PRODUCTIVITY AND QUALITY IMPROVEMENT BY IMPLEMENTING LINE BALANCING AND VALUE STREAM MAPPING TECHNIQUES IN LEATHER INDUSTRY- A CASE STUDY

By

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A thesis submitted to the Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology (BUET), in partial fulfillment of the requirements for the degree of Master of Engineering in Advance Engineering Management (AEM).

DEPARTMENT OF INDUSTRIAL AND PRODUCTION ENGINEERING

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY

DHAKA, BANGLADESH

March 2019

The thesis titled **"PRODUCTIVITY AND QUALITY IMPROVEMENT BY IMPLEMENTING LINE BALANCING AND VALUE STREAM MAPPING TECHNIQUES IN LEATHER INDUSTRY- A CASE STUDY"** submitted by Md. Mehedi Hasan Tito, Roll Number: 0413082111P, Session: April, 2012 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Master of Engineering in Advance Engineering Management (AEM)** on March 30, 2019.

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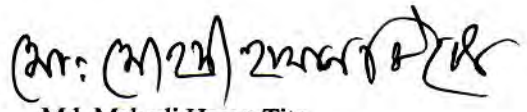

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ACKNOWLEDGEMENT

All praises to the Allah, the most benevolent and the Almighty, for his boundless grace in the completion of this thesis.

I would like to express my sincere respect and gratitude to my thesis supervisor, Dr. Shuva Ghosh, Assistant Professor, Department of Industrial and Production Engineering (IPE), Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, for his thoughtful suggestions, proper guidance and cooperation and encouragement throughout the progress of this thesis work.

I am very much thankful to the CEO of the selected leather products factory. Also thankful to the Factory Manager and other staff for their cordial support and cooperation by providing me the respective information and their valuable time.

Finally, I would like to convey my sincere gratitude to my parents and my family member whose continuous inspiration, sacrifice and support encouraged me to complete the thesis successfully.

ABSTRACT

Higher productivity with perfect quality and meeting lead time are the basic concerns for manufacturers. All operational challenges are surrounded to these concerns and prime approaches to achieve customer satisfaction. In Bangladesh, leather sector is one of the largest export earnings sector. Leather products is the major manufacturing and exporting item of this sector. Leather products manufacturing is going to robust by the next decade due to easy availability of raw materials, cheap work force. This is the high time to develop all backward linkage and improve productivity in leather products manufacturing. A lot of operational tasks involved in leather products making; once the productivity becomes high, the quality falls and vice-versa. Implementation of quality and productivity improvement techniques is becoming the most intelligent parts. Yamazumi line balancing and Value Stream Mapping (VSM) techniques has been applied to improve quality and productivity in a leather products manufacturing industry in Bangladesh as a case study. A little number of research work was carried out before on this regard. This thesis is a visualization of the possibilities for flow oriented production system, distribution of workload among various workstations and eliminating non-value added works to reduce lead time. The outcome of this thesis showed that the quality and productivity can be significantly increased. Therefore, similar type manufacturer can use this thesis outcome as a knowledge base to mitigate challenges to produce perfect quality products with increased productivity within the production flow. It is expected that, extended study can further be conducted based on this thesis outcome in future and can be applied in a large scale industry.

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LIST OF ABBREVIATIONS

SMV	Standard Minute Value
VA	Value Added Activity
NVA	Non-value Added Activity
NNVA	Necessary Non-value Added Activity
VSM	Value Stream Mapping
CSVSM	Current State Value Stream Mapping
FSVSM	Future State Value Stream Mapping
ILO	International Labor Organization
CC	Credit Card
CT	Cycle time
JIT	Just-in-time
Hrs	Hour
Sec	Second
Ft	Feet (distance measurement)
Hw	Hand work
Mw	Machine work
Nos.	Numbers
Config.	Configuration
Kg	Kilogram (weight measurement)
Pcs	Piece
Lr	Leather
QC	Quality Control
Qty.	Quantity
Sl.	Serial

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Leather sector is the most emerging and economically important export earning sector in Bangladesh. Generally this sector is divided into three segments in terms of exporting items such as- (i) Finished Leather, (ii) Leather products, (iii) Footwear. Leather products is the highly value added manufacturing items of leather sector. Leather made products are seems to be a fashionable item. Thus the global market is highly style based rather than the quantity. China is still the largest leather product sourcing country in the world. Also Vietnam, India, Indonesia, Thailand and Cambodia is exporting big volume of leather product. In Bangladesh, this sector has a great potential to expand by the next decade. Because of increased higher wages, buyers are shutting down their sourcing from those countries and starting business in Bangladesh. The main benefit of the leather products industry of Bangladesh is the ample supply of leather which is the main raw materials in leather products making. The easy availability of other raw materials is the biggest strength of this sector. But the major weakness is that, standardize manufacturing system are totally absent in leather sector. Furthermore the labor productivity is comparatively low in Bangladeshi workforce due to the lack of competency. The efficiency and effectiveness is not up to the mark to meet buyer satisfaction in terms of business dealings. Productivity and competitiveness are the primary two important considerations of manufacturers to sustain their business in global market. Competitive lowest costing is becoming more concerning factor for all global brands as because they uses slogan “everyday lower price” to advertise their branding and to get more retail customers. There is no other way to maximum the utilization of production setup to overcome these challenges.

Because of being technologically labor dependent and manual hand work based making system, it has a great chance and opportunity to improve the productivity. To do so, manufacturers have to apply new methods, tools and techniques in different area of production and operation management to get increased quality and productivity. In this respect Line Balancing used by Yamazumi chart and Value Stream Mapping (VSM) plays an important role as a strategic tool in rearrangement of the processing operations to enhance utilization of capacity. It is necessary to arrange production line very effectively and

distribute workload in various workstations to obtain the maximum performance and efficiency. Line balancing is a significant systematic technique that is used to effectively distribute total workload as possible as evenly throughout all workstations [1].Working process of the manufacturing work piece can be separated into a set of different operations such as- front part of the work piece and the back part of the work piece, together which in turn makes the complete product. Due to technological constraints, some tasks must be executed on the same station where no other tasks should be assigned. Other workstations are arranged to increase efficiency at required production rate to overcome the bottleneck tasks within operation times that exceed the cycle time [2]. It is found that, Value Stream Mapping (VSM) techniques leads to a substantial improvement in production line efficiency and the utilization of capacity and resources has been enhanced significantly by which manufacturers can be highly benefitted. This benefit leads to a cumulative improvement of the business with which manufacturers can expect to be competitive over their rivals [3]. VSM consists of five basic steps i.e. create a current state value stream map, evaluate the current value stream map, identify problem areas, create a future state value stream map, implement the final plan [4].Other process mapping techniques usually create documents for the basic product flow, whereas VSM in addition creates documents for the flow of information within the manufacturing operations [5].

This case study illustrates the application of Yamazumi chart line balancing and VSM to the main production process of a leather products industry with a focus on the highest labor and time utilization throughout the cutting, sewing, finishing and packing section. This study would investigate the existing present situation of the quality, productivity and efficiency. Then the Yamazumi chart line balancing and VSM will be implemented as per analysis of the improvement scope. Finally benefits will be evaluated in terms of quality and productivity improvement.

1.2 Rationale of the Study

Optimizing among quality and productivity with cost, resources and time are becoming more challenging for manufacturers day by day. Though the leather products sector is growing rapidly in Bangladesh, it is also true that still manufacturers are straggling to fulfill quality demand of buyer. Sustainability of this growth is heavily depends on buyer confidence about the manufacturing quality and productivity. Considering this, leather products manufacturers are now more focused about the effectiveness of the operation process in bringing the

maximum value to the buyer. Ongoing manufacturing process including overall management are being compared and replaced with more scientific and efficient tools and techniques to improve quality and productivity as well as to reduce all other wastes. Any new manufacturing approach is always difficult, uncertain, and distinct based on individual process. Furthermore manufacturers think about the additional cost and risk involves implementing new manufacturing tools and techniques. There are different tools and techniques according to the individual setup of the industry, products, processes, manpower, and background. Line balancing and VSM in general- are the systematic approach being used by manufacturers in which the industry can sustainably improves the operation process and production. These techniques are heavily focused on the maximum utilization of time and labor. Associated wastes within the production process such as- quality defects, process control failure, unorganized machine layout, non-essential activities, and inefficient manpower configuration are analyzed and eliminated with these techniques.

1.3 Background of the thesis

Productivity is a very important measure in manufacturing operations, besides turnover & profit, because it provides insight into the efficiency & effectiveness of operations. Productivity improvement is nothing but reduction in wastage within inputs and maximizes the outputs. It is always expected by the manufacturer to produce more and more products by using less and less resources (inputs). Comparatively low cost leather products are produced in Bangladesh generally. Thus it is necessary to move towards high cost product market to survive and better expansion of this sector. In order to do so manufacturers need to provide high quality leather products within shorter lead time. Line balancing technique is able to increase the productivity of a company [6]. A common objective for line balancing is to minimize the number of work-stations for a given cycle time and minimize the cycle time for a given number of work stations [7]. Yamazumi chart is used as a supporting tool to proceed workload distribution among workstations towards line balancing. Yamazumi chart is an individual task time bar chart that shows the total cycle time for each operation when performing their process in the production flow [8]. The aim of applying Yamazumi chart with line balancing is to balance the overall cycle time for all workstations. An important measure of performance for a production line is the system throughput such as the average number of products produced in a certain time frame. That can be also evaluated and improved by Value Stream Mapping (VSM) technique. VSM was developed early in 1995 to identify waste in individual value stream to aid researchers or practitioners to find an

appropriate method to eliminate those wastes. This simple and straightforward technique starts from the very beginning of the supply chain and ends with the customer delivery. Graphically documenting the process and collecting data such as cycle time, work-in-process (WIP) levels, quality levels, and equipment performance record, finally it creates a single page map called “Value stream”. Sources of data, pattern of documentation and number of components may be different according to the complexity of the process [5]. It includes identifying and eliminating non value adding activities, production flow, supply chain management, dealing with suppliers and customers.

This study focuses on proper layout of machine and configuration of assigned manpower, work assisting tools, and re-arrangement of the working sequences. Henceforward, improving quality of the product and overall productivity of the manufacturing process using line balancing and VSM techniques through identification, reduction and elimination of non-value added activities. A production line in a leather product industry will be considered as model line to conduct this study. The quality, overall productivity along with line efficiency will be evaluated and compared before and after implementing these techniques.

1.4 Problem Statement

Global buyers are interested to source leather products from Bangladesh mainly for lower wages rate. Quality requirement is very high for the high cost and fancy leather products. Buyers are not still enough confident to place production order of such high cost leather products to the Bangladeshi manufacturers. Leather products manufacturers are facing challenges with quality, productivity, efficiency and effectiveness, lower cost of manufacturing, increased cost of resources, unorganized utilization of resources, and lack of operations management skill. There are some in-built difficulties inside the leather products manufacturing such as- lots of individual tasks, operating sequences, necessary non-value added tasks, manual work etc. The most basic operating sections are Cutting, Sewing, Finishing and Packing. Production process is not continuous flow oriented which is a major cause of inefficiency of production line and workforce. So, lack of quality and productivity is the most common problem faced by leather products manufacturer. This is high time to implement standardize manufacturing tools and techniques to meet competitiveness and to get sustainable growth. Application of Yamazumi chart line balancing and VSM techniques in different operating sections are much helpful.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Line balancing is a manufacturing engineering technique to leveling work load throughout workstations. And the value stream mapping (VSM) is a significant techniques is lean manufacturing methodology used for the continuous elimination of all wastes in the operation process which results productivity & product quality improvement. Both manufacturers and buyers are more focused on waste elimination, reduced lead-time, improved flexibility, and better quality with engaging less time, less space, less human effort, less machinery, less material, fewer costs.

2.2 Value & Waste

Waste can be generated by the different sources. Poorly designed layout, unnecessary distance within workstations, long setup times, incapable processes, poor maintenance, poor work methods, lack of training, large batches, ineffective production scheduling, lack of workplace organization etc. Productivity can be improved and lead time can be shortened by eliminating wastes within the overall process through continuous improvements. Shortened lead time organization can obtain operational benefits as well as administrative benefits [9]. Waste is anything that the customer is not willing to pay for [10]. Basically two types of waste are generated in manufacturing process, these are:- (i). Waste which can be seen or measured, (ii). Waste which cannot be seen or not measured in terms of waste. All defects produced or breakdowns are the first type waste. In second type, waste due to improper transportation of material or management work, due to improper working environment or less knowledge about process [11].

Typically waste in an industry is generated by 7M (man, machine, material, management, market, method and Maule) [11]. These are shown in the upcoming figure:-

2.2.1 Transportation:- Therefore simply transportation is one of the wastes that has to be eliminated from the production system. It does not add value to the end product. This accounts for quality defects, maintenance of higher WIP and additional cost of transporting the goods. Transportation is often caused by poor workplace organization [11].

2.2.2 Over Production:- Overproduction means making more than is required by the next process, making earlier than is required by the next process, or making faster than is required by the next process. That means producing something excess it is actually required.

2.2.3 Inventory:- It is a monetary term which is utilized to earn more money. Due to excess limit of inventories cash flow is blocked which is not used to procure any other resources, and thus it is a waste in an industry. Related to Overproduction, unnecessary inventory negatively impacts cash flow and uses valuable floor space.

2.2.4 Excessive Motion:- Unnecessary physical motions, walking or components movement which delays actual processing work includes excessive motion. Any wasted motion employees have to perform during the course of their work, such as looking for, reaching for, or stacking parts, tools, difficult physical movements due to poorly designed ergonomics, which slow down the workers. Unnecessary motion is caused by poor workflow, poor layout, poor housekeeping, and inconsistent or undocumented work methods [12].

2.2.5 Over Processing:- Rework, Repair, Correction, reprocessing when the work is not done correctly the first time. Unnecessary operation steps of component assembling, poorly designed tool causing unnecessary motion that produce defects. Waste also can be occurred when focusing higher-quality products than necessary. Re-work generally consumes a significant amount of time and therefore add to factory overhead costs. Unnecessary higher quality results unnecessary use of labor and tools. Therefore generates bottlenecks and delays.

2.2.6 WIP (Work in Process):- Work in Process (WIP) is moving components between working sequences due to large batch production system or processes that requires longer cycle times. These staying components consume extra space, block money flow.

2.2.7 Excessive waiting time:- In conventional batch wise production system, excessive waiting is the major time consuming factor. The workstation remain busy and components are kept waiting for the next operation. Semi assembled components are also kept waiting for another required components. This also includes- waiting for raw material, workforce, information, equipment, tools, etc. Lean demands that all resources are provided on a just-in-time (JIT) basis- not too soon, not too late [13]. Waiting time within the process should be reduced or eliminated. Productivity improvements focuses on to maximize the utilization or

efficiency of the worker rather than to maximize the utilization of the machines. Longer setup times, absence of line balancing, improper workload, lack of maintenance etc. are the common causes of excessive waiting time.

2.3 Lean Manufacturing

Lean manufacturing is the methodology for eliminating waste and non-value added tasks. Overproduction, over processing, waiting, excessive time used, unnecessary part movement, excess inventory are common examples of waste in manufacturing process [14]. Various techniques such as Value Stream Mapping (VSM), Kaizen, Six Sigma, Kanban, 5S, Total Quality Management (TQM), Total Productive Maintenance (TPM), Business Process Management (BPM), Visual Management, etc. supports the lean methodology. The success of Lean Manufacturing implementation depends on four critical factors: (i). leadership and management; (ii). Finance; (iii). Skills and expertise; and (iv). Supportive organizational culture of the organization [15].

2.4 Productivity

Productivity is a measure of the rate at which outputs are produced per unit of input. In an organization inputs are labour, capital, raw materials, etc. and outputs are goods or services. It describes various measures of the efficiency of production [16]. It is calculated as the ratio of the amount of outputs produced to some measure of the amount of inputs used. Depending on the context and the selection of input and output measures, productivity calculations can have different interpretations. In leather products manufacturing, the output is measured as the number of units of goods manufactured, and the input is measured as the raw materials, workforce, machinery, and other resources used. The productivity is commonly expressed by the labor productivity in leather products industry. Labour productivity is the ratio of output to the input of labour. Typically, it is measured as the amount of output produced per hour worked.

$$\text{Labor Productivity} = \frac{\text{Total number of output per day}}{\text{Number of workers worked}} \quad \ldots\ldots\ldots \text{(i)}$$

Productivity improvement refers to the efficient use of resources to produce goods or services. Production is measured by the number of quantity produced where the productivity is measured by the ratio of output generated compared to the input used. Productivity measurement is important because high productivity means larger profit gains. In manufacturing industry the only intension is to use less number of inputs to produce

maximum number of outputs. Productivity improvement cannot be achieved only by working hard and by working for long time. Waste elimination and reduction, well panned value chain, method of work, effective effort, intelligence uses of raw materials, good management skills, technological support etc. can effects productivity.

2.5 Efficiency

Generally efficiency is a measurable concept which determined quantitatively by the ratio of useful output to the total input. Efficiency can often be expressed as a percentage of the result that could ideally be expected. But in some cases efficiency can be indirectly quantified with a non-percentage value. Efficiency signifies a level of performance that describes using the least amount of input to achieve the highest amount of output. Higher efficiency refers to reducing the number of unnecessary resources used to produce a given number of output including time, energy and other resources. The success and failure of a manufacturing industry is highly depending on three important factors, i.e. productivity, utilization and efficiency. One of the primary objectives of all the organizations worldwide is to improve the productivity and efficiency. Productivity is the ratio of outputs produced to inputs involved in the process of production. On the other hand, efficiency is the ratio of the actual output produced to the standard output, which should have been produced, at a given amount of time with fewer resources.

$$\text{Line Efficiencey} = \frac{\text{Total output per day x SMV}}{\text{Total manpower worked x Total productive time per day}}\ x\ 100\% \quad \ldots\ldots \text{(ii)}$$

Table 2.1: Differences between Productivity and Efficiency

Basis For Comparison	***Productivity***	***Efficiency***
Meaning	Productivity alludes to the rate at which products are produced, or task is performed.	Efficiency implies the state of producing maximum output with limited resources and minimum wastage.
Describes	How many output produced by one unit of input.	How well the resources are utilized.
Focuses on	Quantity	Quality
Ratio of	Output to Input	Actual Output to Standard Output

2.6 Effectiveness

Effectiveness is the simple concept of being able to achieve a desired result, which can be expressed quantitatively which does not usually require more complicated equations. Effectiveness is the degree at which something is successfully produced with a desired

specification. In contrast to efficiency, effectiveness is determined without reference to costs. Efficiency means "doing the thing right," and effectiveness means "doing the right thing".

2.7 Line layout

When some operations are performed in a specified sequence to produce the exactly the same product, it is a line layout. Sequence of work flows from beginning of the layout to the ending and from workstation to workstation until the product making is completed. In a most efficient line layout the sequence of operations and equipment does not have to be changed frequently [17]. Manufacturing plant may have several lines for making the same style or several lines for making different styles depending on the production volume. Line layout does not necessarily mean each machine is different. Several operators and helpers may perform the same operation to perform in a steady flow. Disadvantages of a line layout include potential bottlenecks and work load imbalance. Each operation depends on the previous one, and downtime, absenteeism, and un-skilled operators may interrupt the workflow. To counteract these problems, some operators may need to cross-trained to perform more than one operation, and substitute machines must be readily available for immediate replacement if equipment breaks down. Failure to meet production schedules for whatever reason may create a need to reroute work, shift personnel, or schedule to avoid further days [18].

2.8 Line Balancing

Line Balancing (LB) is the leveling the workload across all processes in a line or value stream process to remove bottlenecks and excess capacity [20]. It is generally an organized planning of working sequences of a line layout to have an even and steady production flow. Line balancing re-arrange tasks among workstations and used to assign appropriate workforce as required so that each workstation has nearly the equal workload. For the effective line balancing performance, each assigned workforce must need to perform work within specified time period and repeatedly for each unit of product. Leather products manufacturing requires several sequence of operations to complete the product making. Each workstation has a particular part of total sequence and time is also need to be nearly same. If one workstation is over loaded and the taken time is over there is a bottleneck occurs which is not acceptable for the line balancing and it restricts the flow of work resulting the operation less utilized. Work of other stations also be affected. Unequal workload among workstations of a sewing line will lead to the increase of both WIP and waiting time, indicating the

increase of both production cycle time and cost [21]. Thus the concern is, the distribution of work should be equalized throughout all workstations by proper arrangement of man, machine and work contents to achieve improved productivity ensuring the perfect quality.

2.9 Standard Minute Value (SMV)

The amount of time required to complete a specific job or operation under existing condition, using the specified & standard method at a standard pace when there is plenty of repetitive work [18].Standard Minute Value (SMV) actually represents the Standard Time required for any individual process. It is the amount of time taken by a capable worker to conduct a given task at a standard performance. The SMV includes additional allowances. Different types of allowances are allowed in production floor. Such as personal time allowance (rest and relaxation), delay allowances, fatigue allowances, machine delay, anticipated contingencies etc.SMV is a universal measurement system for time study. Production target, balancing line layout, production planning, operator performance, and operation process efficiency is directly measured by the SMV. So, the correctness and consistency of SMV is very much essential. In leather products manufacturing, determining a precise SMV is very difficult using traditional work measurement methods. Because there are lots of manual works needs to accomplish and the performance of workers may vary time to time. Motivation, fatigue and job familiarity affects the performance of workforce. So, the working rate is not constant for all time during working period [19].

SMV for individual process = (Average observed time x Rating %) + Allowance%

Possible production target, cycle time, required minimum workstation for line balancing, required manpower configuration, labor productivity, line balancing efficiency are calculated based on SMV. Following equations are useful to calculate labor productivity and line efficiency [34].

$$\text{Possible Production qty. per day} = \frac{\text{Total no. of manpower x Total workable time x Estimated Efficiency}}{\text{Total SMV}} \quad \text{... (iii)}$$

$$\text{Takt time} = \frac{\text{Production time available per day}}{\text{Target units per day}} \quad \text{..... (iv)}$$

$$\text{Minimum no. of Workstations} = \frac{\text{Total SMV}}{\text{Takt Time x Estimated Efficiency}} \quad \text{..... (v)}$$

$$\text{Required Manpower for single task} = \frac{\text{Single task Time x Total manpower}}{\text{Total SMV}} \quad \text{..... (vi)}$$

$$\text{Line Balancing Efficiency} = \frac{\text{Total SMV}}{\text{Highest Task time x Total no. of Work stations}}\ x\ 100 \quad \text{..... (vii)}$$

2.10 Time Study

Time study is most popular and useful method for line balancing and reducing bottlenecks. It is a work measurement technique consisting of careful time measurement of the task, adjusted for any observed variance from normal effort or pace. One problem of time study is the Hawthorne Effect where it is found that employees change their behavior when they know that their being measured [22]. ILO describes time study as a work measurement technique for recording the times and rates of working for the elements of 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 [23].

2.11 Cycle time

Total time consumed to do all works to complete a single operation, i.e. time from pick up part of first piece to next pick up of the next piece [24].

2.12 Takt Time

Takt time is a German word meaning meter or rhythm. It generally explain the required or expected rate of production or units per available time. It is a calculation based on customer demand and available productive time.

$$\text{Takt time} = \frac{\text{Production time available per day}}{\text{Target units per day}}$$

2.13 Work Measurement

Work measurement is a technique which mainly used to quantify the work content related to a specific task, in terms of the standard time. This is a fundamental tool that results improving productivity. Establish time standard to produce a product at work station is the important thing to follow. It is directly related to the productivity [25]. It establishes an allowed time standard to perform a given task, based upon measurement of work elements of a pre-setup method, with adding allowances [26]. Before conducting work measurement, it is much necessary to select the qualified worker to perform the specific task or operation at normal

pace. The worker should know the standardized method to accomplish task or operation. The Westinghouse performance rating system and ILO recommended allowance factor are used in this study based on judgments of the observation. Time standard as a result of work measurement may be used for cost control, scheduling and wage and budget estimation [27].

2.14 Yamazumi Chart

Yamazumi chart is used to the visual representation of workload on each workstation. Yamazumi chart is used as a tool to proceed re-arrangement of task within workstations for line balancing [6]. Yamazumi chart is a man-machine bar chart that shows the total cycle time for each operation when performing operation processes in the production flow [28]. It is a visual representation of workload on each station that shows how the production time is distributed over the line. Actual standard cycle times found from the time measurement are calculated first to formulate Yamazumi chart. Secondly, construct bar chart from accumulated cycle time for one operator. The cycle time is plotted on the vertical axis and the talk time is plotted on a horizontal axis. The aim of applying Yamazumi chart is to balance the overall cycle time for all the workstation.

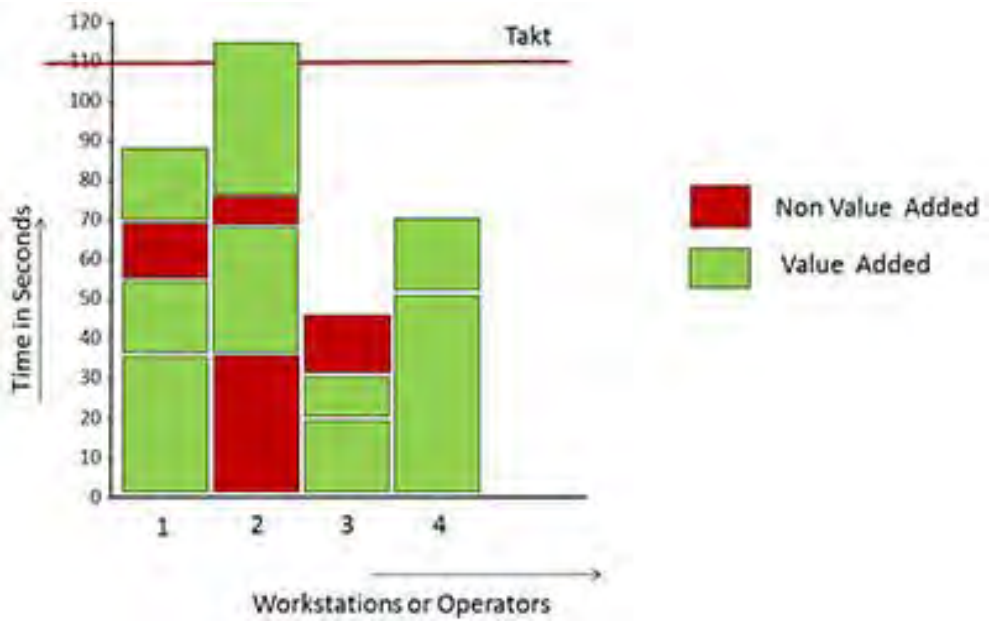

Figure 2.1: Template of Yamazumi Chart

2.15 Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is a lean management tool to visualize overall steps needed to perform from product making concept to reach the product to the customer. It is a method for analyzing the current circumstances and designing a future circumstance for the series of events that take a product from its beginning through to the customer with reduced wastes as compared to current map. To start the approach of improving productivity by identifying and eliminating waste in a manufacturing industry there is no other tool better than VSM. It helps to understand and streamline work processes using other tools and techniques of lean manufacturing. Its fundamental goal is to identify, demonstrate and reduce waste in the operation process [29]. Although value-stream mapping is mostly associated with manufacturing operations, but it is also used in another operation such as- logistics, supply chain, service related industries, healthcare. Implementing VSM the activities can be easily separated into the value stream, which is the focus of one type of attention, and the 'waste' steps. Standard terminology, symbols, and improvement methods allows VSM to be used as a communication tool for both internal communication and sharing techniques and results with the larger lean community [30]. Creating a value stream map allows to document current production lead time, inventory levels, and cycle times in order to determine the ratio of value-added activities implemented. The focus of VSM approach is to reduce the cost by eliminating non-value added activities in the production chain [31].

In this case study, four steps were followed while implementing VSM: product identification, drawing a current state mapping, develops a future state map, and drawing an action plan. Takt time, process cycle time, and efficiency are computed for existing process state and improved process state for comparison and evaluation.

VSM aims to identify waste in terms of non-value added activities. Current state map is prepared to represent details about the existing position and identify various problem areas. Future State Map is made to show the implementation action plan. VSM is visualization and streamlines work processes using the tools and techniques of Lean Manufacturing. It helps to identify demonstrate and decrease waste in the processes. VSM can serve as a blue print for Lean Manufacturing [32].

2.16 Current state VSM

A visual tool that documents the current condition of a manufacturing environment. A present state value stream map captures all of the details of manufacturing processes just as they exist at the moment the map is produced, including any flaws or errors.

2.17 Future state VSM

A visual tool that shows how a value stream can look after improvements have been implemented. A future-state value stream map is an ideal view of a value stream and represents the goal of a lean initiative. Taking a value stream perspective means working on the big picture, not just individual processes, and improving the whole, not just optimizing the parts. Identifying the differences in the current and future states yields a roadmap for improvement activities [33].

2.18 Value Adding Activity

Those activities which are performed to transform the raw material into the exact product as per customer specification are refers as Value Added Activities. These activities makes the product valuable to the customer. A value adding activity is simple to define; it results in something that customer would pay for. This includes all operations those convert the input to the useful end product.

2.19 Non-Value Adding Activity

Non-value-added activities are the activities that are not required for transforming the materials into the product that the customer used to demand. Anything which is non-value-added may be defined as waste. Anything that consume unnecessary time, effort or cost is considered as. Another way to find non-value-added activities can be any approaches or activities for which the customer is not willing to pay for. Testing or inspecting materials is also considered as non-value-added activities since this can be eliminated before it happens within the production process by implementing improvement techniques.

2.20 Necessary Non-Value Adding Activity

Those activities which are not actually accountable to make a product more valuable, but are necessary for the existing operation process. This type of activities are difficult to remove in the short term and should be a target for longer term of continuous improvement.

CHAPTER THREE

OBJECTIVES AND METHODOLOGY

3.1 Objectives of the study

The purpose of this thesis work is to apply Yamazumi chart line balancing and Value Stream Mapping (VSM) appropriately to the manufacturing process and demonstrate how to identify and eliminate non-value added activities, distribute workloads, configure workforce.

The specific objectives of this thesis work are:

1. Identify problem areas in the production process for less productivity.
2. Calculate Standard Minute Value (SMV) to show cycle time, allowances and thus find out opportunities to improvement.
3. Identify bottlenecks in production process and minimize using line balancing technique.
4. Ensure maximum utilization of workforce by coordination between different sections and distributing workloads among workstations.
5. Eliminate or reduce unnecessary activities to improve productivity with better product quality.

The possible outcome of the proposed work is the establishment of a flow-oriented production line that can reduce time wastage and hence improve quality and productivity.

3.2 Methodology

This case study needed to select such article that is a regular production of the selected leather products industry. Considering this, two articles V-5 and V-6 are selected to conduct this case study. Buyer always order these articles together usually in every month.

The methodologies are as follows:

1. One leather products industry of Bangladesh has been selected and visited for the study purpose. Firstly analyze the existing stage of manufacturing and identify the improvement opportunities in terms of quality and productivity in the production line.
2. Basic time and Standard time are calculated separately by the time study from the cycle time of every operation for different components. After that, the Standard Minute Value (SMV) is calculated.

3. Process wise hourly production capacity and labor productivity are calculated by using calculated SMV. Benchmarked production target is calculated and set to meet the lead time.
4. Line balancing technique is applied using Yamazumi chart and every tasks are re-arranged considering existing bottlenecks in the processes. According to the line balancing, new production floor layout and manpower allocation is proposed.
5. New work assisting tools has been developed and implemented to reduce necessary non-value added task time which also improves the product quality.
6. New production layout is applied with the balanced capacity to increase the productivity.
7. Collecting information from the cutting, sewing, finishing and packing sections to develop a current state map using.
8. Analyzing the current state map to identify the potential scope of improvement.
9. Identify value added and non-value added tasks and make a summary sheet for collected data.
10. Reduce non-value added and necessary non-value added tasks by process improvement.
11. Designing a future state map by the improved process and reduce lead time.
12. Finally analyzing improvement compared to the current state.

CHAPTER FOUR
PROBLEM IDENTIFICATION

4.1 Introduction

Leather sector in Bangladesh has been growing significantly from last few years with rising exports in both the international and local market. Impressive growth resulted this sector the country's first potential export earner behind garments and textile. But the existing practices of manufacturing system is not consequently fulfilling the demand of quality and meeting the lead time. Actually in such modern age and competitive business practice the manufacturing throughout the industries worldwide from aircraft to needle manufacturing is following the latest production system called lean manufacturing. It is not a system of just adding some new techniques into how we are producing products, but this system is exactly like changing the way we actually think about manufacturing. Furthermore leather is a highly labor intensive sector and thus to ensure maximum productivity is very important. Alike increasing economic growth and market competition are also encouraging the improvement in quality and productivity for the country's leather sector. Thus modern manufacturing techniques must be implemented throughout the manufacturing system.

4.2 Company Profile

Selected industry is a medium scale leather products manufacturer started in the year 2015. Fully export oriented this manufacturer produces different type of leather products such as- leather made ladies shoulder bag, wallet, clutch, school bag, purse, leather jacket etc. The main customers are from Japan, Italy, France, Germany, and China.

4.3 Present status

The company is a rising leather goods manufacturing industry. From the very beginning it is doing its business very smoothly and yearly business growth is consistent. According to its business volume it may be categorized in the mid-scale industry in our country. This company is trying to develop their internal culture with the standard mechanism but currently they are not following lean manufacturing tools and techniques in production. There are some existing difficulties and thus chance of improvements in every section to be the efficient and more organized manufacturer.

4.4 Scope of Improvement

The main area of productivity improvement found is in the cutting, sewing, finishing and packing section. Due to limited scope other sections are not taken under consideration. There are some established rules and regulations inside the working process which are very hard to change the established in a single day and convince factory peoples in such short period. So the study reveals some problems and suggested some solutions which may leads to the benefit for the company. A systemize working process and maximum deal of top level management involvement with a team based learning process are needed to implement these techniques.

4.4.1 Cutting section

Cutting section has its own working schedule which is not generally followed by the sewing schedule. This section is running to its capacity with separate schedule and that's why it is always keeping an inventory. This inventory usually kept in cutting line which causes congested work place and sometimes resulted walkway blockage. Cutting parts are found dusty and damaged during assembly work started in sewing section due to lack of appropriate packing or storage system. Short quantity of different parts is a common problem. No formal cutting order sheet and cutting instruction sheet provided for tracking cutting quantity. Sometimes few parts are cut much before the sewing input schedule for some unavoidable reasons like leather quality fault (called selection problem), unavailability and change of schedule. If the standard procedure and proper planning is applied the unnecessary cutting inventory will be very less or eliminated.

