains that he has pain on his left hand, neck and back bone during sleeping time so that there need to have something that can carry the shoe while he is grinding.
9. **Roughing:** In this working area the shoe is ironed and roughed to make the shining and beauty. Even though the roughing machine has the capability of sucking the dust removed from upper components; the area is not free from dust. So there is a possibility of inhaling the dust by the operator. The operator does not have protective device for his mouth, nose, and ear.
10. **Stamping:** Trademarks name of the shoe such as the name “peacock”, shoe number or the customer’s company name are stamped in this work area. The nature of the working condition is standing workstation. The component which undergo on stamping is the inner layer of the sole.
11. **Carton box Making:** The operator prepares the carton box which has a size of carrying one pair of shoe. It is standing work station for folding the main box and its cover. The boxes are loaded on the conveyor.
12. **Heating and Pressing:** At this workstation the pair of upper finished component with its pair of sole are picked from the conveyor and inserted in the heater machine to dry the material and then anti tiff or alarm code is inserted in between the sole and to make. After

accomplishing this operation the operator fix the main sol and the upper component finished part and inserted to the pressing machine to firmly attach both components. The hazard that may occur here is only if the air used by the press machine is interrupted, the operators hand may be subjected to hazard.

- 13. Removing the form:** In this working station the form is removed from the completed shoe. The operator did this task by exerting large force for the whole day. The existing machine is not currently working for about three years. The operator explains his feeling to the working condition that he has never slept peacefully since he has assigned on this station and he has pain on his back bone, his neck and on his left hand so that I believed that the load on the operator can be solved if the machine is maintained or replace by another new one. In addition to this action it can also improved if the shoe is made to heat to increase its elasticity for ease of removing.
- 14. Cooling Activity:** The main function of this workstation is cooling the shoe to return it to its original shape to recover the distorted nature of its elasticity due to so many activities such as ironing and brushing of previous steps. After passing the cooling machine the inner upper layer sole is inserted after cemented with glue. It is also this time the shoe lace is tied if required.
- 15. Spraying:** here liquid cream is sprayed to polish the shoe. This workstation is the most dangerous area for health of the worker because the chemical sprayed here has the probability of inhaling the infected dust air. But it was observed that the operator did not use the muff to protect himself. That means he does not have clear awareness about the advantage of the protective equipment.
- 16. Inspection and packing:** at this stage the complete shoe is inspected its quality; leather tearing and stitch problem are some of the quality problems mostly detected. Some minor activities of finishing such as burning treads, posting the shoe number, price of the shoe, and trademark on the finished shoe. After this activities are properly done then the workers pack pair of shoe in one box

4.5 Organizational structure of the company

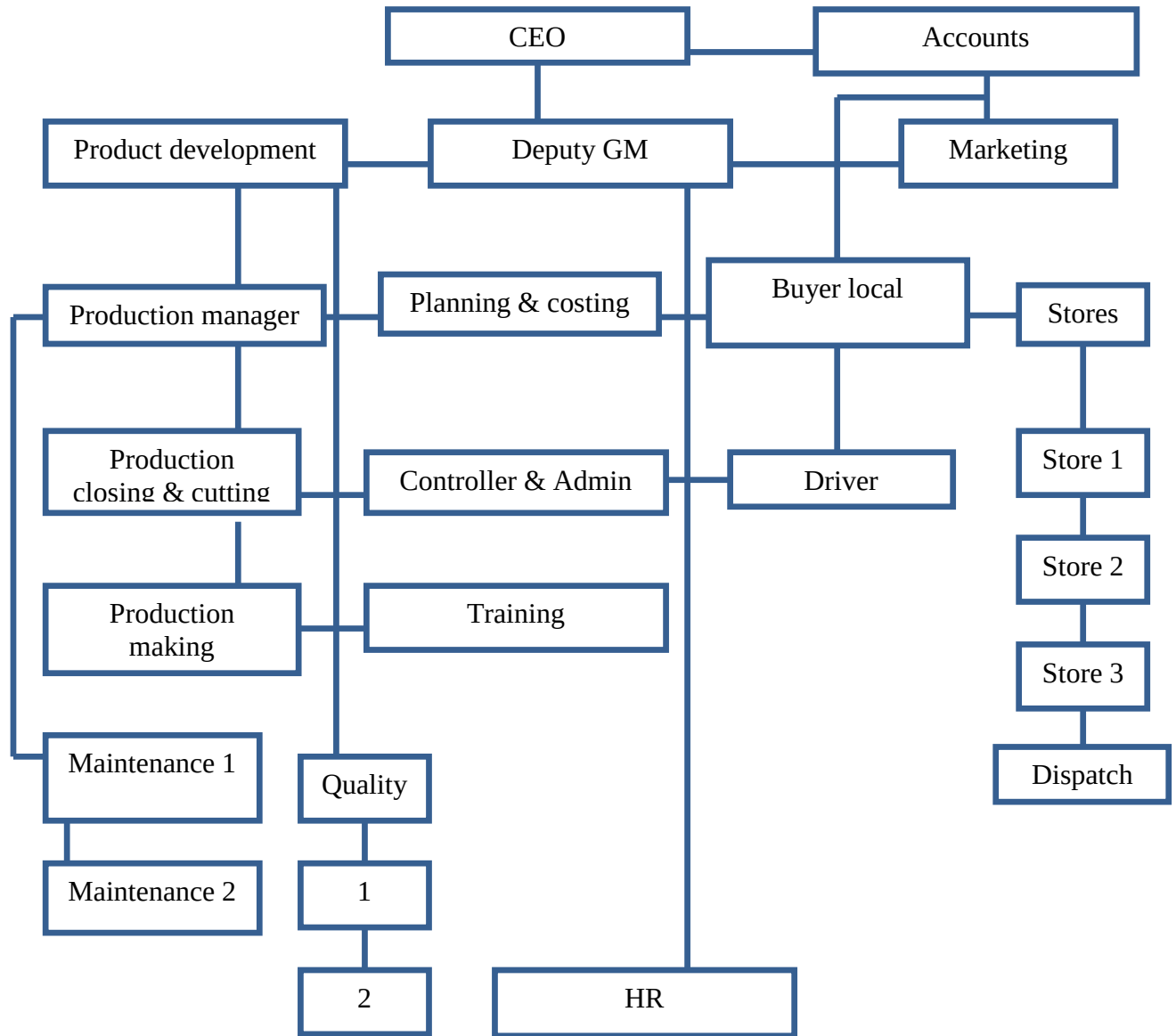


Figure 4.2: Organization structure of peacock shoe factory

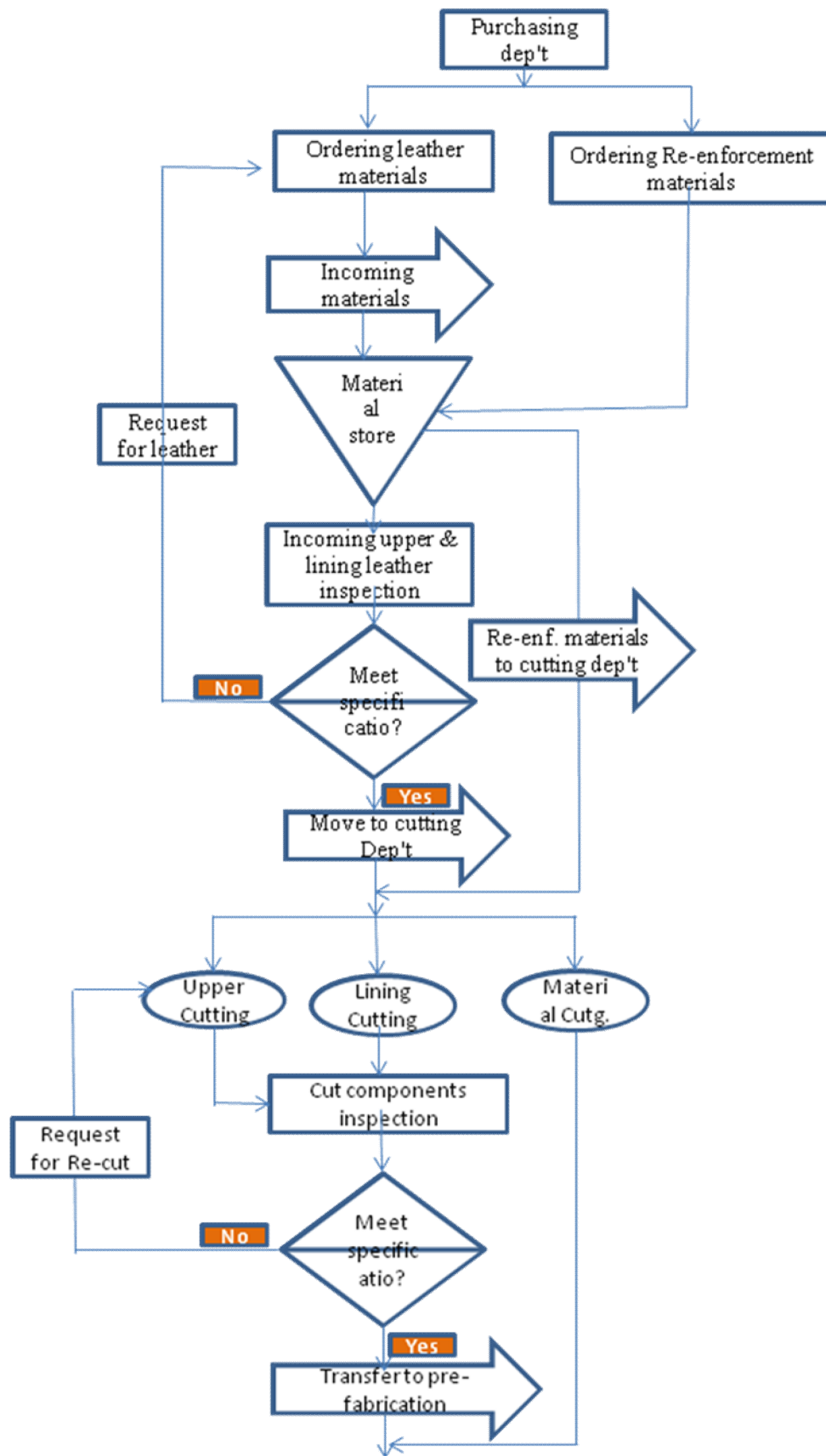
4.6 Overall operations process chart

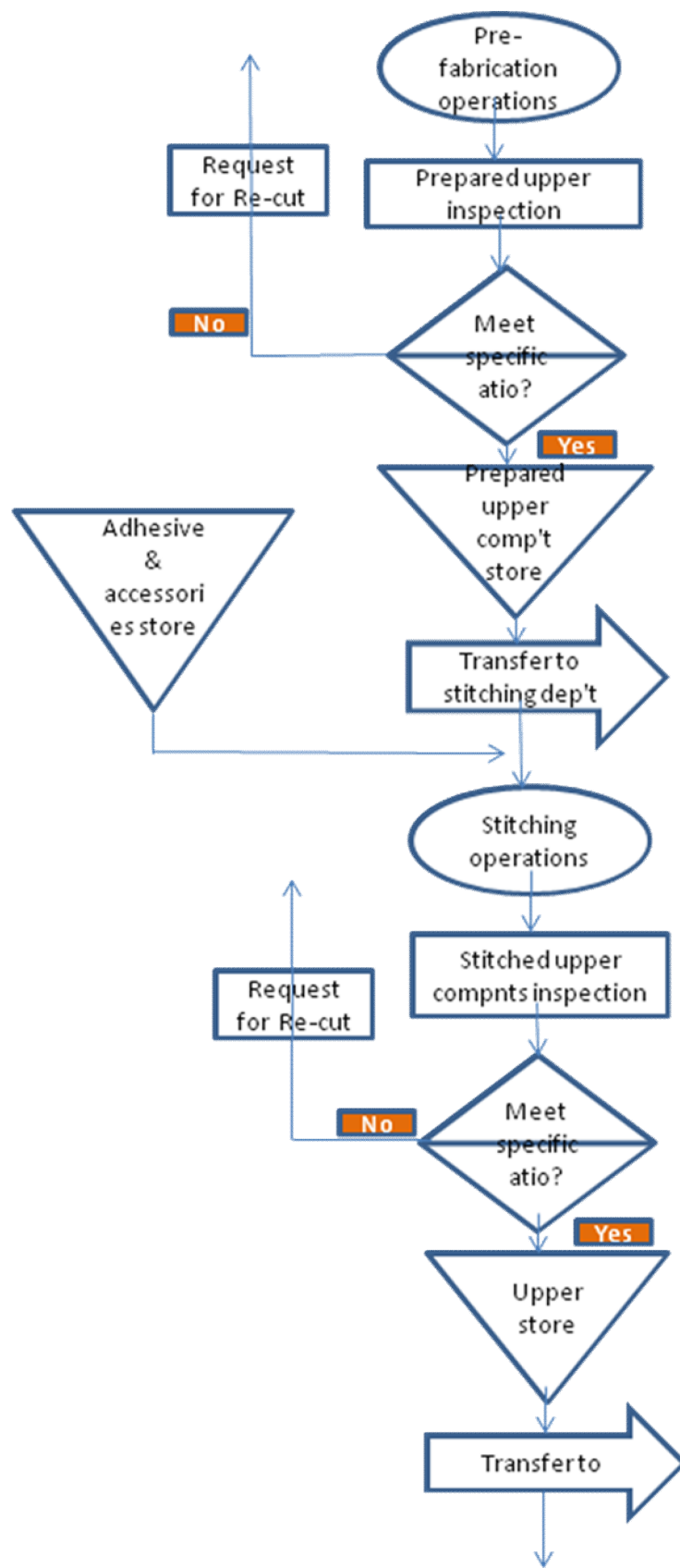
At the initial stages it is valuable to get an overall view of the process. An operation process chart provides a bird's eye view of the whole process or activity. In an operations process chart all the operations and inspections involved are recorded. The chart does not indicate where the work takes place or who performs it. The delay, transport and storages are not indicated. But the entry points of materials are indicated.

"An operations process chart is a graphic representation of the sequence of all the operations and inspections involved in a process or procedure"

Such a chart will serve as a starting point for the critical examination. This is a very useful chart for initial analysis. Where the process is long and complicated, this chart provides an overall picture and gives adequate information for critical examination.

Through the manufacturing of any shoe, there are some recommended procedures for proper production. As this standard manufacturing procedure, the peacock shoe company has three buildings for the production. As any footwear company, Peacock Shoe Company follows the process of footwear production. The process includes cutting, preparation and lasting departments, along with their material storage units.





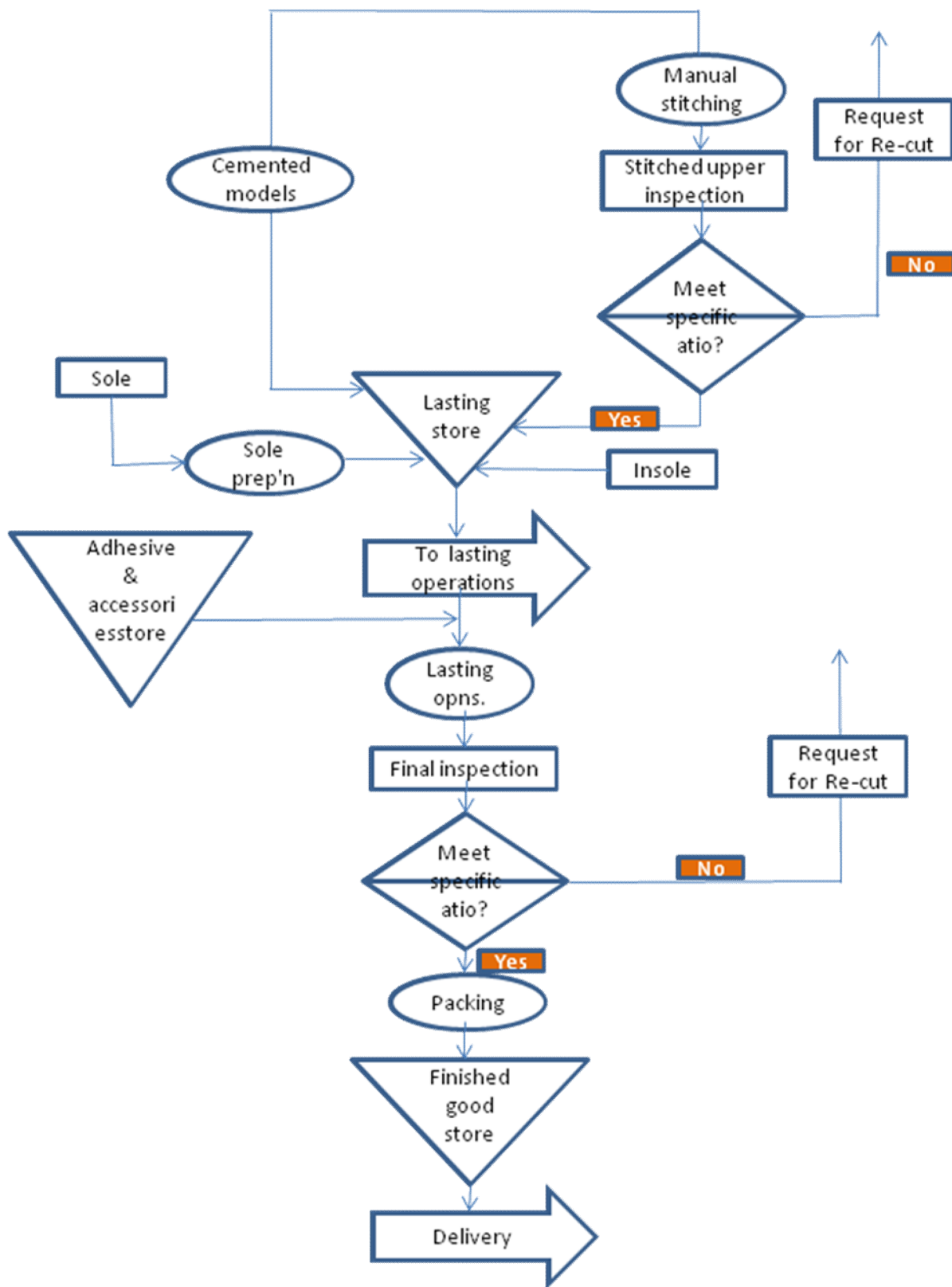


Figure 4.3: Overall outline process chart

4.6.1 Cutting department

Leather for upper and lining and interlining (re-enforcement) materials are the inputs for the cutting department. The outputs of this section are prepared upper, prepared lining and re-enforcement materials; as they all finished their process they will go to the cutting store and will be used as an input for stitching department.

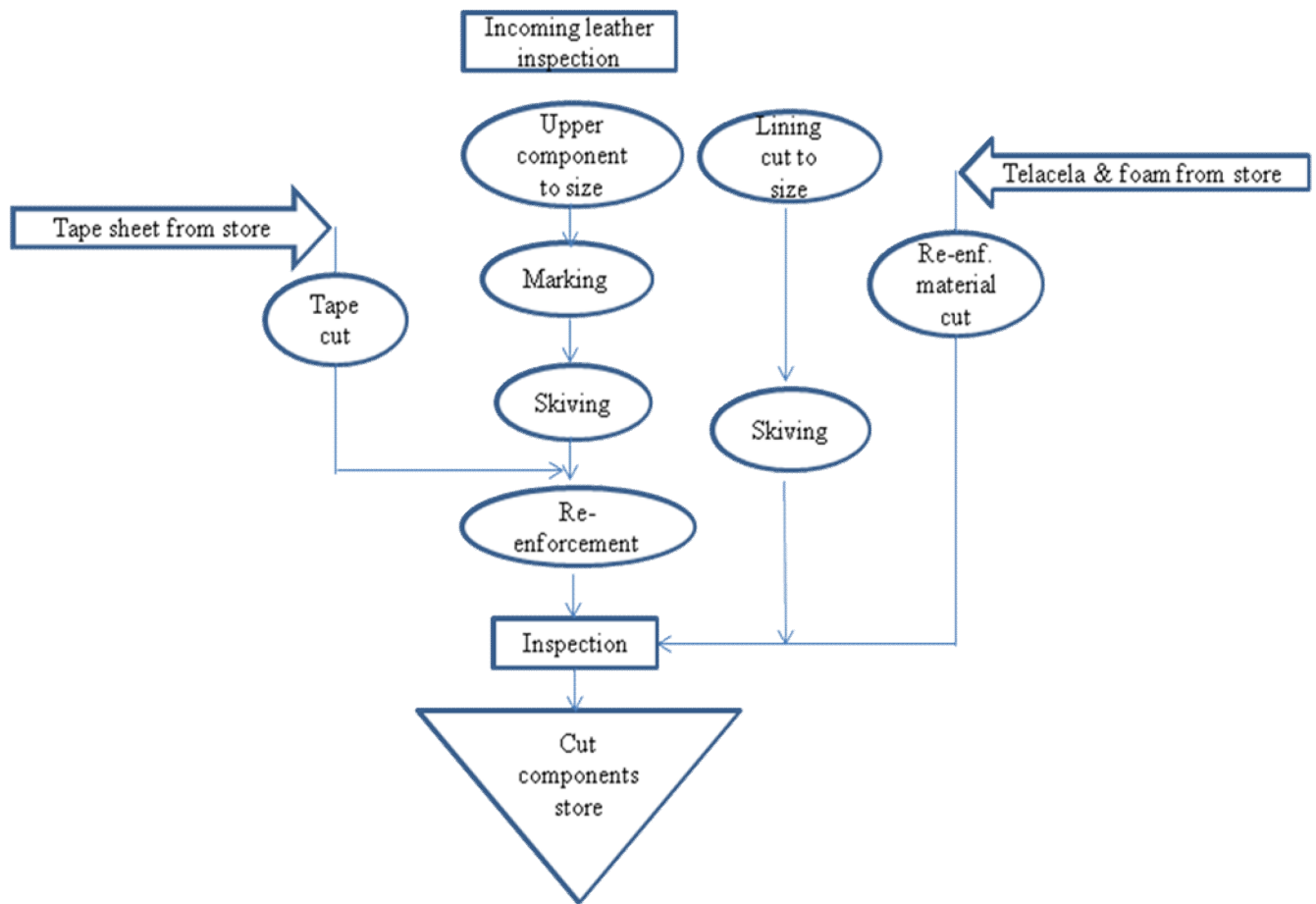


Figure 4.4: Outline process chart of cutting department

4.6.2 Stitching department

Upper, lining and re-enforced materials come in batch from cutting department to feed stitching department. One batch contains 10 components. Quality of components, quantity per one binding and size are checked while the batch arrive stitching department. In addition to the inputs from cutting department counter, thread, stamp foil, glue, alcohol and socks are feed from

the stitching store. In this section assembly of the different components of the upper parts of shoes is done by different types of flat bed, post-bed, zigzag, eyeleting machines and others; Parts of shoes referred as an upper are vamp, apron, strap and socks are done in this department. The first three components are sent to manual stitch (moccasin) if the shoe model passes through moccasin and that of socks are directly go to lasting section.