Figure 4.1: Cutting section

List of basic cutting operation:

1. Receiving from store
2. Lay on table for QC and separating
3. Marking defective area and tracing
4. Machine cutting, hand cutting if necessary
5. Bundling, storing

The cutting supervisor just gets the oral information about the upcoming production article and receives cutting material from store without any requisition from. As mentioned earlier very frequently sewing section found short or excess quantity of cutting parts due to this lack of cutting tracking. Also found difficulties to identify and track mistakes of wastage in cutting section. Cutting operators and supervisor uses excuses to explain wastage and management has no way to verify such excuses due to the lack of tracking system (forms and formats). Materials are issued based on a consumption sheet prepared by the merchandiser. Store only maintains a register of all in and out materials.

4.4.2 Sewing section

Sewing is working at its own motion with a pre-scheduled setting. The floor layout is fixed for all articles and styles that also need to further checking because it does not have enough spacing within the line. Whatever the articles or styles, the machine and working table layout is fixed. The first and foremost observed matter is that everybody is not working with his/her own speed or skill. They have no hurry or it may be said lack of motivation to the positive working speed. Same operation is done by more than one workers with two timings that are very different. The skill level may not be the same but will be closer to each other. The sewing section is using manual process, for example assembly work station. The working sequence is maintained by taking assembled components from one operation to the next operation in a batch quantity by hand by helpers. The quantity of helpers is much more than the requirement. Line balance is not proper and layout is not finalized before the production starting for a new article. All accessories were not available prior to the production starts which causes a lot of inventory in the side of sewing line, beside the table, under the table, on the walk way. Only few workers are fixed to specific task according to their expertise such as sewing operator, punch work, zipper edge burning and thread burning. Most of the workers were assigned randomly in different operations in different times without any pre-plan. There

is no pre-determined task allocation. They were doing any kind of job without planning or layout sequence. They were found gossiping, making the line populated, and making worker lazy and demoralizing to their sharing mentality and speed of work. Surprisingly there was no production target for the day as well as for the whole section. It is done in a way that the actual line condition, worker capacity/capability/skill and motivation are not perfect for the fixed target. So the production report is not maintained daily. Production quantity is calculated only on and just before the shipment day and short quantity shipment is very common problem. This does not illustrate the actual production output.

Finishing and packing section are merged together. This section is in first floor but finished goods inventory is keeping on the ground floor. In line inventory and finished goods or cartoon in sewing floor hampers the production, working environment, lessen the working space and finally de-motivate the worker to utilize their maximum effort.

Figure 4.2: Sewing section

CHAPTER FIVE
DATA COLLECTION AND ANALYSIS

5.1 Introduction

Leather products industry is an example of separate assembly type manufacturing system with no stock before order processing; it is highly labor oriented industry with different kinds of problem in different sections within the manufacturing facility. This chapter includes the analysis of collected data from the studied sections for line balancing. Improvement through line balancing will be evaluated by the Value Stream Mapping (VSM) technique. So this chapter also includes the analysis of collected data for the calculation of current state value stream mapping and finding out the scope of improvement to draw the future state value stream mapping. Data is collected by the stop watch individually for each task for the selected styles, walking through the production floor, from register, and following the target quantity, type of articles, and category of styles, category of the raw materials. Videos were recorded for some operations through mobile hand set and used to conduct further verification and analyses of the work and time study required in various elements of tasks involved in the operations. Here the data is relevant for only the similar production system and the specific style where the process may vary for different styles.

5.2 The common problem identified

Lead time failure and short quantity shipment is the great problem. The supply of raw materials including accessories with a larger period of time involvement so the factory faces difficulties in material plan or so called production scheduling. Accessories were not available in time. Metal buckles were received after six days of production running. So the semi-completed finished goods were making inventory beside the sewing line. The quantity of sewing machine is not enough to run smooth production. Sometimes assembled of specific sequence needs to wait for next operation due to machine shortage. The machine shortage problem was vital at the starting. Moreover if machine troubles, maintenance people were taking time to solve the problem. Only one person is there for maintenance. Maintenance person does not attend office regularly due to his personal business outside the factory. The problem becomes more critical when this person is out of factory. Only corrective maintenance is done and there is no preventive maintenance schedule at all. The storing spaces and the production floor spaces are not enough, the walkway is comparatively narrow than requirement. The supervision is very poor and the motivation is not functioning

properly. There is no job training found. The lack of multi skill operator is visible. There is no process to identify and rating system of labor performance. The production record system is not accurate; production system is not continuous flow oriented. Batch production system is being followed. In line inventory is very common and they does not consider this as a serious matter. Cutting and sewing efficiencies are considerably low because of poor maintenance, poor work place, poor method and lack of proper incentive plan. Line balancing, efficiency and productivity calculation were not done ever before and no other techniques were pursued to track production. There is no MIS and hourly or daily production report.

5.3 Common Barriers to Flow

Variations in work requirements (more styles, less quantity), waiting for decisions and accessories, fluctuations in pace of work, delay production, interruptions, rework, worker inefficiency and lack of motivation to work.

5.4 Existing Floor Layout

Figure 5.1 (a) and 5.1 (b) shows existing ground and first floor layout respectively. This layout shows the machine position, working table placement, location of different sections. Cutting section, sewing section and sample section are located on ground floor. Finishing section is on the 1st floor. Complete assembled products from sewing section are transported to the finishing section. Cleaning, finishing work, final QC and packing is done in this section. Then the sealed carton is transported to ground floor to the finished goods storage area. Usually four persons can easily work in a table. But number of persons varies based on number of tasks assigned to any particular table. Common practice is to consider four work (hand work/assembling work) stations on each table. This layout remains fixed for all styles.

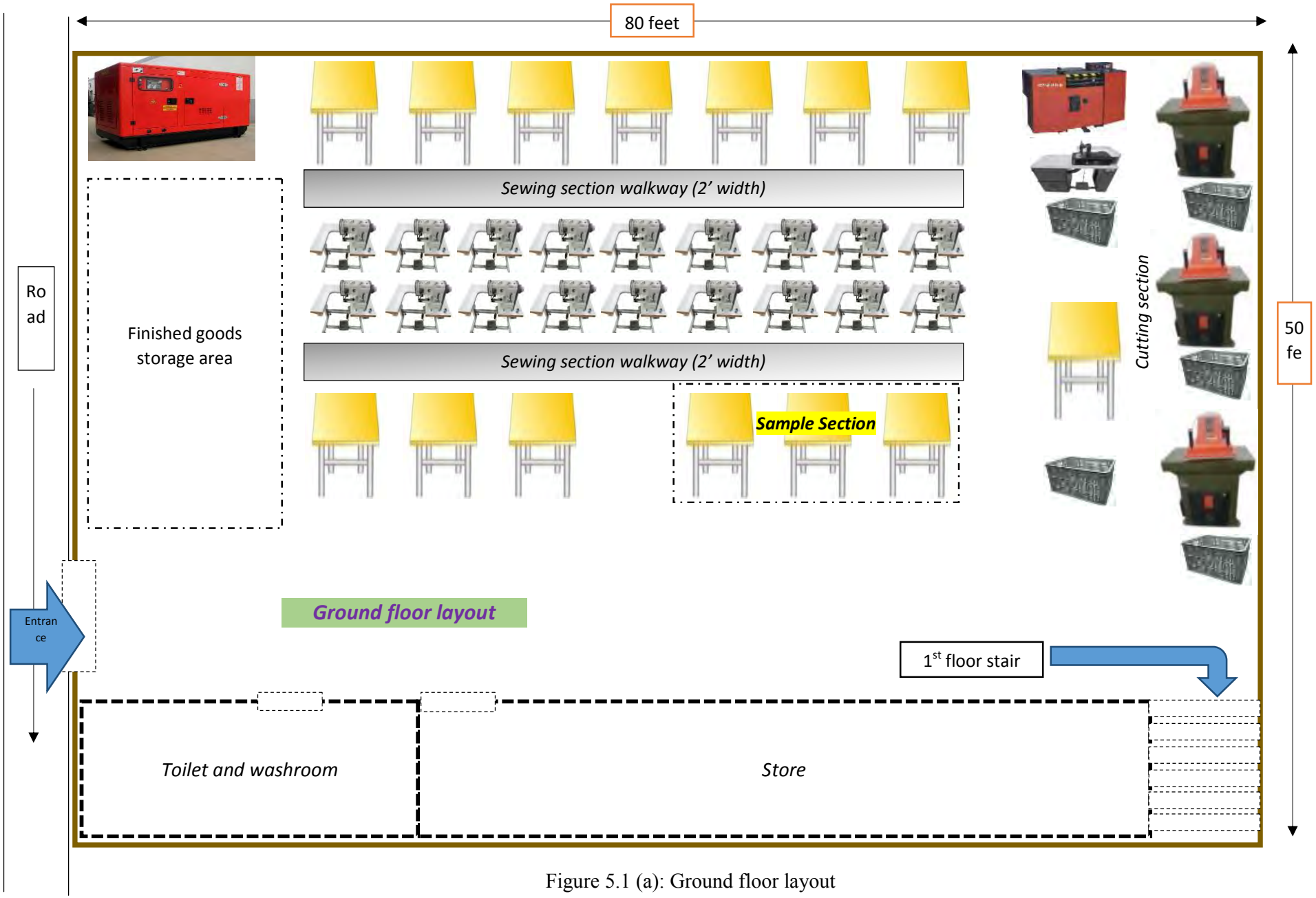

Figure 5.1 (a): Ground floor layout

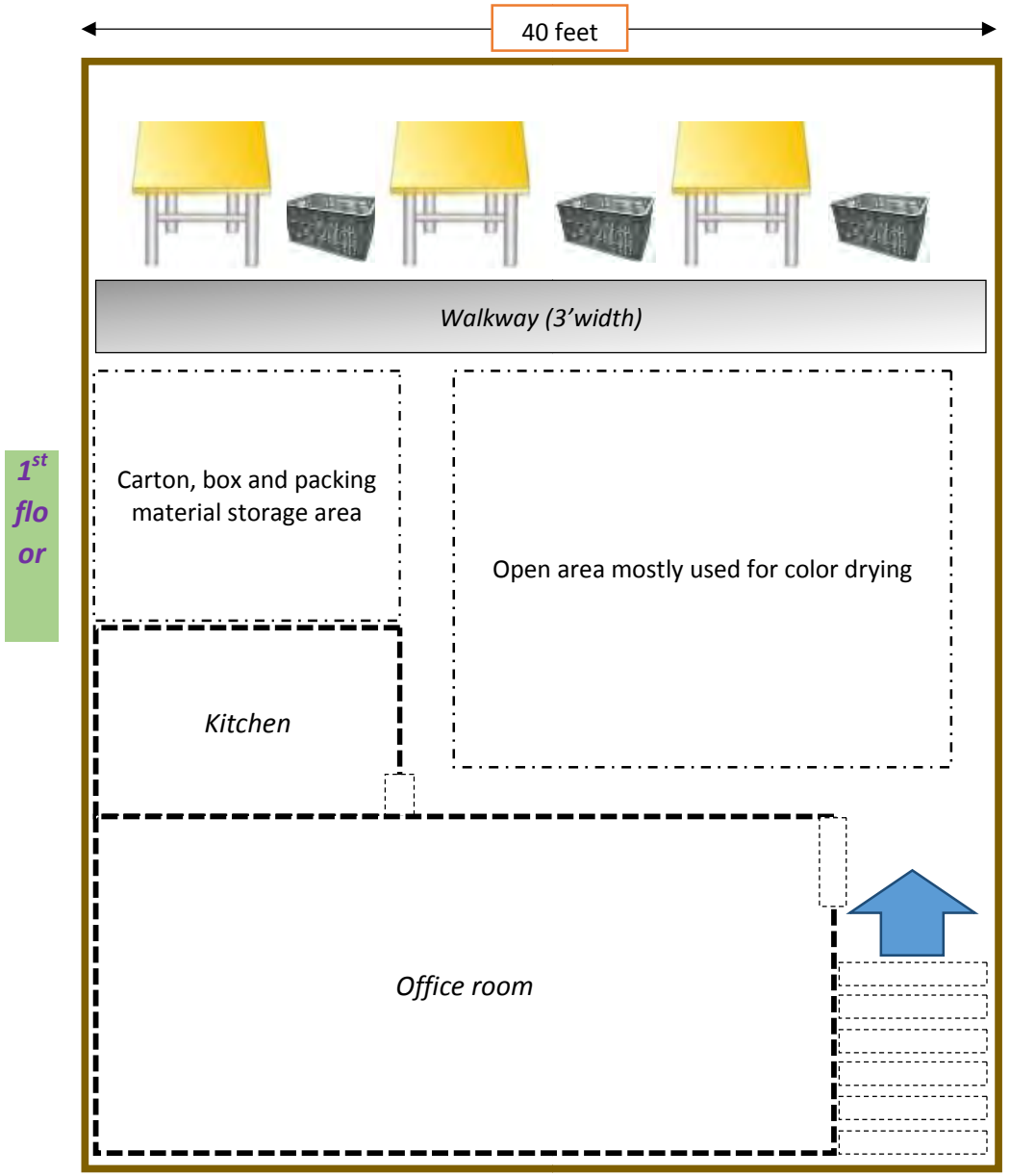

Figure 5.1 (b): First floor layout

5.5 Sewing Sequence and Layout for article no.: V-5

Table 5.1: Operation sequences for Article no. V-5

Body leather: gluing and joining	Hw
Body leather: Sewing at corner	Mw
Body leather: Gluing at corner, folding and hammering	Hw
Body leather: Gluing and attaching reinforcement at punch back side	Hw
Handle base: gluing and joining	Hw
Handle base: net cutting	Mw
Handle base: gluing, make loop and insert d-ring	Hw
Handle base and body leather: gluing and setting	Hw
Handle base and body leather: sewing handle base with body leather	Mw
Inside cc pocket: gluing lining and leather parts, then setting	Hw
inside cc pocket: gluing & folding at top of each cc	Hw
Inside cc pocket: sewing each cc	Mw
Inside cc pocket: adhesive tape apply and setting cc top with cc-1,2,3	Hw
Inside cc pocket: sewing cc top with cc-1, 2, 3	Mw
Inside cc pocket: gluing cc penal and setting, then net cutting	Hw
Inside cc pocket: apply masking tape at middle	Hw
Inside cc pocket: sewing cc at middle	Mw
Inside cc pocket: thread burning	Hw
Inside cc pocket: marking lining to join cc pocket	Hw
Inside cc pocket: sewing cc pocket with lining	Mw
Puller for top opening: gluing and folding	Hw
Puller for top opening: sewing all around	Mw
Puller for top opening: lock hole metal joining	Hw
Puller for top opening: insert puller o-ring	Hw

Inside zip pocket: marking and cut pocket lip	Hw
Inside zip pocket: gluing non-woven and setting on lip area	Hw
Inside zip pocket: gluing and fold lip for opening	Hw
Inside zip pocket: cut zipper length and insert runner	Hw
Inside zip pocket: gluing zipper and lining, then zipper setting	Hw
Inside zip pocket inside: gluing zipper back side and pocket lining, then setting	Hw
Inside zip pocket inside: sewing all around	Mw
Inside zip pocket inside: sewing left & right to close pocket	Mw
Top opening: cut zipper length and insert runner	Hw
Top opening: gluing leather stopper and zipper edges, then setting stopper	Hw
Top opening: sewing leather stoppers	Mw
Top opening: gluing body part opening and zipper, then setting	Hw
Top opening: gluing inside lining at opening and zipper other side, then joining	Hw
Top opening: sewing at opening	Mw
Lining bag: sewing all three sides	Mw
Leather bag: setting flesh sides leather face to face	Hw
Leather bag: sewing all three sides to complete bag	Mw
Insert puller at top opening zipper	Hw
Thread burning	Hw
Long handle: sewing by guide	Mw
Long handle: gluing both ends and insert buckles, adjustor, dog hook	Hw
Long handle: sewing both ends	Mw
Cleaning and finishing work (at 1st floor)	Hw
Final QC	Hw
Labeling, tissue, silica gel, poly packaging	Hw
Carton packaging and labeling	Hw
Sending to finished goods storage area (at ground floor)	

Highlighted cells: starting operation

Figure 5.2: Front and Back view of Article no. V-5

Above sequences are carried throughout the fix layout based on batch production system as drawn in Table: 5.1. This causes excessive unnecessary waiting time and transportation within the production floor. There is no uniformity of work flow. Some workers found overloaded and at the same time some are found very relaxed. This situation decreases productivity and increases material handling cost. Therefore, these causes shipment delay, lower quality, less labor productivity, more waiting times. To overcome these problems there is a need to identify the key areas, which are producing time wastages and to identify bottleneck operations. This can be improved by implementing flow oriented working process through line balancing. It is observed that line balancing enhances efficiency and productivity. . It is the arrangement of all tasks throughout the production line in such form which flows easily and creates a systematic production sequences from one workstation to the next workstation. So there is no delay in any workstation.

5.6 Time Study for the selected articles

The important factor of the line balancing is the value of task times. As because tasks are operated manually by hand work, the variations of the task times are also varies based on skills and motivations of the workers. Among the different work measurement techniques stopwatch study or time study is the most popular. Time study is working measurement technique consisting time measurement of worker that doing jobs in normal pace [35].Breakdown of the operation was done before starting the time study. Manual and machine work elements are kept separated and relatively small considering that task time for any single operation should not be less than 3 second. Time study has been done with smart phone handset digital stopwatch by visiting sewing section and other sections several times and 10 cycle times for each operation have been recorded. This type digital stopwatch records time with one decimal digit. Times are recorded with continuous timing measurement system. Stopwatch was never reset and paused during time study for a single operation. Each cycle time is recorded by clicking “Lap” button in this stopwatch. The cycle time for each operation was measured from the start picking part until it has been putting on the table by performing work. Recorded operations are performed by the assigned worker and operator who usually perform the similar operation for all styles. Operators and workers are observed average in their skill and effort. Average cycle time has been calculated after the recorded 10 cycle times from which total cycle time was calculated [36].

$$\text{Average Observed Time} = \frac{\text{Sum of the time recorded to perform each element}}{\text{Number of cycles observed}} \quad \text{..... (viii)}$$

Observed time is not the actual time required to accomplish the work for operator. It is normalized using the performance rating factor. Performance rating is an evaluation method that considers the effectiveness operator doing work. Then it will be applied to obtain the normal time. The performance rating of the worker is important because it helps to quantify the worker during the operation [35].

There are four types of rating methods such as-

1. Speed rating
2. Westinghouse system
3. Synthetic rating
4. Objective rating

Among them Westinghouse system is most popular used in assembly line operation process. This rating system describes four factors for rating performance. These are-

i. **Skill:** The proficiency of following a pre-determined appropriate method
ii. **Effort:** Demonstration of the willingness to work effectively and efficiently
iii. **Conditions:** Work place condition includes temperature, ventilation, light, noise
iv. **Consistency:** Evaluation of reliability, stability, uniformity in performance

In Westinghouse rating system, there are six classes of each factor as shown in Table 5.2

Table 5.2: Westinghouse performance rating system

Skill	Effort	Conditions	Consistency
Super A1 = + 0.15 A2 = + 0.13	Excessive A1 = + 0.13 A2 = + 0.12	Ideal A = + 0.06	Perfect A = + 0.04
Excellent B1 = + 0.11 B2 = + 0.08	Excellent B1 = + 0.10 B2 = + 0.08	Excellent B = + 0.04	Excellent B = + 0.03
Good C1 = + 0.06 C2 = + 0.03	Good C1 = + 0.05 C2 = + 0.02	Good C = + 0.00	Good C = + 0.00
Average D = 0.00	Average D = 0.00	Average D = 0.00	Average D = 0.00
Fair E1 = – 0.05 E2 = – 0.10	Fair E1 = – 0.04 E2 = – 0.08	Fair E = – 0.03	Fair E = – 0.02
Poor F1 = – 0.16 F2 = – 0.22	Poor F1 = – 0.12 F2 = – 0.17	Poor F = – 0.07	Poor F = – 0.04

Based on observation and evaluation of operators and workers according to the Westinghouse table, performance rating at sewing section is:

Good skill, C2	=	+0.03
Average effort, D	=	0.00
Fair conditions, E	=	-0.03
Good consistency, C	=	+0.00
Total	=	**0.00**
	=	that is 100%

Normal Time = Average Observed Time x Rating factor

Standard time is calculated by adding allowance with normal time. There are few types of allowance, such as personal allowance, fatigue allowance, delay allowance, environmental aspects etc. Allowances of operators and workers can be determined based on the chart recommended by International Labor Organization (ILO). ILO standard is classified into two categories, these are- constant and variable allowances. Table 5.3represents the ILO recommended allowances.

Table 5.3: ILO recommended allowances chart

		Allowance (%)	
A.	**Constant allowances:**	Men	Women
	1. Personal allowance	5	7
	2. Basic fatigue allowance	4	4
B.	**Variable allowances:**		
	1. Standing allowance	2	4
	2. Abnormal position allowance:		
	a. Slightly awkward	0	1
	b. Awkward (bending)	2	3
	c. Very awkward (lying, stretching)	7	7
	3. Use of force, or muscular energy (lifting, pulling, or pushing):		
	Weight lifted, (in Kg):		
	2.5	0	1
	5	1	2
	10	3	4
	12.5	4	6
	15	6	9
	20	10	15
	25	14	
	30	19	
	40	33	
	50	58	
	4. Bad light:		
	a. Slightly below recommended	0	0
	b. Well below	2	2
	c. Quite inadequate	5	5
	5. Atmospheric conditions (heat and humidity):		
	a. Well ventilated, or fresh air	0	0
	b. Badly ventilated, but no toxic fumes or gases	5	5
	c. Work close to furnaces severe, heat etc.	5-15	
	6. Close attention:		
	a. Fairly fine work	0	0
	b. Fine or exacting	2	2
	c. Very fine or very exacting	5	5
	7. Noise level:		
	a. Continuous	0	0
	b. Intermittent - loud	2	2
	c. Intermittent - very loud	5	5
	d. High-pitched - loud	5	5
	8. Mental stresses:		
	a. Fairly complex process	1	1
	b. Complex or wide span of attention	4	4
	c. Very complex	8	8
	9. Monotony (mental):		
	a. Low	0	0
	b. Medium	1	1
	c. High	4	4
	10. Monotony (physical):		
	a. Rather tedious	0	0
	b. Tedious	2	1
	c. Very tedious	5	2

Allowances can be applied to three of the studied time such as (i) Total cycle time, (ii) Machine time only, (iii) Manual effort only. And there are two methods for developing allowances such as (i) Direct observation, (ii) Work sampling.

Based on the direct observation of operators and workers according to ILO recommended allowances, allowances of worker at assembly line was:

Table 5.4: Calculation of Allowance time both for Men and Women

Variable	Men	Women
Personal allowance	5	7
Basic fatigue allowance	4	4
Abnormal position allowance	2	3
Bad light	0	0
Atmospheric conditions	0	0
Close attention	2	2
Noise level	0	0
Mental stresses	1	1
Monotony (mental)	1	1
Monotony (physical)	5	2
Total allowance (%) =	**20**	**20**

Standard Time = Normal Time x (1 + Allowance) ……. (ix)

The Standard Minute Value (SMV) for the Article no. V-5 has been found by the time study is 3040.8 second **(Appendix A)**. And for the Article no. V-6 is 6364.1 second **(Appendix B)**.

5.7 Daily Production Record for Article no. V-5

Factory does not have any existing formal sheet or chart to collect daily production report. So they did not record any production data. A production record sheet is specially developed to record daily production quantity. Actual daily production data used to record at the end on the day for the selected article. Hourly production quantity was also recorded in a big marker board so that everybody in production line can easily observe the up-to-date output status. Order quantity of the selected article is 3600 pieces. There is no particular planning department to plan production schedule and production department has no set daily production target. Production Manager and Merchandiser only calculate the required day for the order quantity based on previous experience about productivity. They used to set a target productivity per table based on this previous experience and plan the production schedule

accordingly. As per the management previous experience, the productivity was agreed by 18 pieces per table per day. 10 tables are available to run the production. So, daily production quantity was expected total 180 pieces. Primarily 8 working hours was considered in day. Thus, total 20 working days was scheduled for 3600 pieces order quantity. The production was started from the date 3rdMarch of 2018. Manufacturing process of a leather goods involves many sequential steps which are mainly performed either manually or machine assisted assembling work. Different parts are assembled in a sequence to make the complete product as demonstrated in Table 5.1. The daily production report in Table 5.5 shows very little output for the first 5 working days which means very low productivity during those days though all workers worked for 8 hours daily. As mentioned earlier, the followed manufacturing process is not continuous flow oriented rather it is a step by step processes with no fixed batch quantity. In the existing production floor layout, though manufacturing steps are sequential but assigned workstations are not generally placed in a sequence. The existing layout is fixed where similar types of work for all styles have been performed in the same workstation though different styles have different manufacturing sequences. Usually according to the existing manufacturing process, all workers and operators worked for some earliest steps including pre-assembling processes. Consequently, latest assembling steps are performed later on. The projected quantity was reached on 13th day by doing 2 hours overtime. Additional 3 working days were spent with excessive overtime to complete full order quantity.

Table 5.5: Summery of the daily recorded production data for Article no. V-5

Article no.: V-5	Table qty.: 10	*Black- 500*	*Blue- 500*	*Gun-500*
Order no.: UT-300	Productivity/table/8hrs: 18	*Red- 500*	*Orange- 500*	
	Daily target: 180 pcs	*Ivory- 500*	*Green- 600*	**Total= 3600**

Sl.	Date	Working hour	Direct Manpower	Actual Output	Remark
1	03.03.2018	8	40	3	
2	04.03. 2018	8	40	10	
3	05.03. 2018	8	40	27	
4	06.03. 2018	8	40	40	
5	07.03. 2018	8	40	90	
6	08.03. 2018	8	38	120	
7	10.03. 2018	8	39	120	
8	11.03. 2018	8	40	120	
9	12.03. 2018	8	40	120	
10	13.03. 2018	8	37	120	
11	14.03. 2018	8	40	150	
12	15.03. 2018	10	40	170	
13	18.03. 2018	10	40	180	
14	19.03. 2018	10	40	180	
15	20.03. 2018	10	40	180	
16	21.03. 2018	10	40	180	
17	22.03. 2018	10	40	180	
18	24.03. 2018	12	40	210	
19	25.03. 2018	12	40	240	
20	27.03. 2018	13	40	270	
21	28.03. 2018	13	40	280	
22	29.03. 2018	13	40	280	
23	31.03. 2018	14	40	330	
			Total (piece)=	**3600**	

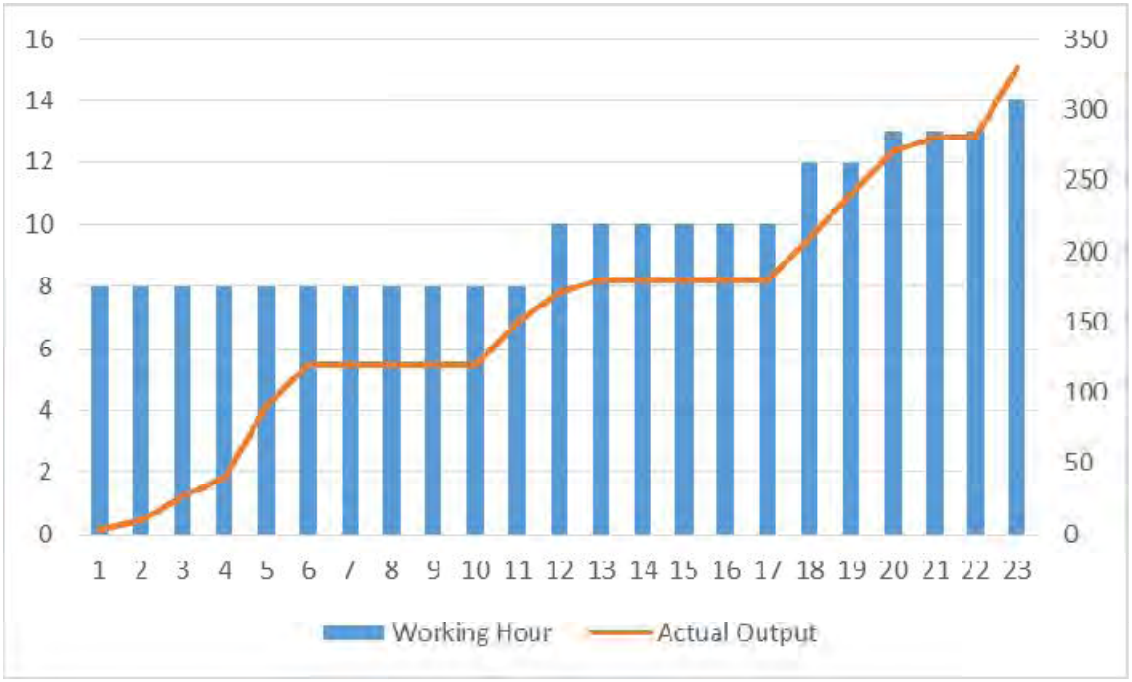

Figure 5.3: Daily working hour Vs Production outputbefore line balancing

5.8 Labor Productivity and Line Efficiency before Line Balancing for Article no. V-5

Total SMV	3040.8	second
No. of assigned manpower	40	person
Productive hour percentage	90	%

$$\text{Labor Productivity} = \frac{\text{Total number of output per day}}{\text{Number of workers worked}}$$

$$\text{Line Efficiencey} = \frac{\text{Total output per day x SMV}}{\text{Total manpower worked x Total productive time per day}}\ x\ 100\%$$

Table 5.6: Daily Productivity and Efficiency report before line balancing

Date	Working hour	Daily manpower	Actual output	Labor productivity	Line Efficiency
03.03.2018	8	40	3	0.08	1%
04.03. 2018	8	40	10	0.25	3%
05.03. 2018	8	40	27	0.68	8%
06.03. 2018	8	40	40	1.00	12%
07.03. 2018	8	40	90	2.25	26%
08.03. 2018	8	38	120	3.16	37%
10.03. 2018	8	39	120	3.08	36%
11.03. 2018	8	40	120	3.00	35%
12.03. 2018	8	40	120	3.00	35%
13.03. 2018	8	37	120	3.24	38%
14.03. 2018	8	40	150	3.75	44%
15.03. 2018	10	40	170	4.25	40%
18.03. 2018	10	40	180	4.50	42%
19.03. 2018	10	40	180	4.50	42%
20.03. 2018	10	40	180	4.50	42%
21.03. 2018	10	40	180	4.50	42%
22.03. 2018	10	40	180	4.50	42%
24.03. 2018	12	40	210	5.25	41%
25.03. 2018	12	40	240	6.00	47%
27.03. 2018	13	40	270	6.75	49%
28.03. 2018	13	40	280	7.00	51%
29.03. 2018	13	40	280	7.00	51%
31.03. 2018	14	40	330	8.25	55%
Average=	**9.78**	**39.74**	**156.52**	**3.93**	**36%**

The currently average labor productivity is 3.93 pieces

The currently average sewing section efficiency is 36%

5.9 Yamazumi chart line balancing implementation for Article no. V-5

Line balancing is concerned with the operations and workloads within a production line. It is commonly used to assigning tasks to workstations in a sequential way to production system by flattening workload across all workstations [40]. As a result, excessive workloads and idle time can be minimized. Yamazumi chart is the most popular line balancing tools used in manufacturing operation. This chart is used to create an image of the structure of the work done by an operator or by a team for the single task. The chart helps in re-balance work content to achieve the lead time. In order to achieve it, the work at each station should re-balance to make all process under or at calculated takt time. In the leather products manufacturing, majority of operations are done manually under sewing section. The implementation of Yamazumi chart line balancing in sewing processes is to assigning tasks to the workstations so that each workstation can perform with a balanced loading. Area of the current layout was determined and re-arrangement of working table, machines, worker sitting positions has been done to draw an improved layout. Considering working distance, types of machine and efficiency, workers who have extra time to work after completing their works, have been shared or re-allocate their work to complete the bottleneck processes. The number of minimum workstations and the manpower configuration is required to calculate to prepare Yamazumi Chart for line balancing **(Appendix D)**.

Following information are considered related to the production line for using in line balancing data calculation: Working shift per day= 1, Working hours per shift= 8 hours, Available time per day= 480 minutes, Working time allowance= 10%, so, Total workable time per day= 480x90%= 432 minutes, Lunch break= 60 minutes (1:00pm to 2:00pm).

Daily production target has been set 75% achievable based on calculated possible production quantity per day. This 75% is a visual estimation that has been set based on the observation observed during data collection from production line.

5.9.1 Data calculation for line balancing of Article no. V-5

$$\text{Possible Production qty. per day} = \frac{\text{Total no.of manpower x Total workable time}}{\text{Total SMV}} x100\%$$

$$= \frac{\text{(39 nos.) x (8*3600*0.90 sec)}}{\text{3040.80 sec}} x100\%$$

= 332.44 pieces

$$\text{Takt time} = \frac{\text{Production time available per day}}{\text{Target units per day}}$$

= 8 hrs x 3600 sec / 332.44 pcs

= 86.63 second

$$\text{Minimum no. of Workstations} = \frac{\text{Total SMV}}{\text{Takt Time}}$$

= 3040.80 sec / 86.63 sec

= 35.10

= 36 nos. *(Rounding up)*

$$\text{Required Manpower for single task} = \frac{\text{Single task Time x Total manpower}}{\text{Total SMV}}$$

$$\text{Line Balancing Efficiency} = \frac{\text{Total SMV}}{\text{Highest Task time x Total no. of Work stations}} x\ 100$$

= 3040.80 sec / (116.4 sec x36 nos.) x 100

= 72.57%

Achievable daily production target = Possible Production qty. per day x Estimated %

= 332.44 x 75%

= 249.33

= 250 pcs *(Rounding up)*

Table 5.7: Time study after Line Balancing

Station	Observed time (sec)	Manpower config	Assigned manpower	Station lead time	Balance time (sec)
1	47.6	0.61	1	47.60	77.84
2	95.2	1.22	1	95.20	77.84
3	82.4	1.06	1	82.40	77.84
4	44.0	0.56	1	44.00	77.84
5	91.6	1.17	1	91.60	77.84
6	64.8	0.83	1	64.80	77.84
7	100.4	1.29	1	100.40	77.84
8	116.4	1.49	1	116.40	77.84
9	106.4	1.36	1	106.40	77.84
10	104.8	1.34	1	104.80	77.84
11	102.4	1.31	1	102.40	77.84
12	68.0	0.87	1	68.00	77.84
13	98.0	1.26	1	98.00	77.84
14	96.8	1.24	1	96.80	77.84
15	34.0	0.44	1	34.00	77.84
16	87.6	1.12	1	87.60	77.84
17	27.6	0.35	1	27.60	77.84
18	95.6	1.23	1	95.60	77.84
19	44.8	0.57	1	44.80	77.84
20	70.4	0.90	1	70.40	77.84
21	103.2	1.32	1	103.20	77.84
22	80.8	1.04	1	80.80	77.84
23	88.0	1.13	1	88.00	77.84
24	81.2	1.04	1	81.20	77.84
25	57.6	0.74	1	57.60	77.84
26	76.4	0.98	1	76.40	77.84
27	69.2	0.89	1	69.20	77.84
28	62.4	0.80	1	62.40	77.84
29	53.6	0.69	1	53.60	77.84
30	73.2	0.94	1	73.20	77.84
31	83.2	1.07	1	83.20	77.84
32	73.2	0.94	1	73.20	77.84
33	86.4	1.11	1	86.40	77.84
34	146.8	1.88	2	73.40	77.84
35	248.0	3.18	3	82.67	77.84
36	78.8	1.01	1	78.80	77.84
Total=	**3040.8**		**39**		

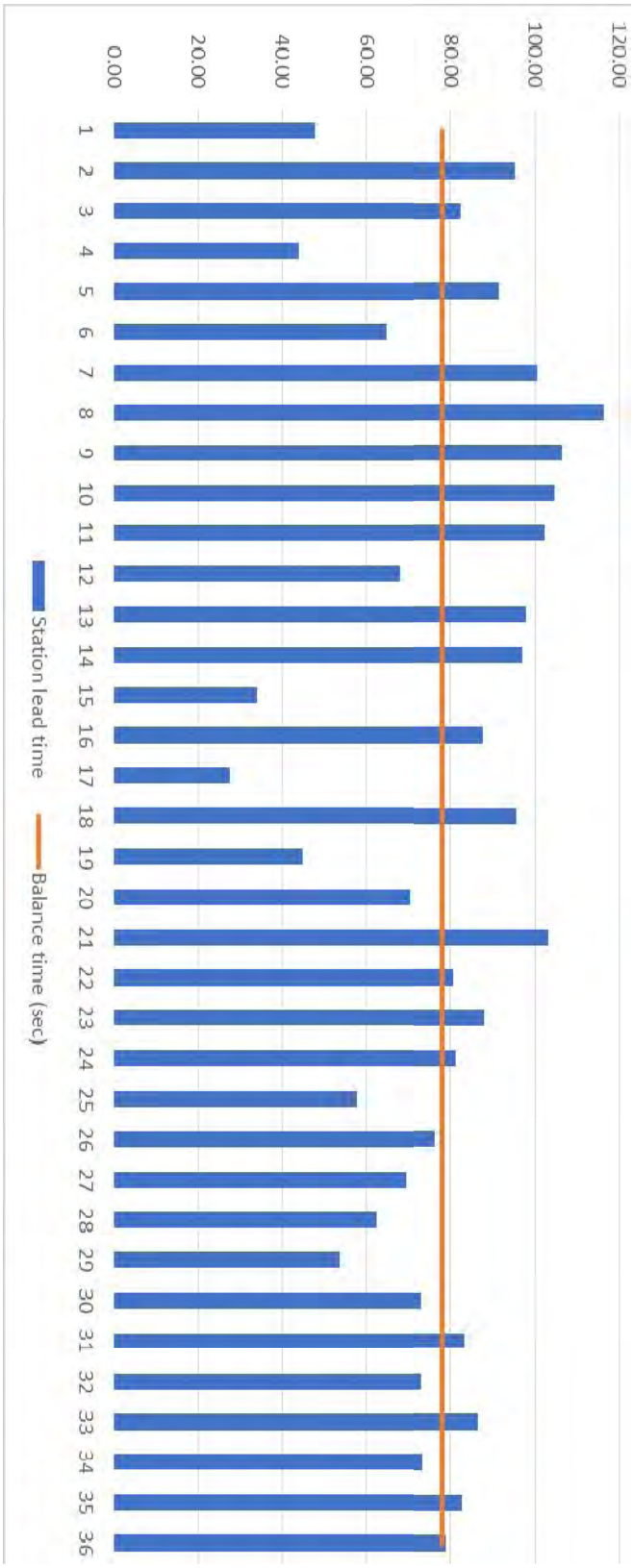

Figure 5.4: Balance time after Line Balancing

Number of workstation is determined and arrangement of tasks among those workstations is done using calculated data based on Yamazumi chart. The calculation using the number of workstation formula will be useful in determining the number of minimum stations needed for the least number of operator used in manpower plan which is 39 workers & operators used in total. Manpower configuration starts from the arrangement of the workstations and that's why this step is very important. Single or several tasks are arranged based on cumulative task time in such way so that the sequence of work can be established. It is best in arranging the work station that the total time of any workstation is more than the Takt time. But if the time of a single task is over than the takt time then assign that single task to a single work station. Next, assign number of operators according to the calculation (Table 5.7)to each station.

The bottlenecks & capacity variations between the workers were clearly visible from line capacity and the task allocation among workstations. After that a change in layout and operation breakdown was done for effective flow of production operation. Assembling aid tools and assistant is developed such as- sewing guide, board made ruler, working pattern and arrange short training for trial for the bottleneck tasks for worker to increase labor capacity and their productivity. By this way a more balanced & efficient line was found with higher productivity. Figure 5.6 shows the modified trial layout which has been developed based on line balancing. Firstly this layout is implemented by keeping working table and machine position unchanged. The sequence of work is observed from this trial layout and further modification is done if observed. Then the proposed final layout is developed and implanted throughout the production process. Figure 5.7 represents the final proposed layout for the production of selected article. In the final layout, tasks has been distributed intending to the equally workload among workstations which make the higher line efficiency and the target output can be achieved without having overtime[37].Work stations 1 to 5 are containing pre-assembling tasks. These pre-assembling tasks are started at least one day before the assembling production starts to ensure adequate supply of required pre-assembled parts to make the complete product through flow oriented production system. Figure 5.4 is showing that here the calculated balance ratio is 72.57%.

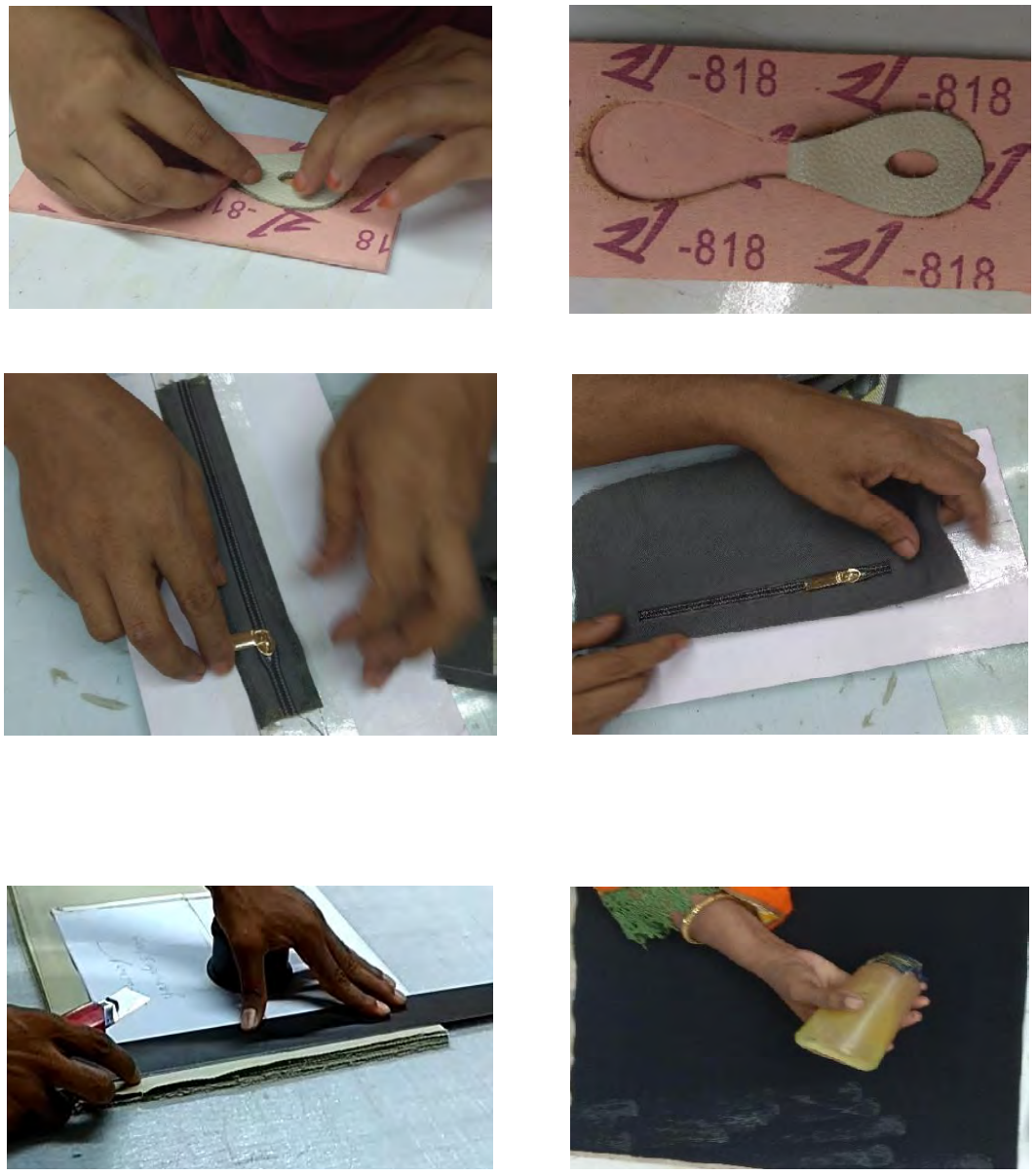

Figure 5.5: Use of specially developed work assisting techniques

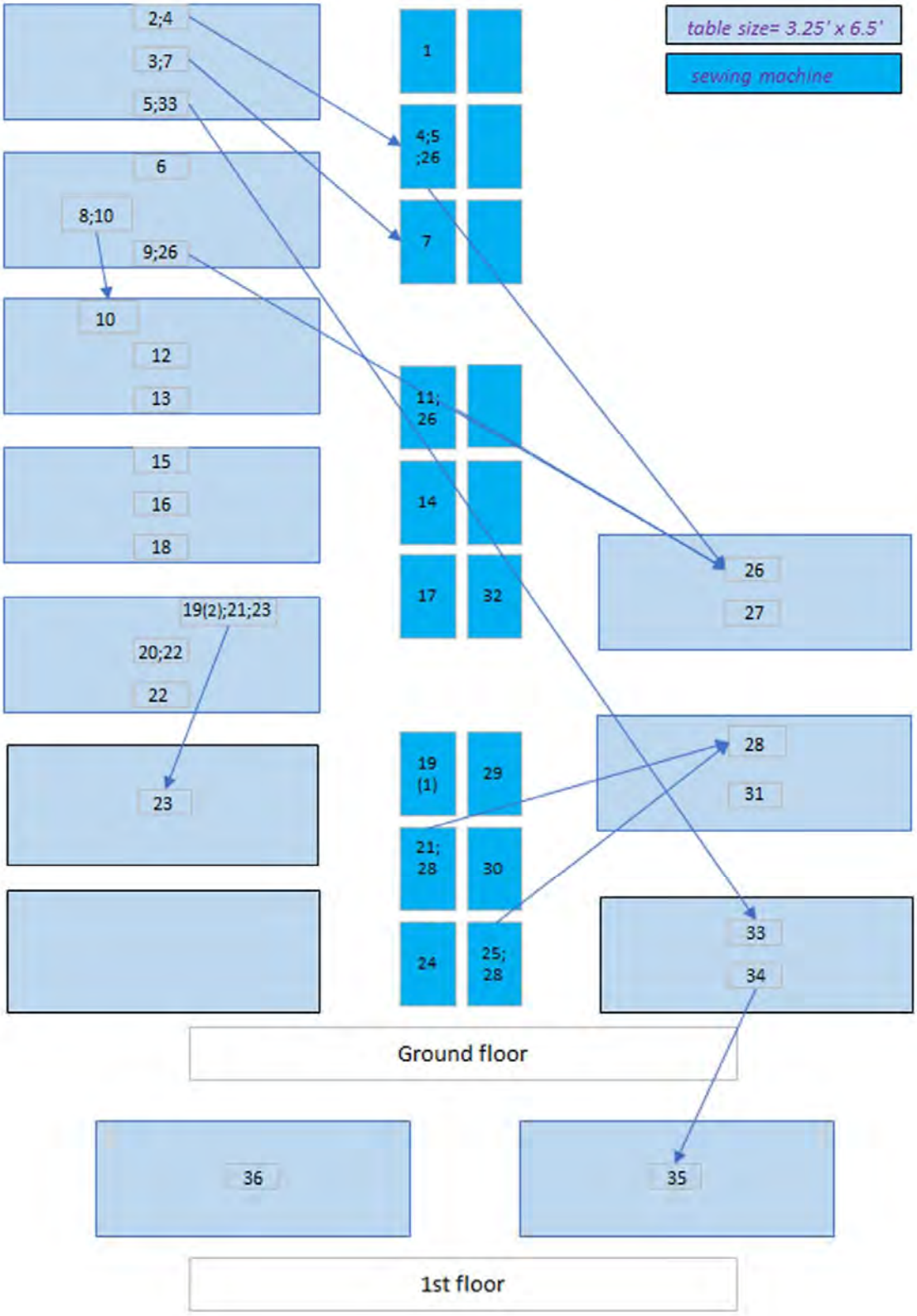

Figure 5.6: Trial proposed layout for workstations after Line Balance (Article no.: V-5)

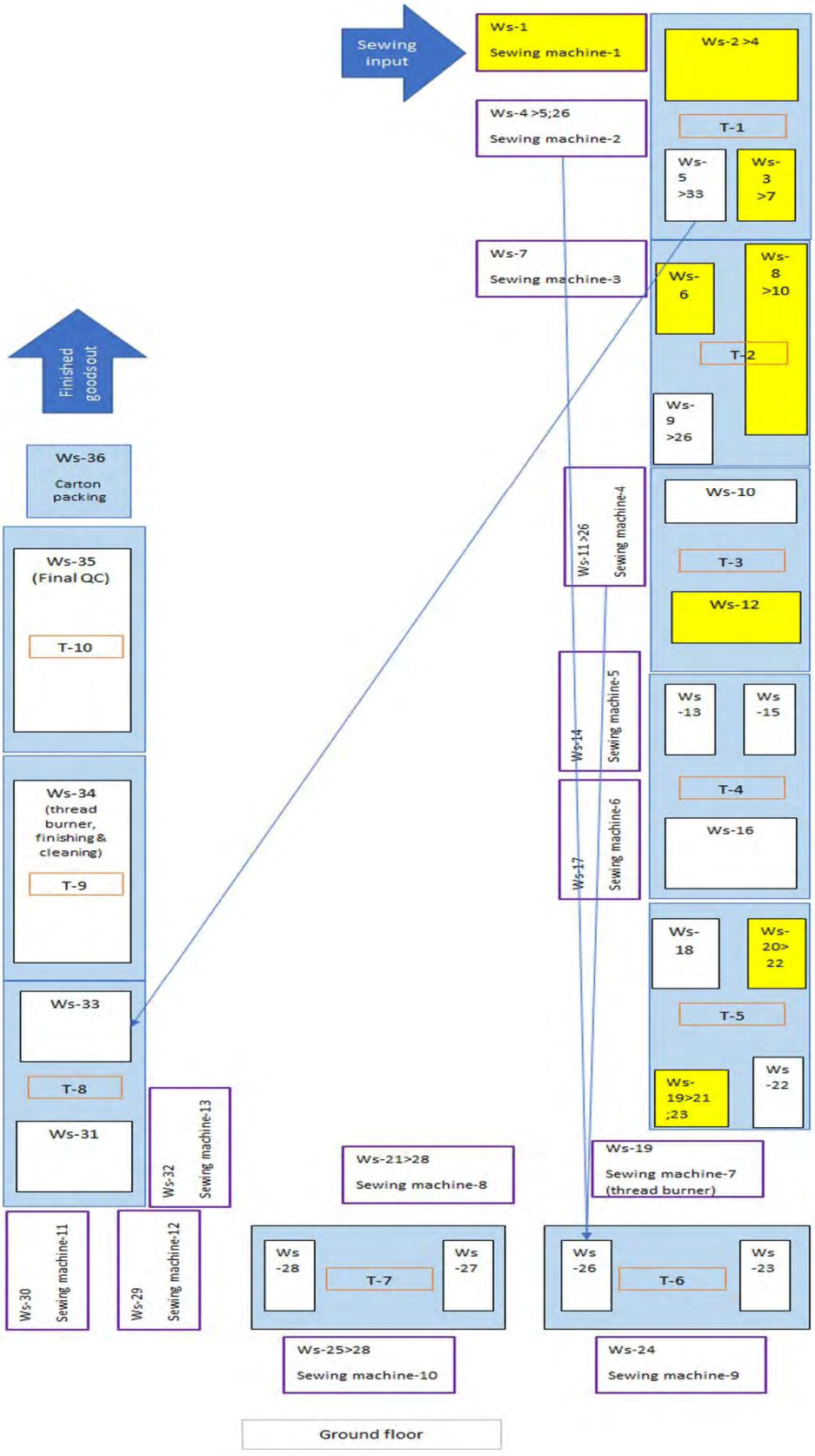

Figure 5.7: Proposed final layout (Article no.: V-5)

5.10 Production Record after Line Balancing for Article no. V-5

Table 5.8: Production record after line balancing

Article no.: V-5	Achievable daily production target = 250 pcs	*Black- 700*	*Blue- 550*	*Gun-400*
Order no.: UT-500-2		*Red- 700*	*Orange- 500*	
Daily target manpower: 39		*Ivory- 700*	*Green- 500*	**Total=4050**

Sl.	Date	Working hour	Direct Manpower	Daily Target	Output	Remark
1	26.05.2018	8	39	250	160	
2	27.05.2018	8	39	250	200	
3	28.05.2018	8	39	250	250	
4	29.05.2018	8	39	250	250	
5	30.05.2018	8	39	250	250	
6	31.05.2018	8	39	250	250	
7	01.06.2018	8	39	250	250	
8	02.06.2018	8	39	250	250	
9	03.06.2018	8	39	250	250	
10	04.06.2018	8	39	250	250	
11	05.06.2018	8	39	250	250	
12	06.06.2018	8	39	250	250	
13	07.06.2018	8	39	250	250	
14	09.06.2018	8	39	250	250	
15	10.06.2018	9	39	250	270	
16	12.06.2018	9	39	250	270	
17	13.06.2018	5	39	250	150	
			Total (piece)=		**4050**	

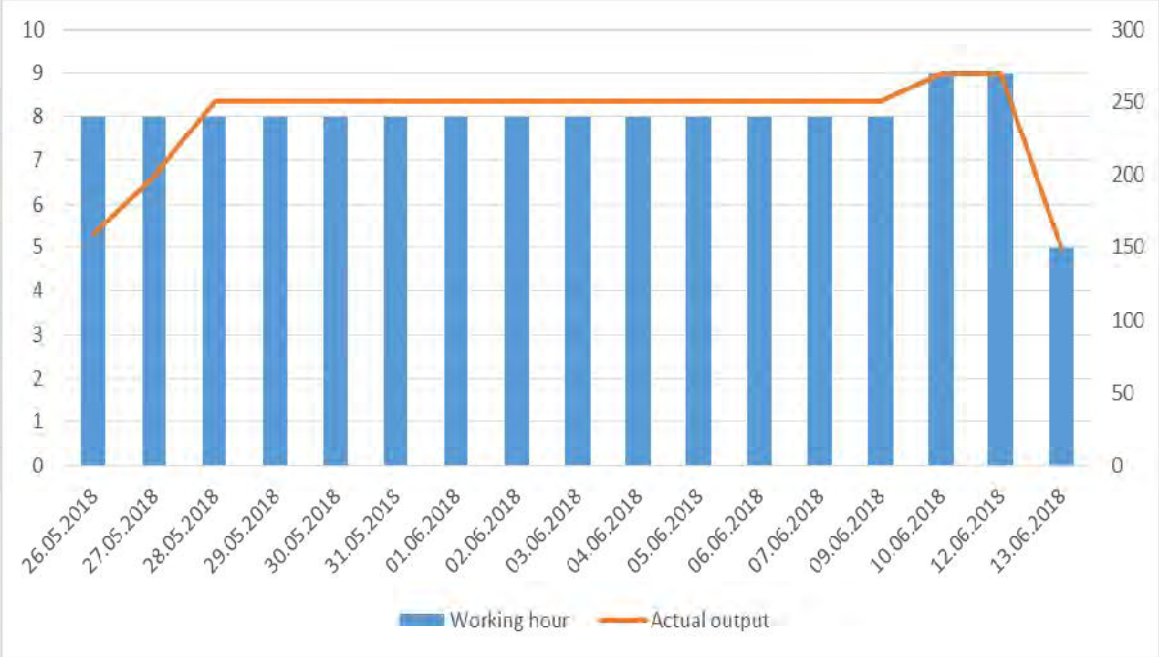

Figure 5.8: Daily working hour Vs Production output after line balancing

5.11 Labor Productivity and Line Efficiency after Line Balancing for Article no. V-5

Total SMV	3040.8	second
No. of assigned manpower	39	person
Productive hour percentage	90	%

$$\text{Labor Productivity} = \frac{\text{Total number of output per day}}{\text{Number of workers worked}}$$

$$\text{Line Efficiencey} = \frac{\text{Total output per day x SMV}}{\text{Total manpower worked x Total productive time per day}}\ x\ 100\%$$

Table 5.9: Daily Productivity and Efficiency report after line balancing

Date	Working hour	Manpower	Actual output	Labor productivity	Line Efficiency
26.05.2018	8	39	160	4.10	48%
27.05.2018	8	39	200	5.13	60%
28.05.2018	8	39	250	6.41	75%
29.05.2018	8	39	250	6.41	75%
30.05.2018	8	39	250	6.41	75%
31.05.2018	8	39	250	6.41	75%
01.06.2018	8	39	250	6.41	75%
02.06.2018	8	39	250	6.41	75%
03.06.2018	8	39	250	6.41	75%
04.06.2018	8	39	250	6.41	75%
05.06.2018	8	39	250	6.41	75%
06.06.2018	8	39	250	6.41	75%
07.06.2018	8	39	250	6.41	75%
09.06.2018	8	39	250	6.41	75%
10.06.2018	9	39	270	6.92	72%
12.06.2018	9	39	270	6.92	72%
13.06.2018	5	39	150	3.85	72%
Average=	**7.94**	**39**	**238.24**	**6.11**	**72%**

The average labor productivity after line balancing is 6.11 pieces

The average sewing section efficiency after line balancing is 72%

The labor productivity increases to 6.11 from 3.93 and the line efficiency increases at 72% from 36% for the Article no. V-5.

5.12 Daily Production Record for Article no. V-6

Order quantity of the article no. V-6 is 3000 pieces. As per the management previous experience, the productivity was agreed by 12 pieces per table per day. 12 tables are available to run the production. So, daily production quantity was expected total 110 pieces. Primarily 8 working hours was considered in day. Thus, total 21 working days was scheduled for 3000 pieces order quantity. The production was started from the date 1st April of 2018. Table 5.10 shows the daily production report. The daily production report shows, complete product has been finished and packed from the seventh day of production started. Total 25 working days were required to produce ordered quantity. In addition, it was also required 2 hours overtime for consecutive last 7 working days.

front side back side

Figure 5.9: Front and Back view of Article no. V-6

Table 5.10: Summery of the daily recorded production data for Article no. V-6

Article no.: V-6	Table qty.: 12	*Black- 500*	*Blue- 500*	*Gun-300*
Order no.: UT-300	Productivity/table/8hrs: 12	*Red- 200*	*Orange- 500*	
	Daily target: 144 pcs	*Ivory- 500*	*Green- 500*	**Total= 3000**

Sl.	**Date**	**Working hour**	**Direct Manpower**	**Actual Output**	**Remark**
1	01.04.2018	8	55	2	
2	02.04.2018	8	55	8	
3	03.04.2018	8	55	10	
4	04.04.2018	8	55	16	
5	05.04.2018	8	55	40	
6	07.04.2018	8	55	50	
7	08.04.2018	8	55	80	
8	09.04.2018	8	55	100	
9	10.04.2018	8	55	120	
10	11.04.2018	8	55	120	
11	12.04.2018	8	55	120	
12	15.04.2018	8	55	120	
13	16.04.2018	8	55	130	
14	17.04.2018	8	55	130	
15	18.04.2018	8	55	130	
16	19.04.2018	8	55	130	
17	21.04.2018	8	55	130	
18	22.04.2018	8	55	140	
19	23.04.2018	9	55	180	
20	24.04.2018	9	55	180	
21	25.04.2018	9	55	180	
22	26.04.2018	10	55	210	
23	28.04.2018	10	55	230	
24	29.04.2018	10	55	230	
25	30.04.2018	10	55	214	
			Total (piece)=	**3000**	

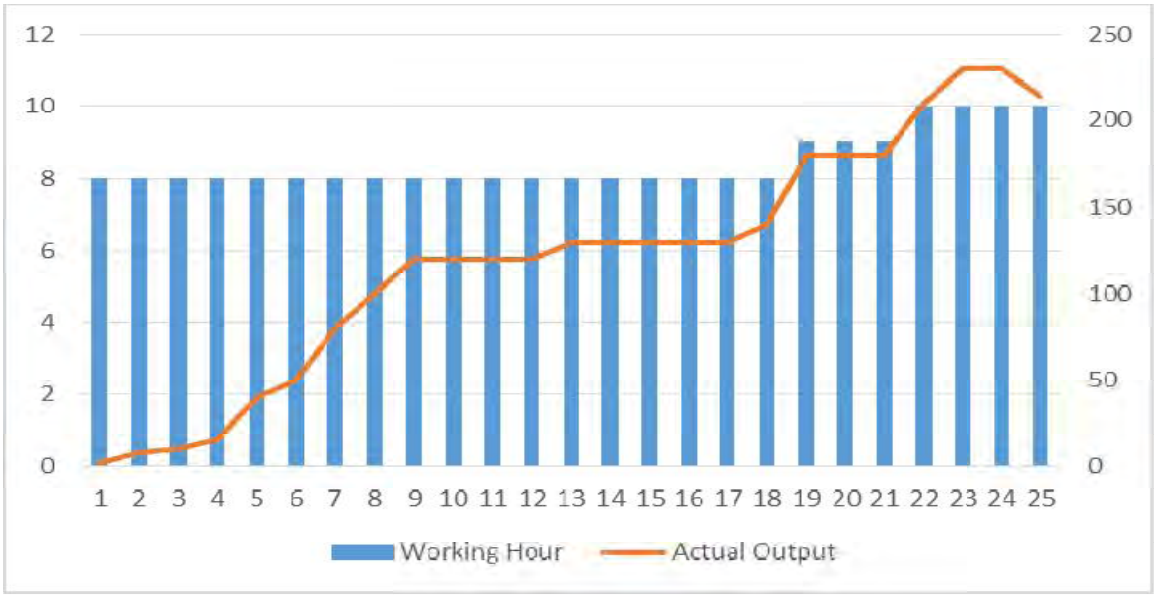

Figure 5.10: Daily working hour Vs Production output before line balancing

5.13 Labor Productivity and Line Efficiency before Line Balancing for Article no. V-6

Total Standard Minute Value (SMV)	6364.1	second
No. of assigned manpower	60	person
Productive hour percentage	90	%

$$\text{Labor Productivity} = \frac{\text{Total number of output per day}}{\text{Number of workers worked}}$$

$$\text{Line Efficiencey} = \frac{\text{Total output per day x SMV}}{\text{Total manpower worked x Total productive time per day}}\ x\ 100\%$$

Table 5.11: Daily Productivity and Efficiency report before line balancing

Date	Working hour	Daily manpower	Actual output	Labor productivity	Line Efficiency
01.04.2018	8	55	2	0.04	1%
02.04.2018	8	55	8	0.15	4%
03.04.2018	8	55	10	0.18	4%
04.04.2018	8	55	16	0.29	7%
05.04.2018	8	55	40	0.73	18%
07.04.2018	8	55	50	0.91	22%
08.04.2018	8	55	80	1.45	36%
09.04.2018	8	55	100	1.82	45%
10.04.2018	8	55	120	2.18	54%
11.04.2018	8	55	120	2.18	54%
12.04.2018	8	55	120	2.18	54%
15.04.2018	8	55	120	2.18	54%
16.04.2018	8	55	130	2.36	58%
17.04.2018	8	55	130	2.36	58%
18.04.2018	8	55	130	2.36	58%
19.04.2018	8	55	130	2.36	58%
21.04.2018	8	55	130	2.36	58%
22.04.2018	8	55	140	2.55	62%
23.04.2018	9	55	180	3.27	71%
24.04.2018	9	55	180	3.27	71%
25.04.2018	9	55	180	3.27	71%
26.04.2018	10	55	210	3.82	75%
28.04.2018	10	55	230	4.18	82%
29.04.2018	10	55	230	4.18	82%
30.04.2018	10	55	214	3.89	76%
Average=	**8.44**	**55**	**120**	**2.18**	**49%**

The currently average labor productivity is 2.18 pieces

The currently average sewing section efficiency is 49%

5.14 Yamazumi chart line balancing implementation for Article no. V-6

Tasks are allocated across the work station for line balancing using Yamazumi Chart. Bottleneck operations are identified and allocated as such the whole process can perform smoothly followed to the flow oriented production system. Workers are re-assigned to the nearby bottleneck operation who have extra time after complete their individual work. An improved layout will be planned through this line balancing chart. All marking with silver color marking pen were eliminated. Working patterns and pin were used substitute the marking work. Cleaning the ink of marking pen and cleaning the over glue are the most time consuming work in during finishing stage. Considering this bottleneck in cleaning and finishing stage, all possible marking work has been eliminated by the use the working pattern and pin. Using of a gluing brush for long time such as 4-7 days causes over gluing which was controlled through using new brush every day. Working techniques of few tasks were improved which reduced the time of the work with the same quality **(Appendix C)**.

The first 15 work stations are for pre-assembling work. There are 49 work stations and total 54 manpower is required for work directly. 1 helper is assigned only to bring particular pre-assembled components from stations 4, 5, 7, 27 to stations 16, 33, 44 and 45. Thus total 55 persons are needed to assign the production line **(Appendix E)**.

Information from the production line for using in line balancing data calculation are remains the same as: Working shift per day= 1, Working hours per shift= 8 hours, Available time per day= 480 minutes, Working time allowance= 10%, so, Total workable time per day= 480x90%= 432 minutes, Lunch break= 60 minutes (1:00pm to 2:00pm).

Calculated possible production quantity per day has been estimated 75% achievable which has been set as daily production target for this article. This is a visual estimation based on the observation observed during data collection from production line.