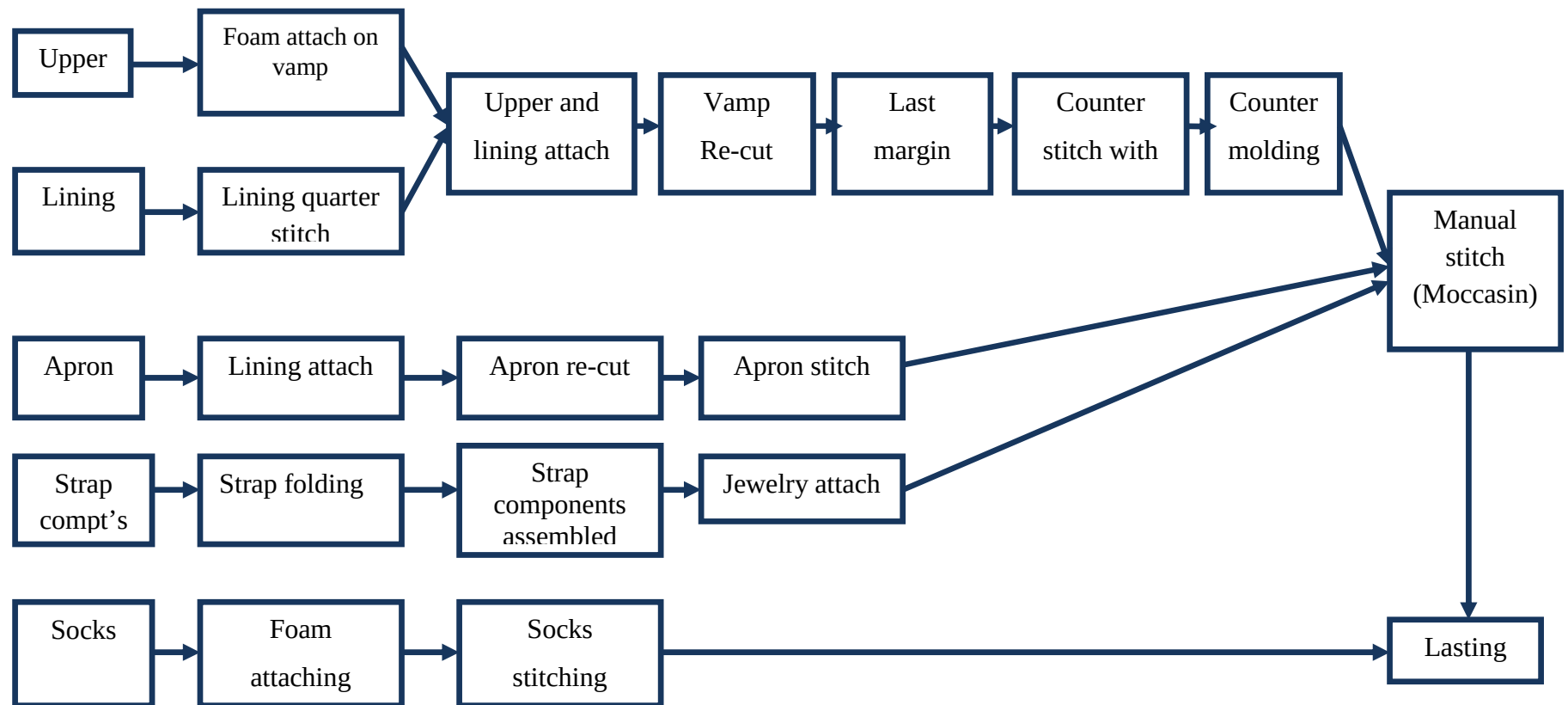


Figure 4.5: Detailed Outline process chart of major Activities of the shoe assembly line (stitching)

4.6.3 Activity flow of shoe assembly in the lasting department

The above listed operations can be summarized and will have the following activity flow as shown in the diagram below.

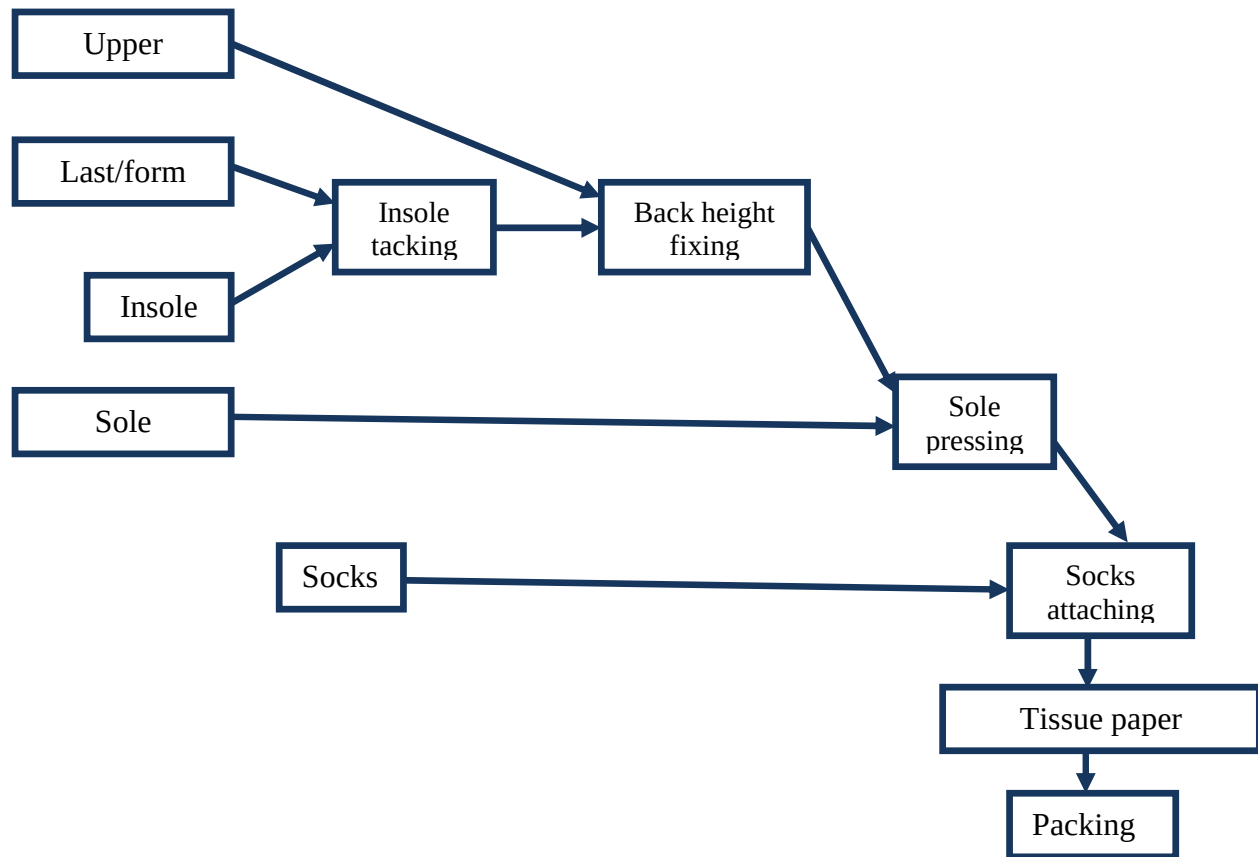


Figure 4.6: Detailed Outline process chart of major activities of the shoe assembly line (lasting)

Description of the flow or precedence diagram

In the lasting and finishing department feeders load the major component of shoe, upper and the lasting (form), at the one end of the rotating conveyor near to the packing station. Then the tacking of insole with the form will be done. Then this will be fixed with the upper manually and the process is called back height fixing. After different operations done on this part, the primed sole, which is stayed for 45 minute to dry, will be attached using sole pressing machine. Then the form will be de-lasting or disassembled and socks attached. After some operations like ironing, cooling, and brushing have done on the shoe, shoe lacing will be accomplished. Finally, inspection will be done and packed.

CHAPTER FIVE

ANALYSIS, DISCUSSIONS AND FINDINGS

Upon making an analysis of the daily work, one finds that it can be classified into two categories. One is continuous performance (routine performance), and the other is performance that occurs rarely and irregularly (irregular performance). An operation analysis is to classify, analyze and investigate all the activities that take place during work for the purpose of drawing up improvement plans for both work and management as well as identifying the allowance rate that will permit the setting of the standard work time.

5.1 Case study approach

The researcher has gone to the case firm formally by having letter from Addis Ababa Institute of Technology (AAIT) then after had discussion with the production manager, who is an industrial engineer, about my title and intervention areas in the firm under the light of my title. From his experience he suggested me major product of the company that has been on the production line for the past recent years. The whole study has been conducted with respect to this shoe model (Bades). Product development center, cutting department, stitching department and lasting & finishing departments are under the control of the production manager Ato Dawit. He disseminated letters for each department head that described about the researcher's authorization to get any information's. In addition he assigned one worker to work with the researcher and providing any information's that the researcher needs to gather.

After having discussions amongst the production manager & production department heads, observations and through literature studies the research problem was formulated this was directed by both the aims of this research.

Data collection process

Accurate data collection and analysis is important as all output depends on it. Initially, data collection begins from identifying the location, entities and others. All the data that are successfully gathered were specifically identified for accurate distribution as the process go to

next level. Data were gathered through observation, interview and analyzing. Observation was carried out starting from raw material store until finished goods store.

For the research work it is well-situated to select a product family. One point to understand clearly before starting the data collection is the need to focus on one product family/model. The Bades shoe product is selected that is suggested from the production manager Ato Dawit (Industrial engineer). This shoe model has been on the production line for the recent past four years (a product with high demand); that is why I selected this shoe model.

In order to ease data collection, data collection form (template) for the time processing was prepared; and then Processing time and labor force size used in each operation or activity for the selected shoe model/article was taken using stop watch in every workstation. I recorded the five different day's processing times of each process and all of the process steps through which the selected article go; the processing times were measured in seconds using stopwatches. The processing times are therefore used to find a standard time (basic time) is found by multiplying recorded time by performance rating (which is benchmarked internationally) which is then changed to standard time by adding allowances like personal, fatigue and contingency.

The kinds of data that were collected for the analysis are mainly empirical data's such as:

- 1) Processing times of each work stations
- 2) Distances between stations and departments
- 3) Daily production plan of all departments
- 4) International data of average output per operatives per shift and qualitative data's.

5.2 Specific objectives for the case company

The research is conducted at peacock shoe factory to find the best way of doing a job through re-arranging the work stations to eliminate backtracking, Setting a standard time for a selected shoe model and then Balancing the line for streamlining the process through detecting bottleneck stations (stations that have a higher workload) to create even flow of production from one work station to the next there by productivity can be enhanced.

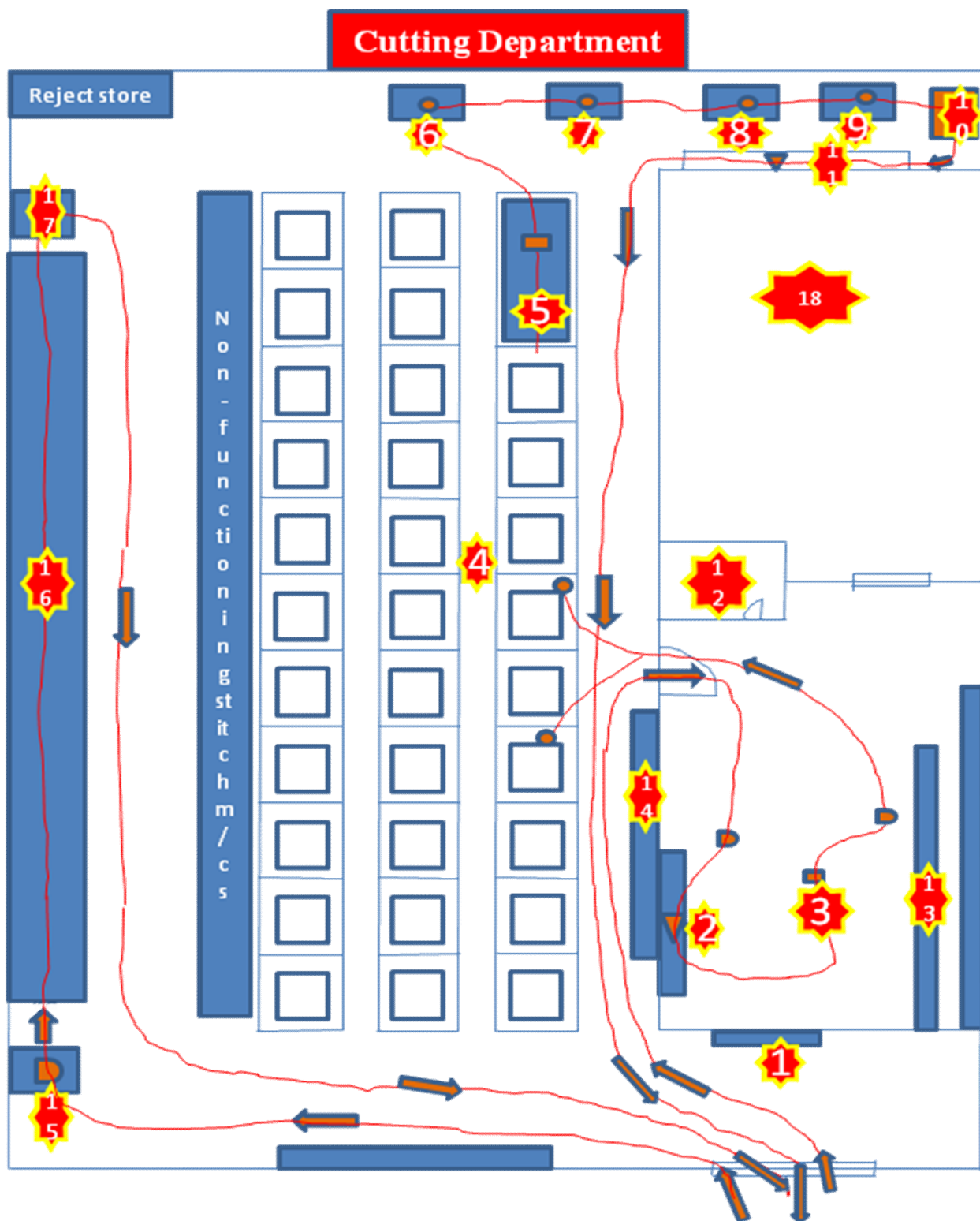
5.3 Method study

5.3.1 Developing the flow Diagram for the selected product (Bades Shoe)

On this thesis from peacock shoe factory products, Bades are selected to analysis of the work study. To develop a flow for only one product or process, it is customary to use the flow process chart supplementing it with a flow diagram. The flow process chart is useful in recording travel distances and the time taken for the various operations. Its value lies in its use as an analytical tool to question the existing method. The flow diagram, on the other hand, is a plan (drawn substantially to scale) of the work area, correctly indicating the positions of machines and working positions. As a result of on-the-spot observation, the paths of movement of the product or its components are traced, sometimes using the process chart symbols to denote the activities carried out at the various points. [12]

5.3.2 Existing work stations arrangement

The flow diagram in the figure below shows the original layout of the cutting and stitching department of peacock shoe factory. The path of movement of the goods from the point of delivery to the storage point is shown by the red line. It will be noticed that the symbols for the various activities have been inserted at the proper places. This enables to looking at the diagram to imagine more readily the activities to which the goods are subjected.



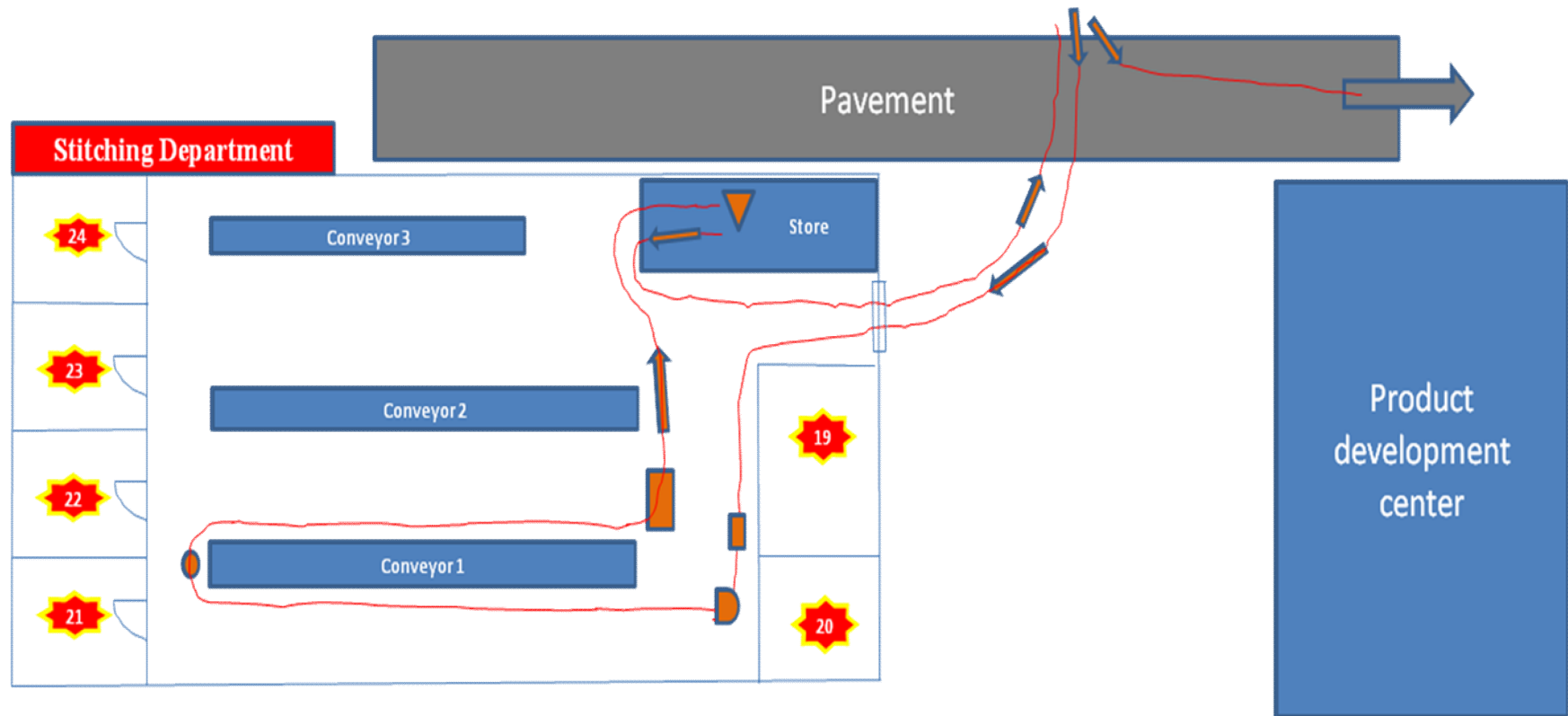


Figure 5.1: Existing work stations arrangement of cutting and stitching department