5.14.1 Data calculation for line balancing of Article no. V-6

$$\text{Possible Production qty. per day} = \frac{\text{Total no. of manpower x Total workable time}}{\text{Total SMV}} \; x \; 100\%$$

$$= \frac{(54 \text{ nos}) \text{ x } (8*3600*0.90 \text{ sec})}{6002.9 \text{ sec}} \; x \; 100\%$$

$$= 233.16 \text{ pieces}$$

$$\text{Takt time} = \frac{\text{Production time available per day}}{\text{Target units per day}}$$

$$= 8 \text{ hrs x } 3600 \text{ sec} / 233.16 \text{ pcs}$$

$$= 123.52 \text{ second}$$

$$\text{Minimum no. of Workstations} = \frac{\text{Total SMV}}{\text{Takt Time}}$$

$$= 6002.9 \text{ sec} / 123.52 \text{ sec}$$

$$= 48.59$$

$$= 49 \text{ nos. } \textit{(Rounding up)}$$

$$\text{Required Manpower for single task} = \frac{\text{Single task Time x Total manpower}}{\text{Total SMV}}$$

$$\text{Line Balancing Efficiency} = \frac{\text{Total SMV}}{\text{Highest Task time x Total no. of Work stations}} \; x \; 100$$

$$= 6002.9 \text{ sec} / (138.8 \text{ sec x } 49 \text{ nos.}) \text{ x } 100$$

$$= 88.26 \%$$

$$\text{Achievable daily production target} = \text{Possible Production qty. per day x Estimated \%}$$

$$= 233.16 \text{ x } 75\%$$

$$= 174.87$$

$$= 175 \text{ pcs } \textit{(Rounding up)}$$

Table 5.12: Time study after Line Balancing

Station	Standard time (sec)	Manpower configuration	Assigned manpower	Station Takt time	Balance time (sec)
1	125.7	1.15	1	125.7	111.59
2	137.1	1.26	1	137.1	111.59
3	122.0	1.12	1	122.0	111.59
4	130.8	1.20	1	130.8	111.59
5	111.5	1.02	1	111.5	111.59
6	128.8	1.18	1	128.8	111.59
7	125.3	1.15	1	125.3	111.59
8	137.6	1.26	1	137.6	111.59
9	116.8	1.07	1	116.8	111.59
10	133.6	1.22	1	133.6	111.59
11	86.4	0.79	1	86.4	111.59
12	91.2	0.84	1	91.2	111.59
13	94.0	0.86	1	94.0	111.59
14	135.6	1.24	1	135.6	111.59
15	68.0	0.62	1	68.0	111.59
16	128.8	1.18	1	128.8	111.59
17	134.0	1.23	1	134.0	111.59
18	88.3	0.81	1	88.3	111.59
19	133.6	1.22	1	133.6	111.59
20	131.7	1.21	1	131.7	111.59
21	143.2	1.31	2	71.6	111.59
22	100.6	0.92	1	100.6	111.59
23	134.4	1.23	1	134.4	111.59
24	135.6	1.24	1	135.6	111.59
25	134.1	1.23	1	134.1	111.59
26	125.5	1.15	1	125.5	111.59
27	100.4	0.92	1	100.4	111.59
28	133.6	1.22	1	133.6	111.59
29	98.8	0.91	1	98.8	111.59
30	138.8	1.27	1	138.8	111.59
31	122.0	1.12	1	122.0	111.59
32	128.4	1.18	1	128.4	111.59
33	116.8	1.07	1	116.8	111.59
34	114.0	1.04	1	114.0	111.59
35	53.6	0.49	1	53.6	111.59
36	96.0	0.88	1	96.0	111.59
37	83.2	0.76	1	83.2	111.59
38	73.2	0.67	1	73.2	111.59
39	50.0	0.46	1	50.0	111.59
40	110.8	1.02	1	110.8	111.59
41	111.2	1.02	1	111.2	111.59
42	122.8	1.13	1	122.8	111.59
43	96.4	0.88	1	96.4	111.59
44	190.8	1.75	2	95.4	111.59
45	388.1	3.56	3	129.4	111.59
46	218.7	2.00	2	109.4	111.59
47	112.2	1.03	1	112.2	111.59
48	130.0	1.19	1	130.0	111.59
49	78.8	0.72	1	78.8	111.59
Total=	**6002.9**		**54**		

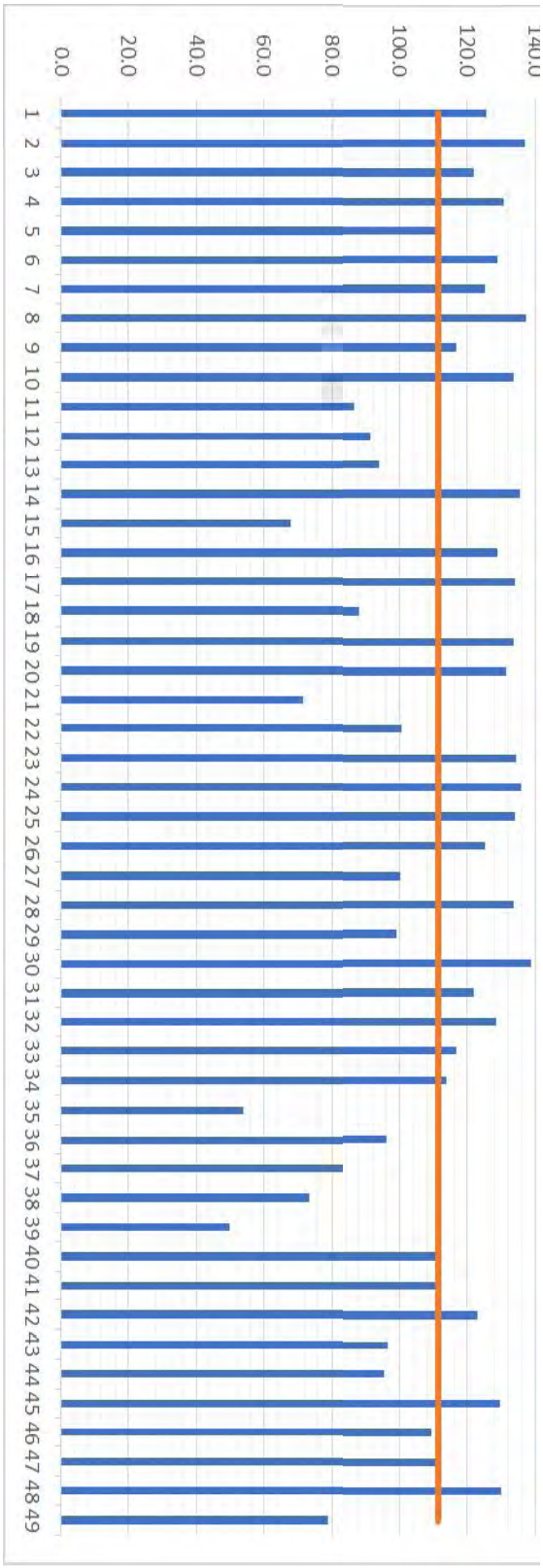

Figure 5.11: Balance time after Line Balancing

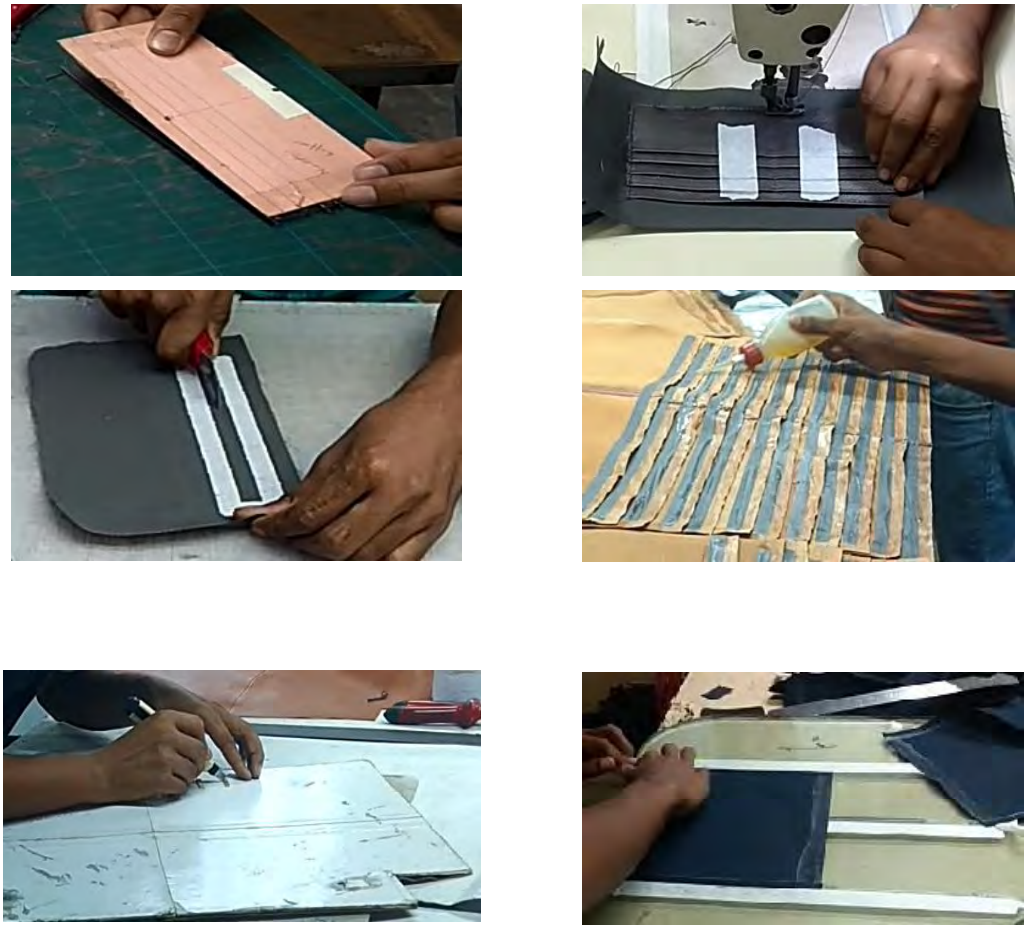

Figure 5.12: Use of specially developed work assisting techniques

Article no. V-6 and V-5 are the continuous order for this company in every month. Production of the V-6 is usually starts after completion of V-5 as always. Pre-assembling works (Work stations 1 to 15) are started at least one day before the assembling production starts to ensure adequate supply of required pre-assembled parts to make the complete product through flow oriented production system. Figure 5.12shows the calculated balance ratio is 88.26%. Figure 5.13 represents the final proposed layout for the production of selected article. Tasks has been sequentially allocated as such way so that the workload is distributed among workstations to ensure higher efficiency and improved work flow with extra expenses like overtime.

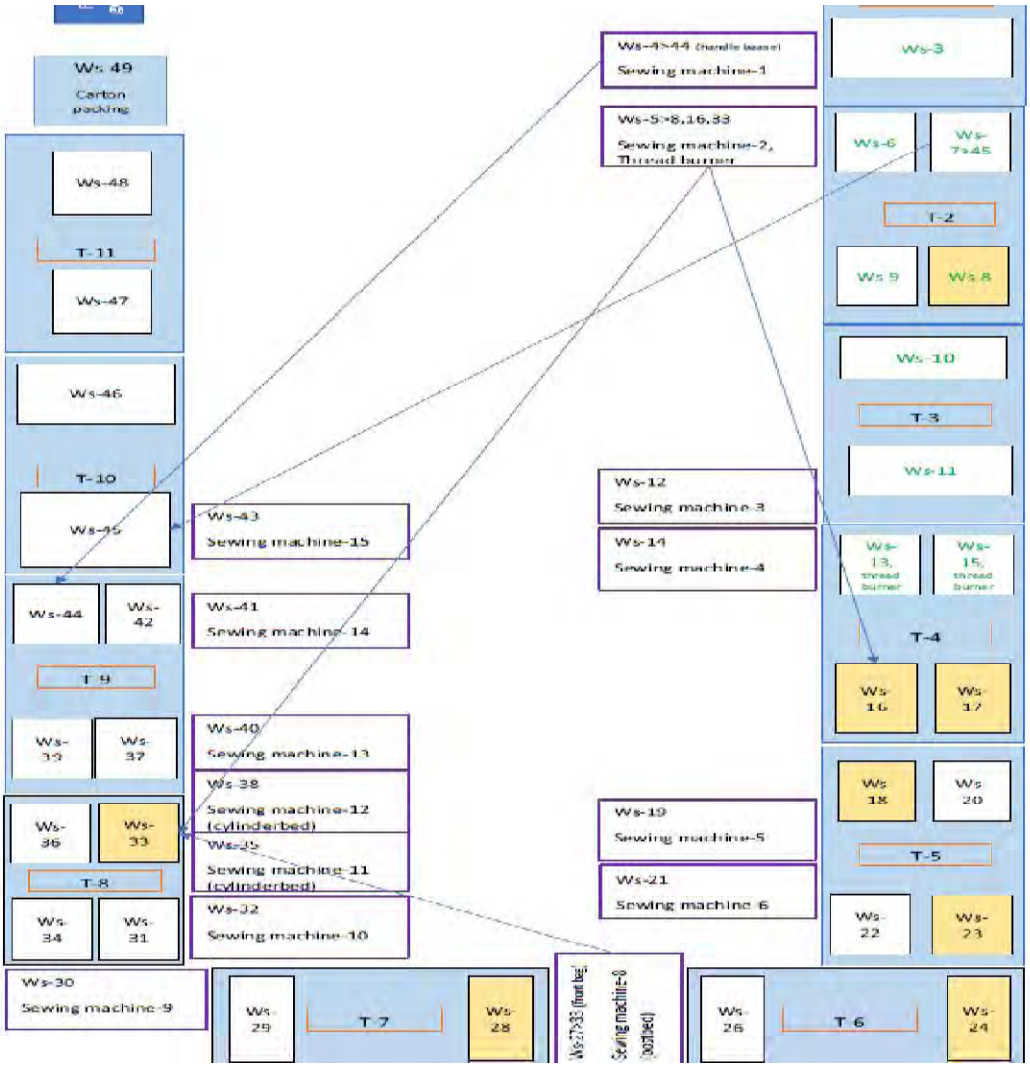

Figure 5.13: Proposed improved layout (article no.: V-6)

The table size is 6.5'x3.5' each. There are 11 tables for the production. Yellow highlighted represents those work stations where the operation starts. Green highlighted texted work stations are the pre-assembling work stations. 1 to 15 are the pre-assembling work stations. There are 15 sewing machine has been required. The helper person who is assigned only to bring pre-assembled parts to another work stations needs to travel approximate 56 meter for each unit of the production.

5.15 Production Record after Line Balancing for Article no. V-6

Table 5.13: Production record after line balancing

Article no.: V-6	Achievable daily production target = 175 pcs	*Black- 700*	*Green- 700*	
Order no.: UT-500-2		*Red- 700*	*Blue- 600*	
Daily target manpower: 55		*Ivory- 700*	*Orange- 600*	**Total= 4000**

Sl.	Date	Working hour	Direct Manpower	Daily Target	Actual Output	Remark
1	23.06.2018	8	55	175	150	
2	24.06.2018	8	55	175	150	
3	25.06.2018	8	55	175	175	
4	26.06.2018	8	55	175	175	
5	27.06.2018	8	55	175	175	
6	28.06.2018	8	55	175	175	
7	30.06.2018	8	55	175	175	
8	01.07.2018	8	55	175	175	
9	02.07.2018	8	55	175	175	
10	03.07.2018	8	55	175	175	
11	04.07.2018	8	55	175	175	
12	05.07.2018	8	55	175	175	
13	07.07.2018	8	55	175	175	
14	08.07.2018	8	55	175	175	
15	09.07.2018	8	55	175	175	
16	10.07.2018	8	55	175	175	
17	11.07.2018	8	55	175	175	
18	12.07.2018	8	55	175	175	
19	13.07.2018	8	55	175	175	
20	14.07.2018	8	55	175	175	
21	15.07.2018	8	55	175	175	
22	16.07.2018	8	55	175	175	
23	17.07.2018	10	55	175	200	
				Total (piece)=	**4000**	

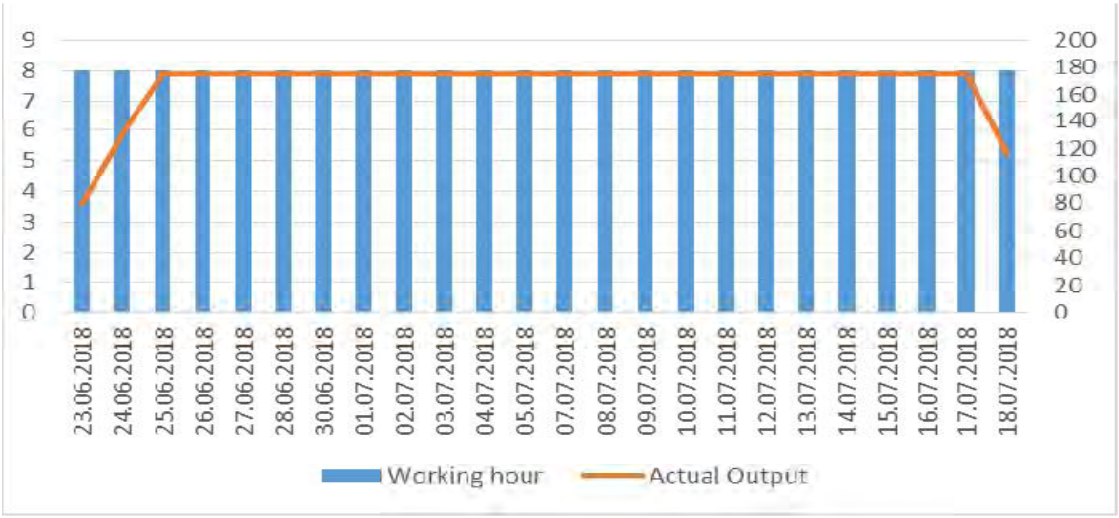

Figure 5.14: Daily working hour Vs Production output after line balancing

5.16 Labor Productivity and Line Efficiency after Line Balancing for Article no. V-6

Total SMV	6002.9	second
No. of assigned manpower	55	person
Productive hour percentage	90	%

$$\text{Labor Productivity} = \frac{\text{Total number of output per day}}{\text{Number of workers worked}}$$

$$\text{Line Efficiencey} = \frac{\text{Total output per day x SMV}}{\text{Total manpower worked x Total productive time per day}}\ x\ 100\%$$

Table 5.14: Daily Productivity and Efficiency report after line balancing

Date	Working hour	Manpower	Actual output	Labor productivity	Line Efficiency
23.06.2018	8	55	150	2.73	63%
24.06.2018	8	55	150	2.73	63%
25.06.2018	8	55	175	3.18	74%
26.06.2018	8	55	175	3.18	74%
27.06.2018	8	55	175	3.18	74%
28.06.2018	8	55	175	3.18	74%
30.06.2018	8	55	175	3.18	74%
01.07.2018	8	55	175	3.18	74%
02.07.2018	8	55	175	3.18	74%
03.07.2018	8	55	175	3.18	74%
04.07.2018	8	55	175	3.18	74%
05.07.2018	8	55	175	3.18	74%
07.07.2018	8	55	175	3.18	74%
08.07.2018	8	55	175	3.18	74%
09.07.2018	8	55	175	3.18	74%
10.07.2018	8	55	175	3.18	74%
11.07.2018	8	55	175	3.18	74%
12.07.2018	8	55	175	3.18	74%
13.07.2018	8	55	175	3.18	74%
14.07.2018	8	55	175	3.18	74%
15.07.2018	8	55	175	3.18	74%
16.07.2018	8	55	175	3.18	74%
17.07.2018	10	55	200	3.64	67%
Average=	**8.09**	**55**	**173.91**	**3.16**	**72%**

The average labor productivity after line balancing is 3.16 pieces

The average sewing section efficiency after line balancing is 72%

The labor productivity to 3.16 from 2.18 and the line efficiency has been increased at 72% from 49% for the Article no. V-6.

CHAPTER SIX
VALUE STREAM MAPPING IMPLEMENTATION

6.1 Introduction

Value Stream Mapping (VSM) includes a set of all activates (value added as well as non-value added) that are essential to bring a product through the main flows, starting with raw material, and ending with the customer [4]. It is generally a paper pencil work to show the material and information flow from the customer order placing to the supply of finished goods with the visualization of waste and the scope of improvement in the process. Thus the main goal of VSM is to find different types of wastes and trying to eliminate them. The first step is to select a specific product or product family as the target for improvement. The second step is that to develop a current state map that is mainly a snapshot capturing how processes are currently being done. The third step is to draw the future state map that is a visualization of how the production process should be done after the wastes and inefficiencies have been removed. The future state map is created based on answering a collection of questions on topics relevant to efficiency as well as implementing technical issues related to the application of lean techniques. Finally, the suggested map is applied as a basis for making essential changes to the manufacturing operation [38].

6.2 Mapping the present state

A Present State Map shows work processes as they currently exist. This is vital both to understand the need for change and to understand where opportunities lie. It is done by simply following the steps for a family of related products that, essentially, use the same processes and sequence. The steps are like the followings-

First the customer, supplier and production control icons are drawn. Customer requirements per month and per day are entered. Outbound and inbound shipping icon and truck with delivery frequency are drawn. Process boxes are added in sequence, left to right and data boxes below. Process attributes are added to data boxes [39].

Operator symbols and numbers are added. Inventory locations and levels in days of demand and graph are placed at bottom. Push, pull and FIFO icons, working hours, cycle and lead times are added to show the clear description.

6.3 Data Analysis of Current State VSM for Article no. V-5

Appendix-G shows total time consumed in detail during production that currently exist for the article no. V-5.

Table 6.1: Current state value stream data summary for article no. V-5

Data Summary	VA	NVA	NNVA	Transportation	Waiting	Inspection	Total	Production
No of steps	94	4	2	44	8	1	153	**VA Steps %**
Time (Sec)	3099.7	1005.6	208.8	464.0	839.0	118.0	5735.1	**62%**
Distance (meter)				167.3			167.3	**VA %= 54%**
	Cutting							
No of steps	16	3		7	2		28	**VA Steps %**
Time (Sec)	491.3	900.0		148.0	135.0		1674.3	**57%**
Distance (meter)				49.1				**VA %= 29%**
	Sewing							
No of steps	78			36	6		120	**VA Steps %**
Time (Sec)	2608.4			311.0	704.0		3623.4	65%
Distance (meter)				116.7			116.7	**VA %=72%**
	Finishing							
No of steps		1		1		1	3	**VA Steps %**
Time (Sec)		105.6		5.0		118.0	228.6	0%
Distance (meter)								**VA %=0%**
	Packing							
No of steps			2				2	**VA Steps %**
Time (Sec)			208.8				208.8	0%
Distance (meter)								**VA %=0%**

Section	VA	NVA	NNVA	Transportation	Distance (meter)	Waiting	Inspection	Manpower	Start date	End date
Cutting	491.3	900.0		148.0	49.1	135.0		5	19.02.2018	07.03.2018
Sewing	2608.4			311.0	116.7	704.0		33	03.03.2018	31.03.2018
Finishing		105.6		5.0	1.5		118.0	5	07.03.2018	31.03.2018
Packing			208.8					2	07.03.2018	31.03.2018
Total=	**3099.7**	**1005.6**	**208.8**	**464.0**	**167.3**	**839.0**	**118.0**	**45**		

Category	Steps	Time	Distance (meter)	Total Distance (meter)	167.3
VA	94	3099.7		**Total VA Time (Sec)**	3099.7
NVA	4	1005.6		**Total Time (Sec)**	5730.1
NNVA	2	208.8		**VA Ratio (%)**	54%
Transportation	44	464.0	**167.3**	**Total VA Steps**	94
Waiting	8	839.0		**Total Steps**	152
Inspection	1	118.0		**VA Steps %**	62%
Total=	**153**	**5735.1**	**167.3**		

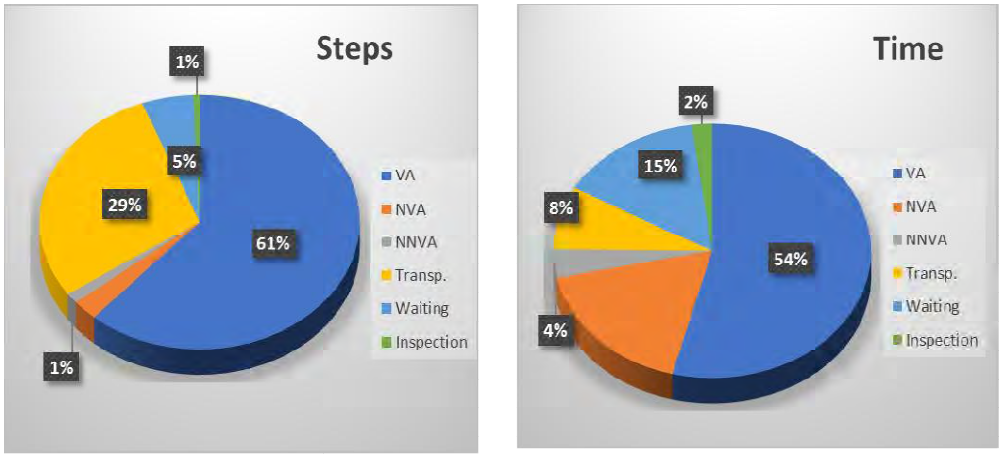

Figure 6.1: Steps and Time summery of Current State VSM (article no. V-5)

6.4 Data Analysis of Current State VSM for Article no. V-6

Appendix-H shows total time consumed in detail during production that currently exist for the article no. V-6.

Table 6.2: Current state value stream data summary for article no. V-6

Data Summary	VA	NVA	NNVA	Transportation	Waiting	Inspection	Total	Production
No of steps	164	8	3	85	20	1	281	**VA Steps %**
Time (Sec)	6426.2	1808.9	49.2	1051.0	3216.0	172.9	12724.1	**58%**
Distance (meter)				392.9			392.9	**VA %= 51%**
	Cutting							
No of steps	17	5		6	3		31	**VA Steps %**
Time (Sec)	933.1	1160.0		128.0	520.0		2741.1	**55%**
Distance (meter)								**VA %= 34%**
	Sewing							
No of steps	147		3	78	17		245	**VA Steps %**
Time (Sec)	5493.1		49.2	918.0	2696.0		9156.4	**60%**
Distance (meter)				349.3			349.3	**VA %=60%**
	Finishing							
No of steps		1		1		1	3	**VA Steps %**
Time (Sec)		440.0		5.0		172.9	617.9	**0%**
Distance (meter)				1.5			1.5	**VA %=0%**
	Packing							
No of steps		2					2	**VA Steps %**
Time (Sec)		208.8					208.8	**0%**
Distance (meter)								**VA %=0%**

Section	VA	NVA	NNVA	Transportation	Distance (meter)	Waiting	Inspection	Manpower	Start date	End date
Cutting	933.1	1160.0		128.0	42.1	520.0		5	08.03.2018	25.03.2018
Sewing	5493.1		49.2	918.0	349.3	2696.0		51	01.04.2018	30.04.2018
Finishing		440.0		5.0	1.5		172.9	7	08.04.2018	30.04.2018
Packing		208.8						2	08.04.2018	30.04.2018
Total=	**6426.2**	**1808.9**	**49.2**	**1051.0**	**392.9**	**3216.0**	**172.9**	65		

Category	Steps	Time	Distance	Total Distance (meter)	392.9
VA	164	6426.2		**Total VA Time (Sec)**	6426.2
NVA	8	1808.9		**Total Time (Sec)**	12724.1
NNVA	3	49.2		**VA Ratio (%)**	51%
Transportation	85	1051.0	392.9	**Total VA Steps**	164
Waiting	20	3216.0		**Total Steps**	281
Inspection	1	172.9		**VA Steps %**	58%
Total=	**281**	**12724.1**			

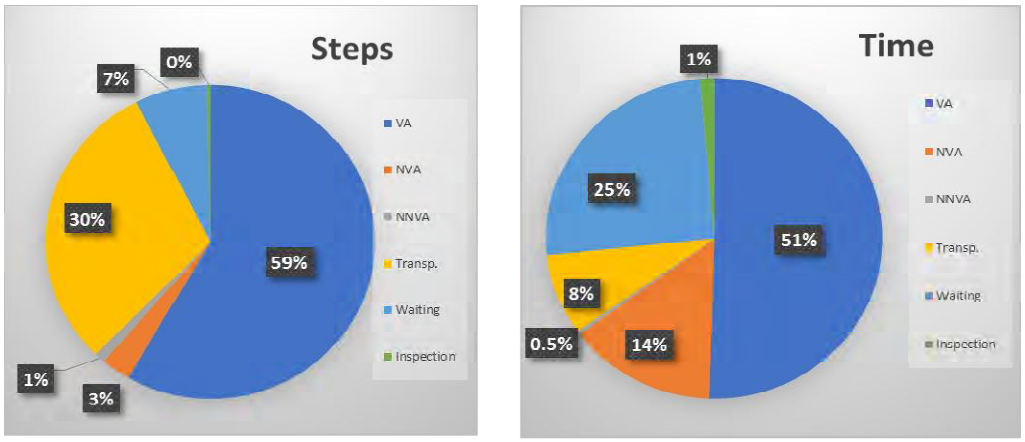

Figure 6.2: Steps and Time summery of Current State VSM (article no. V-6)

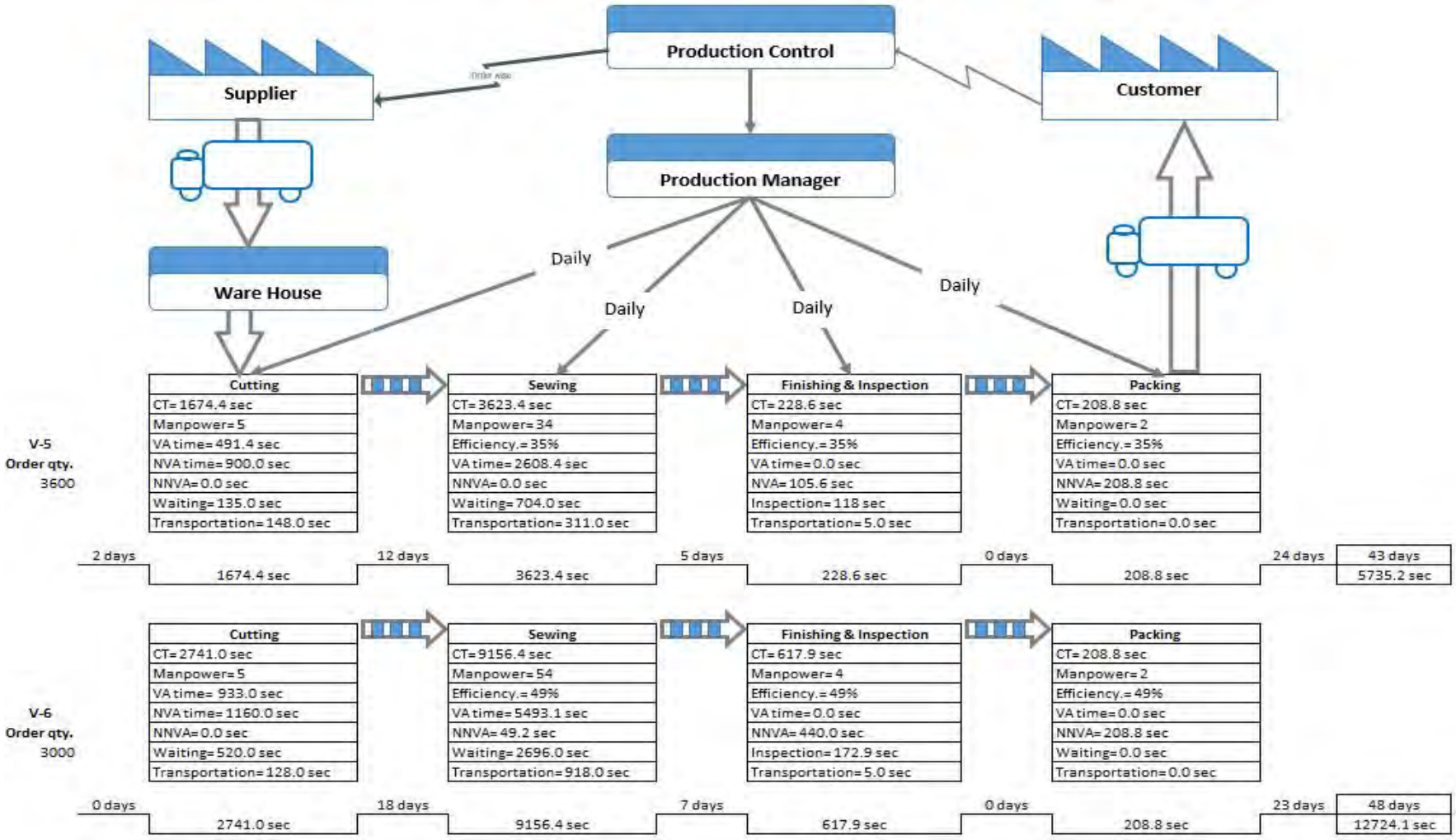

Figure 6.3: Current State VSM

CHAPTER SEVEN
RESULTS AND DISCUSSION

7.1 Remove and minimize bottleneck tasks

Bottleneck tasks are identified as tasks to take more time for doing. Regarding the current VSM, waiting time and transportation are considered as the obvious part of production process. In current VSM, batch production system is followed but there is no specific batch size for the output quantity per unit of time. In future VSM, continuous flow is applied and a batch size 6 pcs has been taken into account as per hourly production data. This is a very efficient means of production since no inventory is created between process steps as well as it eliminates many forms of waste such as waiting time, delay time, transportation. In addition, team meeting at morning (before production starts) and evening (10 minutes) everyday were implemented to eliminate miscommunication and time wastage for rework that results a better organized work process. Incentive bonus system for target fill-up and performance bonus for best worker has been implemented to motivate workers. This bonus system also motivated workers to positively accept and co-operate to all implemented changes and techniques.

7.1.1 Future state mapping implementation

Reviewing the present state map, calculating the Takt-time, designing the production system such that it is being produced to finished goods. It needs to decide at which point the production should be scheduled. And accordingly the processes that will be necessary for the value stream to flow in accordance to the Future-State Map is identified.

The lead time is larger for unwanted delay at every section. The JIT is not applicable in this situation. The plan must not suggest long retention time in any stage. If there is so much doubt in capability then every section needs to be structured in the same capacity building criteria. As the major operation are sewing operation, the store and cutting inventory can be less observation. Sewing WIP should be removed in future state VSM. If we simply eliminate the Non-Value Added Avoidable time (NVA-A) and arbitrarily the lead time will definitely decrease. The other process improvement techniques will further develop the main manufacturing function.

Waiting and Transportation may develop by re-allocation of skilled worker and following line balancing processes accordingly. Non-Value Added Avoidable time (NVA-A) time must be eliminated; some works like quality checking and number sticker adding may be done in parallel situation. Sewing improvement is done by layout correction, line balancing, worker motivation, skill development, maintenance support, proper input, close supervision and monitoring. So that the SMV is decreased and the rate production increased. Finishing and cleaning work improvement is done by maintain a smooth flow and reducing the Waiting time. The finishing accessories were supplied properly.

There are some sequences those are purely hand work. So the task time varies depending on skill of the worker. All workers are not equally expert in all works. Only few workers found highly experienced and rest of the workers are moderately skill in work. Specifically designed working tools such as pattern made by board, scale, gluing tube, metal nail etc. are used to ease of work for comparatively less skilled operators. To do so, the quality of work remains the same even the task is done by less skilled operator. Moreover the task time is reduced. One of the major unnecessary non-value added task time is cleaning the marking ink and excess glue during finishing and cleaning of the finished goods before it goes to the final QC. Marking pen is used to mark assembly point, joining margin for unassembled parts. It is found that the use of marking pen can easily be replaced by using working pattern and press mark by metal nail. The marking pen is announced prohibited from production floor.

7.2 Data summary of Future State VSM for Article no. V-5

Appendix-I shows the future state operation description for the article no. V-5.

Table 7.1: Future state value stream data summary for article no. V-5

Data Summary	VA	NVA	NNVA	Transportation	Waiting	Inspection	Total	Production
No of steps	34		3	5		1	43	**VA Steps %**
Time (Sec)	2686.4		208.8	75.0		84.4	3054.6	79%
Distance (meter)				29.9			29.9	**VA %=88%**
	Sewing							
No of steps	30			5			35	**VA Steps %**
Time (Sec)	2480.8			75.0			2555.8	86%
Distance (meter)				29.9			29.9	**VA %=97%**
	Finishing							
No of steps	3					1	3	**VA Steps %**
Time (Sec)	205.6					84.4	290.0	75%
Distance (meter)								**VA %=71%**
	Packing							
No of steps			3				3	**VA Steps %**
Time (Sec)			208.8				208.8	0%
Distance (meter)								**VA %=0%**

Section	VA	NVA	NNVA	Transpo rtation	Distance (meter)	Waiting	Inspec tion	Manp ower	Start date	End date
Cutting	491.3			148.0	49.1			5	20.05.2018	05.06.2018
Sewing	2480.8			75.0	29.9			33	26.05.2018	13.06.2018
Finishing	205.6						84.4	3	26.05.2018	13.06.2018
Packing			208.8					3	26.05.2018	13.06.2018
Total=	**2686.4**		**208.8**	**75.0**	**29.9**		**84.4**	**44**		

Category	Steps	Time	Distance	Total Distance (meter)	29.9
VA	34	2686.4		**Total VA Time (Sec)**	2686.4
NVA				**Total Time (Sec)**	3054.6
NNVA	3	208.8		**VA Ratio (%)**	88%
Transp.	5	75.0	29.9	**Total VA Steps**	34
Waiting				**Total Steps**	43
Inspection	1	84.4		**VA Steps %**	79%
	43	**3054.6**	**29.9**		

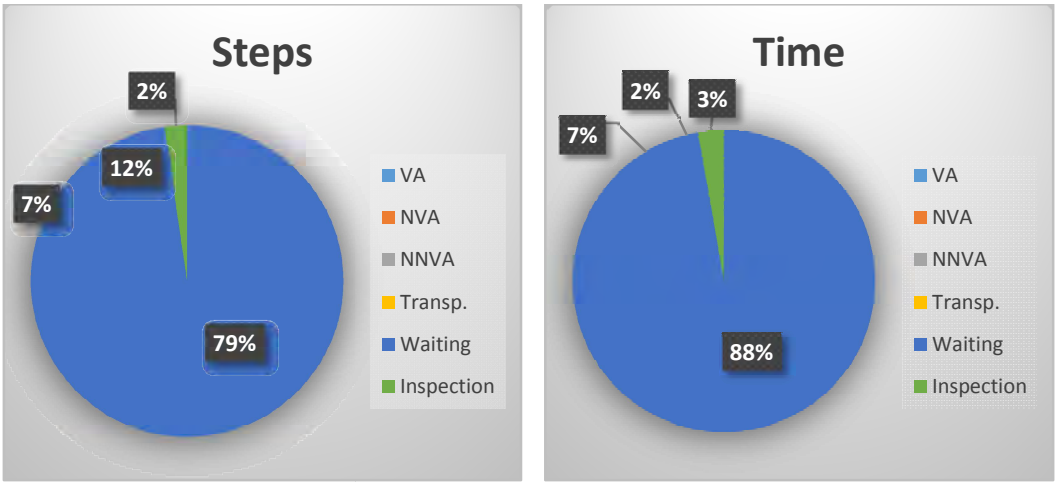

Figure 7.1: Steps and Time summery of Future State VSM (article no. V-5)

7.3 Mapping the Future state for Article no. V-6

Necessary Non-Value Added (NNVA) and Non-Value Added (NVA) tasks has been reviewed. Few of them has been eliminated and improved **(Appendix C)** by the application of some particular working techniques. Thus the total consumed time per unit production is reduced. Waiting and Transportation has been developed by re-allocation of skilled worker and following line balancing processes accordingly. In-line QC is introduced. Finishing and cleaning work time is reduced. Consequently re-work for the defective product is reduced. So that the SMV is decreased and the rate of production increased. Best skilled workers are assigned for the complex and critical hand work like zipper setting on top opening, cc pocket leather folding and penal setting. Less skilled workers are trained and encourage to use specifically designed working tools such as working pattern made by board, scale, gluing tube, metal nail etc. Quality of work remains the same even the task is done by less skilled workers. Excess glue and the marking ink cleaning are the major unnecessary non-value added task in finishing stage for the complete product. Marking pen is used to mark assembly point, joining margin for unassembled parts. Marking pen work has been replaced by using working pattern and press mark by metal nail.