No.	Represents
1	Sample shoes
2	Leather store
3	inspection area
4	Cutting machines
5	Quality check point
6	Marking
7	Skiving
8	Skiving (lining)
9	Re-enforcement
10	Quality checking
11	Prepared upper store
12	Office
13	Die store
14	Running shoes die
15	Apron & Vamp
16	Manual stitch (moccasin)
17	Finished upper store
18	Materials store
19	Stitching dep't office
20	Spare part store
21	Toilet
22	Machine store
23	Maintenance dep't office
24	Work shop

Record

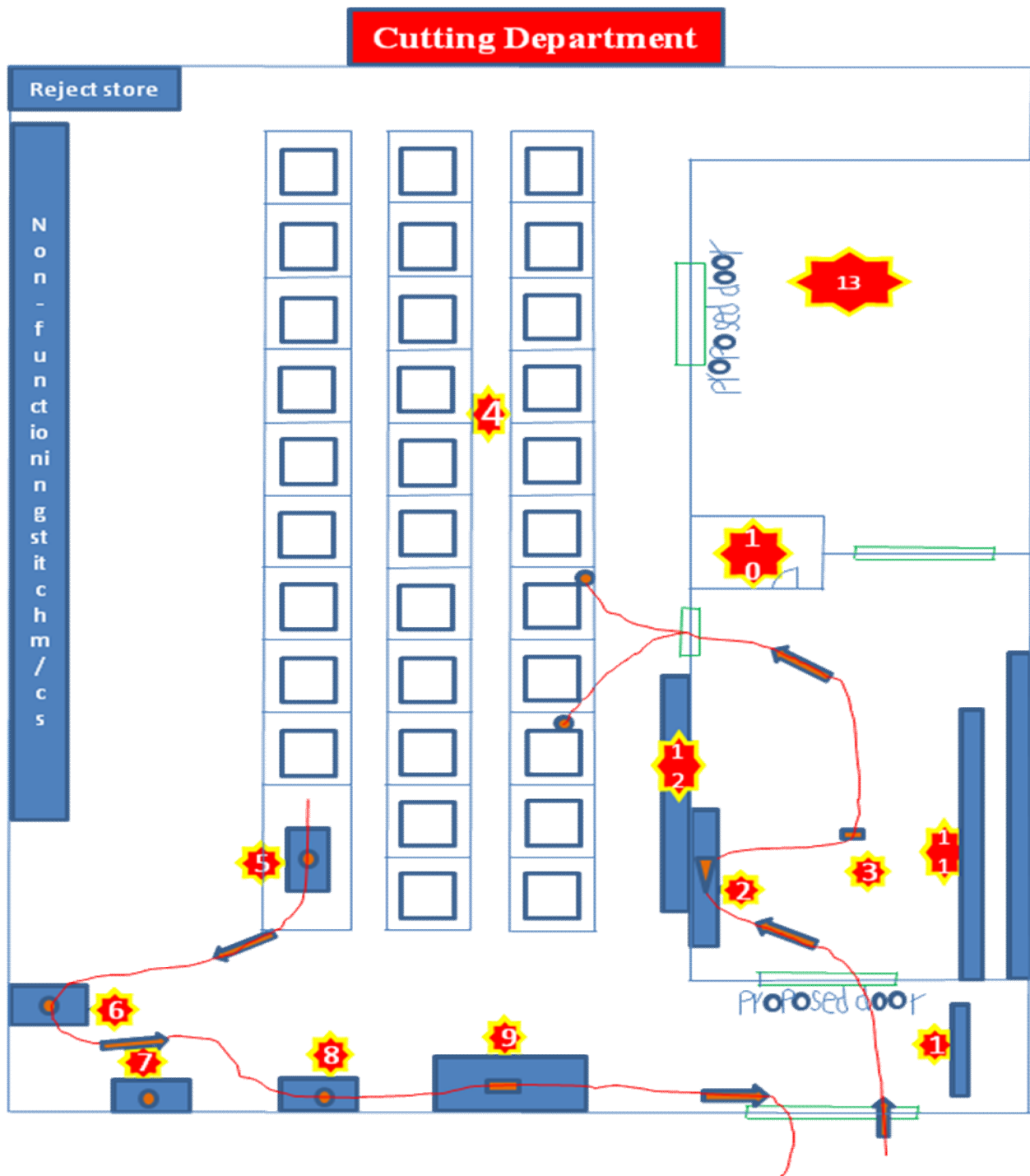
The sequence of activities is one of unloading the leather from the truck, checking, inspecting, cutting, marking, skiving, re-enforcing the upper and then storing. The leather is unloaded from the truck by labors and taken across the floor to the incoming leather storage and inspection room and stored there on the shelf which placed along the wall. By taking out from the stack the leather is inspected and await to transport to the cutting machine where operators are ready to cut the leather into the required amount of shoe components then after the cut components are inspected and delayed until it goes to the marking which uses as a guide for stitching or assembling the components. As a marking operation is accomplished, the next operation is skiving, re-enforcing the upper to increase its strength (thickness) and then after to prepared upper storage.

Flow process chart				Material type						
Chart no. 1		Sheet no.		Summary						
Subject charted: leather for upper				Activity		Prsent	Proposed	Saving		
Activity: inspection, cutting, Pre-fabrication, Stitching, Moccasin, Lasting & finishing, and store. Method: present				Operation ○		8				
				Transport ➡		15				
				Delay D		7				
				Inspection □		7				
				Storage ▼		5				
Location: cutting, stitching and Lasting & finishing department				Distance (m)		819.5				
Operative (s): see remarks column		Clock no.		Time (man-hr)		1.96hr				
Charted by: Sisay Addis		Date: 3-6-2011								
Approved by: Dr-ing. Daniel Kitaw		Date:								
D e s c r i p t i o n		Qty.	Distance (m)	Time (min)	Symbol					Remarks
					○	➡	D	□	▼	
Lifted from truck and loaded on hand truck			1.5	1.49		┌	└			
Trucked to the storage and inspection room			27							
Store the leather			-							
Inspect the incoming leather			-							
Await transport laborer			-	10						
Bring to the cutting area			15	1.02						
Cutting the leather into shoe components			-	2.74		└				
Inspecting the cut component			-			┌				

Delay Awaiting transport to marking		-	4.54						
Move to the marking area		4	}						
Trace the cut component using lead (marking)		-							
Move to skiving		3	}						
Skive components		-							
Move to re-enforcement area		5	}						
Re-enforce the upper (re-enforce attaching)		-							
Prepared upper inspection		-							
Move to cutting storage		4							
Store the cut components		-							
Components load on hand truck		1.5	}						
Transport to stitching department		86							
Inspect the quantity and size of the cut components		-							
Delay to start the stitching processes		-							
Assemble the components		80							
Inspection		-							
Delay awaiting to transport		-							
Move to the stitching storage		30							
Store assembled upper components of shoe		-							
Transport to the moccasin area		86							
Await to the manual stitch		-							
Manual stitching (Moccasin)		-							

Delay awaiting transport to lasting department		-	5.65						
Upper loaded on hand truck		1	5.67						
Trucked to lasting department		320							
Numbering and inspection		-	4						
Upper store		-							
Issuing to the line		-							
Lasting operations		60	19						
Final inspection		-							
Packing		-							
Await loading on hand truck			3						
Load on the hand truck		1.5	4.04						
Transport to storage		94							
Store		-							
Total		819.5m	117.77min	8	1 5	7	7	5	

5.3.3 Develop the improved method



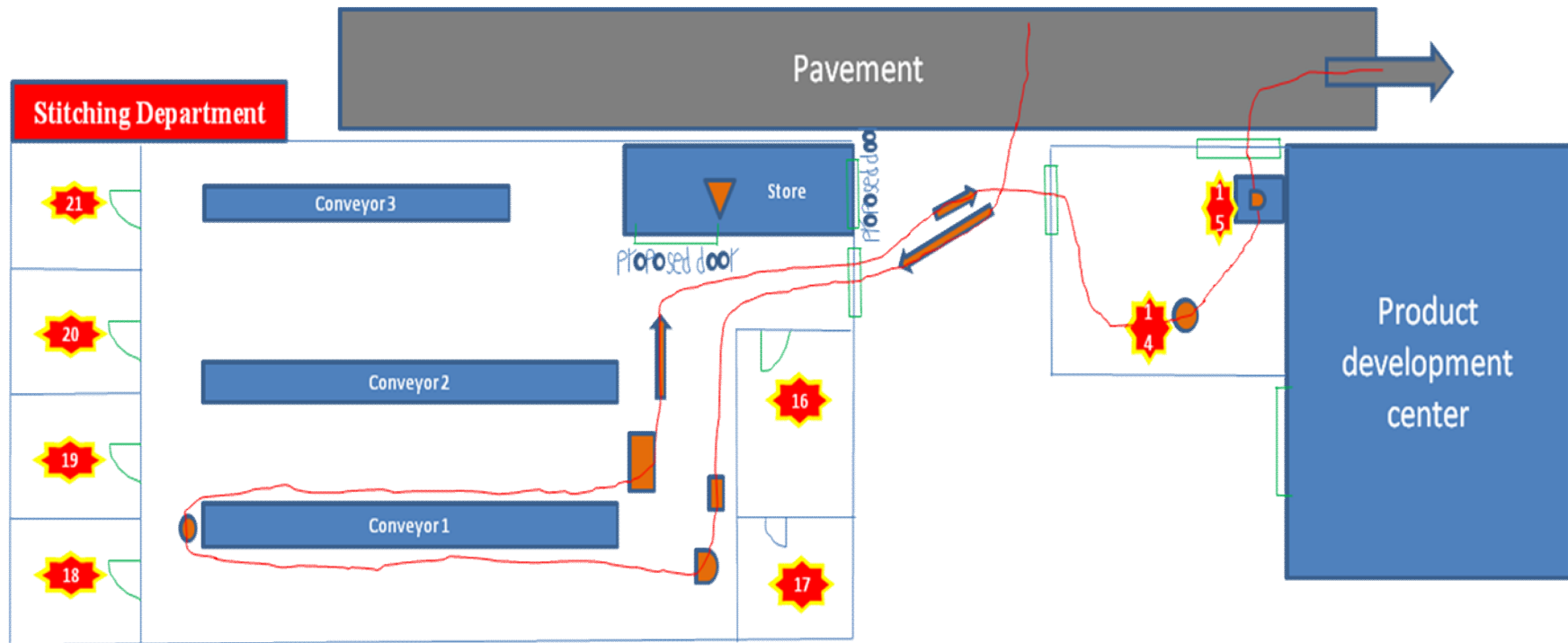


Figure 5.2: Improved work station arrangement (layout) of peacock shoe factory

No.	Represents
1	Sample shoes
2	Leather store
3	Inspection area
4	Cutting & inspection
5	Marking
6	Skiving
7	Skiving (lining)
8	Re-enforcement
9	Quality checking
10	Office
11	Die store
12	Running shoes die
13	Materials store
14	Manual stitch (moccasin)
15	finished upper store
16	Stitching dep't office
17	Spare part store
18	Toilet
19	Machine store
20	Maintenance dep't office
21	Work shop

Flow process chart				Material type								
Chart no. 2			Sheet no.		Summary							
Subject charted: leather for upper				Activity		Present		Proposed		Saving		
Activity: Activity: inspection, cutting, Pre-fabrication, Stitching, Moccasin, Lasting & finishing, and store.				Operation ○		8		7		1		
				Transport ➡		15		14		1		
Method: Improved				Delay D		7		3		4		
				Inspection □		7		6		1		
				Storage ▽		5		2		3		
				Combined □○		-		1				
Location: cutting, stitching and Lasting& finishing department				Distance (m)		819.5		643		176.5m		
Operative (s): see remarks column			Clock no.		Time (man-hr)		1.96		1.23		0.73hr	
Charted by: Sisay Addis			Date: 12-6-2011									
Approved by: Dr.ing Daniel Kitaw			Date:									
D e s c r i p t i o n		Qty.	Distance (m)	Time (min)	Symbol						Rem ark	
					○	➡	D	□	▽	□○		
Lifted from truck and loaded on hand truck			-									
Trucked to the storage and inspection room			10	0.5								
Store the leather			-									
Inspect the incoming leather			-									
Bring to the cutting area			15	0.65								
Cutting the leather into shoe components and inspect it			-	3.5								
Delay Awaiting to transport to marking			-	2								

Await loading on hand truck		-							
Load on the hand truck		-							
Transport to storage		94	2.04						
Store		-							
Total		643m	74.36	7	14	3	6	2	

Summary

The "summary" of the total numbers of activities taking place under both methods, the savings in distance and time which may be expected to accrue from the change has been showed; and the possible savings in money which will result is going to be quantified.

It can be seen from the summary that there have been considerable reductions in the number of "non-productive" activities. The number of "operations" has been reduced from eight to seven by combining leather cutting and inspection; the inspection is carried out directly after cutting. "Transports" have been reduced from 15 to 14 and the distances involved have also been cut from 829.5 to 643 meters, **a saving of over 23 percent** in the travel of each pair. In order to evaluate the existing and the proposed one, times of the various activities have been recorded; in doing so from the study of the two flow process chart it is evident that a saving of 43.41 minutes per a pair of shoe has been achieved.

Final amount in terms of cost

The amount of time for a pair of Bades shoe in the existing condition is 117.77 min and that of the improved one result 74.36 min. One day has a working time of 480 min.

- through the existing method possible pair of shoe produced is $480/117.77= 4\text{shoes}$
- through the improved method = $480/74.36= 6\text{ shoes}$
- therefore there will be a saving of 2 shoe per day
- The price of one pair of Bades shoe is 13 dollar
- there are 24 working days in a month; from the improved method of doing job 2 * 221birr = **442 birr can be gained per day**
- therefore, $442\text{birr/day} * 24\text{ days} = \mathbf{10,608\text{birr/month}}$
- In year = $12\text{months} * 10608\text{birr/month} = 127,296\text{birr/year}$

Total = 127,296 Birr per year is the potential additional gain

5.4 Non-value added activities in peacock shoe factory

1. Ineffective motions: poor feel in handling work pieces, poor coordination of motions of hands and materials are major shortcomings. In the flow diagram the existing layout of the cutting department of peacock shoe factory is shown. The path of movement of the goods from the point of delivery to the storage point is shown by the broad line. It will be noticed that the symbols for the various activities have been inserted at the proper places. This enables to looking at the diagram to imagine more readily the activities to which the goods are subjected. From the diagram one can detect that there is plenty of ineffective motions like back tracking and long distance movement of work from one station to the next. These are due to layout problem of the production system. By improving the layout the total distance moved is reduced from **819.5 meters to 643 meters.** .
2. The cutting workers perform their job on standing on a concrete floor; But it is scientifically proved that a person can sit for about one hour and stand for half an hour before muscle fatigue and stress occurred; but the cutting operatives of peacock shoe factory spent their working time on standing for about eight hour per two shifts without rest. On the other hand, the production equipments such as cutting dies, cutting board, and other necessary materials

are not properly maintained and replaced on time. The productivity of the workers is shown as very low due to these equipments and also the long standing situation of the worker needs great attention that concrete floor exerts reaction force against the operator's which in turn causes fatigue stress on him/her.

Cutting of leather to different shoe components is done by cutting machines. The working area is on a separate building which serves for cutting, preparation and mucus preparation. In this section there are about 27 cutting machine. Due to large number of the electrical fluorescent the temperature of the room is very high, especially in the afternoon. The other problem in the cutting section is as the operator cuts the materials; the operator presses the machine against the cutting die. While he performs this activity due to the cutting die not properly grinded to make its blade sharp, they are forced to exert large force. Because the cutting dies sometimes stick to the cutting board called **mica**, the operators has to take time to remove the cutting die from the board. And also as a result of the cutting die is not sharp enough, it loses its function of cutting the pieces correctly. And the operators exert large force to cut the pieces as well as to remove the knife from the cutting board called mica. To alleviate this, the operators must waste time to cut the pieces using scissors. Consequently the effect of wastage of time on the daily productivity is observed by taking the average time the operator takes to produce one piece of product and the time he wastes to remove the die from the board and to cut with scissors is not part of the operation. The analysis is formulated as follows: the data is taken from one operator performance.

- Average time to cut one piece (for Bades shoe 6104 model) as observed = 2.74 min/pair = 164.4 sec
- Wastage of time for cutting and removing the die = 31 seconds
- Effective time part of the production = $164.4 - 31 = 133.4$ seconds
- Daily product based on the current time = $(110 \text{ pcs/hr}) * (8 \text{ hr/day}) = 880 \text{ pcs/day}$
- Daily product if the waste time is removed = $164.4 / 133.4 * 880 \text{ pcs/day} = 1077 \text{ pcs/day}$
- The opportunity loss is therefore $1077 - 880 = 197 \text{ pcs/day}$.
- As a result of the improper cutting die and un grinded cutting board the productivity of the operator is reduce by $208 * 100 / 1104 = 18.29\%$

3. **Marking:** At this stage some of the upper components which go through stitching are marked by using silver pen. This activity is done in order to help the stitching activity of the workers to follow through the line of marking as a guide. Even though the components which have to be marked differ from model to model, more or less the following can take the marking activity: eye let, apron, vamp, sock lining, and upper components. Analyzing this marking operation, there is a non-value adding activity; while drawing on the components there is so many movements that can be reduced because this extreme (repetitive) movement takes time. In addition, after completing the marking on a piece of component, the right hand takes away it while the left hand is idle to wait for the next component to support the marking die on which there is slot along which the marking pen traces. By making the left hand to bring the next component while the right hand is taking away the marked component, the work content can be reduced there by the marking operation time can be reduced.

5.5 Standard time setting

5.5.1 Existing practice of the company

The standard time is the time required to complete one unit of work, under the predetermined working conditions, according to the predetermined operation method and by worker with average skill. The three factors to be considered are the working conditions, operation method and the workers skill of these factors; the worker's skill in particular has a great influence on the processing time. The individual difference in skill results in difference in the processing time.

To understand the production capacity of the factory, and to draw up plans for an appropriate target output, suitable range of divided labor and optimum production (scheduling, personnel planning or equipment planning), standard time is needed. Despite the fact that about standard time, peacock shoe factory didn't practice it in proper way.

There is an effort to transform the competitiveness of the Ethiopian footwear companies through the application of international standard benchmarking & enable them to build sustainable capability to produce globally competitive footwear products; in doing so there was a study entitled "Implementing Benchmarking (Technology Up gradation) Program For Ethiopian Footwear Companies" to develop an action plan for the seven (peacock shoe factory is the one) footwear manufacturing firms of Ethiopia by identifying intervention areas as indicated in the

Appendix 1. Of these intervention areas standard time setting was the one among the others. But this action plan was not experienced by peacock shoe factory. That is why this research work tries to carry out this task.

5.5.2 Determining Labor Standards from Time Studies

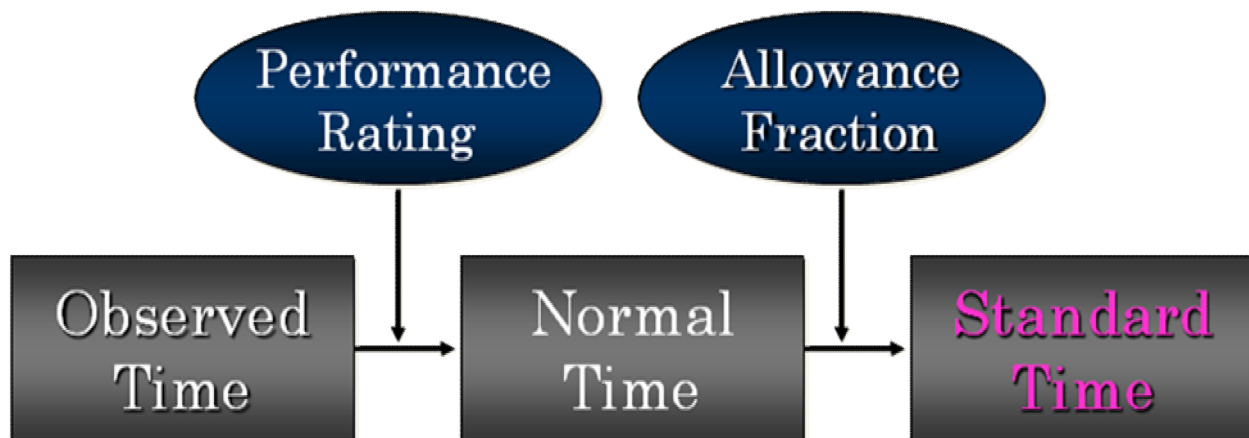


Figure 5.3 Conversion of observed time to standard time

5.5.2.1 International Benchmarking for performance rating determination

When number of qualified operators is performing the same activity, their output will not be same. Some operators will definitely be producing more than what others are producing, while it is assumed that all operators are following the same method and working under the same conditions. As such it is really a problem whose work should be considered as fair day's work. If the slowest worker is considered as standard then the efficient worker will be considered very fast and ultimately there will be lot of difference between their earnings and thereby it will cause dissatisfaction among the workers. As such there should be standard of performance for all the processes and should satisfy the group of workers.