7.4 Data summary of Future State VSM for Article no. V-6

Appendix-J shows the future state operation description for the article no. V-6.

Table 7.2: Future state value stream data summary for article no. V-6

Data Summary	VA	NVA	NNVA	Transportation	Waiting	Inspection	Total	Production
No of steps	46		2	5		1	54	**VA Steps %**
Time (Sec)	5601.9		208.8	167.0		112.2	6089.9	**85%**
Distance (meter)				55.5			55.5	**VA %=92%**
	Sewing							
No of steps	44			5			49	**VA Steps %**
Time (Sec)	4995.1			167.0			5162.1	**90%**
Distance (meter)				55.5			55.5	**VA %=97%**
	Finishing							
No of steps	2					1	3	**VA Steps %**
Time (Sec)	606.8					112.2	719.0	**67%**
Distance (meter)								**VA %=84%**
	Packing							
No of steps			2				2	**VA Steps %**
Time (Sec)			208.8				208.8	**0%**
Distance (meter)								**VA %=0%**

Section	VA	NVA	NNVA	Transpor-tation	Distance (meter)	Waiting	Inspection	Man power	Start date	End date
Cutting	933.1			128.0	42.1			5	06.06.2018	05.07.2018
Sewing	4995.1			167.0	55.5			50	23.06.2018	17.07.2018
Finishing	606.8						112.2	3	23.06.2018	17.07.2018
Packing			208.8					2	23.06.2018	17.07.2018
Total=	**5601.9**		**208.8**	**167.0**	**55.5**		**112.2**	**60**		

Category	Steps	Time	Distance	Total Distance (meter)	55.5
VA	46	5601.9		**Total VA Time (Sec)**	5601.9
NVA				**Total Time (Sec)**	6089.9
NNVA	2	208.8		**VA Ratio (%)**	92%
Transp.	5	167.0	55.5	**Total VA Steps**	46
Waiting				**Total Steps**	54
Inspection	1	112.2		**VA Steps %**	85%
	54	**6089.9**	**55.5**		

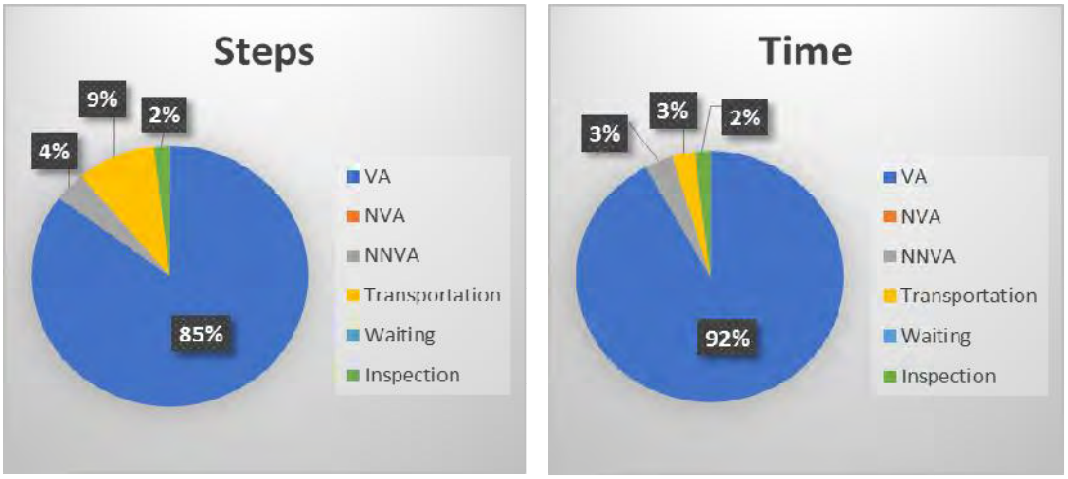

Figure 7.2: Steps and Time summery of Future State VSM (article no. V-6)

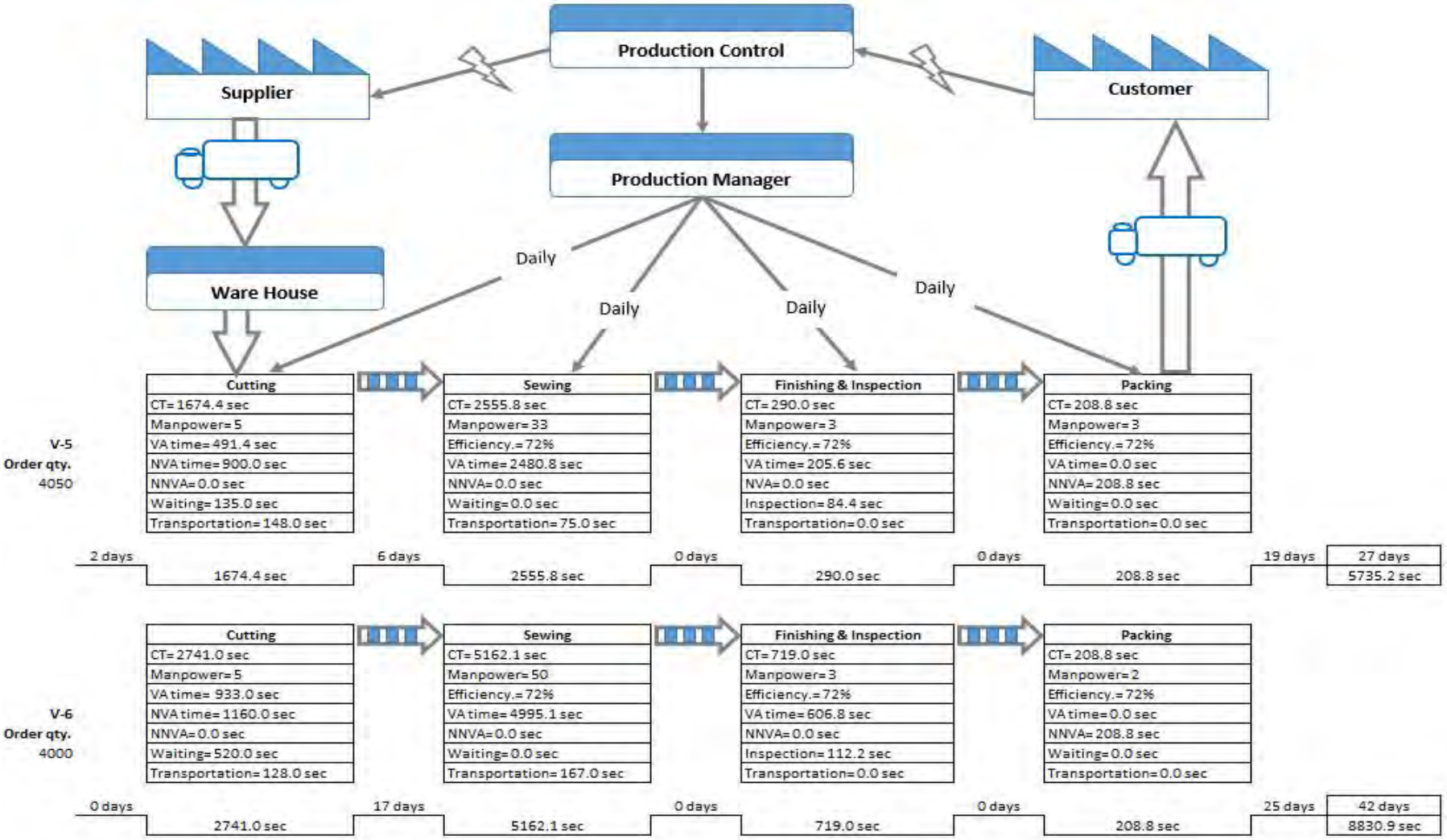

Figure 7.3: Future State VSM

7.5 Results

Most of the operations in leather products manufacturing are the manual work e.g. tasks are mostly hand work. So, the productivity improvement is largely depends on the improvement of labor productivity. Good line balancing in the sewing line increases the efficiency and quality of production. Line balancing has been found very essential in leather products manufacturing as the workload between operators are distributed throughout the work stations which make the higher line efficiency and the target output has been achieved without doing overtime. In this case study, level of resources at bottleneck process has been increased, non-value added activities are avoided by changing work method and layout, similar operations are merged by the application of the line balancing technique. Result shows the increased labor productivity and efficiency. The original production line had a productivity of 3.93 and 2.18 labor/day for article V-5 and V-6 respectively and the efficiency are 36% and 49%. Whereas, after line balancing the productivity are 6.11 and 3.16 labor/day respectively and the efficiency are 72% for both. As a result, adopting and performing line balancing techniques for all upcoming articles can reduce production cost.

Non-value Added (NVA) activities are identified in current state mapping. Necessary Non-value Added (NNVA) activities are considered as the scope of improvement. Non-value Added activities are eliminated and Necessary Non-value Added activities are re-configured in future state (better) mapping. In this case study the future state map shows significant improvement in production process. The value added time increases to 88% and 92% from 54% and 51% for articles V-5 and V-6 respectively. Customer order quantity is higher than that of previous order quantity. Furthermore, production lead time is reduced to 27 days and 42 days from 43 days and 48 days respectively.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Leather products sector of Bangladesh is completely export oriented. Global market is becoming more competitive day by day. Manufacturing process of the leather products is highly labor oriented. Leather products manufacturers are facing a lot of challenges in terms of expected labor output and maximum use of their resources. Manufacturers need to implement new techniques in their production operation to overcome with these new challenges. In the leather products industry this project work is conducted is not following any standardize production system now. So the production output is less and overall operation process is not significantly organized. Result oriented decision making and analysis of operation process are completely absent here. Line balancing and Value Stream Mapping (VSM) are result oriented and performance based techniques used in manufacturing process to increase productivity and efficiency. Consequently the expected competitive advantage is achieved.

Analysis shows that the existing production system is not the continuous flow oriented. Production used to design with part by part making process. The first complete product was produced at least 6-7 after the production starts. Manpower in finishing section found completely workless during these days. In this way, a group of manpower remains always workless by sequence. Thus the labor productivity was found low and the efficiency was also less. Flow oriented production has been implemented by line balancing analysis in which the complete products output starts at the first day of the production. The majority of work in leather products manufacturing is the sewing work. The productivity and efficiency mostly depends on sewing section. Thus the line balancing technique has been conducted on sewing section only in this case study. The work load was distributed among workstations and the idle time of manpower has been eliminated. Customize line layout has been done. That means machines and working table were rearranged as per working sequence. Whereas a fixed layout was followed previous. The productivity and efficiency found significantly increased.

Wastes in terms of time and unnecessary delay happened in the value chain has been identified by Value Stream Mapping (VSM). Consumed waiting time non-value added time

(NVA) in every process or in between process of cutting, sewing, finishing and packing sections has been identified and eliminated. Changes in work sequence and use of working tools has been suggested from VSM data analysis. As a result, capacity utilization is significantly enhanced and the process time of the production is greatly reduced.

8.2 Recommendations

Because of highly labor dependent and manual work production, all leather products manufacturers are always concern about the quality and productivity. They always try to integrate production constraints and time utilization to produce buyer order quantity to meet proper lead time. So, Yamazumi chart line balancing and VSM techniques implementation can be the effective tools for quality and productivity improvement in leather products industry.

This thesis work has been done with a limited scope. The sample industry is such a medium scale leather products manufacturer. Further study in future may include more different tools and techniques with more working sections with a view to wide scope of improvement. These techniques and improvement analysis may be implemented in several leather products industry with a greater production scale and set up as well as similar manufacturing facilities. Then the outcome will be found more realistic and the implementation outline will be more justifiable.

Application of line balancing and VSM techniques in manufacturing process can include the scope of improvement for the lean manufacturing, raw materials supply chain, smooth production flow, less set up time, WIP reduction, and overall effectiveness of operation management.

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Appendices

Appendix A: Time study for Article no. V-5

Section	Activity Name	Part qty.	Cycle Time (single work)										Average time (single work)	Basic time (req. qty./bag)	Performance rating (Westinghouse)	Normal time	Allowance (ILO recom.)	Standard time	Hourly output
			1	2	3	4	5	6	7	8	9	10							
cutting	cutting leather body*2	2	10.2	9.8	12.5	9.6	14.8	11.5	10.8	10.4	16.8	11.6	11.8	23.6	100%	23.6	20%	28.3	127.1
cutting	cutting leather inside zip pocket opening part*1	1	10.8	10.2	14.2	11.4	6.4	6.7	6.3	6.5	8.9	7.7	8.9	8.9	100%	8.9	20%	10.7	336.7
cutting	cutting leather for cc pocket*5 (hand cutting)	5	7.6	6.5	4.5	8.5	7.9	6.3	4.8	9.4	6.4	6.1	6.8	34.0	100%	34.0	20%	40.8	88.2
cutting	cutting leather puller*2	2	2.3	3.1	7.5	3.3	6.9	3.1	5.5	2.8	2.4	2.7	4.0	7.9	100%	7.9	20%	9.5	378.8
cutting	cutting leather zipper stopper*2	2	2.5	3.2	4.5	3.5	4.6	2.9	4.8	2.7	7.3	2.8	3.9	7.8	100%	7.8	20%	9.3	386.6
cutting	cutting leather handle*1 (hand cutting)	1	20.5	21.6	21.4	26.8	23.4	22.1	20.1	18.2	16.8	17.2	20.8	20.8	100%	20.8	20%	25.0	144.2
cutting	cutting leather part for handle base (hand cutting each strip)	1	7.6	6.5	4.5	8.5	7.9	6.3	4.8	5.2	11.3	6.1	6.9	6.9	100%	6.9	20%	8.2	436.7
cutting	cutting leather handle base from together joint leather*2	2	2.5	6.2	4.5	3.5	4.6	2.9	4.8	2.7	2.3	2.8	3.7	7.4	100%	7.4	20%	8.8	407.6
cutting	cutting all lining*8 (hand cutting)	8	22.7	23.5	23.4	20.1	18.6	19.3	20.1	24.7	18.3	17.4	20.8	166.5	100%	166.5	20%	199.8	18.0
cutting	reinforcement cutting*2	2	19.1	23.2	19.9	23.0	20.3	20.8	19.6	24.2	22.5	19.7	21.2	42.5	100%	42.5	20%	51.0	70.7
cutting	skiving leather body*2	2	7.4	7.6	7.7	10.2	8.1	7.2	7.3	6.8	15.6	6.9	8.5	17.0	100%	17.0	20%	20.4	176.9
cutting	splitting leather for cc pocket*5	5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	100%	5.0	20%	6.0	600.0
cutting	skiving leather for cc pocket*5	5	9.0	8.2	7.6	7.1	7.2	12.2	6.8	7.1	7.3	6.6	7.9	39.6	100%	39.6	20%	47.5	75.9
cutting	splitting leather inside zip pocket opening part*1	1	2.2	2.3	4.5	6.1	2.1	2.3	2.1	2.5	2.4	2.1	2.9	2.9	100%	2.9	20%	3.4	1049.0
cutting	splitting leather piece for handle base*1	1	3.2	3.3	3.1	2.9	6.5	2.3	2.8	2.7	2.9	7.4	3.7	3.7	100%	3.7	20%	4.5	808.6
cutting	pattern paper cutting for packaging*2	2	7.6	6.5	7.7	8.5	7.9	6.3	7.9	9.1	7.4	7.1	7.6	15.2	100%	15.2	20%	18.2	197.4
sewing	body leather: gluing leather part top and bottom to fix reinforcement*1	1	13.2	14.5	14.3	13.5	13.5	14.0	14.5	13.1	19.2	13.5	14.3	14.3	100%	14.3	20%	17.2	209.4
sewing	body leather: gluing on reinforcement to be fixed with leather part*2	2	6.6	5.4	6.2	5.3	5.2	6.1	6.9	5.1	5.2	4.7	5.7	11.3	100%	11.3	20%	13.6	264.6
sewing	body leather: joining two reinforcements with leather part*1	1	29.9	26.2	29.8	26.4	28.9	28.8	28.4	28.5	27.3	29.1	28.3	28.3	100%	28.3	20%	34.0	105.9
sewing	body leather: sewing both corner by grain side face to face*2	2	20.4	21.4	19.6	21.5	20.1	19.8	24.7	21.6	21.4	19.5	21.0	42.0	100%	42.0	20%	50.4	71.4
sewing	body leather: gluing both stitched corner flesh side to fold allowance*2	2	16.3	13.5	13.1	13.1	12.9	12.8	12.9	13.1	15.4	13.6	13.7	27.3	100%	27.3	20%	32.8	109.7
sewing	body leather: folding and	2	15.3	13.2	16.6	16.4	13.9	16.2	14.3	15.3	15.3	16.8	15.3	30.7	100%	30.7	20%	36.8	97.8

	hammering allowance at both corner*2																		
sewing	body leather: gluing punch back side area and put reinforcement*1	1	10.2	9.6	9.9	8.8	9.7	9.8	10.4	9.6	10.1	8.6	9.7	9.7	100%	9.7	20%	11.6	310.2
sewing	body leather: punch reinforcement, screw opening and attach lock*1	1	94.4	88.6	85.6	88.6	89.9	87.2	85.3	92.5	87.7	86.9	88.7	88.7	100%	88.7	20%	106.4	33.8
sewing	body leather: scotch tape on lock metal back side*1	1	7.3	9.8	7.5	8.6	8.1	7.6	8.0	9.9	8.8	7.7	8.3	8.3	100%	8.3	20%	10.0	360.1
sewing	handle base: gluing leather flesh side*2	2	11.3	10.4	12.3	13.5	9.2	10.1	10.3	10.5	9.8	12.6	11.0	22.0	100%	22.0	20%	26.4	136.4
sewing	handle base: joining two leather part by flesh side*1	1	7.6	6.3	8.1	8.7	8.1	7.4	6.5	7.2	7.1	6.3	7.3	7.3	100%	7.3	20%	8.8	409.3
sewing	handle base: net cutting*2	2	14.2	18.8	16.7	15.3	16.8	16.4	16.9	16.1	14.1	14.7	16.0	32.0	100%	32.0	20%	38.4	93.8
sewing	handle base: gluing both ends to make loop*2	2	4.1	5.0	4.3	5.1	4.6	4.1	3.9	4.5	4.2	3.5	4.3	8.7	100%	8.7	20%	10.4	346.4
sewing	handle base: inserting d-ring and joining ends together and hammering*2	2	12.6	14.6	12.5	11.8	12.8	12.3	11.5	11.2	15.8	18.2	13.3	26.7	100%	26.7	20%	32.0	112.5
sewing	body leather& handle base: gluing body leather to join handle base*2	2	5.1	4.8	5.3	5.6	5.3	5.2	4.3	4.7	4.6	5.1	5.0	10.0	100%	10.0	20%	12.0	300.0
sewing	body leather& handle base: gluing handle base to be joint with body leather*2	2	3.5	5.5	5.8	5.2	4.4	4.9	4.3	5.6	5.2	5.6	5.0	10.0	100%	10.0	20%	12.0	300.0
sewing	body leather& handle base: setting handle base with body leather and hammering*2	2	8.2	6.4	8.4	8.6	11.2	6.2	6.3	6.4	7.7	7.3	7.7	15.3	100%	15.3	20%	18.4	195.6
sewing	body leather& handle base: sewing handle base with body leather*2	2	34.9	38.7	32.0	31.2	35.3	38.2	38.4	36.2	31.0	34.1	35.0	70.0	100%	70.0	20%	84.0	42.9
sewing	inside cc pocket: gluing cc lining*5	5	12.3	11.5	15.6	14.2	10.2	10.5	10.6	9.4	9.3	9.7	11.3	56.7	100%	56.7	20%	68.0	53.0
sewing	inside cc pocket: gluing cc leather*5	5	8.1	12.3	10.4	9.5	11.1	8.2	9.3	10.4	9.5	11.2	10.0	50.0	100%	50.0	20%	60.0	60.0
sewing	inside cc pocket: setting lining with cc leather*5	5	6.5	5.6	7.9	4.9	7.1	6.2	5.8	7.2	4.8	7.3	6.3	31.7	100%	31.7	20%	38.0	94.8
sewing	inside cc pocket: gluing and folding at top of each cc*5	5	9.1	8.2	9.5	9.6	9.4	8.6	8.2	9.8	7.1	7.2	8.7	43.4	100%	43.4	20%	52.0	69.2
sewing	inside cc pocket: sewing each cc top*5	5	6.6	5.6	5.1	6.1	5.5	5.3	5.4	5.9	5.8	5.4	5.7	28.4	100%	28.4	20%	34.0	105.8
sewing	inside cc pocket: adhesive tape on bottom of cc lining*4	4	9.5	9.5	11.8	9.6	8.9	8.7	9.6	8.3	9.1	8.3	9.3	37.3	100%	37.3	20%	44.8	80.4
sewing	inside cc pocket: setting cc top and cc-1,2,3 to sewing*3	3	22.5	23.1	26.8	22.3	22.4	23.6	24.8	25.4	25.6	26.8	24.3	73.0	100%	73.0	20%	87.6	41.1
sewing	inside cc pocket: sewing cc top with cc-1,2,3 together*3	3	7.3	8.2	8.4	7.2	8.3	9.2	7.3	6.8	7.1	6.9	7.7	23.0	100%	23.0	20%	27.6	130.4
sewing	inside cc pocket: gluing on cc left & right side and cc penal to setting together*1	1	13.5	14.9	13.6	12.9	13.5	13.8	12.7	13.8	15.7	12.3	13.7	13.7	100%	13.7	20%	16.4	219.5
sewing	inside cc pocket: setting cc penal*1	1	23.1	20.8	20.4	21.5	22.3	20.5	20.5	21.1	20.1	19.7	21.0	21.0	100%	21.0	20%	25.2	142.9

sewing	inside cc pocket: net cut cc pocket and marking for middle stitch*1	1	33.1	40.5	38.8	32.8	34.0	37.2	36.5	37.8	39.8	39.5	37.0	37.0	100%	37.0	20%	44.4	81.1
sewing	inside cc pocket: masking taping on cc set to do proper middle stitch*1	1	10.2	7.6	6.4	11.1	8.6	6.6	6.9	8.3	6.2	8.1	8.0	8.0	100%	8.0	20%	9.6	375.0
sewing	inside cc pocket: sewing middle stitch*1	1	10.5	11.5	10.6	11.4	10.2	9.6	9.8	10.2	9.9	9.6	10.3	10.3	100%	10.3	20%	12.4	290.4
sewing	inside cc pocket: thread burn of middle stitch extra thread*1	1	12.3	17.8	16.8	15.3	14.5	16.5	17.5	16.9	16.8	15.6	16.0	16.0	100%	16.0	20%	19.2	187.5
sewing	inside cc pocket: marking lining to join cc pocket*1	1	12.0	11.4	13.6	12.2	14.2	13.5	14.3	9.6	10.4	12.1	12.3	12.3	100%	12.3	20%	14.8	243.3
sewing	inside cc pocket: sewing cc pocket with lining*1	1	91.2	83.2	85.1	83.1	84.2	83.1	86.9	87.3	87.3	88.6	86.0	86.0	100%	86.0	20%	103.2	34.9
sewing	inside zip pocket: marking lining for lip cut*1	1	17.4	19.4	17.6	16.8	17.2	18.6	17.6	15.8	19.3	20.3	18.0	18.0	100%	18.0	20%	21.6	166.7
sewing	inside zip pocket: gluing non-woven*1	1	14.2	19.3	19.2	19.7	13.2	16.3	24.6	15.8	15.7	15.3	17.3	17.3	100%	17.3	20%	20.8	173.1
sewing	inside zip pocket: setting non-woven on lining on lip cut area*1	1	9.3	12.8	13.3	14.1	9.3	11.3	9.2	9.8	8.0	12.9	11.0	11.0	100%	11.0	20%	13.2	272.7
sewing	inside zip pocket: cutting lip*1	1	12.1	12.5	13.6	13.6	12.6	13.2	14.6	16.4	12.1	12.6	13.3	13.3	100%	13.3	20%	16.0	225.1
sewing	inside zip pocket: gluing to make opening*1	1	17.6	21.3	22.8	24.3	21.8	22.3	23.3	22.7	20.2	20.4	21.7	21.7	100%	21.7	20%	26.0	138.4
sewing	inside zip pocket: folding to get opening*1	1	36.4	35.1	29.2	29.1	29.7	29.1	31.8	31.8	35.6	35.5	32.3	32.3	100%	32.3	20%	38.8	92.8
sewing	inside zip pocket: cut zipper with proper length*1	1	5.2	6.6	5.3	5.4	5.3	5.8	5.1	4.8	4.7	5.1	5.3	5.3	100%	5.3	20%	6.4	562.9
sewing	inside zip pocket: insert runner*1	1	5.8	5.1	5.4	6.6	5.3	5.5	6.6	5.3	5.4	5.7	5.7	5.7	100%	5.7	20%	6.8	529.1
sewing	inside zip pocket: gluing zipper to setting with opening*1	1	17.4	15.7	13.6	15.8	17.3	17.6	15.8	16.3	13.4	13.8	15.7	15.7	100%	15.7	20%	18.8	191.4
sewing	inside zip pocket: gluing opening to attach zipper*1	1	13.6	14.2	13.5	14.3	12.1	11.8	12.3	12.6	14.3	14.6	13.3	13.3	100%	13.3	20%	16.0	225.1
sewing	inside zip pocket: setting zipper*1	1	9.3	11.3	9.8	11.8	14.2	13.5	11.1	10.2	10.6	11.5	11.3	11.3	100%	11.3	20%	13.6	264.8
sewing	inside zip pocket inside: gluing zipper back side to join pocket lining*1	1	6.6	5.1	7.0	5.8	7.6	6.4	8.6	6.9	6.8	5.9	6.7	6.7	100%	6.7	20%	8.0	449.8
sewing	inside zip pocket inside: gluing pocket lining to join with zipper*1	1	13.5	14.2	12.6	14.1	14.3	13.2	14.6	13.5	12.2	14.3	13.7	13.7	100%	13.7	20%	16.4	219.5
sewing	inside zip pocekt inside: setting inside pocket lining with opening*1	1	13.6	13.2	12.5	10.4	14.2	14.3	12.7	13.2	10.5	12.1	12.7	12.7	100%	12.7	20%	15.2	236.8
sewing	inside zip pocket opening: sewing all around*1	1	66.5	65.5	67.5	68.2	66.5	68.3	68.6	68.9	67.5	69.2	67.7	67.7	100%	67.7	20%	81.2	44.3
sewing	inside zip pocket inside: sewing left & right side to get pocket closed*1	1	48.1	70.8	46.7	39.4	44.1	44.2	48.7	44.2	48.2	45.6	48.0	48.0	100%	48.0	20%	57.6	62.5
sewing	top opening: cut zipper with proper length*1	1	5.3	5.3	5.4	5.7	5.2	4.6	5.3	4.8	3.8	4.6	5.0	5.0	100%	5.0	20%	6.0	600.0

sewing	top opening: insert runner*1	1	7.1	5.8	6.6	5.7	7.2	7.9	5.3	5.6	5.5	6.6	6.3	6.3	100%	6.3	20%	7.6	473.9
sewing	top opening: gluing leather stopper*2	2	7.1	6.2	7.2	7.3	5.2	5.4	5.2	5.1	7.0	7.6	6.3	12.7	100%	12.7	20%	15.2	237.0
sewing	top opening: gluing zipper both edges*1	1	13.5	18.6	13.1	13.5	14.4	13.7	13.8	14.9	14.9	19.6	15.0	15.0	100%	15.0	20%	18.0	200.0
sewing	top opening: setting leather stoppers with glued zipper both edges*1	1	17.2	16.8	16.8	19.7	18.9	26.8	17.2	17.4	19.8	19.4	19.0	19.0	100%	19.0	20%	22.8	157.9
sewing	top opening: sewing leather stoppers*2	2	10.7	9.1	9.7	9.8	8.9	14.2	8.7	8.6	8.1	8.9	9.7	19.3	100%	19.3	20%	23.2	155.1
sewing	top opening: gluing front and back leather body part on opening side to attach zipper*2	2	16.8	22.4	21.2	22.3	21.5	23.4	20.1	22.8	23.7	25.8	22.0	44.0	100%	44.0	20%	52.8	68.2
sewing	top opening: gluing on zipper to be attached with front and back leather body part*1	1	10.5	10.6	10.4	11.3	16.5	10.5	10.8	10.9	11.3	10.5	11.3	11.3	100%	11.3	20%	13.6	264.8
sewing	top opening: setting front and back body part with zipper*1	1	55.6	46.5	47.2	46.5	47.2	46.3	47.5	46.2	46.1	47.6	47.7	47.7	100%	47.7	20%	57.2	62.9
sewing	top opening: gluing two lining on opening area and cc pocket back for thread binding *2	2	9.3	9.8	8.2	8.6	8.9	8.7	9.3	8.7	7.6	7.6	8.7	17.3	100%	17.3	20%	20.8	173.0
sewing	top opening: gluing on zipper to join cc and inside zip pocket attached lining*1	1	9.2	9.8	9.6	9.4	9.2	9.3	9.7	15.6	9.1	9.1	10.0	10.0	100%	10.0	20%	12.0	300.0
sewing	top opening: joining cc and inside zip pocket attached lining with zipper*1	1	32.3	34.2	33.6	32.8	36.8	32.8	32.4	44.2	32.5	35.1	34.7	34.7	100%	34.7	20%	41.6	86.5
sewing	top opening: sewing*1	1	40.1	40.6	42.5	43.2	44.8	58.2	44.9	42.6	43.2	46.6	44.7	44.7	100%	44.7	20%	53.6	67.2
sewing	lining bag: sewing lining all three sides to complete bag*1	1	66.1	63.2	60.2	61.5	66.1	60.1	57.3	58.9	57.2	59.4	61.0	61.0	100%	61.0	20%	73.2	49.2
sewing	leather bag: gluing front and back part leather three flesh sides*2	2	27.5	28.1	28.6	27.2	26.4	35.7	26.7	26.3	26.7	26.8	28.0	56.0	100%	56.0	20%	67.2	53.6
sewing	leather bag: setting front & back part leather by flesh sides face to face*1	1	14.2	11.1	11.5	15.4	11.4	16.2	14.2	12.5	12.6	14.2	13.3	13.3	100%	13.3	20%	16.0	225.1
sewing	leather bag: sewing to complete leather bag*1	1	62.8	63.1	62.9	58.4	58.3	60.4	59.2	68.0	58.6	58.3	61.0	61.0	100%	61.0	20%	73.2	49.2
sewing	puller for top opening: gluing*1	1	18.3	17.5	17.8	16.8	16.2	26.8	17.2	16.2	16.6	23.3	18.7	18.7	100%	18.7	20%	22.4	160.7
sewing	puller for top opening: folding flesh to flesh sides*1	1	16.3	13.9	14.7	14.6	14.8	15.7	14.2	14.1	14.3	14.1	14.7	14.7	100%	14.7	20%	17.6	204.5
sewing	puller for top opening: sewing all around*1	1	15.3	15.9	15.6	16.6	14.8	15.6	32.2	16.3	15.9	15.1	17.3	17.3	100%	17.3	20%	20.8	173.1
sewing	puller for top opening: lock hole metal attaching and fixing*1	1	63.7	66.9	114.9	62.3	69.5	65.3	95.2	84.8	76.2	64.5	76.3	76.3	100%	76.3	20%	91.6	39.3
sewing	puller for top opening: insert pulling o-ring to hang with runner*1	1	34.2	43.2	36.8	32.1	39.4	36.4	36.1	34.9	34.6	35.6	36.3	36.3	100%	36.3	20%	43.6	82.6

sewing	long handle: sewing by guide*1	1	38.1	40.2	41.3	42.5	42.6	37.6	38.6	38.4	38.1	39.3	39.7	39.7	100%	39.7	20%	47.6	75.6
sewing	long handle: gluing both ends on leather part for folding and gluing for dog hook loop*1	1	8.2	10.2	10.8	11.6	9.9	9.0	12.8	16.8	9.2	8.2	10.7	10.7	100%	10.7	20%	12.8	281.2
sewing	long handle: insert dog hook, adjuster by folding leather ends and make loop*1	1	55.3	48.6	46.4	42.3	42.6	42.8	42.6	43.6	44.6	51.2	46.0	46.0	100%	46.0	20%	55.2	65.2
sewing	long handle: sewing both ends*1	1	41.8	42.6	40.2	41.3	43.7	41.3	41.8	41.6	40.5	41.9	41.7	41.7	100%	41.7	20%	50.0	72.0
sewing	inserting pullers at top opening*1	1	39.2	36.5	36.1	34.3	36.2	34.2	34.8	34.1	34.6	36.7	35.7	35.7	100%	35.7	20%	42.8	84.1
sewing	thread burn for finishing work: thread buring*1	1	33.3	36.4	35.9	36.8	32.1	35.1	33.1	33.4	33.5	33.7	34.3	34.3	100%	34.3	20%	41.2	87.4
finishing	finishing and cleaning work	1	87.7	87.3	86.9	85.5	90.1	90.5	87.2	88.8	88.3	87.7	88.0	88.0	100%	88.0	20%	105.6	34.1
inspection	final qc	1	81.1	103.5	107.2	60.6	66.8	138.6	148.3	83.2	86.5	107.5	98.3	98.3	100%	98.3	20%	118.0	30.5
packing	labeling, tissue, silica gel, poly packaging	1	108.2	109.3	107.2	108.6	108.3	105.2	108.6	109.1	110.5	108.3	108.3	108.3	100%	108.3	20%	130.0	27.7
packing	carton packaging and labeling	1	64.5	66.8	63.9	64.8	64.2	66.8	63.9	66.1	67.6	68.1	65.7	65.7	100%	65.7	20%	78.8	45.7
																	Total=	**3040.80**	