By definition, rating is a comparison of the rate of working observed by the work study man with a picture of some standard level which he is holding in his mind. This standard level is the average rate at which qualified workers will naturally work at a job, when using the correct method and when motivated to apply themselves to their work. [7]

Having said about the performance rating the researcher is going to rate the work through comparing (benchmarking) from the international standard. There was a research done on

Ethiopian footwear manufacturing industries entitled “**Implementing Benchmarking (Technology Up gradation) Program For Ethiopian Footwear Companies**”. The program has the objective of transforming the competitiveness of the Ethiopian footwear companies through the application of international standard benchmarking & enables them to build sustainable capability to produce globally competitive footwear products; these are supposed to be achieved through:

1. Skill transfer & training of technicians, workers & management personnel in order to develop self reliance.
2. Support to leather industry development institute (LIDI) experts by facilitating the skill & knowledge transfer.
3. To prepare action based plans developed for each footwear industry.

STRATEGIC INTERVENTION AREAS THAT THE RESEARCH CONCERNS [SECTORAL ISSUES]:

1. Identification of component sector bottleneck
2. function development
 - product development center
 - Quality control
 - merchandizing
3. activity analysis
 - facility plan
 - **standard time application**
4. resource utilization
 - material utilization
 - inventory management
 - maintenance management
5. organization development
 - role definition
 - skill development
 - organization function specific system application
6. human resource development

- level and skills based training program
- functional manual & product quality manual in English language

STRATEGIC INTERVENTION AREAS [PARTNER INSTITUTIONS]

1. knowledge transfer
 - manufacturing methods
 - quality control
 - design development
 - maintenance
2. Training resource development- Development of training manual in clicking, stitching, lasting, design manual in English language, CDs for training.

Table 5.1: Standard shoe production in pairs per shift per day

Benchmark	Dimension	International Bench mark (=100%)	Remarks Critical (Deviation %)	Intervention area
B. Stitching Production Section				
1. Stitching productivity	Pairs/shift/person	21		2,3,5,6,7
2.Allowable Idle man-hour	%	<10		
3. Section size	No. of employee	75		2,3,5,6,7
C. Lasting and Finishing Production Section				
1. Lasting productivity	Pairs/shift/person	128		2,3,5,6,7
2. Lasting production section size	No. of employee	13		2,3,5,6,7
3. Finishing productivity	Pairs/shift/person	256		2,3,5,6,7
4. Finishing production section size	No. of employee	6		2,3,5,6,7

Source: Implementing Benchmarking (Technology Up gradation) Program for Ethiopian Footwear Companies. Presented by, Footwear Design & Development Institute, Ministry of commerce, GOVT. OF INDIA, INDIA

Using this international benchmark the research has conducted a benchmarking activity at a selected footwear manufacturing firms of Ethiopia and set a production target per operative for 8-hr working time. Tikur Abay shoes company, **peacock shoe factory**, Walia leather and leather products PLC, Ethiopian canvas Rubber shoe factory [Kangaro], Anbesa shoe Share Company, OK Jamaica shoe factory, Ramsay shoe factory are among the selected factories for the research. The research has identified Gaps which have been considered while specifying the target plan or

action plan. According to this research an action plan specified for peacock shoe factory is displayed in **Appendix 1**. [N.B this benchmarking research excludes the machines advancements gap; that means the benchmarking activity is upgrading the productivity using the existing resources which is the big concern of work study.]

According to this research the target plan per operatives has been identified for peacock shoe Share Company. This can be achieved only if all the above gaps are filled to reach the productivity to the bench mark level.

- CUTTING= 200pairs per person per 8-hr;
- STICHING= 15 PAIRS/PERSON/SHIFT;
- LASTING AND FINISHING = 25 PAIRS /PERSON/SHIFT

Using this standard benchmarking level, the researcher has determined the rating for the three departments below.

DIRE INDUSTRIES Pvt. Ltd/Peacock Shoe
PLANNING AND PROGRAMMING UNIT
DAILY PRODUCTION PLAN of ALL DEPARTMENT

Table 5.2 Daily production plan of all departments of peacock shoe factory

DEP'T	GROUP		STITCHING		LASTING	
	BADES	BEAD	C1(BADES)	C2(BEAD)	C1(BEAD)	C2(BADES)
Cutting	800	650				
Pre-fabrication	800	600				
Stitching			800	600		
Moccasin			700			
Lasting					500	600

Note: These values are approximated based on the demand; Bades shoe has a higher demand than Bead. Though the number of shoe components of Bades is higher than Bead, the approximated daily production plan of Bades is higher since the number of workforce assigned are greater than workforces assigned for Bead.

- The actual production of cutting of peacock shoe factory ranges from 160-180pairs per day [for 8hr working time]; therefore, the rating for clicking operation will be $170/200 * 100\% = 85\%$. I will consider this rating figure for pre-fabrication operations since there is

no a benchmarking figures for the pre-fabrication [Marking, Skiving and reinforcement]. These operations are found in cutting department.

- In the stitching department there are three conveyors to process various kinds of shoe model with the total work force of 100; of this shoe models Bades and Bead are the major one and the actual total daily production of this shoe models is 1300 pairs of shoe upper though the total daily production plan is 1400 so that the labor productivity will be $1300/100 = 13$ pair of shoe per person per 8hr working time so that the rating will be $13/15 * 100\% = 86.67\%$
- Similarly in the lasting and finishing section there are 58 workers on the line. Out of these 58 workers two persons are for loading and for final inspection. The direct workers for lasting and finishing are 56. The total daily production plan of this section is 1100 but the average daily actual production is 1000. Therefore, labor productivity is $1000/56 = 18$ pair of shoe; the rating will be $18/25 * 100\% = 72\%$. This lowest figure of rating is due to high bottleneck problem in the lasting department.

N.B these 58 workers in the lasting and finishing department are needed for shoe models that needs toe activating and toe last operations but bades shoe which is a moccasin (manual stitch) shoe type doesn't need these operations. Therefore, number of workers required for bades shoe type in the lasting and finishing department are 40.

5.5.2.2 Allowance fraction determination for each department

Method study investigation tries to minimize the energy expended by the worker in performing the operation through the development of improved methods. Even when the most practical, economic and effective methods have been developed, the job will still require the expenditure of human effort. Therefore, some allowances must be provided for recovery from fatigue, and for relaxation. It is also obvious that any worker will not be able to carry out work throughout the day without interruptions. The worker also needs some time to attend to his personal needs, and hence these allowances must be added to the Normal Time in order to give the work content.

Table 5.3: A System of Rest Allowances Given As Percentages of Basic Times [7]

CONSTANT ALLOWANCES		Men	Women
	A. Personal Needs Allowance	5	7
	B. Basic Fatigue Allowance	4	4
		9	11
VARIABLE ADDITIONS TO BASIC FATIGUE ALLOWANCE			
	C. Standing Allowance	2	4
	D. Abnormal Position Allowance		
	Slightly awkward	0	1
	Awkward (bending)	2	3
	Very awkward (lying, stretching up)	7	7
	E. Light Conditions		
	Slightly below recommended value	0	0
	Well below	2	2
	Quite inadequate	5	5
	F. Air Conditions (excluding climatic factors)		
	Well ventilated, or fresh air	0	0
	Badly ventilated, but no toxic or injurious fumes	5	5
	G. Visual Strain		
	Fairly fine work	0	0
	Fine or exacting	2	2
	Very fine or very exacting	5	5
	H. Aural Strain		
	Continuous	0	0
	Intermittent, loud	2	2
	Intermittent, very loud	5	5
	High-pitched, loud	5	5
	I. Mental Strain		
	Fairly complex process	1	1
	Complex or wide span of attention	4	4
	Very complex	8	8
	J. Monotony: Mental		
	Low	0	0
	Medium	1	1
	High	4	4
	K. Monotony: Physical		
	Rather tedious	0	0
	Tedious	2	1
	Very tedious	5	2

Source: Based on information supplied in 1956 by Personnel Administration Ltd. (now P.A. Management Consultants Ltd.). [7]

Allowance for cutting department

The operations found in this department are cutting, marking, skiving and re-enforcement. The nature of these workstations is standing; the workers perform their job on standing on a concrete floor. But it is scientifically proved that a person can sit for about one hour and stand for half an hour before muscle fatigue and stress occurred. However, these workers spent on standing for the whole working time, i.e. 8hr/day, without rest performing their job. In addition to this, electrical light with large number of fluorescent lamps are used which in turn contributes to raise the temperature of the room. To compensate this it is better and possible to use natural light from the sun. The production equipments such as cutting dies, cutting board, and other necessary materials are not properly maintained and replaced on time. As a result, the productivity of the workers has shown as very low due to these equipments and also they are suffering in health problems like back part pain, heel pain, kidney infection and others. In order to alleviate such problems the long standing situation of the worker needs great attention that concrete floor exerts reaction force against the operator's which in turn causes fatigue stress on him. Based on these real conditions and the above table, allowances for men and women in cutting department determined. In this department women's are engaged in the pre-fabrication operations [Marking, Skiving and re-enforcement].

Table 5.4: Allowance determination for cutting department

Allowances	For Men	For Women
Constant Allowances	9	11
Standing Allowance	2	4
Badly Ventilated, But No Toxic Or Injurious Fumes	5	5
Total	16%	20%

Allowance for stitching department

Like the cutting room the stitching room also has problem of using large number of fluorescent lamps which is the cause for high room temperature. Relatively the sitting workstations are better than the other rooms. Stitching, trimming, hammering is among the seating workstations. Workers assigned on hammering machine and trimming machine need to have ear muff and hand glove to protect them from hazards. All workers in this department are females so that the

allowance will be made for them. In similar fashion to that of cutting department, allowance for women in this department is determined as follows:

Table 5.5: Allowance determination for stitching department

Allowances	For Women
Constant Allowances	11
Standing Allowance	3
Lighting condition (good)	0
Badly Ventilated, But No Toxic Or Injurious Fumes	5
Monotony: mental (medium)	1
Total	20%

Allowance for lasting department

Similar problems like cutting section are observed. Relatively there are a lot of machines which uses electric power which intern contributes to temperature increment of the room and dust from the roughing machines due to failure of the dust sacker. Due to failer of some machines like side lasting machine most of the workers are forced to perform jobs manually. This in turn creates physical stresses and strains on the workers. And also health problem are the major problems in this room in relation to standing condition of work stations. The arrangement of available machines is perpendicular to the conveyor's movement so that the operators must stand in between the machine and the conveyor moving on his back side. This needs the operator to turn his face to pick the input material and put his output from/to the conveyor. This repetitive work activity causes the workers to get fatigue on his neck and backbone quickly. It seems convenient to arrange machines parallel to the conveyor motion; so that workers can stand on the side of conveyor motion and can pick and put from and to the conveyor by their right hand side. Based on these real conditions and the above table, an allowance for lasting and finishing department is to be **18%**.

5.5.3 Work Sampling for Cutting Department

Work study is used in the development and control of work situations. Work study encompasses all those procedures concerned with work measurement and motion study. Motion study is qualitative analysis of a work situation leading to the design or improvement of an operation. Work measurement techniques such as time study and work sampling are used in measuring or

forecasting the rate of output of an existing or newly designed operation, as well as in determining how much time is consumed for various productive and non-productive activities of a process or operation. Also involved is the determination of standard times which represent the allowable time for the performance of work (Chuter, 1990; Jenkins and Orth, 2004).

Time study is used to determine a standard time for an operation by direct time measurement. Work Sampling Technique can be used to determine the required data necessary for the application of a percentage allowance of personal needs, fatigue and unavoidable delays (Brock, 1978, Pape, 1991). The main difference between time study and work sampling is that time study requires a definite period of uninterrupted time to observe and considerable time to work up the study. Work sampling, however, will provide essentially the same results in 1/3-1/6 of the time and cost. Other advantages of work sampling studies can be made over a period of days or weeks thus decreasing the change of day-to-day or week-to-week variations (Barnes, 1980; Brisley, 1992; Brock, 1978, Chuter, 1990); this day-to-day or week-to-week period is necessary when one needs to see the machines idleness verses machines working time or other variables. But for my case am going to see how much time a cutter spent to cut shoe components for pair of shoe [6104 article]. This is done through analyzing the cutting operator activities and the percentages of distribution of work elements found in the cutting operation; the researcher identified 11 work elements. The operations are observed, the ratios within manufacturing period are derived. It is also be interested in the percentage time spent by a worker or groups of workers on a given element of work. By observing a worker at the defined points in time I record on which element the cutter spent much time i.e. identifying work element that has a high percentage occurrence and therefore arrive at a percentage distribution of the time the cutter spending on each element.

Work sampling is appropriate for long duration operations like cutting because it is very simple just ticking no need to write any number so that the clicking operation is going to be studied using work sampling; the operation is divided into 11 work elements.

1. Bringing leather to the horse
2. Take the leather from the horse to mica (cutting board)
3. Die handling
4. Nesting (placing the die on the leather)
5. Cutting
6. Checking the leather
7. Spreading leather to the mica (cutting board)
8. Component handling
9. Scrap handling
10. Reading work tickets
11. Missed elements

The works contents will not be appear in sequence; let us use this sequence since it will make sense. The researcher observed what is happening or which work element is executing in every 20cmin or [12 sec] interval.

Table 5.6: Work sampling sheet for cutting department

Work sampling sheet: cutting department																					
Factory/dep't:		Peacock shoe factory: Bades shoe (6104 article)												Page 1 of 1							
Work/process		Clicking												Date: May 21, 2011							
Quantity produced during study		26 pairs												Observation interval 20c min = 12 sec							
Start at		9:30 am												Total time study 72 min							
Finished at		10:42 am																			
Time elapsed		72min																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	K	% of occurrence	Rating	
No.	Description (work elements)	Observation (tally)																			
1	Bringing leather to the horse																	3	0.83%		
2	Take the leather from the horse to mica (cutting board)																	6	1.67%		
3	Die handling																	5	1.39%		
4	Nesting (placing the die on the leather)																	124	34.44%		
5	Cutting																	156	43.43%		
6	Checking the leather																	36	10.00%	85%	
7	Spreading leather to the mica																	18	5.00%		
8	Component handling																	8	2.22%		
9	Scrap handling																	4	1.11%		

10	Reading work tickets																		
11	Missed elements																		
Total observations (N)																	360	100%	
Number of pairs made during study = B = 26 pairs										Basic time = Obs. time * R = 278c min/pair * 0.85 = 236c min/pair									
Total time = (observational interval * N) = A = 20cmin * 360 = 7200 c min										Allowances = 16% of 236 c min									
Observed time / pairs = A/B = 7200cmin/26 = 278cmin										Standard time = 236 c min * 1.16 = 273.78 c min/pair = 2.74min/pair									
K = number of occurrences (frequency);										N = Total observation;					R = performance rating				

5.5.4. Time Study for stitching and lasting department

Table 5.7: Standard time determination

Time study sheet for Pre-fabrication											
Model: Bades shoe [article no. 6104]										Allowance 20%	
All time in second		Standard time is for one person								Rating: 85%	
Sr. No.	Operations in sequence	Observation time (sec)					Avg. obs. time	Normal time	STD. time	No. of worker	Equipment
1	Marking	32.98	34.22	28.03	29.04	37.42	32.33	27.36	34.20	3	Manual
2	Skiving	19.05	20.22	18.93	21.02	27.33	21.31	17.86	22.32	3	Skiving m/c
3	Re-enforcing	45.08	41.22	37.05	37.08	40.77	40.24	34.66	43.33	3	manual
	Total time								99.85 sec		

Time study sheet: Stitching Department											
Product name: Bades shoe (article number 6104) Conveyor no.: 1							Time study observer: Sisay Addis Date: May 29, 2011 Standard time is for one person			Rating = 86.67% Allowance: 20%	
S.no	Operations in sequence	Observed time (sec)					Avr. Obs. time	Normal time	STD time	No. of worker	Equipment
		1	2	3	4	5					
1	Inspection	15.44	11.54	13.23	15.41	12.22	13.01	11.28	14.1	1	Manual
2	Stamping on lining	14.33	10.29	14.46	9.84	15.51	12.83	11.12	13.9	1	Stamping m/c
3	Re-enf. attachment on counter	22.01	24.33	16.12	26.1	22.42	22.05	19.11	23.89	1	Manual
4	Back seam stitching	19.95	20.53	23.69	19.24	15.13	18.65	16.17	20.21	1	Post bed m/c
5	Upper quarter stitching	21.43	20.33	15.52	20.12	18.43	18.68	16.19	20.24	1	“
6	Lining quarter stitching	15.33	18.21	19.75	19.32	15.64	17.33	15.02	18.77	1	“
9	Hammering	16.44	12.54	13.23	15.41	25.22	16.35	14.17	17.71	1	Manual
10	Foam attachment on vamp	40.24	33.43	38.21	29.11	37.86	71.03	63.3	79.12	2	Manual
11	Foam attaching on apron	35.8	29.32	25.64	40.3	35.97	68.49	59.36	74.2	2	Manual
12	Glue app. on quarter lining	41.12	31.67	45.65	39.8	36.21	74.06	64.19	80.24	2	Manual
13	Lining attaching on upper	10.14	16.13	11.44	19.12	15.11	13.91	12.06	15.07	1	Manual
14	lining attaching on apron	19.14	15.13	11.56	10.12	14.11	13.98	11.78	14.72	1	Manual
15	Vamp re-cut	16.22	14.98	14.89	24.98	16.33	17.57	15.23	19.04	1	Cutting m/c
16	Apron re-cut	15.87	14.03	16.65	20.54	13.9	16.04	13.9	17.38	1	Cutting m/c
17	Lasting margin stitch (vamp)	29.98	29.54	39.65	44.09	37.98	36.65	31.77	39.71	1	Post bed m/c
18	Marking on vamp	28.97	27.9	35.34	31.32	41.99	33.43	28.98	36.22	1	Manual
19	Counter stiffener and lining attach	39.98	29.67	35.45	44.54	31.33	36.19	31.37	39.21	2	Manual

20	Counter stitch with vamp	58.66	67.87	64.23	53.45	65.33	61.31	56.61	70.76	1	flat bed
21	Trimming	31.12	35.54	30.87	34.43	35.49	33.77	29.27	36.59	1	Triming m/c
22	Counter molding	22.34	17.76	20.99	19.34	15.09	18.83	14.58	18.23	1	Molding m/c
23	Vamp zigzag stitch	18.89	23.56	19.98	20.09	21.71	20.01	17.34	21.68	1	Zigzag stitch m/c
24	Elastic stitch on quarter	42.65	43.76	31.32	41.9	29.57	37.91	32.86	41.07	1	Post bed
25	Apron stitch	31.56	38.97	21.34	40.11	29.24	32.43	28.1	35.13	1	Post bed
26	Thread burning and cleaning	42.03	31.21	40.9	33.69	45.86	77.66	67.31	84.14	2	Manual
27	Bind tape attaching	32.21	25.33	33.12	36.1	40.42	33.9	29.38	36.73	2	Manual
28	Bind stitching	30.14	39.13	38.44	25.12	28.11	32.81	28.44	35.55	1	Collar stitch m/c
29	Binding trimming	38.33	34.39	40.09	33.21	32.78	70.54	61.14	76.42	2	Manual
30	Thread burning and cleaning	19.44	21.54	29.23	21.41	17.22	21.33	18.49	23.11	2	Manual
31	Strap Folding	37.98	31.39	31.05	37.01	30.55	33.21	28.78	35.98	1	Folding m/c
32	Strap stitch one	47.65	36.33	32.54	34.1	41.33	38.78	33.61	42.01	1	m/c
33	Strap attachment	21.05	17.43	16.31	14.33	14.09	16.36	14.18	17.72	1	Manual
34	Strap stitch two	18.33	15.21	19.75	15.32	19.64	17.33	15.02	18.77	1	m/c
35	Jewelry attach	11.44	15.54	13.65	12.41	9.22	12.72	11.02	13.78	1	Manual
36	Foam attaching	20.9	19.08	25.65	25.08	23.06	22.43	19.44	24.3	1	Manual
37	Socks stitching	14.54	16.9	19.87	12.01	14.9	15.22	13.19	16.49	1	m/c
38	Inspection	10.44	11.54	11.23	15.41	10.22	11.68	10.12	12.65	1	Manual
	Total time								1204.84 sec		

Time study sheet: Lasting & Finishing Department											
Rating = 72% Allowance = 18%											
Sr. No.	Operations in sequence	Observed time (sec)					Avg. Obs. time	Normal time	STD. time	No. of worker	Equipment
		1	2	3	4	5					
1	Feeding	14.07	18.13	14.18	22.78	19.78	17.12	12.32	15.03	1	Manual
2	Sole priming	23.13	17.12	35.32	28.12	17.06	24	17.28	21.07	1	Manual
3	Insole tacking	36.5	28.5	37.97	56.5	45.16	40.74	29.33	35.77	1	Manual
4	Moccasin Pre-forming	23.11	20.33	27.54	21.62	23.34	45.78	32.96	40.2	2	m/c
5	last entering to upper	41.23	49.67	34.11	45.13	45.67	41.77	30.08	36.68	1	Manual
6	Back height fixing	41.25	33.34	47.75	35.13	27.34	36.81	26.5	32.32	1	Manual
7	Glue application	52.31	41.78	33.25	43.47	57.54	45.36	32.66	39.83	1	Manual
8	Side listing	26.07	34.12	31.34	29.75	37.18	31.82	22.91	27.94	2	Manual
9	Heal lasting	18.65	31.25	27.07	15.9	20.22	22.8	16.42	20.02	1	Heal lasting m/c
10	Mark remover	23.78	21.34	21.71	20.13	16.78	20.45	14.73	17.96	1	Manual
11	heat seating	23.12	24.72	27.16	21.07	17.21	22.3	16.06	19.58	1	Heat setter
12	Lace and tack remover	10.9	12.09	18.54	22.91	14.66	15.31	11.02	13.44	1	Manual
13	Hammering	23.5	27.28	26.03	28.88	26.47	26.15	18.83	22.96	1	Manual
14	Wrinkle chasing	49.66	34.22	39.62	49.23	44.72	43.49	31.32	38.19	1	Wrinkle chasing
15	Thread burning	45.09	30.38	37.93	33.66	41.76	37.91	27.3	33.29	1	Manual
16	Polishing	56.01	46.09	59.16	49.63	54.32	52.1	37.52	45.75	1	Manual
17	Ironing	37.12	33.25	47.22	29.29	49.91	39.51	28.45	34.69	1	Ironing module8
18	Brushing	41.21	48.66	39.66	49.09	54.22	46.72	34.36	41.9	1	Brushing m/c

19	Roughing	58	60.9	51.94	48.28	64.06	113.46	81.69	99.62	2	Roughing m/c
20	PU appl. 1st coat on upper	43.44	49.66	55.63	42.09	59.99	50.43	36.31	44.28	1	Manual
21	PU application on sole	55.75	45.65	39.84	40.22	35.28	43.15	31.07	37.89	1	Manual
22	PU appl. 2nd coat on upper	34.15	46.4	38.37	44.5	35.59	39.3	28.3	34.51	1	Manual
23	Socks stamping (labeling)	21.11	30.12	16.54	19.23	20.12	22.31	16.79	20.47	1	Stamping m/c
24	Shoe box preparation	25.4	29.01	30	22.01	25.12	26.08	18.78	22.9	1	Manual
25	Drying and heat setting	18.11	19.31	25.02	18.1	15.04	40.91	29.45	35.92	2	Dryer & Heat setter
26	Sole pressing	59.93	54.31	58.35	50.12	54.21	55.13	39.7	48.41	1	Sole press m/c
27	Sole edge coloring	36.13	24.94	32.75	39.5	45.53	35.45	25.53	31.13	1	Manual
28	Cooling (chilling)	18.21	25.33	19.12	23.33	27.11	22.24	16.01	19.53	1	Chiller machine
29	De-lasting	17.98	16.53	25.94	18.72	19.79	19.66	14.15	17.26	1	Manual
30	Socks attaching	68.08	80.59	70.6	74.06	72.94	73.42	53.58	65.34	1	Manual
31	Lining ironing	49.31	51.73	54.12	30.01	55.12	51.99	37.43	45.65	1	Ironing module
32	Tissue paper inserting	33.13	41.22	56.11	33.01	38.87	42.65	30.71	37.45	1	Manual
33	Spray	27.12	24.12	26.32	20.12	36.09	25.49	18.35	22.38	1	Manual
34	Quality checker	15.13	24.93	17.19	18.16	19.39	18.48	13.31	16.23	1	Manual
35	Brushing	45.72	36.34	40.69	29.31	44.93	39.76	28.63	34.91	1	Brushing m/c
36	Sticker attaching	14.82	15.98	18.65	16.75	11.82	15.39	11.08	13.51	1	Manual
37	Packing	40.72	37.5	28.4	22.78	27.78	31.18	22.45	27.38	1	Manual
	Total time								1211.39 sec		

Summary: Total time that the shoe spends on the production line is:

- Cutting department = **2.74min/pair**
- Pre-fabrication = 99.85 sec = **1.66 min/pair**
- Stitching Department = 1204.84 sec = **20.08 min/pair**
- Lasting & Finishing Department = 1211.39 sec = **20.19 min/pair**

The total time needs for the production of pair of shoe is = 44.67 min per pair

5.6 Overview of the Manual Assembly line

The manual assembly line as it is a work system consists of multiple workers organized to produce range of shoe products. The assembly workers perform tasks at workstations located along the line-of-flow of the product. Assembly tasks are performed by human workers manually or with the help of machines.

- Work Transport Systems: The work transport system to accomplish the movement of work units along a manual assembly line is by mechanized system. There is *continuously moving circular conveyor*, which operates at constant velocity and work units are removable from the conveyor.
- The type of assembly line system present here is *Batch model assembly line (BMAL) – multiple model line*: Products are so different that they must be made in batches with setup between batches. This is because there are different models of shoe produced and they produce them in batches with some set up change among models.

The analysis will show the existing condition of labor productivity and line efficiency. As we can see the line efficiency of the existing system, it is low and with this the factory can't meet the production target (daily production plan). So that analyzing the system by accomplishing the following activities tries to increase the line efficiency through improving labor productivity. The activities include identifying bottleneck stations and analyze it to reduce the workstation process time through:

- adding workers so some idle time minimized
- Group some work elements to the nearest station so that workstations will be minimized
- Giving training to workers to know and can help the load of the worker near to his/her worktable. Moreover, utilizations of workers will be improved.

Depending on my observation and the workstation process times, there are some workstations identified as bottleneck.

5.6.1 Capacity determination of each station

The paper will discuss through comparing the productivity and efficiency before and after applying the balancing technique. One Shoe model order is chosen which was started in the line [Bades shoe], knowing total amount of order, style description, and color. Two important attributes have been considered, one is possible standard method for each process and another is considerable time in between the input has been fed to the time study took to record the actual individual capacity of each worker. The researcher recorded the time to find out the number of operators, type of machines, basic and standard pitch time and individual capacity. To find out the (standard allowable minute) S.A.M value, process wise capacity has been calculated, in addition to that the target, benchmark capacity, actual capacity line graph, labor productivity and line efficiency has been calculated. The production line has been balanced considering the bottleneck and balancing process where the balancing process has shared the excess time after the benchmark production in the bottleneck process. After balancing, new manpower has been proposed and final capacity of each worker has been reallocated. The researcher has compared the line graph after balancing the line, labor productivity and line efficiency.

- **Capacity:** stations capacity per day is determined using the standard time and the working time available in a day i.e. 8hr or 28800sec. For instance, Capacity of cutting/day = $28800\text{sec}/164.4\text{ sec} = 175$ pairs of shoe; but there are 6 cutters. Therefore, the total of 1051 pair of shoe can be produced in a day. In similar fashion the researcher determined capacity/day for all stations.

Table 5.8: Capacity determination of stations

Capacity determination for Cutting and pre-fabrication					
Date: June 8. 2011		Model: Bades shoe [article no. 6104]			28800sec working time per day
All time in second					
Sr. No.	Operations in sequence	STD. time	Capacity/day	No. of worker	Remark
1	Cutting	164.4	1051	6 upper cutters	
2	Marking	102.6	842	3	
3	Skiving	66.96	1290	3	
4	Re-enforcing	129.99	664	3	Assisted from Skiving

Capacity determination for stitching department					
Line one					Target 750
Sr. No.	Operations in sequence	Std. time	Capacity/day	No. of worker	Remark
1	Stamping on lining	13.90	2071	1	Club together and assist the next operations
2	Re-enf. attachment on counter	23.89	1205	1	
3	Back seam stitching	20.21	1425	1	Club together
4	Upper quarter stitching	20.24	1423	1	
5	Lining quarter stitching	18.77	1534	1	Club together and assist operation 7
6	Hammering	17.71	1626	1	
7	Foam attachment on vamp	79.12	728	2	
8	Foam attaching on apron	74.2	776	2	
9	Glue app. on quarter lining	80.24	718	2	
10	Lining attaching on upper	15.07	1911	1	Club together and assisted from operation 8
11	lining attaching on apron	14.72	1957	1	
12	Vamp re-cut	19.04	1513	1	Club together and assist operation 9
13	Apron re-cut	17.38	1657	1	

14	Lasting margin stitch (vamp)	39.71	725	1	
15	Marking on vamp	36.22	795	1	Assist operation 14
16	Counter stiffener and lining attach	39.21	734	2	
17	Counter stitch with vamp	70.76	407	1	Assist operation 21
18	Trimming	36.59	787	1	Assist operation 16
19	Counter molding	18.23	1579	1	Club together and assisted from operation 24
20	Vamp zigzag stitch	21.68	1328	1	
21	Elastic stitch on quarter	41.07	701	1	
22	Apron stitch	35.13	822	1	Assist operation 23
23	Thread burning and cleaning	84.14	684	2	
24	Bind tape attaching	36.73	784	1	
25	Bind stitching	35.55	810	1	Assist operation 27
26	Binding trimming	76.42	753	2	
27	Thread burning and cleaning	23.11	1246	2	
28	Strap Folding	35.98	820	1	Assist operation 29
29	Strap stitch one	42.01	685	1	
30	Strap attachment	17.72	1625	1	Club together
31	Strap stitch two	18.77	1534	1	
32	Jewelry attach	13.78	2090	1	Club together
33	Foam attaching	24.30	1185	1	
34	Socks stitching	16.49	1747	1	Club together
35	Inspection	12.65	2277	1	
	Total	1191sec=20min		42	

Capacity determination for Lasting department					
Line Two					Std. Time for one person
Sr. No.	Operations in sequence	Std. time	Capacity/day	No. of worker	Remark
1	Feeding	15.03	1916	1	Club together
2	Sole priming	21.07	1367	1	
3	Insole tacking	35.77	805	1	
4	Moccasin Pre-forming	40.2	1432	2	Remove 1 worker
5	last entering to upper	36.68	785	1	
6	Back height fixing	32.32	891	1	
7	Glue application	39.83	723	1	
8	Side listing	27.94	1031	1	Club together and assisted from operation 7
9	Heal lasting	20.02	1439	1	
10	Mark remover	17.96	1604	1	Club together
11	heat seating	19.58	1471	1	
12	Lace & tack remover	13.44	2143	1	
13	Hammering	22.96	1254	1	Club together
14	Wrinkle chasing	38.19	754	1	
15	Thread burning	33.29	865	1	
16	Polishing	45.75	630	1	Assisted from operation 15
17	Ironing	34.69	830	1	
18	Brushing	41.9	687	1	
19	Roughing	99.62	578	2	Add 1 person and assist operation 20
20	PU appl. 1st coat on upper	44.28	650	1	
21	PU application on sole	37.89	760	1	
22	PU appl. 2nd coat on upper	34.51	835	1	
23	Socks stamping (labeling)	20.47	1407	1	Club together and assisted from operation 22

24	Shoe box preparation	22.9	1258	1	
25	Drying and heat setting	35.92	1604	2	Remove 1 person
26	Sole pressing	48.41	595	1	
27	Sole edge coloring	31.13	925	1	
28	Cooling (chilling)	19.53	1475	1	Club together
29	De-lasting	17.26	1669	1	
30	Socks attaching	65.34	882	2	
31	Lining ironing	45.65	631	1	
32	Tissue paper inserting	37.45	769	1	
33	Spray	22.38	1287	1	Club together and assist operation 32
34	Quality checker	16.23	1774	1	
35	Brushing	34.91	825	1	
36	Sticker attaching	13.51	2132	1	Club together and assisted from operation 35
37	Packing	27.38	1052	1	
	Total	1280sec=19min		41	

5.7 Balancing the production line (Work Organization)

The capacity determination showed that the bottleneck stations are subsist in the stitching and lasting department therefore the balancing work will focus on these departments. The cutting and pre-fabrication stations are performing their tasks properly and are not susceptible to bottleneck problem.

5.7.1 Benchmark Production Target Setting

The lasting department's bottleneck problem determined the total production line efficiency. But from the capacity determination (shown above) of each station it is possible to upgrade the target daily production to 750. This benchmark level can be overcome by **the logic of modular system** which aims cross-trained workers perform multiple tasks; agile work system can shift work or workers from one station to another to balance the load (piece flow production). On this occasion, skilled workers are eligible for the production processes and proper training and supervision is essential to achieve the optimum improvements on productivity and efficiency.

5.7.2. Before Balancing the Line: Stitching Department

Time study sheet has shown the different types of machine used, number of operators, basic and standard pitch time and capacity per hour; and in the line balancing sheet the researcher determined the daily capacity for each station and indicated the corrections taken in balancing the line as a remark.

Equations

1. Standard Pitch Time (S.P.T) = Basic Pitch Time (B.P.T) + Allowances (%)
2. Labor productivity = Total number of output per day per line/number of workers worked
3. Line efficiency = Total output per day per line * S.A.M/ (total manpower per line * total working minutes per day) * 100%

Table 5.9: Bench mark Target, Labor productivity and Line Efficiency before balancing line
Stitching Department for **Bades shoe model [6104 article]**

Total Output Per Day	700		
Total Manpower =	42		
Working Time =	480 Minute		
S.A.M =	20min		
Target /day =	750		Bench Mark
Labor Productivity =	17		
Line Efficiency % =	69.44		

Process wise capacity of each work station has been shown in the above table where Standard allowable minutes (S.A.M) has been calculated by adding S.P.T of each process. The above table shows the target per day for the line calculating total 42 manpower worked on that line for 480 minutes with a S.A.M value of 20. The researcher standardized the Bench mark target of 750 pair of shoes per day. Observation before balancing the line has been reflected as labor productivity of 17 and line efficiency of 69.44%.

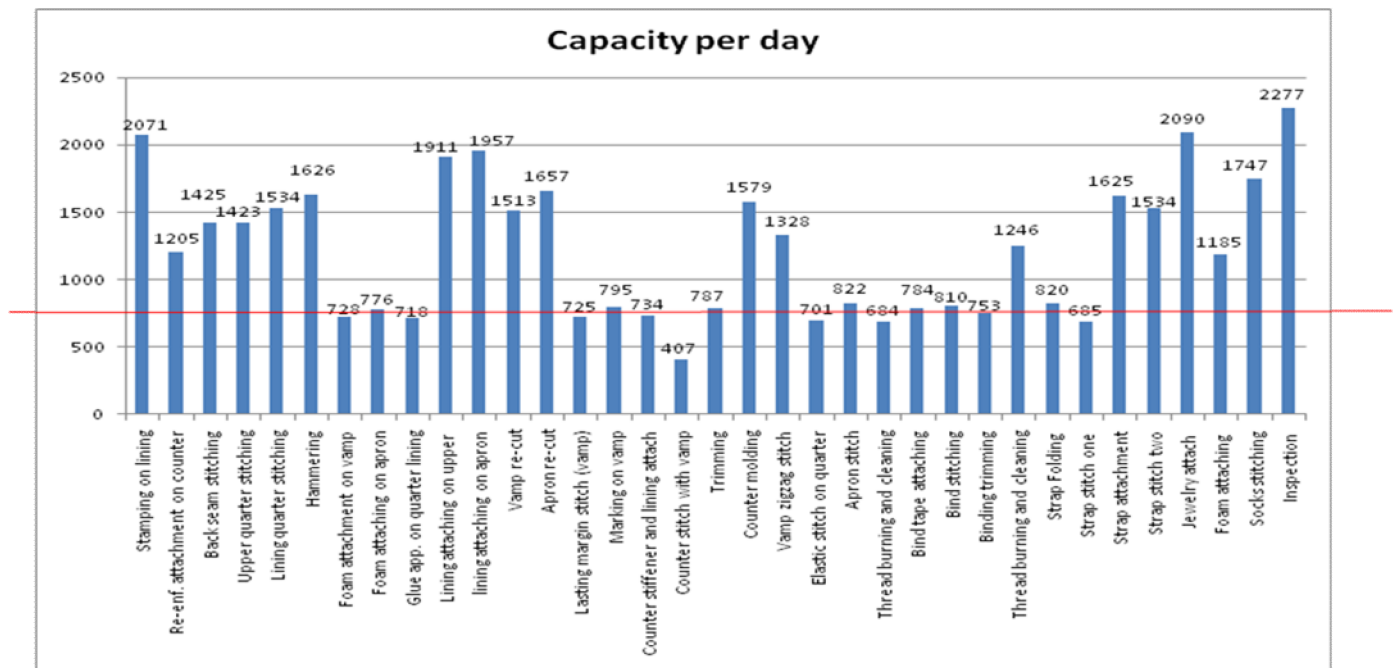


Figure 5.4: Variation in each process capacity per day compare to bench mark target per day [750]

Plotting process wise capacity in a line graph shows the variation of each process from the bench mark target as the upper capacity is 2277 pairs per day where the lower capacity is only 407 pairs per day compare to the bench mark target of 750 pairs.

5.7.3. Balancing the Line: Stitching Department

Table 5.10: Proposed capacity per day for each process showing proposed manpower and bottleneck processes

Proposed capacity per day				
Sr. No.	Process	STD time	Proposed manpower	Total cap.
1	Stamping on lining and Re-enf. attachment on counter	37.09	1	776
2	Back seam stitching and Upper quarter stitching	40	1	720
3	Lining quarter stitching and Hammering	35.68	1	807
4	Foam attachment on vamp	79.12	2	728
5	Foam attaching on apron	74.2	2	776
6	Glue app. on quarter lining	80.24	2	718
7	Lining attaching on upper and lining attaching on apron	39.01	1	739
8	Vamp re-cut and Apron re-cut	36.5	1	789
9	Lasting margin stitch (vamp)	39.71	1	725
10	Marking on vamp	36.22	1	795
11	Counter stiffener and lining attach	39.21	1	734
12	Counter stitch with vamp	63.76	2	814
13	Trimming	36.59	1	787
14	Counter molding and Vamp zigzag stitch	39.26	1	733
15	Elastic stitch on quarter	41	1	701
16	Apron stitch	35.13	1	822
17	Thread burning and cleaning	84.14	2	684
18	Bind tape attaching	36.73	1	784
19	Bind stitching	35.55	1	810
20	Binding trimming	76.42	2	753
21	Thread burning and cleaning	40.03	1	720
22	Strap Folding	35.98	1	820
23	Strap stitch one	42.01	1	685
24	Strap attachment and Strap stitch two	36.49	1	789
25	Jewelry attach and Foam attaching	38.08	1	756
26	Socks stitching and Inspection	35.12	1	800
	Total		32	

Summary: Once these operation sequence problems are identified and improving the work station, it is quite a simple matter to re-organize the line, and this is to be done with the result that only 32 people were required to perform the work necessary to complete the stitching department operations with no loss in output.

Original People on line	Revised number	Savings
42	32	$1 - 32/42 = 1 - 0.896 = 0.238 = 23.8\%$

The basic objective of line balancing is to achieve efficient utilization of productive capacity. The focus of classical industrial engineering studies of line balancing has been on evenly distributing work in the line over the long term. But even if a line is balanced with regard to average loads it can still become seriously unbalanced in the short term due to variability. Changes in product mix, machine failures, quality problems, operator related issues and many other events can cause workloads at individual stations to become temporarily imbalanced. Traditionally, this variability has been buffered by either capacity (e.g., the line is paced to allow operators 60 seconds to complete their tasks, even though the tasks require only 45 seconds on average to complete) or inventory (e.g., WIP in buffers between stations, which serves to partially decouple the stations from one another). In recent years, however, spurred by the JIT and lean manufacturing movements, another alternative for buffering variability in a flow line has arisen, workforce agility. By having cross-trained workers perform multiple tasks, an agile work system can shift work or workers from one station to another to balance the load. [20].