Appendix B: Time study for Article no. V-6

Section	Activity Name	Part qty.	Cycle Time (single work)										Average time (single work)	Basic time (req. qty./bag)	Performance rating (Westinghouse)	Normal time (sec)	Allowance (ILO recom.)	Standard time (sec)	Hourly output
			1	2	3	4	5	6	7	8	9	10							
cutting	cutting leather body*3	3	10.2	9.8	12.5	9.6	14.8	11.5	10.8	10.4	16.8	11.6	11.8	35.4	100%	35.4	20%	42.5	84.75
cutting	cutting leather inside zip pocket opening part*1	1	10.8	10.2	14.2	11.4	6.4	6.7	6.3	6.5	8.9	7.7	8.9	8.9	100%	8.9	20%	10.7	336.70
cutting	cutting leather for cc pocket*5 (hand cutting)	5	7.6	6.5	4.5	8.5	7.9	6.3	4.8	9.4	6.4	6.1	6.8	34.0	100%	34.0	20%	40.8	88.24
cutting	cutting leather puller*4	4	2.3	3.1	7.5	3.3	6.9	3.1	5.5	2.8	2.4	2.7	4.0	15.8	100%	15.8	20%	19.0	189.39
cutting	cutting leather zipper stopper*3	3	2.5	3.2	4.5	3.5	4.6	2.9	4.8	2.7	7.3	2.8	3.9	11.6	100%	11.6	20%	14.0	257.73
cutting	cutting leather handle*3 (hand cutting)	3	20.5	21.6	21.4	26.8	23.4	22.1	20.1	18.2	16.8	17.2	20.8	62.4	100%	62.4	20%	74.9	48.05
cutting	cutting leather handle base*4	4	2.5	6.2	4.5	3.5	4.6	2.9	4.8	2.7	2.3	2.8	3.7	14.7	100%	14.7	20%	17.7	203.80
cutting	cutting all lining*13 (hand cutting)	13	22.7	23.5	23.4	20.1	18.6	19.3	20.1	24.7	18.3	17.4	20.8	270.5	100%	270.5	20%	324.6	11.09
cutting	reinforcement cutting*7	7	19.1	23.2	19.9	23.0	20.3	20.8	19.6	24.2	22.5	19.7	21.2	148.6	100%	148.6	20%	178.3	20.19
cutting	skiving leather body*3	3	20.4	20.6	20.7	20.2	20.1	20.2	20.3	21.8	23.5	22.9	21.1	63.2	100%	63.2	20%	75.9	47.46
cutting	splitting leather for cc pocket*5	5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	5.0	100%	5.0	20%	6.0	600.00
cutting	skiving leather for cc pocket*5	5	9.0	8.2	7.6	7.1	7.2	12.2	6.8	7.1	7.3	6.6	7.9	39.6	100%	39.6	20%	47.5	75.85
cutting	skiving short handle leather*2	2	11.7	12.7	12.2	11.8	12.2	11.1	11.3	13.6	12.4	12.1	12.1	24.2	100%	24.2	20%	29.1	123.86
cutting	splitting leather inside zip pocket opening part*1	1	2.2	2.3	4.5	6.1	2.1	2.3	2.1	2.5	2.4	2.1	2.9	2.9	100%	2.9	20%	3.4	1048.95
cutting	splitting leather small pullers*3	3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	100%	3.0	20%	3.6	1000.00
cutting	splitting leather piece for handle base*4	4	3.2	3.3	3.1	2.9	6.5	2.3	2.8	2.7	2.9	7.4	3.7	14.8	100%	14.8	20%	17.8	202.16
cutting	pattern paper cutting for packaging*3	3	7.6	6.5	7.7	8.5	7.9	6.3	7.9	9.1	7.4	7.1	7.6	22.8	100%	22.8	20%	27.4	131.58
sewing	front top inside front: cutting zipper with proper length and bending one edge*1	1	25.3	25.8	28.1	26.5	25.6	25.7	25.8	29.8	25.3	25.4	26.3	26.3	100%	26.3	20%	31.6	113.94
sewing	front top inside front: gluing lining and folding*1	1	18.8	15.6	17.3	18.1	19.3	15.6	17.6	15.2	14.8	14.5	16.7	16.7	100%	16.7	20%	20.0	179.86
sewing	front top inside front: gluing on facing leather grain side to join zipper*1	1	6.6	5.3	8.4	7.6	9.2	5.2	5.1	5.4	5.2	5.3	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	front top inside front: gluing on lining to join zipper back side*1	1	9.3	9.5	10.3	9.1	10.2	9.9	10.5	10.7	13.8	13.4	10.7	10.7	100%	10.7	20%	12.8	281.16
sewing	front top opening: insert runner*1	1	13.2	18.3	15.3	13.4	13.3	13.5	13.6	12.9	14.5	15.3	14.3	14.3	100%	14.3	20%	17.2	209.35
sewing	front top opening: gluing on leather stopper*1	1	6.9	6.8	6.9	6.2	6.5	6.9	7.5	7.2	6.6	6.5	6.8	6.8	100%	6.8	20%	8.2	441.18
sewing	front top opening: gluing on zipper edge*1	1	6.1	6.0	6.3	6.2	5.7	5.8	5.8	6.1	6.2	5.8	6.0	6.0	100%	6.0	20%	7.2	500.00
sewing	front top opening: setting leather stopper	1	11.2	10.8	11.3	9.8	9.9	9.8	10.4	10.1	10.2	9.8	10.3	10.3	100%	10.3	20%	12.4	290.42

	with zipper*1																		
sewing	front top opening: sewing leather stopper*1	1	5.7	5.4	5.1	6.3	6.7	6.4	6.5	6.9	6.8	6.4	6.2	6.2	100%	6.2	20%	7.5	482.32
sewing	front top front opening: setting the zipper with facing leather*1	1	12.2	10.2	11.2	11.3	11.2	11.5	12.5	15.8	11.6	12.5	12.0	12.0	100%	12.0	20%	14.4	250.00
sewing	front top front opening: sewing facing leather& lining with zipper at middle*1	1	14.7	14.8	14.7	14.8	17.1	14.8	14.5	14.4	14.6	15.6	15.0	15.0	100%	15.0	20%	18.0	200.00
sewing	front top outside: gluing punch back side area and put reinforcement*1	1	10.2	10.3	9.8	9.1	9.5	9.8	9.5	9.3	9.7	9.5	9.7	9.7	100%	9.7	20%	11.6	310.24
sewing	front top outside: punch reinforcement, screw opening and attach lock*1	1	94.1	88.5	87.7	87.4	85.9	94.2	86.6	87.8	87.8	86.7	88.7	88.7	100%	88.7	20%	106.4	33.83
sewing	front top front leather part: gluing reinforcement to attach with leather back side top*1	1	8.1	7.9	10.2	7.7	8.2	7.9	7.8	8.3	9.4	7.9	8.3	8.3	100%	8.3	20%	10.0	359.71
sewing	front top front leather part: gluing leather part flesh side top to attach reinforcement*1	1	6.1	6.2	6.1	6.5	6.4	6.4	6.6	6.4	6.5	6.1	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	front top front leather part: joining reinforcement with leather part*1	1	15.8	14.5	14.8	14.5	14.6	14.0	14.1	14.8	14.7	14.9	14.7	14.7	100%	14.7	20%	17.6	204.50
sewing	front top front opening: gluing on front top leather flesh side to join facing leather*1	1	6.2	6.1	6.2	6.3	6.2	6.2	6.8	6.5	6.4	6.4	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	front top front opening: gluing on facing leather flesh side to join with front top leather*1	1	7.8	7.6	7.7	7.7	9.2	9.1	7.8	7.6	7.8	7.7	8.0	8.0	100%	8.0	20%	9.6	375.00
sewing	front top front opening: setting zipped facing with front top leather part*1	1	31.8	32.2	32.4	31.4	31.5	31.6	30.8	30.4	30.2	31.0	31.3	31.3	100%	31.3	20%	37.6	95.75
sewing	front top front opening: sewing zipped facing with front top leather part*1	1	27.8	26.6	41.3	27.1	27.0	27.2	36.8	28.5	32.5	31.9	30.7	30.7	100%	30.7	20%	36.8	97.82
sewing	front top inside back: gluing cc lining*5	5	12.2	10.2	12.5	10.8	10.4	10.3	10.4	10.7	14.3	11.5	11.3	56.7	100%	56.7	20%	68.0	52.96
sewing	front top inside back: gluing cc leather*5	5	8.2	8.4	12.6	10.7	9.6	9.9	10.3	10.1	10.6	9.7	10.0	50.1	100%	50.1	20%	60.1	59.94
sewing	front top inside back: setting lining with cc leather*5	5	6.1	6.1	6.3	6.2	6.2	6.2	6.1	6.2	7.1	6.8	6.3	31.7	100%	31.7	20%	38.0	94.79
sewing	front top inside back: gluing to top folding each cc*5	5	9.8	8.5	8.6	8.4	8.3	8.1	8.6	8.9	9.2	8.3	8.7	43.4	100%	43.4	20%	52.0	69.20
sewing	front top inside back: sewing each cc top*5	5	6.4	5.8	5.9	5.8	5.7	5.4	5.6	5.2	5.4	5.5	5.7	28.4	100%	28.4	20%	34.0	105.82
sewing	front top inside back: adhesive tape on bottom of cc lining*4	4	8.8	8.9	8.9	8.9	14.4	8.8	8.8	8.4	8.5	8.9	9.3	37.3	100%	37.3	20%	44.8	80.39
sewing	front top inside back: setting cc top and cc-1,2,3 to sewing*3	3	23.4	23.3	26.8	23.3	23.4	23.8	23.7	24.2	24.8	26.6	24.3	73.0	100%	73.0	20%	87.6	41.10
sewing	front top inside back: sewing cc top with cc-1,2,3 together*3	3	8.8	8.4	8.4	7.8	7.9	7.6	7.4	6.8	6.7	6.9	7.7	23.0	100%	23.0	20%	27.6	130.38
sewing	front top inside back: gluing on cc left & right side and cc penal to setting together*1	1	13.6	13.1	13.4	13.8	13.7	12.8	13.9	15.4	13.6	13.4	13.7	13.7	100%	13.7	20%	16.4	219.46
sewing	front top inside back: setting cc penal*1	1	20.2	20.3	20.5	20.4	26.3	20.2	20.4	20.5	20.5	20.7	21.0	21.0	100%	21.0	20%	25.2	142.86
sewing	front top inside back: net cut cc pocket and	1	35.6	35.4	35.4	48.1	35.2	35.1	35.4	35.5	35.1	39.2	37.0	37.0	100%	37.0	20%	44.4	81.08

	marking for middle stitch*1																		
sewing	front top inside back: masking taping on cc set to do proper middle stitch*1	1	10.2	8.6	6.6	6.4	6.5	6.9	6.8	6.8	11.5	9.7	8.0	8.0	100%	8.0	20%	9.6	375.00
sewing	front top inside back: sewing middle stitch*1	1	10.8	11.1	11.0	11.6	11.4	10.8	10.0	8.9	8.9	8.8	10.3	10.3	100%	10.3	20%	12.4	290.42
sewing	front top inside back: thread burn of middle stitch extra thread*1	1	13.5	17.6	17.4	16.1	15.8	15.2	15.3	16.5	16.2	16.4	16.0	16.0	100%	16.0	20%	19.2	187.50
sewing	front top inside back: marking lining to join cc pocket*1	1	12.1	12.6	12.2	12.5	14.5	10.4	17.5	10.6	10.4	10.5	12.3	12.3	100%	12.3	20%	14.8	243.31
sewing	front top inside back: sewing cc pocket with lining*1	1	90.6	91.5	85.6	84.6	85.6	84.4	84.9	84.5	84.2	84.1	86.0	86.0	100%	86.0	20%	103.2	34.88
sewing	front top back opening: adhesive tape on cc attached lining to join zipper*1	1	11.5	11.6	11.4	11.5	10.8	10.9	10.6	10.9	10.7	10.1	11.0	11.0	100%	11.0	20%	13.2	272.73
sewing	front top back opening: setting lining with zipper*1	1	11.5	11.4	11.8	11.2	11.6	11.2	11.0	11.3	12.6	16.4	12.0	12.0	100%	12.0	20%	14.4	250.00
sewing	front body leather: gluing leather part top and bottom to fix reinforcement*1	1	14.6	13.5	14.4	14.2	19.5	20.5	11.4	11.6	11.7	11.9	14.3	14.3	100%	14.3	20%	17.2	209.35
sewing	front body leather: gluing on reinforcement to be fixed with leather part*2	2	6.6	6.4	5.4	5.3	5.5	5.6	5.6	5.4	5.6	5.3	5.7	11.3	100%	11.3	20%	13.6	264.55
sewing	front body leather: joining two reinforcements with leather part*1	1	28.6	29.5	29.8	29.6	27.5	27.1	27.3	28.9	28.4	26.7	28.3	28.3	100%	28.3	20%	34.0	105.86
sewing	front body leather: gluing zipper attached lining to join with front body leather*1	1	11.9	12.2	11.4	11.7	16.4	12.7	13.3	13.5	12.8	10.8	12.7	12.7	100%	12.7	20%	15.2	236.78
sewing	front body leather: gluing leather on grain side to join zipper attached lining*1	1	13.2	12.2	12.2	12.1	12.5	12.1	12.4	13.7	13.3	13.0	12.7	12.7	100%	12.7	20%	15.2	236.78
sewing	front top back opening: setting front body leather with front top locked attached part*1	1	32.3	23.8	23.9	23.7	23.9	23.4	23.6	35.2	23.8	23.1	25.7	25.7	100%	25.7	20%	30.8	116.87
sewing	front top back opening: sewing tag stitch left & right side*1	1	26.9	26.4	26.3	26.6	26.4	26.6	26.4	36.1	25.9	25.7	27.3	27.3	100%	27.3	20%	32.8	109.77
sewing	front top inside: scotch tape on lock metal back side*1	1	8.8	7.8	10.1	10.2	7.6	7.6	8.5	7.4	7.6	7.9	8.4	8.4	100%	8.4	20%	10.0	359.28
sewing	front top inside: gluing left & right side and bottom side to get pocket closed*1	1	60.4	60.6	60.5	56.4	56.8	57.1	57.3	57.9	62.1	64.2	59.3	59.3	100%	59.3	20%	71.2	50.56
sewing	front top inside: setting and hammering to send to sewing*1	1	18.3	14.3	15.1	15.2	14.7	14.5	14.4	15.6	15.8	15.4	15.3	15.3	100%	15.3	20%	18.4	195.69
sewing	front top inside: sewing three sides to complete pocket*1	1	35.2	35.3	36.7	35.1	35.6	36.0	35.9	35.4	35.6	35.9	35.7	35.7	100%	35.7	20%	42.8	84.10
sewing	mobile pocket: gluing all 4 sides to folding*1	1	20.8	23.3	23.5	20.5	20.4	22.4	20.5	20.4	24.1	20.7	21.7	21.7	100%	21.7	20%	26.0	138.50
sewing	mobile pocket: folding all 4 sides*1	1	64.5	62.3	66.5	60.1	60.3	60.5	60.6	60.4	60.8	60.9	61.7	61.7	100%	61.7	20%	74.0	48.63
sewing	mobile pocket: adhesive tape on half area of two sides for folding double layer*1	1	10.0	10.6	10.4	10.2	8.7	10.2	9.8	9.1	9.2	8.5	9.7	9.7	100%	9.7	20%	11.6	310.24
sewing	mobile pocket: folding to get double layer*1	1	18.6	18.4	18.2	18.1	18.7	18.6	18.3	19.4	20.4	21.3	19.0	19.0	100%	19.0	20%	22.8	157.89
sewing	mobile pocket: sewing top side*1	1	9.9	9.9	10.8	10.3	10.8	10.7	11.5	13.2	9.8	9.8	10.7	10.7	100%	10.7	20%	12.8	281.16

sewing	mobile pocket: marking lining to setting mobile pocket*1	1	12.3	12.2	12.4	12.6	12.5	12.3	12.3	11.7	10.8	10.9	12.0	12.0	100%	12.0	20%	14.4	250.00
sewing	mobile pocket: gluing and putting reinforcement potti back side*2	2	5.1	5.2	5.3	5.1	5.5	5.6	5.6	5.1	5.6	5.2	5.3	10.7	100%	10.7	20%	12.8	281.43
sewing	mobile pocket: sewing mobile pocket with lining*1	1	85.3	84.6	84.2	83.4	85.2	86.1	85.7	85.3	86.1	84.6	85.1	85.1	100%	85.1	20%	102.1	35.27
sewing	mobile pocket: thread burning*1	1	15.6	15.8	15.2	14.9	18.7	14.7	14.6	16.6	17.2	16.7	16.0	16.0	100%	16.0	20%	19.2	187.50
sewing	inside zip pocket: marking lining for lip cut*1	1	18.7	18.6	16.9	16.7	21.6	18.2	17.6	17.8	16.9	17.0	18.0	18.0	100%	18.0	20%	21.6	166.67
sewing	inside zip pocket: gluing non-woven*1	1	16.5	17.5	17.2	17.3	18.3	18.1	17.8	17.6	16.5	16.5	17.3	17.3	100%	17.3	20%	20.8	173.11
sewing	inside zip pocket: setting non-woven on lining on lip cut area*1	1	11.2	11.2	11.8	10.7	10.6	10.5	11.6	11.5	10.2	10.7	11.0	11.0	100%	11.0	20%	13.2	272.73
sewing	inside zip pocket: cutting lip*1	1	12.8	13.1	13.2	13.1	14.2	13.8	13.2	13.4	13.2	13.4	13.3	13.3	100%	13.3	20%	16.0	224.89
sewing	inside zip pocket: gluing to make opening*1	1	19.5	19.8	19.4	22.4	26.1	21.8	21.4	22.8	21.7	21.9	21.7	21.7	100%	21.7	20%	26.0	138.38
sewing	inside zip pocket: folding to get opening*1	1	32.2	30.2	32.3	32.1	32.8	32.5	32.8	32.7	33.1	32.6	32.3	32.3	100%	32.3	20%	38.8	92.79
sewing	inside zip pocket: cut zipper with proper length*1	1	5.2	5.3	5.2	5.1	5.2	5.1	7.1	4.9	5.2	5.0	5.3	5.3	100%	5.3	20%	6.4	562.85
sewing	inside zip pocket: insert runner*1	1	6.3	6.5	6.6	5.6	5.4	5.5	5.1	5.4	5.1	5.2	5.7	5.7	100%	5.7	20%	6.8	529.10
sewing	inside zip pocket: gluing zipper to setting with opening*1	1	15.4	15.6	15.2	15.6	15.8	16.2	16.4	15.3	15.9	15.3	15.7	15.7	100%	15.7	20%	18.8	191.45
sewing	inside zip pocket: gluing opening to attach zipper*1	1	11.9	17.5	11.7	11.6	18.6	11.5	11.2	11.3	11.7	16.5	13.4	13.4	100%	13.4	20%	16.0	224.72
sewing	inside zip pocket: setting zipper*1	1	10.2	10.3	10.4	10.6	10.7	10.9	10.7	10.9	15.9	12.7	11.3	11.3	100%	11.3	20%	13.6	264.78
sewing	inside zip pocket inside: gluing zipper back side to join pocket lining*1	1	6.6	7.6	7.4	6.5	6.4	6.3	6.5	6.6	6.3	6.8	6.7	6.7	100%	6.7	20%	8.0	447.76
sewing	inside zip pocket inside: gluing pocket lining to join with zipper*1	1	13.2	15.8	13.2	13.5	12.4	14.9	13.8	13.8	13.3	12.7	13.7	13.7	100%	13.7	20%	16.4	219.56
sewing	inside zip pocket inside: setting inside pocket lining with opening*1	1	12.0	12.5	12.4	12.9	12.7	12.5	14.3	12.9	12.2	12.3	12.7	12.7	100%	12.7	20%	15.2	236.78
sewing	inside zip pocket opening: sewing all around*1	1	63.2	63.5	63.3	66.6	63.1	63.8	63.5	72.4	77.6	79.7	67.7	67.7	100%	67.7	20%	81.2	44.33
sewing	inside zip pocket inside: sewing left & right side to get pocket closed*1	1	45.6	45.0	45.8	45.3	44.2	41.2	45.6	45.8	55.9	65.6	48.0	48.0	100%	48.0	20%	57.6	62.50
sewing	back part zip pocket: gluing leather cut opening to join zipper*1	1	15.8	17.6	16.5	13.6	16.5	18.6	14.8	14.9	15.6	12.8	15.7	15.7	100%	15.7	20%	18.8	191.45
sewing	back part zip pocket: gluing zipper to join with leather cut opening*1	1	11.4	11.8	11.8	11.6	11.2	11.4	11.3	11.5	16.6	11.4	12.0	12.0	100%	12.0	20%	14.4	250.00
sewing	back part zip pocket: setting zipper on opening*1	1	91.8	91.6	91.8	90.5	91.5	88.5	87.2	86.3	84.2	93.3	89.7	89.7	100%	89.7	20%	107.6	33.46
sewing	back part zip pocket inside: gluing lining to join with opening*1	1	10.5	9.5	9.6	9.8	9.4	10.5	9.1	13.5	10.6	10.8	10.3	10.3	100%	10.3	20%	12.4	290.42
sewing	back part zip pocket inside: setting lining for pocket*1	1	12.8	12.1	13.0	10.8	10.3	11.6	11.5	11.6	12.9	13.4	12.0	12.0	100%	12.0	20%	14.4	250.00
sewing	back part zip pocket opening: sewing all around*1	1	62.5	62.8	68.6	64.5	69.5	67.1	61.5	61.6	67.3	61.3	64.7	64.7	100%	64.7	20%	77.6	46.39

sewing	back part zip pocket inside: sewing lining two sides to get pocket closed*1	1	41.2	41.5	45.6	46.6	41.1	41.8	41.5	42.3	40.6	41.1	42.3	42.3	100%	42.3	20%	50.8	70.87
sewing	back part body leather: gluing on top opening side to fix reinforcement*1	1	10.4	8.5	8.4	8.7	8.8	8.5	8.2	11.1	8.5	8.9	9.0	9.0	100%	9.0	20%	10.8	333.33
sewing	back part body leather: gluing reinforcement to be fixed with leather part*1	1	5.5	5.6	5.5	5.3	5.2	5.9	5.4	4.9	6.8	6.6	5.7	5.7	100%	5.7	20%	6.8	529.10
sewing	back part body leather: joining reinforcement with leather part*1	1	12.4	15.7	11.3	11.3	15.6	11.8	11.2	11.3	11.5	14.6	12.7	12.7	100%	12.7	20%	15.2	236.78
sewing	top opening: cut zipper with proper length*1	1	5.5	5.2	4.9	6.2	4.8	4.9	4.6	4.7	4.4	4.8	5.0	5.0	100%	5.0	20%	6.0	600.00
sewing	top opening: insert runner*1	1	6.5	6.1	6.4	7.6	5.8	6.6	6.4	6.2	6.8	4.9	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	top opening: gluing leather stopper*1	1	7.6	5.5	7.1	5.6	5.5	5.7	5.9	5.7	5.9	8.8	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	top opening: gluing zipper edge*1	1	5.5	5.5	5.9	5.6	8.6	7.4	7.6	9.6	5.6	6.4	6.8	6.8	100%	6.8	20%	8.1	443.13
sewing	top opening: setting leather stopper with glued zipper edge*1	1	7.5	8.5	9.0	7.5	7.3	7.2	7.4	7.2	7.9	10.5	8.0	8.0	100%	8.0	20%	9.6	375.00
sewing	top opening: sewing leather stopper*1	1	7.6	8.6	9.5	6.6	7.2	6.3	6.8	10.5	8.3	15.3	8.7	8.7	100%	8.7	20%	10.4	346.02
sewing	top opening: bending zipper on another edge*1	1	18.6	18.6	18.4	18.2	18.6	18.4	18.7	20.3	24.2	26.5	20.1	20.1	100%	20.1	20%	24.1	149.63
sewing	top opening: gluing front and back leather body part on opening side to attach zipper*2	2	18.3	18.2	25.3	21.5	20.6	23.5	25.5	21.3	25.6	20.2	22.0	44.0	100%	44.0	20%	52.8	68.18
sewing	top opening: gluing on zipper to be attached with front and back leather body part*1	1	12.6	12.4	11.8	11.7	11.6	10.4	10.6	10.5	10.9	10.8	11.3	11.3	100%	11.3	20%	13.6	264.78
sewing	top opening: setting front and back body part with zipper*1	1	47.6	45.6	45.6	45.2	45.5	45.9	49.6	50.3	55.6	45.8	47.7	47.7	100%	47.7	20%	57.2	62.93
sewing	top opening: gluing mobile and inside zip pocket attached lining on opening area*2	2	9.6	9.8	9.4	8.9	8.8	8.3	8.7	7.9	7.5	7.8	8.7	17.3	100%	17.3	20%	20.8	173.01
sewing	top opening: gluing on zipper to join mobile and inside zip pocket attached lining*1	1	9.8	10.9	10.6	10.9	9.5	9.1	9.5	9.7	9.8	9.9	10.0	10.0	100%	10.0	20%	12.0	300.90
sewing	top opening: joining mobile and inside zip pocket attached lining with zipper*1	1	36.5	33.3	33.5	33.8	33.9	33.4	32.9	32.0	38.8	38.6	34.7	34.7	100%	34.7	20%	41.6	86.53
sewing	top opening: sewing*1	1	43.6	43.8	43.2	43.8	44.2	43.8	45.7	49.4	45.3	43.9	44.7	44.7	100%	44.7	20%	53.6	67.16
sewing	leather bag: edge chemical apply on each raw edges*1	1	75.6	78.6	79.6	80.6	106.3	77.4	77.8	76.9	74.6	72.7	80.0	80.0	100%	80.0	20%	96.0	37.50
sewing	leather bag: gluing front and back part leather three grain sides*2	2	28.6	29.6	28.6	28.7	28.4	26.4	26.5	27.5	27.1	28.6	28.0	56.0	100%	56.0	20%	67.2	53.57
sewing	leather bag: setting front & back part leather by grain side face to face*1	1	13.7	11.4	12.5	12.8	14.2	13.5	13.8	13.6	13.1	14.9	13.4	13.4	100%	13.4	20%	16.0	224.72
sewing	leather bag: sewing to complete leather bag*1	1	62.3	62.4	60.5	60.6	60.3	60.1	60.5	60.3	62.6	60.5	61.0	61.0	100%	61.0	20%	73.2	49.18
sewing	leather bag: gluing left & right bottom corner and flatten by hammering to cross stitch*1	1	40.6	41.7	41.5	41.9	44.8	41.3	41.9	41.2	41.5	40.2	41.7	41.7	100%	41.7	20%	50.0	72.01

sewing	leather bag: sewing left & right bottom corner cross stitch*1	1	92.3	92.8	93.1	93.4	90.3	91.5	95.6	89.6	92.6	92.1	92.3	92.3	100%	92.3	20%	110.8	32.49
sewing	leather bag: sewing to complete lining bag and keep little open area at bottom*1	1	102.5	93.7	92.6	95.3	90.3	90.2	90.4	90.6	90.8	90.3	92.7	92.7	100%	92.7	20%	111.2	32.37
sewing	leather bag: turn around*1	1	104.2	99.7	102.7	102.6	100.5	102.6	102.9	101.3	102.3	104.5	102.3	102.3	100%	102.3	20%	122.8	29.32
sewing	leather bag: sewing lining bottom to close un-stitch area*1	1	58.8	61.8	59.6	59.5	58.9	57.2	59.6	59.3	59.7	58.9	59.3	59.3	100%	59.3	20%	71.2	50.56
sewing	leather bag: sewing rest of the un-stitch area to complete lining bag*1	1	25.8	22.3	20.4	20.8	20.4	19.7	19.6	21.5	19.7	19.8	21.0	21.0	100%	21.0	20%	25.2	142.86
sewing	handle base: marking body bag on left & right for punching point*1	1	17.6	17.9	16.8	16.2	16.4	16.3	16.5	16.2	16.7	16.2	16.7	16.7	100%	16.7	20%	20.0	179.86
sewing	handle base: gluing handle base leather to join together*2	2	10.3	11.2	13.2	11.2	11.5	15.6	14.1	12.3	14.2	13.1	12.7	25.3	100%	25.3	20%	30.4	118.39
sewing	handle base: joining handle base together*2	2	6.2	6.2	6.3	6.2	6.4	5.8	6.1	6.6	6.8	6.7	6.3	12.7	100%	12.7	20%	15.2	236.97
cutting	handle base: net cutting with punch*2	2	8.6	8.7	9.1	9.3	7.4	7.6	7.7	7.1	7.2	7.3	8.0	16.0	100%	16.0	20%	19.2	187.50
sewing	handle base: sewing all around*2	2	35.8	34.2	36.7	34.1	33.9	33.8	33.4	33.9	33.8	33.7	34.3	68.7	100%	68.7	20%	82.4	43.69
sewing	handle base: punch body part for inserting rivet*2	2	30.9	29.8	29.3	29.6	32.5	32.8	31.1	30.2	30.1	30.4	30.7	61.3	100%	61.3	20%	73.6	48.91
sewing	handle base: inserting rivet by inserting d-ring*2	2	22.8	22.6	22.6	22.4	22.4	23.5	23.6	22.6	22.3	21.8	22.7	45.3	100%	45.3	20%	54.4	66.20
sewing	handle base: rivet pressing*2	2	19.6	18.9	19.6	19.4	22.5	19.6	19.8	19.4	19.9	24.6	20.3	40.7	100%	40.7	20%	48.8	73.78
sewing	puller for front top pocket: adhesive tape and fold*1	1	7.7	6.5	6.9	5.6	5.4	5.9	5.5	5.9	5.8	8.1	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	puller for front top pocket: sewing on middle*1	1	10.9	14.2	10.8	10.1	10.4	10.6	10.7	10.0	8.4	10.6	10.7	10.7	100%	10.7	20%	12.8	281.16
sewing	puller for front top pocket: thread burn*1	1	14.1	14.6	13.8	12.5	12.3	12.1	12.7	12.5	12.6	12.8	13.0	13.0	100%	13.0	20%	15.6	230.77
sewing	puller for front top pocket: insert pulling o-ring to hang with runner*1	1	37.0	34.2	34.8	36.8	32.7	33.2	45.1	38.8	33.5	33.9	36.0	36.0	100%	36.0	20%	43.2	83.34
sewing	puller for back part zip pocket: gluing*1	1	7.3	6.4	6.9	6.3	8.6	6.2	7.4	7.1	7.5	6.3	7.0	7.0	100%	7.0	20%	8.4	428.57
sewing	puller for back part zip pocket: bending flesh to flesh sides*1	1	10.2	10.6	10.6	15.6	11.6	16.5	16.8	10.1	10.5	10.8	12.3	12.3	100%	12.3	20%	14.8	243.31
cutting	puller for back part zip pocket: net cutting*1	1	8.7	8.6	8.9	8.1	8.5	8.6	8.6	7.9	7.1	8.6	8.4	8.4	100%	8.4	20%	10.0	358.85
sewing	puller for back part zip pocket: sewing all around*1	1	10.5	10.6	10.4	10.9	15.8	14.5	10.0	10.3	14.6	15.7	12.3	12.3	100%	12.3	20%	14.8	243.31
sewing	puller for back part zip pocket: thread burn*1	1	11.6	12.9	14.8	16.8	13.2	12.5	11.6	11.8	11.9	19.6	13.7	13.7	100%	13.7	20%	16.4	219.46
sewing	puller for back part zip pocket: insert pulling o-ring to hang with runner*1	1	36.8	35.6	35.4	34.7	34.9	34.6	32.7	33.4	32.4	39.5	35.0	35.0	100%	35.0	20%	42.0	85.71
sewing	puller for top opening: gluing*1	1	21.4	20.6	20.8	18.2	19.6	19.4	15.6	16.5	16.8	17.8	18.7	18.7	100%	18.7	20%	22.4	160.69
sewing	puller for top opening: bending flesh to flesh sides*1	1	14.6	14.8	14.7	14.7	14.6	14.5	14.9	15.1	14.3	14.5	14.7	14.7	100%	14.7	20%	17.6	204.50
cutting	puller for top opening: net cutting with lock hole punching*1	1	11.9	10.5	10.5	10.4	10.4	10.6	10.5	10.5	10.5	10.9	10.7	10.7	100%	10.7	20%	12.8	281.16

sewing	puller for top opening: sewing all around*1	1	19.3	18.5	18.2	16.3	16.1	16.5	16.8	16.2	16.5	18.9	17.3	17.3	100%	17.3	20%	20.8	173.11
sewing	puller for top opening: thread burning*1	1	12.2	11.5	10.2	8.9	10.4	10.2	15.1	10.8	16.9	10.5	11.7	11.7	100%	11.7	20%	14.0	257.07
sewing	puller for top opening: lock hole metal attaching and fixing*1	1	73.6	72.4	72.6	78.4	71.7	74.5	75.6	76.2	83.6	84.7	76.3	76.3	100%	76.3	20%	91.6	39.30
sewing	puller for top opening: insert pulling o-ring to hang with runner*1	1	33.6	33.5	36.5	33.9	34.5	37.9	36.5	38.4	38.6	39.9	36.3	36.3	100%	36.3	20%	43.6	82.58
sewing	short handle: gluing leather*2	2	28.6	30.7	29.8	30.7	28.6	28.9	28.4	28.5	28.1	27.6	29.0	58.0	100%	58.0	20%	69.6	51.74
sewing	short handle: folding leather*2	2	49.7	48.9	45.2	46.5	46.6	46.6	46.5	46.8	52.1	57.8	48.7	97.3	100%	97.3	20%	116.8	30.82
sewing	short handle: ends folding and make good corner by trimming extra folded leather*2	2	54.7	57.2	58.4	53.2	54.4	54.8	53.6	59.3	55.2	55.9	55.7	111.3	100%	111.3	20%	133.6	26.94
sewing	short handle: joining two parts together*1	1	83.5	75.8	78.9	66.3	67.9	68.2	70.2	79.3	64.2	65.7	72.0	72.0	100%	72.0	20%	86.4	41.67
sewing	short handle: sewing all around*1	1	35.2	36.4	32.3	35.2	35.1	35.8	32.5	32.6	32.4	35.8	34.3	34.3	100%	34.3	20%	41.2	87.39
sewing	short handle: thread burning*2 sides	2	10.1	9.9	9.6	9.2	10.0	10.2	10.1	12.6	11.1	10.5	10.3	20.7	100%	20.7	20%	24.8	145.21
sewing	short handle: gluing two ends for dog hook loop*1	1	8.2	8.8	8.6	8.4	7.9	7.4	7.5	7.3	8.1	7.8	8.0	8.0	100%	8.0	20%	9.6	375.00
sewing	short handle: inserting dog hook and make loop both sides and hammering*1	1	46.3	59.6	45.4	45.6	45.2	45.8	59.1	55.9	45.7	48.1	49.7	49.7	100%	49.7	20%	59.6	60.40
sewing	short handle: sewing all around at both ends with dog hook*1	1	120.5	113.2	106.7	113.5	113.4	112.4	112.3	112.5	112.8	112.7	113.0	113.0	100%	113.0	20%	135.6	26.55
sewing	short handle: thread burning at both ends loop area*1	1	60.3	52.8	58.4	56.7	55.8	55.4	58.6	56.2	57.6	55.1	56.7	56.7	100%	56.7	20%	68.0	52.92
sewing	long handle: sewing by guide*1	1	38.9	40.5	39.3	39.1	40.6	39.7	39.2	40.4	39.4	39.6	39.7	39.7	100%	39.7	20%	47.6	75.62
sewing	long handle: gluing both ends on leather part for folding and gluing for dog hook loop*1	1	9.8	10.7	14.0	9.4	9.8	9.2	9.6	10.5	11.9	11.8	10.7	10.7	100%	10.7	20%	12.8	281.16
sewing	long handle: insert dog hook, adjuster by folding leather ends and make loop*1	1	50.4	45.8	46.6	44.5	44.8	44.2	47.6	45.2	45.1	45.8	46.0	46.0	100%	46.0	20%	55.2	65.22
sewing	long handle: sewing both ends*1	1	40.9	40.3	40.6	40.7	40.5	40.3	45.6	45.2	41.1	41.8	41.7	41.7	100%	41.7	20%	50.0	71.94
sewing	tag leather: emboss*1	1	19.8	22.5	22.6	22.8	22.4	22.1	21.8	21.6	21.5	20.6	21.8	21.8	100%	21.8	20%	26.1	137.80
sewing	tag leather: insert chain through handle base d-ring and fix*1	1	6.1	5.9	6.2	5.8	6.6	6.7	6.4	7.8	5.7	6.1	6.3	6.3	100%	6.3	20%	7.6	473.93
sewing	inserting all pullers and tag leather with bag*4	4	77.7	79.4	96.3	78.6	78.1	78.9	78.0	81.7	78.6	81.2	80.9	323.4	100%	323.4	20%	388.1	9.28
finishing	finishing and cleaning work	1	370.2	368.5	356.3	370.2	371.2	370.6	370.5	359.6	362.9	366.9	366.7	366.7	100%	366.7	20%	440.0	8.18
finishing	final qc	1	165.9	145.5	122.3	82.6	96.3	198.6	101.8	220.6	176.5	130.5	144.1	144.1	100%	144.1	20%	172.9	20.82
finishing	labeling, tissue, silica gel, poly packaging	1	108.1	108.6	108.4	108.9	108.0	108.4	108.3	107.5	108.9	108.4	108.4	108.4	100%	108.4	20%	130.0	27.69
finishing	carton packaging and labeling	1	62.9	62.8	63.4	63.5	64.2	63.8	66.5	69.1	68.4	72.1	65.7	65.7	100%	65.7	20%	78.8	45.68
																	Total=	**6364.1**	