Table 5.11: Balancing processes to equalize the bottleneck process

S.No.		Bottleneck process				Balancing process		
		Process No.	Cap./hr	Balanced Cap.		Process No.	Capacity/hr	Balanced Capacity
1	Back seam stitching and Upper quarter stitching	2	720	753	Stamping on lining and Re-enf. attachment on counter	1	786	753
Remarks: Process # 7 can work for 7.38hr and share work with process # 2 for last 22 min.								
2	Foam attachment on vamp	4	728	760	Lining quarter stitching and Hammering	3	807	775
Remarks: Process # 3 can work for 7.39hr. and share work with process # 4 for last 21 min.								
3	Lining attaching on upper and lining attaching on apron	7	739	755	Foam attaching on apron	5	776	760
Remarks: Process # 5 can work for 7.49. and share work with process # 7 for last 11 min.								
4	Glue app. on quarter lining	6	718	751	Vamp and Apron re-cut	8	789	756
Remarks: Process # 8 can work for 7.38hr. and share work with process # 6 for last 22 min.								
5	Lasting margin stitch (vamp)	9	725	760	Marking on vamp	10	795	760
Remarks: Process # 10 can work for 7.37hr. and share work with process # 9 for last 23 min.								
6	Counter stiffener and lining attach	11	734	757	Trimming	13	787	764
Remarks: Process # 13 can work for 7.45hr. and share work with process # 11 for last 15 min.								
7	Elastic stitch on quarter	15	701	755	Counter stitch with vamp	12	814	760
Remarks: Process # 12 can work for 7.23hr. and share work with process # 11 for last 37 min.								
8	Thread burning and cleaning	17	684	751	Apron stitch	16	822	755
Remarks: Process # 16 can work for 7.14hr. and share work with process # 7 for last 46 min.								
9	Counter molding and Vamp zigzag stitch	14	733	756	Bind tape attaching	18	784	761
Remarks: Process # 18 can work for 7.45hr. and share work with process # 15 for last 15 min.								
10	Thread burning and cleaning	21	720	760	Bind stitching	19	810	770
Remarks: Process # 19 can work for 7.33hr. and share work with process # 21 for last 27 min.								
11	Strap stitch one	23	685	754	Strap Folding	22	820	751
Remarks: Process # 22 can work for 7.11hr. and share work with process # 23 for last 49 min.								

Proposed balanced line has been followed the logic of modular system (one worker works more than two processes who is skilled on all processes and these combination of skilled workers finish their work in piece flow production) and traditional system (one worker works in one process and all the workers who may be skilled or not finish their work in bundle flow production) both together where only modular production system can be applicable with a series of skilled workers to achieve more productivity. On this occasion, skilled workers are eligible for the production processes and proper training and supervision is essential to achieve the optimum improvements on productivity and efficiency.

Bottleneck processes: From the bar figure that showed the daily capacity variation compared to the bench mark target of 750, The researcher identified stations that show variations in capacity from the red line and the lower capacity from the bench mark target is the bottleneck process as production flow would stuck on the bottleneck point. Comparing total capacity of each process to the 92% bench mark target, The researcher identified the bottleneck processes named **Back seam stitching and Upper quarter stitching, Foam attachment on vamp, lining attaching on upper and lining attaching on apron, Glue app. on quarter lining, Lasting margin stitch (vamp), Counter stiffener and lining attach, Elastic stitch on quarter, Thread burning and cleaning, Counter molding and Vamp zigzag stitch, Thread burning and cleaning and Strap stitch one**, marked with yellow color. Total production has been blocked in these eleven work stations and large work in process (WIP) has been stuck in these bottleneck processes.

Balancing Processes: Balancing method is very essential to make the production flow almost smoother compare to the previous layout. Considering working distance, type of machines and efficiency, workers who have extra time to work after completing their works, have been shared their work to complete the bottleneck processes. Previously identified eleven bottleneck processes have been listed in the left side of the above table. Operator who work in Process no. 1, “stamping on lining and Re-enf Attachment on counter”, have been worked for 7.38hr per day in the first process for the capacity of 753 pairs and then have been worked in the process no. 2 Back seam stitching and Upper quarter stitching for last 22 minutes to make additional 33 pieces for overall capacity of 753 pairs on process no. 2. Similarly Process no. 3, Lining quarter stitching and Hammering, have been worked for 7.39hr and rest 21 minutes

have been worked on process no. 4 to make total capacity of 760 pairs which was originally 728 pairs shown in the above table. Process no.5, 8, 10, 13, 12, 16, 18, 19, and 22 have been similarly worked on the process no.7, 6, 9, 11, 15, 17, 14, 21 and 23 for the capacity of 755, 751, 760, 757, 755, 751, 756, 760 and 754 pairs per day.

Result and Findings

The total worker in stitching department will be 32 instead of 42; there by labor productivity has been increased to 24 from 17 and line efficiency has been improved from 69.44% to 87.6%.

Table 5.12: Bench mark Target, Labor productivity and Line Efficiency after line balancing.
[For bades shoe model]

Total Output Per Day =	750
Total Manpower =	32
Working Time =	480Minutes
Labor Productivity =	24
Line Efficiency % =	87.6

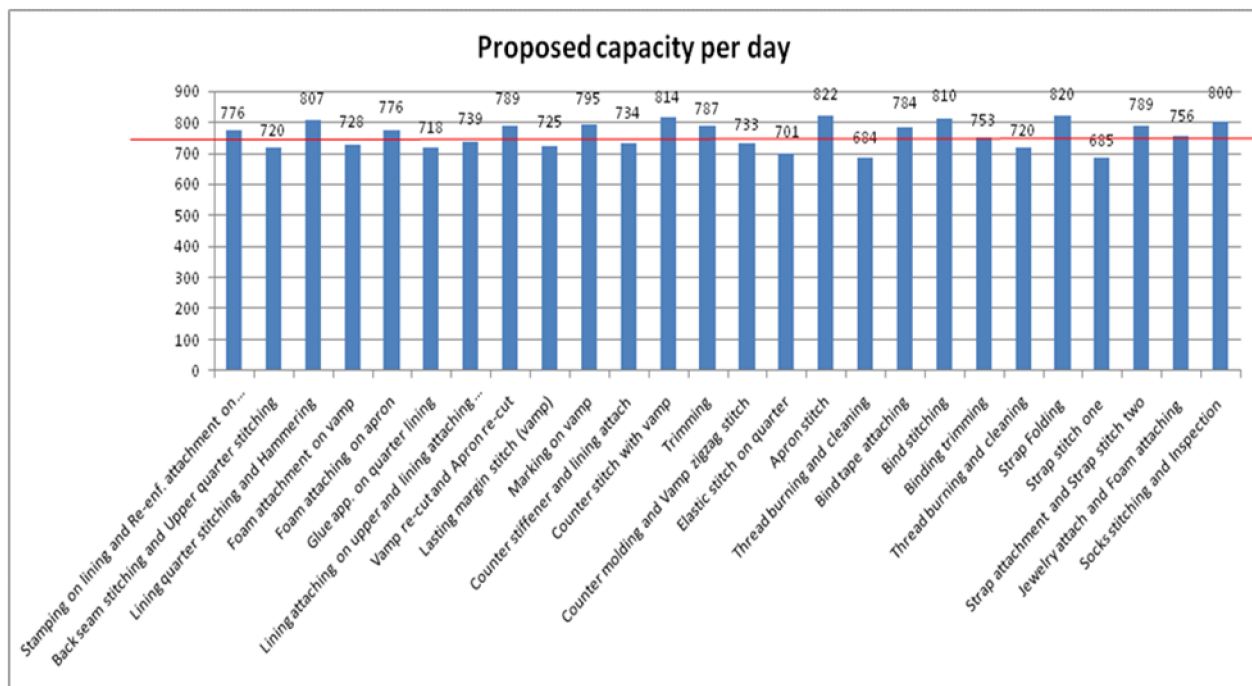


Figure 5.5: Variation in each process capacity per day compare to bench mark target per day [750]

After balancing the process flow, the above figure, shows the less variation of each process from the bench mark target as the upper capacity is 822 (previous one was 2277) pieces per hour where the lower capacity is only 684 (previous one was 407) pieces per hour compare to the bench mark target of 750 pairs which shows that the variation in each process has been decreased from the previous one and reflects much better balanced production flow in the line.

5.7.4. Before balancing the line: Lasting and Finishing Department

Time study sheet has shown the different types of machine used, number of operators, basic and standard pitch time and capacity per hour. using the same equation to that of stitching dep't the following parameters are determined:

Table 5.13: Bench mark Target, Labor productivity and Line Efficiency before balancing line
Lasting & Finishing Department [for Bades shoe model]

Total Output Per Day	600
Total Manpower =	40 direct labor force (the remains 1 is for final inspection)
Working Time =	480 minutes
S.A.M =	19
Labor Productivity =	14
Line Efficiency % =	64.43

Process wise capacity of each work station has been shown in the above table where Standard allowable minutes (S.A.M) has been calculated by adding S.P.T of each process. The above table shows the target per day for the line calculating total 40 manpower worked on that line for 480 minutes with a S.A.M value of 19. Observation before balancing the line has been reflected as labor productivity of 14 and line efficiency of 64.43%.

The researcher identified some variations in departmental production capacity. The department that has a lower capacity is the bottleneck as production flow would stick on this department. In peacock shoe factory the total production has been blocked in lasting and finishing department and large work in process (WIP) [750-600 = 150 upper] has been stuck in this. In order to smooth out the production flow, with no stacked WIP, The researcher standardized the Bench mark target of 750 pair of shoes per day for this

department; and the analysis will be done for stations capacity with reference to this benchmark target.

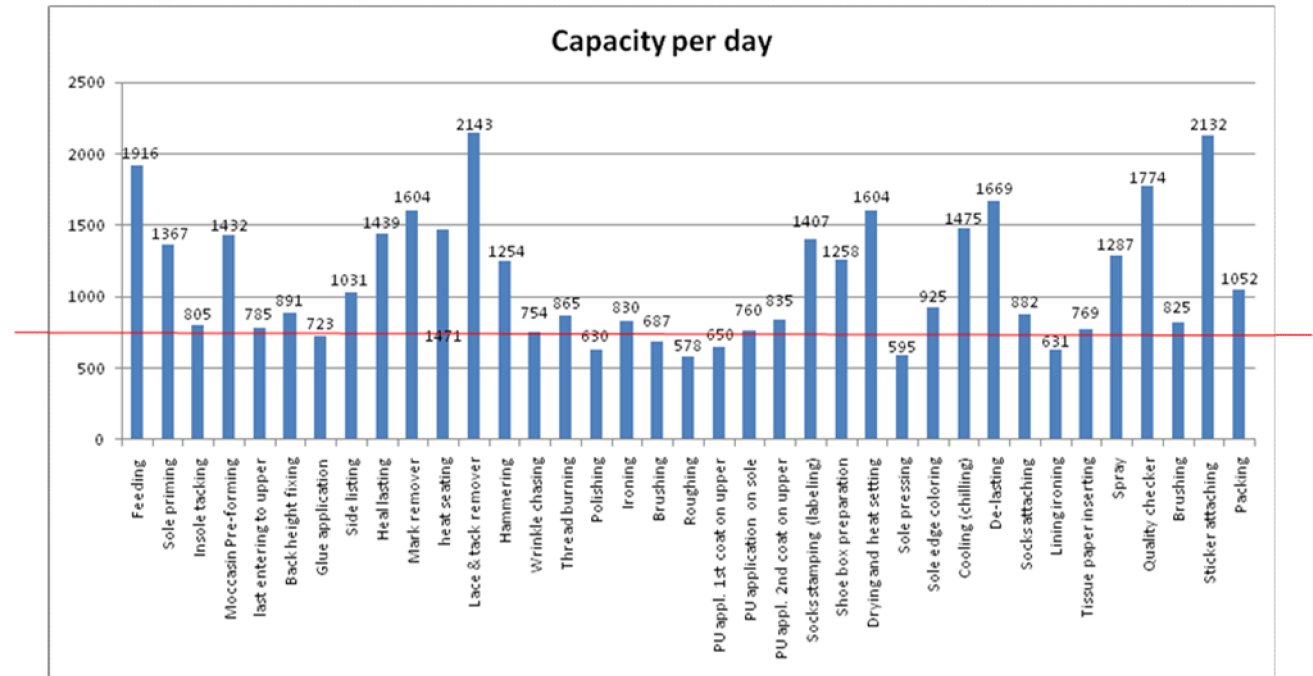


Figure 5.6: Variation in each process capacity per day compare to bench mark target per day [750]

Plotting process wise capacity in a line graph shows the variation of each process from the bench mark target as the upper capacity is 2143 pairs per day where the lower capacity is only 578 pairs per day compare to the bench mark target of 750 pairs. This shows the imbalance situation in the line and bottleneck condition throughout the process making as lots of WIP stations in the line.

5.7.5. Balancing the Line: Lasting & Finishing Department

Table 5.14: Proposed capacity per day for each process showing proposed manpower and bottleneck processes

Proposed capacity per day				
Sr. no.	Process	STD time	Proposed manpower	Total cap.
1	Feeding and Sole priming	36.10	1	798
2	Insole tacking	35.77	1	804
3	Moccasin Pre-forming	40.2	1	717
4	last entering to upper	36.68	1	785
5	Back height fixing	32.32	1	891
6	Glue application	39.83	1	723
7	Side listing and Heal lasting	45.42	1	634
8	Mark remover and heat seating	37.54	1	767
9	Lace and tack remover and Hammering	36.4	1	791
10	Wrinkle chasing	38.19	1	754
11	Thread burning and cleaning	33.29	1	865
12	Polishing	45.78	1	629
13	Ironing	34.69	1	830
14	Brushing	41.9	1	687
15	Roughing	99.62	3	867
16	PU appl. 1st coat on upper	44.28	1	650
17	PU application on sole	37.89	1	760
18	PU appl. 2nd coat on upper	34.51	1	835
19	Socks stamping (labeling) and Shoe box preparation	42.37	1	679
20	Drying and heat setting	35.92	1	802
21	Sole pressing	48.41	1	595
22	Sole edge coloring	31.13	1	925
23	Cooling (chilling) and De-lasting	36.79	1	782
24	Socks attaching	65.34	2	882
25	Lining ironing	45.65	1	631
26	Tissue paper inserting	37.45	1	769
27	Spray and quality checker	38.24	1	753
28	Brushing	34.91	1	825
29	Sticker attaching and Packing	40.89	1	704
	Total		32	

Summary: only 32 people were required to perform the work necessary to complete the stitching department operations with no loss in output.

Original People on line	Revised number	Savings
40	32	$1 - 32/40 = 1 - 0.896 = 0.2 = 20\%$

Table 5.15: Balancing processes to equalize the bottleneck process

S.No.	Bottleneck processes				Balancing process			
	Process Name	Process No.	Cap./hr	Balanced Cap.	Process Name	Process No.	Capacity /Hour	Balanced Capacity
1	Moccasin Pre-forming	3	717	758	Insole tacking	2	804	763
Remarks: Process # 2 can work for 7.32hr and share work with process # 3 for last 28 min.								
2	Glue application	6	723	753	last entering to upper	4	785	755
Remarks: Process # 4 can work for 7.40hr. and share work with process # 6 for last 20min.								
3	Side listing and Heal lasting	7	634	760	Back height fixing	5	891	765
Remarks: Process # 5 can work for 6.24 and share work with process # 7 for last 1:36hr.								
4	Polishing	12	629	739	Thread burning and cleaning	11	865	755
Remarks: Process # 11 can work for 6.36hr. And share work with process # 12 for last 1.24hr.								
Process # 12 can improve the method or use floater to balance the process								
5	Brushing	14	687	757	Ironing	13	830	760
Remarks: Process # 13 can work for 7.11hr. and share work with process # 14 for last 49 min.								
6	PU appl. 1st coat on upper	16	650	757	Roughing	15	867	754
Remarks: Process # 15 can work for 6.41hr. and share work with process # 16 for last 1.19hr.								
7	Socks stamping (labeling) and Shoe box preparation	19	679	754	PU appl. 2nd coat on upper	18	835	760
Remarks: Process # 18 can work for 7.07hr. and share work with process # 19 for last 53min.								
8	Sole pressing	21	595	756	Sole edge coloring	22	925	764
Remarks: Process # 22 can work for 5.57hr. And share work with process # 21 for last 23hr.								
9	Lining ironing	25	631	755	Socks attaching	24	882	758
Remarks: Process # 24 can work for 6.25hr. and share work with process # 25 for last 1.35hr.								
10	Sticker attaching and Packing	29	704	763	Brushing	28	825	766
Remarks :		Process # 28 can work for 7.19hr. and share work with process # 29 for last 41min.						

Bottleneck processes: from the above figure that showed the daily capacity variation, the researcher identified some variations in process capacity from the bench mark target and the lower capacity from the bench mark target is the bottleneck process as production flow would stick on the bottleneck point. Comparing total capacity of each process to the bench mark target, The researcher identified the bottleneck processes named **Moccasin Pre-forming, Glue application, Side listing and Heal lasting, Polishing, Brushing, PU appl. 1st coat on upper, Socks stamping (labeling) and Shoe box preparation, Sole pressing, Lining ironing and Sticker attaching & Packing** marked with yellow color. Total production has been blocked in these ten work stations and large work in process (WIP) has been stuck in these bottleneck processes.

The waiting times invite disadvantages such as “reduction in pace of work,” “increase in processing time,” “reduction in operation rate due to an increase in necessary allowance work” to cause a substantial drop in productivity.

Balancing Processes: Considering working distance, type of machines and efficiency, workers who have extra time to work after completing their works, have been shared their work to complete the bottleneck processes. Previously identified ten bottleneck processes have been listed in the left side of the above table. Operator who work in Process no. 2, “Insole tacking”, have been worked for 7.32hr per day in the first process for the capacity of 763 pairs and then have been worked in the process no. 3 “Moccasin Pre-forming” for last 28 minutes to make additional 41 pairs for overall capacity of 758 pairs on process no. 2. Similarly Process no. 4 “last entering to upper”, have been worked for 7.40hr and rest 20 minutes have been worked on process no. 6 to make total capacity of 753 pairs which was originally 723 pairs shown in the above table. Process no.5, 11, 13, 15, 18, 22, 24, and 28 have been similarly worked on the process no.7, 12, 14, 16, 19, 21, 25 and 29 for the capacity of 760, 739, 757, 757, 754, 756, 755, and 763 pairs per day.

Result and Findings

The total worker in lasting and finishing department will be 32 instead of 40; there by labor productivity has been increased to 24 from 14 and line efficiency has been improved from 54.43% to 92.77%.

Table 5.16: Bench mark Target, Labor productivity and Line Efficiency after line balancing.
[For bades shoe model]

Total Output Per Day =	750
Total Manpower =	32
Working Time =	480Minutes
S.A.M =	19
Labor Productivity =	24
Line Efficiency % =	92.77

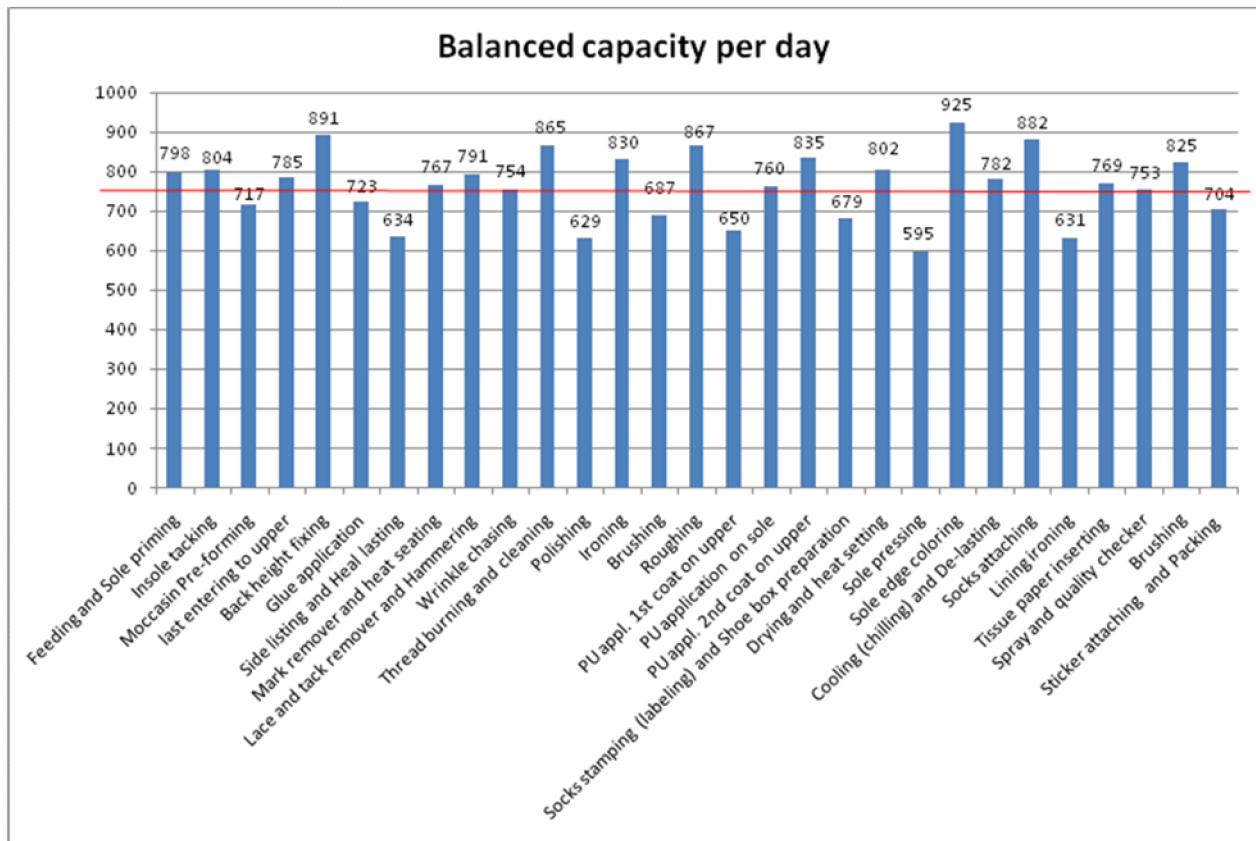


Figure 5.7: Variation in each process capacity per day compare to bench mark target per day [750]

After balancing the process flow, the above figure, shows the less variation of each process from the bench mark target as the upper capacity is 925 (previous one was 22143) pieces per hour where the lower capacity is only 595 (previous one was 578) pieces per hour compare to the bench mark target of 750 pairs which shows that the variation in each process has been decreased from the previous one and reflects much better balanced production flow in the line.

5.8 Total Line Efficiency Calculation

By studying many iterations of each work task and element, the researcher is able to arrive at time allocations which are highly reliable across a very wide sample of the work associates are asked to perform and can very accurately predict how long any given work assignment should take. Measurement then becomes the process of capturing actual time applied to the task and comparing it with the predicted or calculated “standard” time.

Capturing Actual Performance Data-This process need not be complex, but must be complete in order to be valid. Beginning and ending times for all tasks and all users are essential. Data can be captured using time measuring devices. The key is to minimize the time required to capture the information, while assuring that it is captured properly. This affords management an opportunity to see both performance and utilization at the individual or any other level.

Calculating Performance ratings-Performance calculation simply relates standard time to the actual time applied by that individual to the accomplishment of that task. If, in the course of the task, time elapses which does not relate to the work and which is beyond the individuals control, an adjustment is made to remove that portion of the total time from consideration (exception time). By dividing standard shoe production per day per shift (Cutting= 200pairs Per Person Per 8-Hr; Stitching= 15 Pairs/Person/Shift; Lasting And Finishing = 25 Pairs /Person/Shift) by the actual shoe production (Cutting=170 pairs per person, Stitching=13 pairs/person/shift and Lasing & Finishing=18 pairs/person/shift), the system returns a performance rating of 85%, 86.67% & 72% respectively.

Calculating Total line Efficiency: In combination, these two calculations provide a powerful and otherwise unseen indication of how efficiently work is being accomplished.

		Line efficiency (%)	Total line efficiency = % x %
Before balancing the line	Stitching	69.44	44.74%
	Lasting & finishing	64.43	
After balancing the line	Stitching	87.6	81.26%
	Lasting & finishing	92.77	

The factory do not know the performance level, and although the labor portion of the cost is significant as per the survey did on foot wear manufacturing firms (see chapter three), there are great opportunities for improved profitability through improved practices and better methods. It is important to note that the footwear industry have to consider work study as a vital part of their operation. Footwear factories will not survive in the future without well organized measurement techniques; they must know their performance levels and constantly work to improve them.

5.9. Comparison of the case company with and without work study application

The chart below shows the comparison of “with work study application” and “without work study application” in peacock shoe factory on line (production) efficiency.

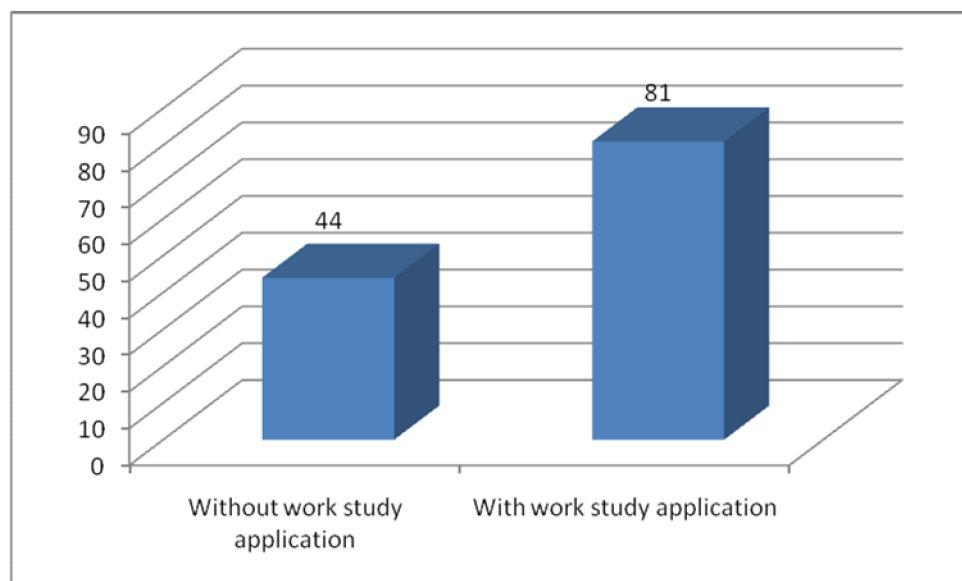


Figure 5.8: Comparison of the case firm with and without work study application

[By upgrading the production line to the benchmark target level of 750 bades shoe per day (which is specified based on the stations capacity) the production efficiency can be increased by 37%]

Looking at the comparison shown above it is obvious that the factory “with work study application” is more productive than the factory “without work study application”. The factory “with work study application” results a combined score of 81% for line efficiency whereas factory “without work study application” achieved a score of only 44%.

Final amount in terms of cost

From this result the improved line balancing have an additional $750 - 600 = 150$ shoes in one day; in one year = $150 \text{ shoes} \times 288 \text{ days} = 43,200$ shoes are gain in one year; in cost = $43,200 \times 221\text{birr} = \mathbf{9,574,200 \text{ birr}}$.

In addition, from the 18 fired workers the company can save a significant amount of money; average salary of line workers is 400br. Therefore, from those 18 workers = $18 \times 400 \text{ birr} = 7200$ in one month; for one year = $12 \times 7200 \text{ birr} = \mathbf{86,400 \text{ birr}}$.

Total = $9,574,200 + 86,400 = 9,633,600 \text{ birr}$ can be gained by utilizing the new balancing method

5.10 Means of Reducing the Number of Bottleneck Processes

- Investigate the relation between the bottleneck process and its previous and subsequent processes to correct the line organization
- Investigate whether it is possible to further divide the process
- Conduct the motion study for work improvement
- Make improvements to equipment, jig and tools.
- Mechanize the manual work
- Change the positions of workers
- Investigate the modification to the machining specifications.
- Make it a rule to lend the worker in charge of the bottleneck process a helping hand.

CHAPTER SIX

IMPROVEMENT AREAS IN THE CASE COMPANY

In today's environment the need to improve manufacturers must realize the importance of using scientific ways to analyze how best outfits can be made and how manufacturing procedures can be improved. Work study is one of the most important tools that can be used for this purpose as demonstrated in the research work. It is the most important tool for controlling production and improving productivity thereby contribute to profitability. It is not part of expenses but a part of investments (savings) which is bound to bring returns to the factory cheque books as shown in the possibly gained monetary determination due to the work study techniques.

In the preceding chapter, the amount of loss due to less awareness about work study benefits, for the case of Peacock shoe factory, is seen. All of those techniques demonstrated are not available due to awareness problem. The identified intervention areas can be eliminated or minimized through familiarizing work study and its benefits as it is discussed in the preceding chapter. Thus, the main intention of this chapter is to discuss on improvement areas which are considered as the good means of improving productivity through work study

6.1 Standard Time and Target Setting

Footwear manufacturing companies in Ethiopia are not clearly aware of using standard time systems. Establishment of Standard times and the development of the best method to manufacture are vitally important to improve productivity.

Target setting is an important component of an effective performance management program. Targets are just one means of managing performance. In simple terms work study measures work and defines (some) performance standards. There are many uses for time estimates for tasks. Targets should be attainable. If the target represents a large improvement over current performance, consider using a stepped approach. Gradually increase the target over a number of time periods (even years in some cases) to get to the desired level.

Why You Need Targets: To manage performance effectively, you need to understand how you are doing. Your measures will give you quantitative information about your performance, but to

understand if you are optimizing performance you need to put those numbers into perspective. Comparisons help you gain perspective by gauging your performance with respect to a broader context. Comparisons with a target show how performance compares with a goal set by the program. This primer focuses on targets.

Used appropriately, targets have significant benefits. They can:

- Communicate leaders' expectations,
- Drive continuous improvement, and
- Motivate staff (provided that the target is realistic).

Positive Uses for Targets: Target setting and working toward those targets is an integral part of performance measurement and performance management. Targets are intended to motivate employees and guide the agency to improved performance in strategically important areas. Accordingly emphasis should be placed on making positive uses of targets to foster an improvement-oriented culture.

Targets can motivate staff by providing a clear and measureable goal. Achieving or exceeding a target can provide a reason for celebrating important achievements. Even disappointing or poor performance need not be an occasion for self-doubt. Instead, a failure to meet a target can be grounds for inquiry and learning more about the factors driving performance. Such inquiry helps identify opportunities for improvement. Disappointing performance may also lead to more effective resource allocation (which may involve prioritization and advocacy for essential program needs). Targets also help organizations monitor pain points, such as process bottlenecks, and show progress made in addressing them.

Action plan to achieve the target and final check

- Consider the time period for achievement of the target.
- Clarify what action would need to be taken to achieve the target in this time period.
- Produce an action plan with accountabilities, costs and timescales.
- Ensure that an action plan is in place to deliver against the target

6.2 Workplace Layout

A good workplace layout will eliminate unnecessary motions and fatigue resulting in substantial increase in the efficiency of the operator. It offers improvements as demonstrated in the research work but many organizations are challenged with older facilities with traditional layouts resulting in excessive material handling, flow problems and additional costs. The layout should be taken, however, as only a “tangible form of various improvement plans.” In fact, the “layout changing” many directly increase productivity or the number of pieces produced, or enhance the space efficiency. It is important, however, to investigate the “production system” (such as division of labor, transfer unit, transfer method, etc.) that decides the layout described in the former section as well as to recognize that the layout means the arrangement of the available space that gives concrete expression to the results of the production system design.

In peacock shoe factory the better utilization of services of labor is possible through the elimination of unnecessary and time-consuming movement within the working area of factory.

However, while studying the operator at the workplace,

- The main goal is to study the way (s) he applies the efforts and amount of fatigue resulting from the manner in which worker performs the tasks.
- Objective is to improve worker productivity.

The results achieved by applying Lean workplace and facilities layout are:

- Improved flow
- Reduced material handling and costs
- Increased Productivity
- Improvements in safety and quality
- Reduction in floor space required
- Reduction in lead time and turnaround time

6.3 Operation Sequence

The operation sequence indicates the order in which you perform operations on a routing. You can assign any component to any operation on the routing, including all components to the same operation (such as the first operation). But all of the production departments work without a

properly planned or written operation sequence. This is a critical step in footwear garment production and a mistake or negligence at this stage can result into huge losses later in terms of operator time, work content and quality.

6.4 Operator Monitoring

Footwear companies surveyed do not have the means to control workers performance against standard, so they have no idea where they stand. There are no proper measurements so their efficiency levels are at best a guess, it is impossible to understand how they will be able to continue to compete unless they have proper controls in place, and have established productivity improvement programs to move forward in the future.

A simple technique aimed at establishing operator potential against their actual performance (the essence of cycle checks), this can be done relatively by experienced work study personnel and is a great aid to factory performance improvement. None of the companies perform cycle checks.

While machinery and robotics are very accurate, every process must still be monitored for accuracy. When used in conjunction with live video feeds, the frame grabber allows a human operator to keep a very close eye on everything that is going on. By using a frame grabber to pull individual stop motion images from the flow, the operator or the image matching software can quickly compare a known exact positioning image with what is happening on the production line to ensure a perfect match. When the images don't match, adjustments can be made on the fly to bring everything back into line.

What about for the works that uses labors intensively? It is necessary to use Operator Monitoring Assessment (OMA) to strengthen auditing of operators' self-monitoring arrangements.

Work starting times: This factory is supposed to start at 8am but everyday it starts at 8.15, the discipline is very poor and no senior management staffs are available on the factory floor at starting time. The organization work starting time is bad, no buses for workers coming from a distance and there seems to be no urgency to start on time. 98 people losing 15 min every morning means 24.5 hrs lost in a day; having 24 working days in a month and 8 working hrs in a day 79 man days lost every month. Therefore, in order to save this much amount of days the factory has to manage the starting and finishing times properly; senior management staffs has to be available on the factory floor at the starting times.

6.5 Improving the Operator's Attitude through Training

Training is essential to business success and has a strategic advantage for every company. It also supports employee satisfaction, development and retention. While almost all of your assets depreciate, your human resources can actually gain value.

Matching the skills of your employees to the needs of your organization will ultimately determine the fate of your company. Training employees in their careers leads to increased profits, reduced errors and greater effectiveness. This less workers training culture problem is the main causes for the existence of bottleneck stations on the production line of peacock shoe factory.

6.6 Bottleneck processes

A bottleneck is commonly referred to step in a process which limits the total capacity of the process. It is the step, workstation, or stage which causes work in progress to build-up because it cannot be processed at the same rate as the other steps or workstations or has the greatest cycle time in a one path process. Bottlenecks should be identified and addressed when planning capacity expansions. Potential process bottlenecks should be investigated in production planning, and new facility planning. This can be achieved through preventive risk thinking and other problem analysis tools. Bottlenecks not only slow or limit the capacity of a process but also cause to other problems in a process which are:

Processing Blocking: this occurs when there is no more room to store WIP or buffer stock before the bottleneck process. This will cause the production line to bank up and stop until the WIP is cleared or processed.

Process Starvation: this occurs when the steps after the bottleneck step are forced to stop or idle because of no material process until the bottleneck process can supply materials to this next step. This limits the capacity utilization of the whole process.

The "speed of the bottleneck is the speed of the plant"

How to Identify Bottlenecks: Identifying bottlenecks in manufacturing is usually pretty easy. On an assembly line, you see when products pile up at a certain point.

Here are some other signs of bottlenecks:

- Long wait times – For example, your work is delayed because you're waiting for a product, a report, or more information. Or materials spend time waiting between steps of a business or manufacturing process.
- Backlogged work – There's too much work piled up at one end, and not enough at the other end.
- High stress levels

To review the actual production status, pay attention particularly to the location of “bottleneck process” and organization efficiency; If the operator who is in charge of the process just after the bottleneck process carries out his/her job at a normal speed, he/she will wait for the delivery of the work piece from the bottleneck process. The operator who is in charge of the bottleneck process will have “work-in-process” since the smooth workflow is prevented so that the bottleneck processes have be examined.

CHAPTER SEVEN

IMPLEMENTATION FRAMEWORK

7.1 Introduction

The productivity improvement through work study method is not practicing in footwear garment factories. They are not still standardized they work in addition they do not know efficiency of their operators. The framework includes process analysis; lay out, time measurement, balancing (organization efficiency). The specific study of the work study is done in peacock shoe factory, the results obtained show 37% of efficiency increment i.e. when solution is fully implemented the efficiency of the organization increases to 81%. The rest of losses are due to rework and absenteeism. The level of improvement is increased by eliminating certain processes, changing the arrangement of the processes, and combining certain processes, in the order given.

7.2 General implementation framework

Apart from identification of the problem and developing a solution methodology, the next tricky task will be how to implement the solution developed. This is partly because it involves people and people must be convinced and motivated to implement the solution. The major challenge here is that of persuading people to accept change or at least not to fight the prospect major change.

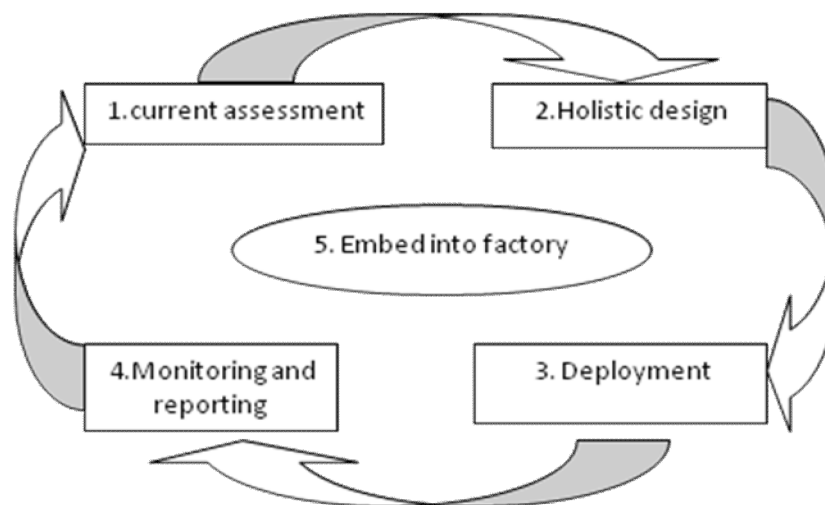


Figure7.1: General implementation framework

Current assessment: The current status assessment is the current overview of the factory. It is designed to help the factory develop visibility on the differences between where a company thinks its efficiency is and where it actually is. This visibility is the starting point for helping the organization defines where improvements and changes need to be made. By engaging in a current state assessment, an organization will realize a thorough analysis of root-cause issues that diminishes the productivity level and a call to action to help an organization understand what needs to be changed for them to reach business objectives. This current assessment is accomplished by the researcher. And that of the design is also illustrated by the researcher in the analysis part of the document as method study, setting standard time and balancing.

Deployment: it is an implementation, or putting into use, of the design.

Monitoring and reporting: Project monitoring and reporting are essential components of project management. Monitoring is the continuous process of assessing the status of project implementation in relation to the approved work plan and budget. Monitoring helps to improve performance and achieve results. The overall purpose of monitoring is to ensure effectively managed results and outputs through measurement and assessment of performance. Good monitoring consists of the following Focus on results and follow -ups: It looks for “what is going well” and “what is not progressing” in terms of progress toward the intended results whereas reporting is the formal presentation of monitoring information. The main reason for reporting is to formally inform the project director.

7.3 Management commitment

Top managements have to show their commitment by devoting much time and effort to human relations, expending their time much on the work, and access to every employee at all times for the successful implementation. In the case factory these important issues are missing. For the successful implementation of the framework an overall culture of an organization has to be changed. Therefore, Managements should be committed in changing the working culture of the company.

7.4 Project team organization

In this paper the researcher presented a framework for improving productivity through work study components. The framework aims to offer the possibility to overcome the problem areas identified. To make possible the implementation process it is necessary to form the study team. The proposed study team comprises of professional team members (the production manager and other staffs who have an Industrial engineering background), supported by Departmental supervisors. The professional team is well qualified and experienced in matters relevant to the proposed study since all of them are industrial engineers. The team members will be responsible to the Project Director (the production manager) for their respective areas of input in the study.

Project Director – Ato Dawit (Industrial engineer)-production manager

The Project Director will lead the study team and be responsible for the overall project technical management and direction. A key function will involve ensuring smooth coordination among team members in order to achieve the common objectives of the study. The team members will be well briefed at the commencement of the study in order to ensure close interaction.

The other team members for the implementation are:

1. Ato Dereje Tollosa (Industrial Engineer working as A bench marker)
2. Ato Eyob (Industrial Engineer working as Stitching department planner)
3. Ato Nasir (Industrial Engineer working as Lasting department planner) and
4. departmental supervisors

These team members will assist in organizing and facilitating the implementation programs and activities, Encouraging and working with the operators in the respective departments by providing technical support.

To ensure that weather the implementation process is progressing in a well organized manner or not, the project director has to have frequent meeting with these study members.

7.5 Activities and scope of the implementation framework

Accurate standard times are the base of a footwear factory, but the factory must first specify the method very clearly before establishing a time. One of the great worries in the industry is that old fashioned time study techniques may include timing operations in which the method of doing the

operation is not clearly specified and in fact the operator is timed using a method that is not economical and that has too many extra motions that are totally unnecessary. This will mean that the time for the operation is wrong! Thereby it cannot be guarantee for smooth flow of production (proper work organization). This is really true in peacock shoe factory.

In order to address this problem, the framework is divided in to three steps: the first step tries to address the method study that defining the order of process and the work stations arrangement; the second step focused on the time measurement and finally the line balancing (smooth production flow) is considered which is highly considerable.

Based on the agreed daily production targets, the researcher formulates the programmes and activities necessary to ensure the realization of the vision and the achievement of the targets. It is envisaged to be a comprehensive framework that will chart the way forward for selected committee participation in the initiative. It will address programmes and activities, responsible body for the activities, estimated time duration for each activity, resources required and funding to carry out each activity.

Step One: Method study

The process analysis is one of the basic methods of analysis that allows you to understand the actual status of divided Production work activities. Starting from the input of materials and ending with finished products. The **estimated** time duration and funding are indicated.