Appendix C: Improved Time Study for Article no. V-6

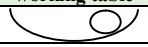
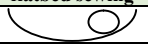
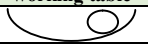
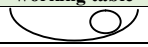
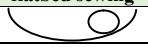
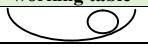
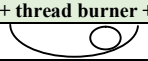
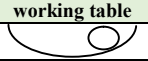
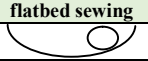
Section	Description	Category	Time (sec)	Scope of improvement	Applied techniques	Time study after improvements done (sec)										Average time	Allowance (20%)
sewing	front top inside back: arranging cc lining & leather 3 pcs each to apply glue	VA	-		1 new worker assigned	19.4	19.7	20.2	19.8	19.6	20.9	22.6	19.6	19.8	20.1	20.2	24.2
sewing	front top inside back: gluing cc lining*5	VA	68.0	improved	3 pcs together	11.8	13.4	11.1	12.4	12.1	12.6	11.7	11.9	11.5	12.8	12.1	14.6
sewing	front top inside back: gluing cc leather*5	VA	60.1	improved	3 pcs together	9.6	9.9	9.1	9.5	9.8	10.4	9.5	9.3	9.5	9.6	9.6	11.5
sewing	front top inside back: gluing to top folding each cc*5	VA	52.0	improved	3 pcs together	36.7	37.9	36.5	36.2	36.5	36.6	36.8	36.7	37.2		36.8	44.1
sewing	front top inside back: net cut cc pocket and marking for middle stitch*1	VA	44.4	marking eliminated	using pin	24.6	25.4	23.9	24.7	24.4	25.4	25.6	25.3	25.7	26.4	25.1	30.2
sewing	front top inside: scotch tape on lock metal back side*1	VA	10.0	improved	using tape holder	6.2	6.3	5.9	6.4	6.3	6.3	6.3	5.9	6.2	6.5	6.2	7.5
sewing	mobile pocket: marking lining to setting mobile pocket*1	NNVA	14.4	marking eliminated	using working pattern												
sewing	inside zip pocket: marking lining for lip cut*1	VA	21.6	marking eliminated	using working pattern												
sewing	handle base: marking body bag on left & right for punching point*1	NNVA	20.0	marking eliminated	using working pattern												
sewing	handle base: punch body part for inserting rivet*2	VA	73.6	extra time for using working pattern		36.2	38.7	36.5	36.9	36.4	36.8	35.9	36.1	37.5	34.2	36.5	87.6
finishing	finishing and cleaning work	NVA	440.0	Eliminated all marking. So no need to clean marking ink. In-line QC implemented		180.9	160.1	191.6	100.7	250.3	199.2	165.6	223.6	180.4	170.2	182.3	218.7
finishing	final qc	Inspection	172.9			98.2	114.6	93.7	65.4	157.6	78.2	93.4	68.2	72.1	93.7	93.5	112.2

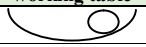
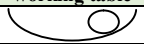
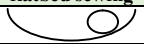
Appendix D: Line balancing work stations for article no. V-5

Required machinery and tools : Flatbed sewing-9, Post bed sewing-2, Cylinder bed sewing-1, Thread burner-2, Cutting mat-1, Working table-22

Line balancing efficiency : 72.57%, Pre-assembly work: Station 1-5

long handle: sewing by guide*1	47.6	puller for top opening: gluing*1	22.4	top opening: cut zipper with proper length*1	6.0
		puller for top opening: folding flesh to flesh sides*1	17.6	top opening: insert runner*1	7.6
				top opening: gluing leather stopper*2	15.20
		long handle: insert dog hook, adjuster by folding leather ends and make loop*1	55.2	top opening: gluing zipper both edges*1	18.00
				top opening: setting leather stoppers with glued zipper both edges*1	22.80
				long handle: gluing both ends on leather part for folding and gluing for dog hook loop*1	12.8
		**transportation puller to st-4 for all around sewing		**transportation long handle to st-7 for sewing both ends	
flatbed sewing		**working table**		**working table**	
	47.60		**95.20**		**82.40**
Station-1 (independent station for long handle weaving stitch)		**Station-2 (independent station for puller leather part gluing)**		**Station-3 (independent station for zipper length and onward)**	
puller for top opening: sewing all around*1	20.80	puller for top opening: lock hole metal attaching and fixing*1	91.6	body leather: gluing leather part top and bottom to fix reinforcement*1	17.2
top opening: sewing leather stoppers*2	23.20			body leather: gluing on reinforcement to be fixed with leather part*2	13.6
**transportation puller to st-5 hole metal fixing				body leather: joining two reinforcements with leather part*1	34.0
**transportation stopper attached zipper to st-26		**transportation puller to st-33 to join o-ring			
flatbed sewing		**working table**		**working table**	
	44.00		**91.60**		**64.80**
Station -4		**Station-5**		**Station-6 (independent station)**	
body leather: sewing both corner by grain side face to face*2	50.40	body leather: gluing both stitched corner flesh side to fold allowance*2	32.80	body leather: punch reinforcement, screw opening and attach lock*1	106.40
		body leather: folding and hammering allowance at both corner*2	36.80		
long handle: sewing both ends*1	50.0	body leather: gluing punch back side area and put reinforcement*1	11.60		
		handle base: gluing leather flesh side*2	26.4		
		handle base: joining two leather part by flesh side*1	8.8		
		**transportation handle base to st-10 to net cutting		**transportation body leather to st-26 for gluing top opening	
Cylinder bed sewing		**working table**		**working table**	
	100.40		**116.40**		**106.40**
Station-7		**Station-8 (independent station for handle base)**		**Station-9**	

handle base: net cutting*2	38.40	body leather & handle base: setting handle base with body leather and hammering*2	18.40	inside cc pocket: gluing cc lining*5	68.00
		body leather & handle base: sewing handle base with body leather*2	84.00		
handle base: gluing both ends to make loop*2	10.4				
handle base: inserting d-ring and joining ends together and hammering*2	32.00				
body leather & handle base: gluing body leather to join handle base*2	12.0				
body leather & handle base: gluing handle base to be joint with body leather*2	12.0	**transportation handle base to st-26 for gluing top opening			
working table		**Post bed sewing**		**working table**	
	**104.80**		**102.40**		**68.00**
Station-10		**Station-11**		**Station-12 (independent station)**	
inside cc pocket: gluing cc leather*5	60.00	inside cc pocket: gluing and folding at top of each cc*5	52.0	inside cc pocket: sewing each cc top*5	34.0
		inside cc pocket: adhesive tape on bottom of cc lining*4	44.8		
inside cc pocket: setting lining with cc leather*5	38.0				
working table		**flatbed sewing**		**working table**	
	**98.00**		**96.80**		**34.00**
Station-13		**Station-14**		**Station-15**	
inside cc pocket: setting cc top and cc-1,2,3 to sewing*3	87.60	inside cc pocket: sewing cc top with cc-1,2,3 together*3	27.6	inside cc pocket: gluing on cc left & right side and cc penal to setting together*1	16.40
				inside cc pocket: setting cc penal*1	25.2
				inside cc pocket: masking taping on cc set to do proper middle stitch*1	9.6
				inside cc pocket: net cut cc pocket and marking for middle stitch*1	44.4
working table		**flatbed sewing**		**working table**	
	**87.60**		**27.60**		**95.60**
Station-16		**Station-17**		**Station-18**	
inside cc pocket: sewing middle stitch*1	12.4	inside cc pocket: marking lining to join cc pocket*1	14.80	inside cc pocket: sewing cc pocket with lining*1	103.2
inside cc pocket: thread burn of middle stitch extra thread*1	19.2	inside zip pocket: marking lining for lip cut*1	21.60		
		inside zip pocket: gluing non-woven*1	20.80		
inside zip pocket: cut zipper with proper length*1	6.4	inside zip pocket: setting non-woven on lining on lip cut area*1	13.20		
inside zip pocket: insert runner*1	6.8				
**transportation zipper to st-23 for gluing & setting and inside cc pocket to st-21		**transportation non-woven attached lining to st-22 for pocket lip cutting		**transportation cc pocket attached lining to st-28 for gluing at top opening	
flatbed sewing + thread burner + working table		**working table**		**flatbed sewing**	
	**44.80**		**70.40**		**103.20**
Station-19 (independent station for zipper length cutting)		**Station-20 (independent station)**		**Station-21**	

inside zip pocket: cutting lip*1	16.00	inside zip pocket: gluing zipper to setting with opening*1	18.8	inside zip pocket opening: sewing all around*1	81.20
inside zip pocket: gluing to make opening*1	26.00	inside zip pocket: gluing opening to attach zipper*1	16.0		
inside zip pocket: folding to get opening*1	38.80	inside zip pocket: setting zipper*1	13.60		
		inside zip pocket inside: gluing zipper back side to join pocket lining*1	8.0		
		inside zip pocket inside: gluing pocket lining to join with zipper*1	16.4		
		inside zip pocket inside: setting inside pocket lining with opening*1	15.2		
working table		**working table**		**flatbed sewing**	
	**80.80**		**88.00**		**81.20**
Station-22		**Station -23**		**Station -24**	
inside zip pocket inside: sewing left & right side to get pocket closed*1	57.60	top opening: gluing front and back leather body part on opening side to attach zipper*2	52.80	top opening: setting front and back body part with zipper*1	57.20
		top opening: gluing on zipper to be attached with front and back leather body part*1	13.60	top opening: gluing on zipper to join cc and inside zip pocket attached lining*1	12.00
		body leather: scotch tape on lock metal back side*1	10.00		
**transportation inside zip pocket attached lining to st-28 for gluing					
flatbed sewing		**working table**		**working table**	
	**57.60**		**76.40**		**69.20**
Station -25		**Station -26**		**Station -27**	
top opening: gluing two lining on opening area and cc pocket back for thread binding *2	20.80	top opening: sewing*1	53.60	lining bag: sewing lining all three sides to complete bag*1	73.2
top opening: joining cc and inside zip pocket attached lining with zipper*1	41.60				
working table		**flatbed sewing**		**flatbed sewing**	
	**62.40**		**53.60**		**73.20**
Station -28		**Station -29**		**Station -30**	
leather bag: gluing front and back part leather three flesh sides*2	67.2	leather bag: sewing to complete leather bag*1	73.2	puller for top opening: insert pulling o-ring to hang with runner*1	43.6
leather bag: setting front & back part leather by flesh sides face to face*1	16.00			inserting pullers at top opening*1	42.8
working table		**post bed sewing**		**working table**	
	**83.20**		**73.20**		**86.40**
Station -31		**Station -32**		**Station -33**	
finishing work: thread burning	41.2	final qc	118.0	carton packaging and labeling	78.8
finishing and cleaning work	105.60	labeling, tissue, silica gel and poly packing	130.0		
working table + thread burner		**working table**		**small working table**	
	**146.80**		**248.00**		**78.80**
Station -34		**Station -35**		**Station -36**	

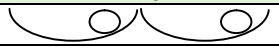
Appendix E: Line balancing work stations for article no. V-6

Required machinery and tools : Flatbed sewing-12, Post bed sewing-1, Cylinder bed sewing-2, Thread burner-4, Working Table-34

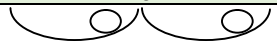
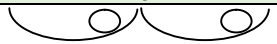
Line balancing efficiency : 88.26%, Pre-assembly work: Station 1-15

top opening: cut zipper with proper length*1	6.0	front top opening: gluing on leather stopper*1	8.2	puller for top opening: net cutting with lock hole punching*1	12.8
front top inside front: cutting zipper with proper length and bending one edge*1	31.6	top opening: gluing leather stopper*1	7.6	puller for back part zip pocket: net cutting*1	10.0
top opening: bending zipper on another edge*1	24.1	handle base: gluing handle base leather to join together*2	30.4	handle base: net cutting with punch*2	19.2
inside zip pocket: insert runner*1	6.8	front top opening: gluing on zipper edge*1	7.2		
top opening: insert runner*1	7.6	top opening: gluing zipper edge*1	8.1	transportation time to cutting section	80.0
front top opening: insert runner*1	17.2	handle base: joining handle base together*2	15.2		
puller for back part zip pocket: bending flesh to flesh sides*1	14.8	front top opening: setting leather stopper with zipper*1	12.4		
puller for top opening: bending flesh to flesh sides*1	17.6	top opening: setting leather stopper with glued zipper edge*1	9.6		
		puller for top opening: gluing*1	22.4		
		puller for back part zip pocket: gluing*1	8.4		
		puller for front top pocket: adhesive tape and fold*1	7.6		
working table		working table		working table	
	125.7		137.1		122.0
Station-1 (starting station for zipper cutting and pullers)		Station-2 (starting station for handle base, top opening)		Station-3	
handle base: sewing all around*2	82.4	puller for front top pocket: thread burn*1	15.6	puller for front top pocket: insert pulling o-ring to hang with runner*1	43.2
puller for front top pocket: sewing on middle*1	12.8	puller for back part zip pocket: thread burn*1	16.4	puller for back part zip pocket: insert pulling o-ring to hang with runner*1	42.0
puller for back part zip pocket: sewing all around*1	14.8	puller for top opening: thread burning*1	14.0	puller for top opening: insert pulling o-ring to hang with runner*1	43.6
puller for top opening: sewing all around*1	20.8				
		long handle: sewing by guide*1	47.6		
		front top opening: sewing leather stopper*1	7.5		
		top opening: sewing leather stopper*1	10.4		
		transportation long handle to the station- 8			
		transportation stitched stopper of front top opening to the station-16			
transportation handle base to the station- 44		transportation stitched stopper of top opening to the station- 33			
flatbed sewing machine		flatbed sewing machine and thread burner		working table	
	130.8		111.5		128.8
Station-4		Station-5		Station-6	

puller for top opening: lock hole metal attaching and fixing*1	91.6	short handle: gluing leather*2	69.6	short handle: folding leather*2	116.8
tag leather: emboss*1	26.1	long handle: gluing both ends on leather part for folding and gluing for dog hook loop*1	12.8		
tag leather: insert chain through handle base d-ring and fix*1	7.6	long handle: insert dog hook, adjuster by folding leather ends and make loop*1	55.2		
transportation pullers to the station- 45					
working table		working table		working table	
	125.3		137.6		116.8
Station-7 (starting station for tag leather)		Station-8 (starting station for short handle)		Station-9	
short handle: ends folding and make good corner by trimming extra folded leather*2	133.6	short handle: joining two parts together*1	86.4	short handle: sewing all around*1	41.2
				long handle: sewing both ends*1	50.0
working table		working table		flatbed sewing machine	
	133.6		86.4		91.2
Station-10		Station-11		Station-12	
short handle: thread burning*2 sides	24.8	short handle: sewing all around at both ends with dog hook*1	135.6	short handle: thread burning at both ends loop area*1	68.0
short handle: gluing two ends for dog hook loop*1	9.6				
short handle: inserting dog hook and make loop both sides and hammering*1	59.6			transportation short handle to the station- 46	
working table and thread burner		flatbed sewing machine		working table and thread burner	
	94.0		135.6		68.0
Station-13		Station-14		Station-15	
front top inside front: gluing on facing leather grain side to join zipper*1	7.6	front top front leather part: gluing reinforcement to attach with leather back side top*1	10.0	front top inside back: arranging cc lining & leather 3 pcs each to apply glue	24.2
front top inside front: gluing on lining to join zipper back side*1	12.8	front top front leather part: joining reinforcement with leather part*1	17.6		
front top inside front: gluing lining and folding*1	20.0	front top outside: punch reinforcement, screw opening and attach lock*1	106.4	front top inside back: gluing cc lining*5	14.6
front top front opening: setting the zipper with facing leather*1	14.4			front top inside back: gluing cc leather*5	11.5
front top outside: gluing punch back side area and put reinforcement*1	11.6			front top inside back: setting lining with cc leather*5	38.0
front top front leather part: gluing leather part flesh side top to attach reinforcement*1	7.6				
front top front opening: gluing on front top leather flesh side to join facing leather*1	7.6				
front top front opening: gluing on facing leather flesh side to join with front top leather*1	9.6				
front top front opening: setting zipped facing with front top leather part*1	37.6				
working table		working table		working table	
	128.8		134.0		88.3
Station-16 (starting station for front top inside front)		Station-17 (starting station for front top front leather part)		Station-18 (starting station for front top inside back)	

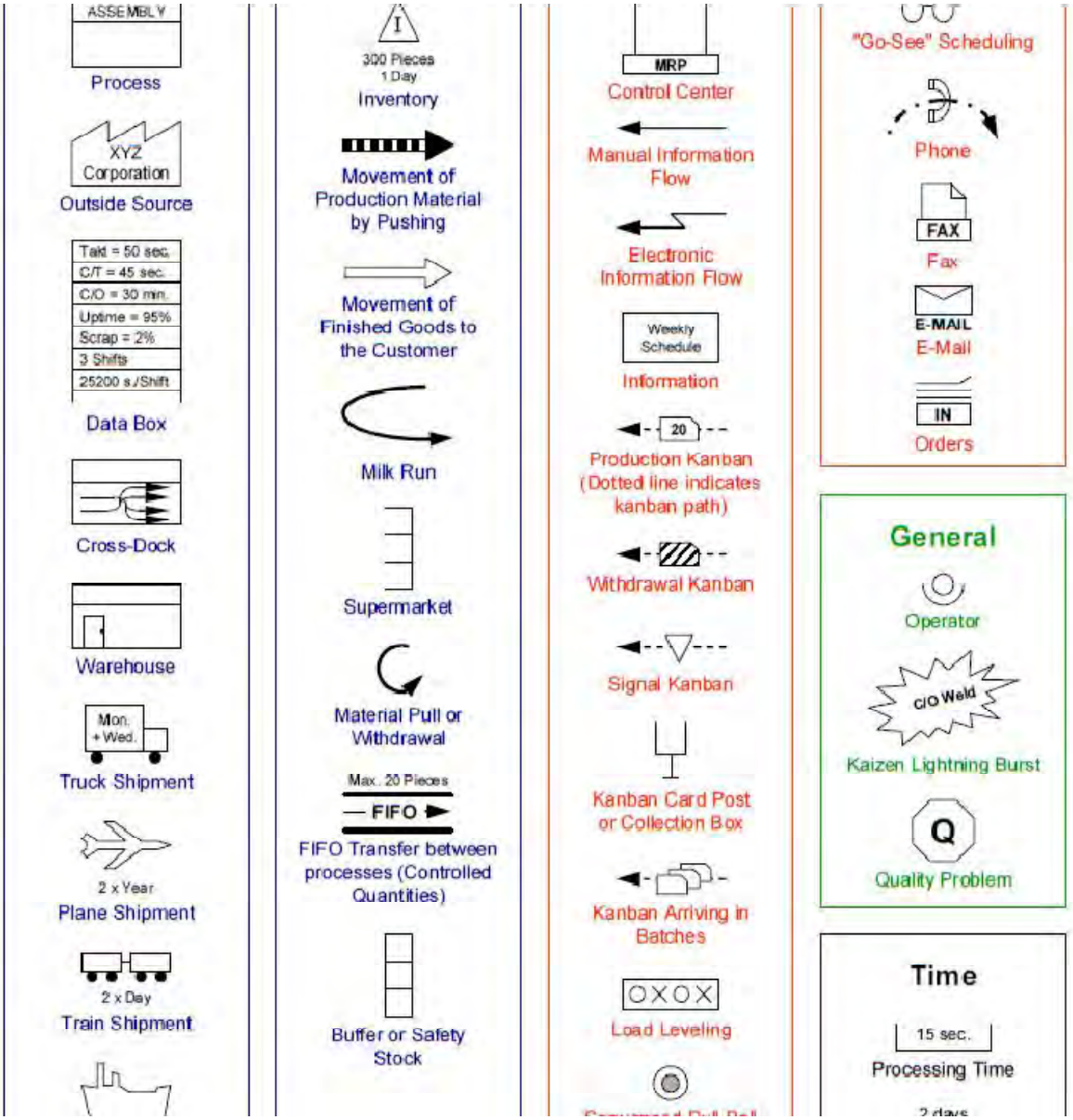
front top front opening: sewing facing leather & lining with zipper at middle*1	18.0	front top inside back: gluing to top folding each cc*5	44.1	front top inside back: sewing cc top with cc-1,2,3 together*3	27.6
front top front opening: sewing zipped facing with front top leather part*1	36.8				
front top inside back: sewing each cc top*5	34.0	front top inside back: setting cc top and cc-1,2,3 to sewing*3	87.6	front top inside back: sewing middle stitch*1	12.4
front top inside back: adhesive tape on bottom of cc lining*4	44.8			front top inside back: sewing cc pocket with lining*1	103.2
flatbed sewing machine		working table		flatbed sewing machine	
	133.6		131.7		143.2
Station-19		Station-20		Station-21	
front top inside back: gluing on cc left & right side and cc penal to setting together*1	16.4	front top back opening: adhesive tape on cc attached lining to join zipper*1	13.2	mobile pocket: gluing all 4 sides to folding*1	26.0
front top inside back: setting cc penal*1	25.2	front top back opening: setting lining with zipper*1	14.4		
front top inside back: net cut cc pocket and marking for middle stitch*1	30.2	front body leather: gluing leather part top and bottom to fix reinforcement*1	17.2	mobile pocket: folding to get double layer*1	22.8
front top inside back: masking taping on cc set to do proper middle stitch*1	9.6	front body leather: gluing on reinforcement to be fixed with leather part*2	13.6		
		front body leather: joining two reinforcements with leather part*1	34.0	mobile pocket: folding all 4 sides*1	74.0
front top inside back: thread burn of middle stitch extra thread*1	19.2	front body leather: gluing zipper attached lining to join with front body leather*1	15.2		
		front body leather: gluing leather on grain side to join zipper attached lining*1	15.2	mobile pocket: gluing and putting reinforcement potti back side*2	12.8
		mobile pocket: adhesive tape on half area of two sides for folding double layer*1	11.6		
working table		working table		working table	
	100.6		134.4		135.6
Station-22		Station-23 (starting station for front body leather)		Station-24 (starting station for mobile pocket)	
mobile pocket: sewing top side*1	12.8	front top back opening: setting front body leather with front top locked attached part*1	30.8	front top back opening: sewing tag stitch left & right sides*1	32.8
mobile pocket: sewing mobile pocket with lining*1	102.1			front top inside: setting and hammering to send to sewing*1	18.4
mobile pocket: thread burning*1	19.2	front top inside: scotch tape on lock metal back side*1	7.5	front top inside: sewing three sides to complete pocket*1	42.8
		front top inside: gluing left & right side and bottom side to get pocket closed*1	71.2	inside zip pocket: cut zipper with proper length*1	6.4
		inside zip pocket: cutting lip*1	16.0	transportation front bag to the station- 33	
flatbed sewing machine and thread burner		working table		Postbed sewing machine	
	134.1		125.5		100.4
Station-25		Station-26		Station-27	

inside zip pocket: gluing non-woven*1	20.8	inside zip pocket: setting zipper*1	13.6	inside zip pocket opening: sewing all around*1	81.2
inside zip pocket: setting non-woven on lining on lip cut area*1	13.2	inside zip pocket inside: gluing zipper back side to join pocket lining*1	8.0	inside zip pocket inside: sewing left & right side to get pocket closed*1	57.6
inside zip pocket: gluing to make opening*1	26.0	inside zip pocket inside: gluing pocket lining to join with zipper*1	16.4		
inside zip pocket: folding to get opening*1	38.8	inside zip pocket inside: setting inside pocket lining with opening*1	15.2		
inside zip pocket: gluing zipper to setting with opening*1	18.8				
inside zip pocket: gluing opening to attach zipper*1	16.0	back part zip pocket: gluing leather cut opening to join zipper*1	18.8		
		back part zip pocket: gluing zipper to join with leather cut opening*1	14.4		
		back part zip pocket inside: gluing lining to join with opening*1	12.4		
working table		working table		flatbed sewing machine	
	133.6		98.8		138.8
Station-28 (starting station for inside zip pocket)		Station-29		Station-30	
back part zip pocket: setting zipper on opening*1	107.6	back part zip pocket opening: sewing all around*1	77.6	back part body leather: gluing on top opening side to fix reinforcement*1	10.8
back part zip pocket inside: setting lining for pocket*1	14.4	back part zip pocket inside: sewing lining two sides to get pocket closed*1	50.8	back part body leather: gluing reinforcement to be fixed with leather part*1	6.8
				top opening: gluing mobile and inside zip pocket attached lining on opening area*2	20.8
				top opening: gluing on zipper to join mobile and inside zip pocket attached lining*1	12.0
				top opening: gluing front and back leather body part on opening side to attach zipper*2	52.8
				top opening: gluing on zipper to be attached with front and back leather body part*1	13.6
working table		flatbed sewing machine		working table	
	122.0		128.4		116.8
Station-31		Station-32		Station-33 (starting station for back part body leather)	
back part body leather: joining reinforcement with leather part*1	15.2	top opening: sewing*1	53.6	leather bag: edge chemical apply on each raw edges*1	96.0
top opening: joining mobile and inside zip pocket attached lining with zipper*1	41.6				
top opening: setting front and back body part with zipper*1	57.2				
working table		Cylinder bed sewing machine		working table	
	114.0		53.6		96.0
Station-34		Station-35		Station-36	

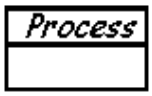
leather bag: gluing front and back part leather three grain sides*2	67.2	leather bag: sewing to complete leather bag*1	73.2	leather bag: gluing left & right bottom corner and flatten by hammering to cross stitch*1	50.0
leather bag: setting front & back part leather by grain side face to face*1	16.0				
working table		Cylinder bed sewing machine		working table	
	83.2		73.2		50.0
Station-37		Station-38		Station-39	
leather bag: sewing left & right bottom corner cross stitch*1	110.8	leather bag: sewing to complete lining bag and keep little open area at bottom*1	111.2	leather bag: turn around*1	122.8
flatbed sewing machine		flatbed sewing machine		working table	
	110.8		111.2		122.8
Station-40		Station-41		Station-42	
leather bag: sewing lining bottom to close un-stitch area*1	71.2	handle base: punch body part for inserting rivet*2	87.6	inserting all pullers and tag leather with bag*4	388.1
leather bag: sewing rest of the un-stitch area to complete lining bag*1	25.2	handle base: inserting rivet by inserting d-ring*2	54.4		
		handle base: rivet pressing*2	48.8		
flatbed sewing machine		working table		working table	
	96.4		190.8		388.1
Station-43		Station-44		Station-45	
finishing and cleaning work	218.7	final qc	112.2	labeling, tissue, silica gel, poly packaging	130.0
working table		working table		working table	
	218.7		112.2		130.0
Station-46		Station-47		Station-48	

carton packaging and labeling	78.8
working table	
	78.8
Station-49	

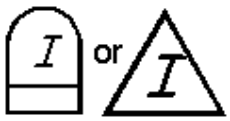
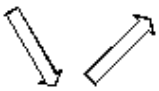
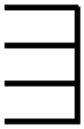
Appendix F: Symbols of VSM



VSM Process Symbols

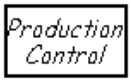
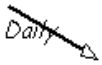
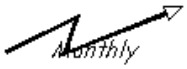
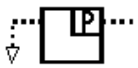
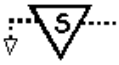
 **Customer/Supplier**	This icon represents the Supplier when in the upper left, the usual starting point for material flow. The customer is represented when placed in the upper right, the usual end point for material flow.
 **Dedicated Process**	This icon is a process, operation, machine or department, through which material flows. Typically, to avoid unwieldy mapping of every single processing step, it represents one department with a continuous, internal fixed flow path. In the case of assembly with several connected workstations, even if some WIP inventory accumulates between machines (or stations), the entire line would show as a single box. If there are separate operations, where one is disconnected from the next, inventory between and batch transfers, then use multiple boxes.
 **Shared Process**	This is a process operation, department or workcenter that other value stream families share. Estimate the number of operators required for the Value Stream being mapped, not the number of operators required for processing all products.
 **Data Box**	This icon goes under other icons that have significant information/data required for analyzing and observing the system. Typical information placed in a Data Box underneath FACTORY icons is the frequency of shipping during any shift, material handling information, transfer batch size, demand quantity per period, etc.
 **Workcell**	This symbol indicates that multiple processes are integrated in a manufacturing workcell. Such cells usually process a limited family of similar products or a single product. Product moves from process step to process step in small batches or single pieces.

VSM Material Symbols

 **Inventory**	These icons show inventory between two processes. While mapping the current state, the amount of inventory can be approximated by a quick count, and that amount is noted beneath the triangle. If there is more than one inventory accumulation, use an icon for each. This icon also represents storage for raw materials and finished goods.
 **Shipments**	This icon represents movement of raw materials from suppliers to the Receiving dock/s of the factory. Or, the movement of finished goods from the Shipping dock/s of the factory to the customers
 **Push Arrow**	This icon represents the "pushing" of material from one process to the next process. Push means that a process produces something regardless of the immediate needs of the downstream process.
 **Supermarket**	This is an inventory "supermarket" (kanban stockpoint). Like a supermarket, a small inventory is available and one or more downstream customers come to the supermarket to pick out what they need. The upstream workcenter then replenishes stocks as required. When continuous flow is impractical, and the upstream process must operate in batch mode, a supermarket reduces overproduction and limits total inventory.
 **Material Pull**	Supermarkets connect to downstream processes with this "Pull" icon that indicates physical removal.
 **FIFO Lane**	First-In-First-Out inventory. Use this icon when processes are connected with a FIFO system that limits input. An accumulating roller conveyor is an example. Record the maximum possible inventory.
 **Safety Stock**	This icon represents an inventory "hedge" (or safety stock) against problems such as downtime, to protect the system against sudden fluctuations in customer orders or system failures. Notice that the icon is closed on all sides. It is intended as a temporary, not a permanent storage of stock; thus; there should be a clearly-stated management policy on

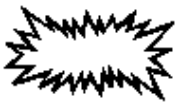
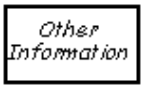
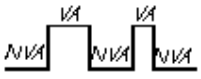
	when such inventory should be used.
 **External Shipment**	Shipments from suppliers or to customers using external transport.

2.24 VSM Information Symbols

 **Production Control**	This box represents a central production scheduling or control department, person or operation.
 **Manual Info**	A straight, thin arrow shows general flow of information from memos, reports, or conversation. Frequency and other notes may be relevant.
 **Electronic Info**	This wiggle arrow represents electronic flow such as electronic data interchange (EDI), the Internet, Intranets, LANs (local area network), WANs (wide area network). You may indicate the frequency of information/data interchange, the type of media used ex. fax, phone, etc. and the type of data exchanged.
 **Production Kanban**	This icon triggers production of a pre-defined number of parts. It signals a supplying process to provide parts to a downstream process.
 **Withdrawal Kanban**	This icon represents a card or device that instructs a material handler to transfer parts from a supermarket to the receiving process. The material handler (or operator) goes to the supermarket and withdraws the necessary items.
 **Signal Kanban**	This icon is used whenever the on-hand inventory levels in the supermarket between two processes drops to a trigger or minimum point. When a Triangle Kanban arrives at a supplying process, it signals a changeover and production of a predetermined batch size of the part noted on the Kanban. It is also referred as “one-per-batch” kanban.

 Kanban Post	A location where kanban signals reside for pickup. Often used with two-card systems to exchange withdrawal and production kanban.
 **Sequenced Pull**	This icon represents a pull system that gives instruction to subassembly processes to produce a predetermined type and quantity of product, typically one unit, without using a supermarket.
 **Load Leveling**	This icon is a tool to batch kanbans in order to level the production volume and mix over a period of time
 **MRP/ERP**	Scheduling using MRP/ERP or other centralized systems.
 **Go See**	Gathering of information through visual means.
 **Verbal Information**	This icon represents verbal or personal information flow.