Sr. No.	Tasks	Responsible	Time duration	Resources needed	Funding
1	The project director have a meeting with study members about the developed method of working	Project director	2 days	Coffee, tea, water...	1,500
2	Examining the flow Diagram developed and sequence of activities with respect to the existing layout	Team members	3 days	Stationary Materials, Coffee, tea,	2,000
3	Examine a flow process chart developed starting from the input of materials and ending with finished products including the distances moved and times for Operation, transport, inspections, delay, storage where they are appropriate there	Team members	5 days	Stationary Materials, Coffee, tea,	2,500

	by Examine the improvement areas on the layout				
4	Carry out Process re-arrangements	Hire temporary laborers	4 days		3,000
Total			14 days		9,000

Step two: work measurement: The **estimated** time duration and funding are indicated.

Sr. No	Tasks	Responsible	Time duration	Resources needed	Funding
1	Development of training manual in clicking, stitching, lasting	Study team members	10 days	Stationary Materials, Coffee, tea,	5,000
2	Meeting b/n project director and operators	Project director	2 days	Stationary Materials, Coffee, tea,	1,500
3	Conducting the Training & Seminars for operators	Project director & trainers	20 days	Stationary Materials, Coffee, tea,	5,000
4	Analyzing the work Contents for cutting operations and conduct work sampling	Study team members	1 day		500
5	Measuring the time for operations	Study team members	5 days	Stationary Materials	1,000
6	Time Study	Study team members	2 days	Stationary Materials	1,000
Total			40 days		14,000

Step three: work organization

The process organization is to design a smooth production flow. The **estimated** time duration and funding are indicated.

Sr. No	Tasks	responsible	Time duration	Resources needed	Funding
1	Train the selected workers to have multiple skills	trainers	45 days	Stationary Materials, Coffee, tea, water	10,000
2	Making corrections by merging work stations, adding and eliminating	supervisors	2 days	-----	30,000

	line workers.				
3	controlling the Progress of the work.	Study team members		-----	
4	Analyzing the results	Study team members	1 day	Stationary Materials, Coffee, tea, water	
Total			48 days		40,000

- It is estimated that the implementation framework will be completed 102 days from the date of commencement.
- The estimated funding for the implementation will be:

Step 1 = 9,000 Birr

Step 2 = 14,000 Birr

Step 3 = 40,000 Birr

Total = 63,000 Birr

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Once the major problems of the factory are identified, then this thesis work showed utilization of work study components to solve labor utilization problem and standardization of work in order to increase the productivity. The footwear garment industries are classified in the category of light industries. There is no heavy machinery and equipment involved in the production process of a footwear industry. It is labor intensive rather than equipment intensive. The direct manpower is one of the most important resources of footwear industries as they produce the wealth of the business.

In the case company, work study application didn't employed so that labor utilization is not as good as it wants to be; there is no such a sound and detail study which considers factors such as methods of doing jobs, standard times to perform the duty, proper workplace layouts, proper working environment, good work organization (balanced line) and other factors. Rather standard times were set for some jobs with the help of personal judgment which results in the production line not to be balanced. In addition to this non-value added activities have been identified such as ineffective motions, improper cutting die & ungrinded cutting board and unnecessary repetitive movement on marking operations. Because the cutting dies sticks to the cutting board called mica, the operators has to take time to remove the cutting die from the board; and also as a result of the cutting die is not sharp enough, it loses its function of cutting the pieces correctly; and the operators exert large force on the cutting machine to cut the pieces as well as to remove the knife (cutting die) from the cutting board. As a result of the improper cutting die and ungrinded cutting board, the productivity of the operator is reduced by 18.29%.

The other parameter that has been conducted is method study; in doing so considerable reductions in the number of "non-productive" activities have been revealed. By combining leather cutting and inspection, the number of "operations" has been reduced from eight to seven; the inspection was carried out directly after cutting. "Transports" have been reduced from 15 to

14 and the distances involved have also been cut from 829.5 to 643 meters, a **saving of over 23 percent** in the travel of each pair. In order to evaluate the existing and the proposed one, times of the various activities have been recorded, so from the study of the two flow process chart it is evident that a saving of 43.41 minutes per a pair of shoe can be achieved. Therefore, there will be a saving of 2 shoes per day which earns a total of 127,296 Birr per year. Based on the improved method, setting standard time was followed.

In setting of performance rate for the operators, international bench mark has been made; work sampling and time study was conducted that provides a fair way of estimating the time that it should take to do a job. Conducting these work measurement techniques, the total time needed for the production of pair of bades shoe is identified as 44.67 min; Cutting department = 2.74min/pair, Pre-fabrication = 1.66 min/pair, Stitching Department = 20.08 min/pair and Lasting & Finishing Department = 20.19 min/pair.

Standard minute was used as a tool for balancing production control and the estimation of efficiency. The lasting department's bottleneck problem determined the total production line efficiency. But from the capacity determination of each station it is possible to upgrade the daily production of bades shoe to 750. This benchmark level can be overcome by the logic of modular system which aims cross-trained workers perform multiple tasks. Designing of a new production line has been carried out to correct the detected bottleneck problems. The comparison revealed that the factory "with work study application" is more productive than the factory "without work study application." The factory "with work study application" results a combined score of 81% for line efficiency whereas factory "without work study application" achieved a score of only 44%.

8.2 Recommendations

Based on the outcome of the paper, the following general and specific issues are forwarded for the case company and similar footwear companies:

- As revealed in the document, currently the case company is facing many complex and interrelated problems that diminishes their productivity. To avoid those problems, the companies should make use of work study method to improve their productivity
- Footwear manufacturing companies in Ethiopia do not clearly aware of using standard time systems (as per the information gathered from LIDI); establishment of standard times and the development of the best method to manufacture are vitally important to improve productivity. All footwear manufacturing firms that wish to compete in the future must realize this.
- All of the production departments are working without a properly planned or written operation sequence and without considering the concept of work place layout. This is a critical step in footwear garment production and a mistake or negligence at this stage can result into huge losses later in terms of operator time, work content and quality. Therefore, there has to be a written document that illustrates operation sequence for the different models of shoes.
- The case company does not have the means to establish their performance against standard, so they have no idea where they stand. There are no proper measurements so their efficiency levels are at best a guess; it is impossible to understand how they will be able to continue to compete unless they have proper controls in place, and have established productivity improvement programs to move forward in the future. On the other hand conducting cycle checks is necessary to monitor operators' potential.
- Improving the operator's attitude through training is essential to diminish skill difference which results in processing times variability. Therefore, giving training for operators to make them capable to different operations it could be concluded that skill gap does exist between stations.

- To review the actual production status, pay attention particularly to the location of “bottleneck process” and organization efficiency. If the operator who is in charge of the process just after the bottleneck process carries out his/her job at a normal speed, he/she will wait for the delivery of the work piece from the bottleneck process. The operator who is in charge of the bottleneck process will have “work-in-process” since the smooth workflow is prevented. Therefore, the bottleneck processes have to be examined.
- Generally, work study awareness and commitment should be created in the company starting from the top management up to the lower level through training and seminars. It should be an organizational policy as one of the strategy in being productive and competitive. And the production departments should be given emphasis, as it is one of the main apparatus for productivity improvement. The developed study is recommended for effectiveness. Besides this all footwear industries should work together to support each other concerning the work study activities.

If the solution presented in this paper is fully applied, the researcher believes that the benefits can be enjoyed.

References

1. Misikir Teklemariam, productivity improvement in Ethiopian leather industry through efficient maintenance management, 2004
2. Nyhetsbrev om Økonomi og Næringsutvikling, Ethiopia emerges amongst leading sub-Saharan footwear exporters
3. Mahassan M. Khatera and Noha A. Mostafaa, Selection of productivity improvement techniques via mathematical modeling, 25 January 2011
4. Gboyega A. Oyeranti, Concept And Measurement Of Productivity, 1991
5. S.K. Sharma, Savita and Tushar Sharma, Industrial Engineering and Operation Management, S.K. Kataria & Sons, 2004
6. Chary S N, Production and Operation Management, 2nd Ed, (2000) Tata McGraw Hill.
7. Introduction To International Labour Office Work Study Revised Edition, International Labour Office, Geneva 1969
8. Goitom Birhane, Method Study for Productivity Improvement: case at Sur construction PLC, April 2006
9. Mihret Gelan, role of work study in productivity improvement, 2009
10. Adam Abruzzi, Work, Workers, and Measurement, 1963, Colombia University Press
11. www.accel-team.com
12. International labor office, introduction to work study, 3rd edition, 1979.
13. Hazmil Bin Hapaz, Productivity Improvement Through Line Balancing, November 2008
14. Theo van der Loop, The Importance Of The Leather Footwear Sector For Development In Ethiopia, 2003
15. Tegegne GebreEgziabher, The Developmental Impact of China and India on Ethiopia with Emphasis on Small Scale Footwear Producers, 2006
16. Tetsushi Sonobe, John E. Akoten, and Keijiro Otsuka, an Exploration into the Successful Development of the Leather-Shoe Industry in Ethiopia, 2009
17. Richard D, Arvey John A, Fossum, APPLICATION OF PERSONNEL ASSESSMENT CONCEPTS AND METHODS IN JOB EVALUATION PROCEDURES, Volume 1, Number 1, November, 1980

18. Negus Sisay, MODELING PRODUCTIVITY IMPROVEMENT WITH WORK STUDY APPROACHES FOR ETHIOPIAN GARMENT INDUSTRIES, June 2006
19. Sinem Gunesoglu and Binnaz Meric, The analysis of personal and delay allowances using work sampling technique in the sewing room of a clothing manufacturer, Textile Engineering Department, Uludag University, Bursa, Turkey, August 2006
20. Esma S. Gel, Wallace J. Hopp and Mark P. Van Oyen, Factors Affecting Opportunity of Worksharing as a Dynamic Line Balancing Mechanism, June 12, 2000
21. O.P. Khanna, Industrial Engineering and Management: New Delhi, 1999.
22. S.Bhaskar, Management Science: First Edition” Butterworth Heinemann, Oxford, second edition, 2001.
23. Rupert Gedye, Workers Management and Productivity: Prentice hall, Englewood cliffs, New Jersey, 1979.
24. Lee/Schniederjans, Operations Management, Houghton Mifflin, USA, 1994.
25. Nigel Slack, Stuart Chambers and Robert Johnston, Operation Management, Forth Edition, Chapman & Hall, London, 2004.
26. Donald. P.Cushman, Continuously Improving an Organization Performance, N Chapman & Hall, London, 1996ovem. 1997.
27. Charles E. Waston,Vision , Managing with Integrity , Delmar Publishers, Albany, New York, 1997.
28. O.P. Khanna, Industrial Engineering and Management: New Delhi, 1999.
29. Sumanth, D.J. (1984), **Productivity Engineering and Management**,McGraw Hill, New York, NY
30. Theo van der Loop (June 2003), **The Importance of the Leather Footwear Sector for Development in Ethiopia**, Addis Ababa University Printing Press ETHIOPIA
31. **Productivity**, <http://en.wikipedia.org/wiki/Productivity>

Appendix 1: Action plan for peacock shoe factory

S. No.	Gap Identified	Activity Objective	Expected Outcome	Work Completed	Augmentation Focus
1	Management System	Improve In Organizational Structure. Define The Clear cut Roles And Responsibility Of Each Management Personnel. Equal Distribution Of Work With No Overlapping Of Responsibilities Between Various Departments	Better Management, Smooth Functioning And Increasing The Overall Efficiency Of The Company.	Organizational Structure With Roles And Responsibility Provided. New Department Of Product Development, Quality Control And Preparation Of New Department. Separation Of Leather Store From Cutting.	Implementation Of Process, Strengthening Of New Departments
2	Proper Planning & Documentation System	Better Production Planning, Flow Of Material, Timely Dispatches, To Know The Profitability Correctly,	To Know The Efficiency Of Workers And The Capacity Of Department, Better Productivity, Quality And Overall Material Saving	New Reports Introduced In Cutting Which Can Calculate Each Cutters Capacity, Leather Consumption Cutter wise, Cutters Ticket, Leather Consumption Order wise Etc. In Closing And Lasting New Format Introduced Which Gives The Daily Productivity, Daily Production, Conveyor Stoppage Time Etc.	Resource Planning Enhancement
3	Manpower Skill Up gradations	Improve The Skills Existing And New Work Force Of The Company	Better Productivity, Quality And Overall Material Saving	Trained New Industrial Engineers In Making Reports In Cutting, Closing, Lasting And Planning. Training Of New Workers In Stitching. Online Training In Cutting, Closing And Lasting On The Quality Aspects.	Training At Middle Level & Multi Skilling Of Operators

4	Maintenance	Reduce Machine Break Down, More Production, Better Quality	Better Productivity & Quality	List Of Spares For Stitching Machines Prepared And Given.	Plant Maintenance Management & Preventive, Break Down Maintenance System, Spare Part Management
5	Modernization Of Machinery	Change Of Old And Unproductive Machines	Better Productivity And Quality	List Of New Machines Required To Improve The Over All Quality And The Productivity Of The Factory. The Machine Requirement Is Made In Such Way That It Balance The Production All Three Departments To 2000 Pairs. Now The Capacity Of Lasting Is More Than Cutting And Stitching.	Installation Capacity Enhancement
6	Product Development Centre	Formation Of New Department With Designers, Pattern Cutters, Sample Makers	Better Marketing For Finding New Customers, Less Problems In Production Due To Design Problems	New Product Development Centre Has Started. New Pdc Has Already Provided With New Area, Machines And Dedicated Workers. Full Time Designer And Pdc Manager Required. Some Furnishing Work For The New Centre Required. New Layout For Pdc Centre Provided And Also Working System Provided.	Strengthening Of The Product Development, Forecasting & Engineering

7	Marketing Strategy		More Order For The Factory, More Bargaining Power With Buyers, Work On The Strength Of The Company	Not In Scope Of Intervention	
8	Inventory Reduction	Reduce The Inventory Level Of Stocks	Better Inventory Turnover	Store Management For Leather Completed Including Cutting System.	Expansion Of Scope For The Entire Inventory
9	Quality And Availability Of Raw Material (Cow, Goat, Buffalo Etc.)	To Increase The Product Range	More Order For The Factory, More Bargaining Power With Buyers, Work On The Strength Of The Company	Not In Scope Of Intervention	
10	Quality Assurance System	To Reduce The Rejection Rate And Produce Quality Product	Material Saving And Less Buyer Claims	New Independent Department Formed. Still Requires Improvement. Once The Quality Assurance System Is Fully Implemented Then We Can Start The Quality Monitoring System.	The Department Needed To Strengthen And Quality Monitoring System To Be Started.
11	Power Supply	Install Generator In Lasting	Better Productivity And Proper Utilization Of Man Power And Machine. Timely Shipment Dispatch	Not In Scope Of Intervention	
12	Productivity	Improve Productivity Of Various Departments	If All The Above Gaps Are Filled To Reach The Productivity To The Bench	Productivity In Cutting Department Is Between 2000-2200 Strokes For Sheep Leather And In Cow Leather With Small Components It Reaches Up to	The Capacity Of Cutting, Closing Needed To Strengthen. In

			Mark Level. • Cutting= 2500 To 3000clicks; • Stitching=15Pairs/Person/Shift; • Lasting=25Pairs/Person/Shift	U2800-3000 In Case Of Full Loading. In Stitching The Productivity Reaches to 10-12 Pairs When Similar Article Is Running And The Loading Is Full. In Lasting New System Has Been Applied And Production Has Been Shifted From Two Conveyors To One Conveyor Which Has A Capacity Of 1200 Pairs With 55 Workers In Full Loading And Similar Article Running. Out Of these 55 Workers Two Are For Loading, Two Are For Inspection. The Direct Workers For Lasting And Finishing Is 51. With This The Productivity Can Reach Up to 23.5. Since Peacock Is Making High Quality Formal Shoes It Requires More Persons In Finishing. If Calculate Only Lasting Workers There Are Only 20 Workers And Rest 31 In Finishing And Packing Operations. So In Lasting Operation The Productivity Of The Department Is 60 Pairs Per Persons. Presently Peacock Is Making 20 Pairs In Case Of Full Loading.	Lasting The Second Conveyor To Be Started In Case Of Order More Than 1400 Pairs Per Day.
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Appendix 2: Interview Questions

Interview Questions for Middle Managers

Process Analysis

1. How long you have been working in this organization, what is your position in the organization and for how many years you work at this position?
2. In what year did your firm begin operations in this country?
3. Does the company have a document setting out the details of an operation or job, how it is to be performed, the layout of the workplace, particulars of machines, tools and appliances to be used, and the duties and responsibilities of the worker?
4. Is the sequence of elements which are required to perform a job or yield a unit of production clearly described?
5. Do you think that the sequence of operations is the best possible, or would changing the sequence improve the operation?
6. Does the company have a standard time to accomplish operations on time? If yes, are allowances like relaxation and contingency allowance considered? And is there a control on time? If so, how are the starting and finishing times of the job checked?
7. Are workers accomplishing their work within the pre-specified standard time?
8. How do you feel about the present workload of line workers or did you recognize workers that have a high burden of work and workers that wait work from the precedence operations?
9. In which section bottleneck operations found and which operation?
10. Is there a delay in the production flow? If yes, in which section and operation?
11. Have you been recognized operations that can be combined with another operation? Can it be eliminated?
12. Could the operation be done in another department to save the cost of handling?
13. Is a concise study of the operation be made by means of a flow process chart?
14. Can the purpose of the operation be obtained in another way and still maintain the same results?

15. How the companies inspect its jobs? Or is the job inspected at its most critical point, or when it is completed?
16. Does all the operations on the line are necessary to carry out the work?
17. Do you think that necessary equipments, tools and labor are available to carry out each operation?

Particulars of the job

1. Please explain how you schedule your work? Is there any consideration of time duration of elemental tasks while scheduling works?
2. Does the company meet its planned amount of production within its planned production schedule? If not, what could be the reason behind; does it related to workers performance, machines availability or any other?
3. Do you have detailed schedules below the work package to clarify work schedules to line workers?
4. Do you think that enough operatives are employed to carry out the job?
5. Does the company specify the average output per operative per day?
6. Does the company have a financial incentive system? Payment by results (jobs obtained) or wage incentive methods.

Machines utilization

What do you say about the machines utilizations index and machines idle times? Are they available all the time? If not what are the causes; if idle times are due to workers related problem or machines related problem?

Supervisory questions

1. How long have you been in this position?
2. You have supervised people in the past. What were their titles and what type of supervision did you give them?
3. How do you plan your day? That means on what ground you plan the daily jobs?
4. How do you motivate people to accomplish their work on time?
5. How do you measure success as a supervisor?

Interview Questions for Line Workers

Concerning operations

1. How long you have been working in this organization and for how many years you work at the operation for which you are currently engaged?
2. Tell me about the objective or purpose of your job? Does the objective clearly contribute to the department's basic function?
3. Do you have a standard time to accomplish operations on time? Are allowances like relaxation and contingency allowance considered? If yes, how much you are using it?
4. If not what are the major factors that affect you not to perform well?
5. Have you been recognized operations that can be combined with another operation? Can it be eliminated?
6. Is there anything that will prevent you from getting to work on time? Working the job's regular hours?
7. How do you feel about your present workload?
8. Describe your supervisor's management style. In what way he/she control your work?

Workplace Layout

1. Do you think that the existing workspace allowed is enough for the job?
2. How is material obtained? Is the locations of the storage shelves are appropriate? That means whether the materials position is far from your place of work or not?
3. Are tools prepositioned properly; i.e. are they found at an average place to all workers?
4. Does the layout (machines arrangement or flow of work in progress materials) of the work area prove effective or comfortable for you? If not, have you any suggestion about the work place layout or can it be improved?
5. Did you recognize any reverse flow or cross flow of products and is there any overlapping flow of products?
6. Is the transfer distance (path load) is too long or where you put your finished work (part)?
7. Is the space clearly separated for each process and do you have enough workspace for your work?

Working Conditions

1. Does your work require sufficient light? If yes, is the light even and sufficient at all time? If yes, from where it comes; natural light or fluorescence? What about glare has it been eliminated from the workplace if any?
2. What do you say about the temperature at the workplace? Is the proper temperature for comfort provided at all times; if not, can fans or heaters be used? Would installation of air-conditioning equipment be justified?
3. What do you say about the floor at which you are standing while working? If concrete floors are used, is sacking or matting provided to make standing more comfortable?
4. Are drinking fountains with cool water provided and are they located nearby?
5. Is the clothing suitable from a safety standpoint?
6. Is there an incentive system for your work? If yes how you got your rewards: Payment by results (jobs obtained) or wage incentive methods?

Machines utilization

What do you say about the machines utilizations and machines idle times? Are they available all the time? If not what are the causes?

Appendix 3: Cutting Machine and Preparation Operations

Cutting machine



Marking operation and marked component



Skived leather shoe component



Re-enforcing the leather component using textile fabrics