VSM General Symbols

 **Kaizen Burst**	These icons are used to highlight improvement needs and plan kaizen workshops at specific processes that are critical to achieving the Future State Map of the value stream.
 **Operator**	This icon represents an operator. It shows the number of operators required to process the VSM family at a particular workstation.
 **Other**	Other useful or potentially useful information.
 **Timeline**	The timeline shows value added times (Cycle Times) and non-value added (wait) times. Use this to calculate Lead Time and Total Cycle Time.

Appendix G: Current State Operation Description for Article no. V-5

Sl.	Description	Category	Time (sec)	Distance (ft)
cutting	material selection, tracing and arrangement	NVA	600	
cutting	cutting leather body*2	VA	28.3	
cutting	cutting leather inside zip pocket opening part*1	VA	10.7	
cutting	cutting leather puller*2	VA	9.5	
cutting	cutting leather zipper stopper*2	VA	9.3	
cutting	Waiting	Waiting	83.0	
cutting	cutting leather for cc pocket*5 (hand cutting)	VA	40.8	
cutting	cutting leather handle*1 (hand cutting)	VA	25.0	
cutting	cutting leather part for handle base (hand cutting each strip)	VA	8.2	
cutting	cutting leather handle base from together joint leather*2	VA	8.8	
cutting	Grouping	NVA	180.0	
cutting	transportation to splitting	Transportation	20.0	15
cutting	cutting all lining*8 (hand cutting)	VA	199.8	
cutting	Grouping	NVA	120.0	
cutting	Waiting	Waiting	52.0	
cutting	transportation to sewing input	Transportation	15.0	18
cutting	reinforcement cutting*2	VA	51.0	
cutting	transportation to sewing input	Transportation	18.0	20
cutting	splitting leather for cc pocket*5	VA	6.0	
cutting	transportation to skiving	Transportation	7.0	8
cutting	splitting leather inside zip pocket opening part*1	VA	3.4	
cutting	splitting leather piece for handle base*1	VA	4.5	
cutting	transportation to sewing input	Transportation	18.0	22
cutting	skiving leather for cc pocket*5	VA	47.5	
cutting	skiving leather body*2	VA	20.4	
cutting	transportation to sewing input	Transportation	15.0	18
cutting	pattern paper cutting for packaging*2	VA	18.2	
cutting	transportation to packing section	Transportation	55.0	60
sewing	body leather: gluing leather part top and bottom to fix reinforcement*1	VA	17.20	
sewing	body leather: gluing on reinforcement to be fixed with leather part*2	VA	13.60	
sewing	body leather: joining two reinforcements with leather part*1	VA	34.00	
sewing	sending to sewing	Transportation	8.00	12.00
sewing	body leather: sewing both corner by grain side face to face*2	VA	50.40	
sewing	sending to table work	Transportation	8.00	12.00
sewing	waiting	Waiting	80.00	
sewing	body leather: gluing both corner stitched flesh side to fold allowance*2	VA	32.80	
sewing	body leather: folding and hammering allowance at both corner*2	VA	36.80	
sewing	body leather: gluing punch back side area and put reinforcement*1	VA	11.60	
sewing	sending to punch table	Transportation	15.00	20.00
sewing	waiting	Waiting	120.00	
sewing	body leather: punch reinforcement, screw opening and attach lock*1	VA	106.40	
sewing	body leather: scotch tape on lock metal back side*1	VA	10.00	
sewing	waiting	Waiting	124.00	
sewing	handle base: gluing leather flesh side*2	VA	26.40	
sewing	handle base: joining two leather part by flesh side*1	VA	8.80	
sewing	sending to net cutting table	Transportation	8.00	10.00
sewing	handle base: net cutting*2	VA	38.40	
sewing	handle base: gluing both ends to make loop*2	VA	10.40	
sewing	handle base: inserting d-ring and joining ends together and hammering*2	VA	32.00	
sewing	body leather & handle base: gluing body leather to join handle base*2	VA	12.00	
sewing	body leather & handle base: gluing handle base to be joint with body leather*2	VA	12.00	
sewing	body leather & handle base: setting handle base with body leather and hammering*2	VA	18.40	
sewing	sending to sewing	Transportation	6.00	8.00
sewing	body leather & handle base: sewing handle base with body leather*2	VA	84.00	

sewing	sending to table work	Transportation	6.00	8.00
sewing	waiting	Waiting	240.00	
sewing	inside cc pocket: gluing cc lining*5	VA	68.00	
sewing	inside cc pocket: gluing cc leather*5	VA	60.00	
sewing	inside cc pocket: setting lining with cc leather*5	VA	38.00	
sewing	inside cc pocket: gluing and folding at top of each cc*5	VA	52.00	
sewing	sending to sewing	Transportation	5.00	5.00
sewing	inside cc pocket: sewing each cc top*5	VA	34.00	
sewing	sending to table work	Transportation	5.00	5.00
sewing	inside cc pocket: adhesive tape on bottom of cc lining*4	VA	44.80	
sewing	inside cc pocket: setting cc top and cc-1,2,3 to sewing*3	VA	87.60	
sewing	sending to sewing	Transportation	5.00	5.00
sewing	inside cc pocket: sewing cc top with cc-1,2,3 together*3	VA	27.60	
sewing	sending to table work	Transportation	10.00	12.00
sewing	inside cc pocket: gluing on cc left & right side and cc penal to setting together*1	VA	16.40	
sewing	inside cc pocket: setting cc penal*1	VA	25.20	
sewing	inside cc pocket: net cut cc pocket and marking for middle stitch*1	VA	44.40	
sewing	inside cc pocket: masking taping on cc set to do proper middle stitch*1	VA	9.60	
sewing	waiting	Waiting	50.00	
sewing	sending to sewing	Transportation	5.00	6.00
sewing	inside cc pocket: sewing middle stitch*1	VA	12.40	
sewing	sending to thread burning table	Transportation	13.00	16.00
sewing	inside cc pocket: thread burn of middle stitch extra thread*1	VA	19.20	
sewing	sending to table work	Transportation	5.00	6.00
sewing	inside cc pocket: marking lining to join cc pocket*1	VA	14.80	
sewing	sending to sewing	Transportation	5.00	6.00
sewing	inside cc pocket: sewing cc pocket with lining*1	VA	103.20	
sewing	sending to table work	Transportation	5.00	6.00
sewing	inside zip pocket: marking lining for lip cut*1	VA	21.60	
sewing	inside zip pocket: gluing non-woven*1	VA	20.80	
sewing	inside zip pocket: setting non-woven on lining on lip cut area*1	VA	13.20	
sewing	inside zip pocket: cutting lip*1	VA	16.00	
sewing	inside zip pocket: gluing to make opening*1	VA	26.00	
sewing	inside zip pocket: folding to get opening*1	VA	38.80	
sewing	transportation to another table to set zipper	Transportation	5.00	5.00
sewing	inside zip pocket: cut zipper with proper length*1	VA	6.40	
sewing	inside zip pocket: insert runner*1	VA	6.80	
sewing	inside zip pocket: gluing zipper to setting with opening*1	VA	18.80	
sewing	inside zip pocket: gluing opening to attach zipper*1	VA	16.00	
sewing	inside zip pocket: setting zipper*1	VA	13.60	
sewing	transportation to another table to set inside pocket lining	Transportation	12.00	15.00
sewing	inside zip pocket inside: gluing zipper back side to join pocket lining*1	VA	8.00	
sewing	inside zip pocket inside: gluing pocket lining to join with zipper*1	VA	16.40	
sewing	inside zip pocket inside: setting inside pocket lining with opening*1	VA	15.20	
sewing	sending to sewing	Transportation	5.00	6.00
sewing	inside zip pocket opening: sewing all around*1	VA	81.20	
sewing	sending to sewing	Transportation	5.00	6.00
sewing	inside zip pocket inside: sewing left & right side to get pocket closed*1	VA	57.60	
sewing	sending to table work	Transportation	10.00	12.00
sewing	top opening: cut zipper with proper length*1	VA	6.00	
sewing	top opening: insert runner*1	VA	7.60	
sewing	transportation to another table	Transportation	8.00	12.00
sewing	top opening: gluing leather stopper*2	VA	15.20	
sewing	top opening: gluing zipper both edges*1	VA	18.00	
sewing	top opening: setting leather stoppers with glued zipper both edges*1	VA	22.80	
sewing	waiting	Waiting	90.00	
sewing	sending to sewing	Transportation	5.00	6.00
sewing	top opening: sewing leather stoppers*2	VA	23.20	
sewing	sending to table work	Transportation	5.00	6.00

sewing	top opening: gluing front and back leather body part on opening side to attach zipper	VA	52.80	
sewing	top opening: gluing on zipper to be attached with front and back leather body part*1	VA	13.60	
sewing	top opening: setting front and back body part with zipper*1	VA	57.20	
sewing	transportation to another table	Transportation	5.00	5.00
sewing	top opening: gluing 2 lining on opening area & cc pocket back for thread binding	VA	20.80	
sewing	top opening: gluing on zipper to join cc and inside zip pocket attached lining*1	VA	12.00	
sewing	top opening: joining cc and inside zip pocket attached lining with zipper*1	VA	41.60	
sewing	sending to sewing	Transportation	8.00	10.00
sewing	top opening: sewing*1	VA	53.60	
sewing	sending to another sewing for lining stitch	Transportation	8.00	10.00
sewing	lining bag: sewing lining all three sides to complete bag*1	VA	73.20	
sewing	sending to table work	Transportation	15.00	18.00
sewing	leather bag: gluing front and back part leather three flesh sides*2	VA	67.20	
sewing	leather bag: setting front & back part leather by flesh sides face to face*1	VA	16.00	
sewing	sending to sewing	Transportation	8.00	12.00
sewing	leather bag: sewing to complete leather bag*1	VA	73.20	
sewing	sending to table work	Transportation	8.00	12.00
sewing	puller for top opening: gluing*1	VA	22.40	
sewing	puller for top opening: folding flesh to flesh sides*1	VA	17.60	
sewing	sending to sewing	Transportation	5.00	5.00
sewing	puller for top opening: sewing all around*1	VA	20.80	
sewing	sending to table work	Transportation	5.00	5.00
sewing	puller for top opening: lock hole metal attaching and fixing*1	VA	91.60	
sewing	puller for top opening: insert pulling o-ring to hang with runner*1	VA	43.60	
sewing	long handle: sewing by guide*1	VA	47.60	
sewing	sending to table work	Transportation	6.00	8.00
sewing	long handle: gluing both ends on leather to fold and gluing for dog hook loop	VA	12.80	
sewing	long handle: insert dog hook, adjuster by folding leather ends and make loop*1	VA	55.20	
sewing	sending to sewing	Transportation	6.00	8.00
sewing	long handle: sewing both ends*1	VA	50.00	
sewing	sending to table work	Transportation	8.00	10.00
sewing	inserting pullers at top opening*1	VA	42.80	
sewing	sending to thread burning table	Transportation	5.00	5.00
sewing	thread burn for finishing work: thread burning*1	VA	41.20	
sewing	sending to 1st floor for finishing work	Transportation	60.00	70.00
finishing	finishing and cleaning work	NVA	105.60	
finishing	final qc	Inspection	118.00	
packing	labeling, tissue, silica gel, poly packaging	NNVA	130.00	
packing	carton packaging and labeling	NNVA	78.80	

Appendix H: Current State Operation Description for Article no. V-6

Section	Description	Category	Time (sec)	Distance (ft)	Remark
cutting	material selection, tracing and arrangement	NVA	900		
cutting	cutting leather body*3	VA	42.5		
cutting	cutting leather inside zip pocket opening part*1	VA	10.7		
cutting	cutting leather for cc pocket*5 (hand cutting)	VA	40.8		
cutting	cutting leather puller*4	VA	19.0		
cutting	cutting leather zipper stopper*3	VA	14.0		
cutting	cutting leather handle base*4	VA	17.7		
cutting	waiting	Waiting	195.0		
cutting	cutting leather handle*3 (hand cutting)	VA	74.9		
cutting	grouping	NVA	60.0		
cutting	transportation to splitting	Transportation	20.0	15	
cutting	cutting all lining*13 (hand cutting)	VA	324.6		
cutting	grouping	NVA	60.0		
cutting	waiting	Waiting	180.0		
cutting	transportation to sewing input	Transportation	15.0	18	
cutting	reinforcement cutting*7	VA	178.3		
cutting	transportation to sewing input	Transportation	18.0	20	
cutting	splitting leather for cc pocket*5	VA	6.0		
cutting	waiting	Waiting	145.0		
cutting	splitting leather inside zip pocket opening part*1	VA	3.4		
cutting	splitting leather small pullers*3	VA	3.6		
cutting	splitting leather piece for handle base*4	VA	17.8		
cutting	grouping	NVA	60.0		
cutting	transportation to the skiving	Transportation	5.0	7	
cutting	skiving leather body*3	VA	75.9		
cutting	skiving leather for cc pocket*5	VA	47.5		
cutting	skiving short handle leather*2	VA	29.1		
cutting	grouping	NVA	80.0		
cutting	transportation to sewing input	Transportation	15.0	18	
cutting	pattern paper cutting for packaging*3	VA	27.4		
cutting	transportation to packing	Transportation	55.0	60	
sewing	front top inside front: cutting zipper with proper length and bending one edge*1	VA	31.6		pre-assembly
sewing	edge bending by heating (sending & receiving)	Transportation	80.0	90	
sewing	front top inside front: gluing lining and folding*1	VA	20.0		
sewing	front top inside front: gluing on facing leather grain side to join zipper*1	VA	7.6		
sewing	front top inside front: gluing on lining to join zipper back side*1	VA	12.8		
sewing	sending to insert runner	Transportation	20.0	24	
sewing	front top opening: insert runner*1	VA	17.2		pre-assembly
sewing	receiving runner inserted zipper to assemble table	Transportation	20.0	24	
sewing	front top opening: gluing on leather stopper*1	VA	8.2		pre-assembly
sewing	front top opening: gluing on zipper edge*1	VA	7.2		pre-assembly
sewing	front top opening: setting leather stopper with zipper*1	VA	12.4		pre-assembly
sewing	sending to sewing	Transportation	13.0	16	
sewing	front top opening: sewing leather stopper*1	VA	7.5		pre-assembly
sewing	sending to assemble table	Transportation	13.0	16	
sewing	front top front opening: setting the zipper with facing leather*1	VA	14.4		
sewing	sending to sewing	Transportation	20.0	24	
sewing	front top front opening: sewing facing leather & lining with zipper at middle*1	VA	18.0		
sewing	sending to assemble table	Transportation	13.0	16	
sewing	front top outside: gluing punch back side area and put reinforcement*1	VA	11.6		
sewing	sending to punching and screw table	Transportation	12.0	14	
sewing	front top outside: punch reinforcement, screw opening and	VA	106.4		

	attach lock*1				
sewing	sending to assemble table	Transportation	12.0	16	
sewing	front top front leather part: gluing reinforcement to attach with leather back side top*1	VA	10.0		
sewing	front top front leather part: gluing leather part flesh side top to attach reinforcement*1	VA	7.6		
sewing	front top front leather part: joining reinforcement with leather part*1	VA	17.6		
sewing	front top front opening: gluing on front top leather flesh side to join facing leather*1	VA	7.6		
sewing	front top front opening: gluing on facing leather flesh side to join with front top leather*1	VA	9.6		
sewing	front top front opening: setting zipped facing with front top leather part*1	VA	37.6		
sewing	sending to sewing	Transportation	8.0	12	
sewing	front top front opening: sewing zipped facing with front top leather part*1	VA	36.8		
sewing	sending to assemble table	Transportation	8.0	8	
sewing	front top inside back: gluing cc lining*5	VA	68.0		need improvement
sewing	front top inside back: gluing cc leather*5	VA	60.1		need improvement
sewing	front top inside back: setting lining with cc leather*5	VA	38.0		
sewing	front top inside back: gluing to top folding each cc*5	VA	52.0		need improvement
sewing	sending to sewing	Transportation	6.0	6	
sewing	front top inside back: sewing each cc top*5	VA	34.0		
sewing	sending to assemble table	Transportation	10.0	12	
sewing	front top inside back: adhesive tape on bottom of cc lining*4	VA	44.8		
sewing	front top inside back: setting cc top and cc-1,2,3 to sewing*3	VA	87.6		
sewing	sending to sewing	Transportation	12.0	16	
sewing	front top inside back: sewing cc top with cc-1,2,3 together*3	VA	27.6		
sewing	sending to assemble table	Transportation	6.0	12	
sewing	front top inside back: gluing on cc left & right side and cc penal to setting together*1	VA	16.4		
sewing	front top inside back: setting cc penal*1	VA	25.2		
sewing	sending to net cut table	Transportation	14.0	18	
sewing	front top inside back: net cut cc pocket and marking for middle stitch*1	VA	44.4		need to eliminate marking
sewing	sending to assemble table	Transportation	30.0	40	
sewing	front top inside back: masking taping on cc set to do proper middle stitch*1	VA	9.6		
sewing	sending to sewing	Transportation	6.0	12	
sewing	front top inside back: sewing middle stitch*1	VA	12.4		
sewing	sending to thread burn table	Transportation	8.0	10	
sewing	front top inside back: thread burn of middle stitch extra thread*1	VA	19.2		
sewing	sending to assemble table	Transportation	8.0	10	
sewing	front top inside back: marking lining to join cc pocket*1	NNVA	14.8		need to eliminate
sewing	sending to sewing	Transportation	6.0	10	
sewing	front top inside back: sewing cc pocket with lining*1	VA	103.2		
sewing	sending to assemble table	Transportation	8.0	12	
sewing	front top back opening: adhesive tape on cc attached lining to join zipper*1	VA	13.2		
sewing	front top back opening: setting lining with zipper*1	VA	14.4		
sewing	waiting for next operation	Waiting	240.0		
sewing	front body leather: gluing leather part top and bottom to fix reinforcement*1	VA	17.2		
sewing	front body leather: gluing on reinforcement to be fixed with leather part*2	VA	13.6		
sewing	front body leather: joining two reinforcements with leather part*1	VA	34.0		

sewing	front body leather: gluing zipper attached lining to join with front body leather*1	VA	15.2		
sewing	front body leather: gluing leather on grain side to join zipper attached lining*1	VA	15.2		
sewing	front top back opening: setting front body leather with front top locked attached part*1	VA	30.8		
sewing	sending to sewing	Transportation	8.0	12	
sewing	front top back opening: sewing tag stitch left & right side*1	VA	32.8		
sewing	sending to assemble table	Transportation	8.0	12	
sewing	front top inside: scotch tape on lock metal back side*1	VA	10.0		need improvement
sewing	front top inside: gluing left & right side and bottom side to get pocket closed*1	VA	71.2		
sewing	front top inside: setting and hammering to send to sewing*1	VA	18.4		
sewing	sending to sewing	Transportation	8.0	12	
sewing	front top inside: sewing three sides to complete pocket*1	VA	42.8		
sewing	sending to assemble table	Transportation	15.0	20	
sewing	mobile pocket: gluing all 4 sides to folding*1	VA	26.0		
sewing	mobile pocket: folding all 4 sides*1	VA	74.0		
sewing	mobile pocket: adhesive tape on half area of two sides for folding double layer*1	VA	11.6		
sewing	mobile pocket: folding to get double layer*1	VA	22.8		
sewing	sending to sewing	Transportation	14.0	18	
sewing	mobile pocket: sewing top side*1	VA	12.8		
sewing	sending to assemble table	Transportation	10.0	12	
sewing	mobile pocket: marking lining to setting mobile pocket*1	NNVA	14.4		need to eliminate
sewing	waiting to sewing	Waiting	120.0		
sewing	mobile pocket: gluing and putting reinforcement potti back side*2	VA	12.8		
sewing	sending to sewing	Transportation	6.0	8	
sewing	mobile pocket: sewing mobile pocket with lining*1	VA	102.1		
sewing	sending to thread burn table	Transportation	8.0	12	
sewing	mobile pocket: thread burning*1	VA	19.2		
sewing	sending to assemble table	Transportation	6.0	6	
sewing	inside zip pocket: cut zipper with proper length*1	VA	6.4		pre-assembly
sewing	inside zip pocket: insert runner*1	VA	6.8		pre-assembly
sewing	waiting to be attached on zip opening	Waiting	70.0		
sewing	inside zip pocket: marking lining for lip cut*1	VA	21.6		need to eliminate
sewing	waiting to join non-woven	Waiting	60.0		
sewing	inside zip pocket: gluing non-woven*1	VA	20.8		
sewing	inside zip pocket: setting non-woven on lining on lip cut area*1	VA	13.2		
sewing	inside zip pocket: cutting lip*1	VA	16.0		
sewing	inside zip pocket: gluing to make opening*1	VA	26.0		
sewing	inside zip pocket: folding to get opening*1	VA	38.8		
sewing	inside zip pocket: gluing zipper to setting with opening*1	VA	18.8		
sewing	inside zip pocket: gluing opening to attach zipper*1	VA	16.0		
sewing	inside zip pocket: setting zipper*1	VA	13.6		
sewing	inside zip pocket inside: gluing zipper back side to join pocket lining*1	VA	8.0		
sewing	waiting for pocket inside lining	Waiting	48.0		
sewing	inside zip pocket inside: gluing pocket lining to join with zipper*1	VA	16.4		
sewing	inside zip pocket inside: setting inside pocket lining with opening*1	VA	15.2		
sewing	sending to sewing	Transportation	6.0	10	
sewing	inside zip pocket opening: sewing all around*1	VA	81.2		
sewing	sending to flatbed sewing for stitch lining	Transportation	10.0	12	
sewing	inside zip pocket inside: sewing left & right side to get pocket closed*1	VA	57.6		

sewing	sending to assemble table	Transportation	5.0	5	
sewing	back part zip pocket: gluing leather cut opening to join zipper*1	VA	18.8		
sewing	waiting for zipper gluing	Waiting	46.0		
sewing	back part zip pocket: gluing zipper to join with leather cut opening*1	VA	14.4		
sewing	back part zip pocket: setting zipper on opening*1	VA	107.6		
sewing	back part zip pocket inside: gluing lining to join with opening*1	VA	12.4		
sewing	back part zip pocket inside: setting lining for pocket*1	VA	14.4		
sewing	sending to sewing	Transportation	6.0	8	
sewing	back part zip pocket opening: sewing all around*1	VA	77.6		
sewing	sending to flatbed sewing for stitch lining	Transportation	10.0	12	
sewing	back part zip pocket inside: sewing lining two sides to get pocket closed*1	VA	50.8		
sewing	sending to assemble table	Transportation	6.0	6	
sewing	back part body leather: gluing on top opening side to fix reinforcement*1	VA	10.8		
sewing	waiting to reinforcement gluing	Waiting	35.0		
sewing	back part body leather: gluing reinforcement to be fixed with leather part*1	VA	6.8		
sewing	back part body leather: joining reinforcement with leather part*1	VA	15.2		
sewing	top opening: cut zipper with proper length*1	VA	6.0		pre-assembly
sewing	sending to insert runner	Transportation	8.0	12	
sewing	top opening: insert runner*1	VA	7.6		pre-assembly
sewing	waiting for leather stopper joining	Waiting	36.0		
sewing	top opening: gluing leather stopper*1	VA	7.6		pre-assembly
sewing	top opening: gluing zipper edge*1	VA	8.1		pre-assembly
sewing	top opening: setting leather stopper with glued zipper edge*1	VA	9.6		pre-assembly
sewing	sending to sewing	Transportation	5.0	5	
sewing	top opening: sewing leather stopper*1	VA	10.4		pre-assembly
sewing	sending to zipper bending by heating	Transportation	30.0	35	
sewing	top opening: bending zipper on another edge*1	VA	24.1		pre-assembly
sewing	sending to assemble table	Transportation	30.0	35	
sewing	top opening: gluing front and back leather body part on opening side to attach zipper*2	VA	52.8		
sewing	waiting	Waiting	49.0		
sewing	top opening: gluing on zipper to be attached with front and back leather body part*1	VA	13.6		
sewing	top opening: setting front and back body part with zipper*1	VA	57.2		
sewing	waiting	Waiting	46.0		
sewing	top opening: gluing mobile and inside zip pocket attached lining on opening area*2	VA	20.8		
sewing	waiting	Waiting	26.0		
sewing	top opening: gluing on zipper to join mobile and inside zip pocket attached lining*1	VA	12.0		
sewing	top opening: joining mobile and inside zip pocket attached lining with zipper*1	VA	41.6		
sewing	sending to sewing	Transportation	5.0	5	
sewing	top opening: sewing*1	VA	53.6		
sewing	sending to chemical cleaning	Transportation	8.0	8	
sewing	leather bag: edge chemical apply on each raw edges*1	VA	96.0		
sewing	sending to assemble table	Transportation	6.0	8	
sewing	leather bag: gluing front and back part leather three grain sides*2	VA	67.2		
sewing	leather bag: setting front & back part leather by grain side face to face*1	VA	16.0		
sewing	sending to sewing	Transportation	5.0	5	
sewing	leather bag: sewing to complete leather bag*1	VA	73.2		
sewing	sending to assemble table	Transportation	5.0	5	
sewing	leather bag: gluing left & right bottom corner and flatten by hammering to cross stitch*1	VA	50.0		
sewing	sending to sewing	Transportation	8.0	12	

sewing	leather bag: sewing left & right bottom corner cross stitch*1	VA	110.8		
sewing	sending to flatbed sewing for stitch lining	Transportation	5.0	5	
sewing	leather bag: sewing to complete lining bag and keep little open area at bottom*1	VA	111.2		
sewing	sending to assemble table	Transportation	6.0	8	
sewing	leather bag: turn around*1	VA	122.8		
sewing	sending to sewing	Transportation	5.0	5	
sewing	leather bag: sewing lining bottom to close un-stitch area*1	VA	71.2		
sewing	sending to flatbed sewing for stitch lining	Transportation	5.0	3	
sewing	leather bag: sewing rest of the un-stitch area to complete lining bag*1	VA	25.2		
sewing	sending to assemble table	Transportation	6.0	10	
sewing	handle base: marking body bag on left & right for punching point*1	NNVA	20.0		need to avoid marking
sewing	waiting	Waiting	66.0		
sewing	handle base: gluing handle base leather to join together*2	VA	30.4		pre-assembly
sewing	handle base: joining handle base together*2	VA	15.2		pre-assembly
sewing	sending to hydraulic press cutter	Transportation	20.0	26	
sewing	handle base: net cutting with punch*2	VA	19.2		pre-assembly
sewing	sending to sewing	Transportation	15.0	20	
sewing	handle base: sewing all around*2	VA	82.4		pre-assembly
sewing	sending to assemble table	Transportation	8.0	12	
sewing	handle base: punch body part for inserting rivet*2	VA	73.6		
sewing	handle base: inserting rivet by inserting d-ring*2	VA	54.4		
sewing	sending to riveting table	Transportation	18.0	22	
sewing	handle base: rivet pressing*2	VA	48.8		
sewing	sending to assemble table	Transportation	18.0	22	
sewing	puller for front top pocket: adhesive tape and fold*1	VA	7.6		pre-assembly
sewing	sending to sewing	Transportation	6.0	6	
sewing	puller for front top pocket: sewing on middle*1	VA	12.8		pre-assembly
sewing	sending to thread burn table	Transportation	5.0	5	
sewing	puller for front top pocket: thread burn*1	VA	15.6		pre-assembly
sewing	sending to assemble table	Transportation	8.0	12	
sewing	puller for front top pocket: insert pulling o-ring to hang with runner*1	VA	43.2		pre-assembly
sewing	waiting for joining with runner	Waiting	490.0		
sewing	puller for back part zip pocket: gluing*1	VA	8.4		pre-assembly
sewing	puller for back part zip pocket: bending flesh to flesh sides*1	VA	14.8		pre-assembly
sewing	puller for back part zip pocket: net cutting*1	VA	10.0		pre-assembly
sewing	sending to sewing	Transportation	8.0	10	
sewing	puller for back part zip pocket: sewing all around*1	VA	14.8		pre-assembly
sewing	sending to thread burn table	Transportation	8.0	10	
sewing	puller for back part zip pocket: thread burn*1	VA	16.4		pre-assembly
sewing	sending to assemble table	Transportation	10.0	14	
sewing	puller for back part zip pocket: insert pulling o-ring to hang with runner*1	VA	42.0		pre-assembly
sewing	waiting for joining with runner	Waiting	338.0		
sewing	puller for top opening: gluing*1	VA	22.4		pre-assembly
sewing	puller for top opening: bending flesh to flesh sides*1	VA	17.6		pre-assembly
sewing	sending to hydraulic press cutter	Transportation	25.0	30	
sewing	puller for top opening: net cutting with lock hole punching*1	VA	12.8		pre-assembly
sewing	sending to sewing	Transportation	5.0	5	
sewing	puller for top opening: sewing all around*1	VA	20.8		pre-assembly
sewing	sending to thread burn table	Transportation	10.0	13	
sewing	puller for top opening: thread burning*1	VA	14.0		pre-assembly
sewing	sending to assemble table	Transportation	10.0	15	
sewing	puller for top opening: lock hole metal attaching and fixing*1	VA	91.6		pre-assembly
sewing	puller for top opening: insert pulling o-ring to hang with runner*1	VA	43.6		pre-assembly
sewing	waiting for joining with runner	Waiting	66.0		

sewing	short handle: gluing leather*2	VA	69.6		
sewing	waiting for glue activation	Waiting	300.0		
sewing	short handle: folding leather*2	VA	116.8		
sewing	short handle: ends folding and make good corner by trimming extra folded leather*2	VA	133.6		
sewing	short handle: joining two parts together*1	VA	86.4		
sewing	sending to sewing	Transportation	8.0	10	
sewing	short handle: sewing all around*1	VA	41.2		
sewing	sending to thread burn table	Transportation	5.0	5	
sewing	short handle: thread burning*2 sides	VA	24.8		
sewing	sending to assemble table	Transportation	10.0	13	
sewing	short handle: gluing two ends for dog hook loop*1	VA	9.6		
sewing	short handle: inserting dog hook and make loop both sides and hammering*1	VA	59.6		
sewing	sending to sewing	Transportation	5.0	5	
sewing	short handle: sewing all around at both ends with dog hook*1	VA	135.6		
sewing	sending to thread burn table	Transportation	8.0	10	
sewing	short handle: thread burning at both ends loop area*1	VA	68.0		
sewing	Waiting for finishing section	Waiting	660.0		
sewing	long handle: sewing by guide*1	VA	47.6		pre-assembly
sewing	sending to assemble table	Transportation	10.0	13	
sewing	long handle: gluing both ends on leather part for folding and gluing for dog hook loop*1	VA	12.8		
sewing	long handle: insert dog hook, adjustor by folding leather ends and make loop*1	VA	55.2		
sewing	sending to sewing	Transportation	5.0	5	
sewing	long handle: sewing both ends*1	VA	50.0		
sewing	sending to assemble table	Transportation	5.0	5	
sewing	tag leather: emboss*1	VA	26.1		pre-assembly
sewing	sending to assemble table	Transportation	20.0	28	
sewing	tag leather: insert chain through handle base d-ring and fix*1	VA	7.6		pre-assembly
sewing	sending to joining all final work table	Transportation	12.0	16	
sewing	inserting all pullers and tag leather with bag*4	VA	388.1		
sewing	sending to 1st floor for finishing work	Transportation	60.0	70	
finishing	finishing and cleaning work	NVA	440.0		need to reduce time
finishing	final qc	Inspection	172.9		need to reduce time
finishing	sending to packing	Transportation	5.0	5	
packing	labeling, tissue, silica gel, poly packaging	NVA	130.0		
packing	carton packaging and labeling	NVA	78.8		

Appendix I: Future State Operation Description for Article no. V-5

Section	Station no.	Category	Time (sec)	Distance (ft)
sewing	1	VA	47.6	
sewing	2	VA	95.2	
sewing	3	VA	82.4	
sewing	4	VA	44	
sewing	Transportation to st-24	Transportation	24.00	30
sewing	5	VA	91.6	
sewing	Transportation to st-31	Transportation	16.00	20
sewing	6	VA	64.8	
sewing	7	VA	100.4	
sewing	8	VA	116.4	
sewing	9	VA	106.4	
sewing	Transportation to st-24	Transportation	16.00	24
sewing	10	VA	104.8	
sewing	11	VA	102.4	
sewing	Transportation to st-24	Transportation	15.00	18
sewing	12	VA	166	
sewing	13	VA	96.8	
sewing	14	VA	34	
sewing	15	VA	87.6	
sewing	16	VA	27.6	
sewing	17	VA	51.2	
sewing	18	VA	76	
sewing	19	VA	70.4	
sewing	20	VA	103.2	
sewing	Transportation to st-26	Transportation	4.00	6
sewing	21	VA	94	
sewing	22	VA	88	
sewing	23	VA	81.2	
sewing	24	VA	57.6	
sewing	25	VA	76.4	
sewing	26	VA	69.2	
sewing	27	VA	62.4	
sewing	28	VA	53.6	
sewing	29	VA	73.2	
sewing	30	VA	83.2	
sewing	31	VA	73.2	
finishing	32	VA	87.6	
finishing	33	VA	38	
finishing	34	VA	80	
finishing	35	Inspection	84.4	
packing	36	NNVA	60	
packing	37	NNVA	70	
packing	38	NNVA	78.8	

Appendix J: Future State Operation Description for Article no. V-6

Section	Station no.	Category	Tasks Time (sec)	No. of Manpower	Station Takt time	Distance (ft)	Transported to
sewing	1	VA	125.7	1	125.7		
sewing	2	VA	137.1	1	137.1		
sewing	net cutting	Transportation	80.0	1	122.0	96	cutting
sewing	3	VA	42.0				
sewing	4	VA	130.8	1	130.8		
sewing		Transportation	15.0			20	44
sewing	5	VA	111.5	1	111.5		
sewing		Transportation	45.0			38	16, 33
sewing	6	VA	128.8	1	128.8		
sewing	7	VA	125.3	1	125.3		
sewing		Transportation	15.0			15	45
sewing	8	VA	137.6	1	137.6		
sewing	9	VA	116.8	1	116.8		
sewing	10	VA	133.6	1	133.6		
sewing	11	VA	86.4	1	86.4		
sewing	12	VA	91.2	1	91.2		
sewing	13	VA	94.0	1	94.0		
sewing	14	VA	135.6	1	135.6		
sewing	15	VA	68.0	1	68.0		
sewing	16	VA	128.8	1	128.8		
sewing	17	VA	134.0	1	134.0		
sewing	18	VA	88.3	1	88.3		
sewing	19	VA	133.6	1	133.6		
sewing	20	VA	131.7	1	131.7		
sewing	21	VA	143.2	2	71.6		
sewing	22	VA	100.6	1	100.6		
sewing	23	VA	134.4	1	134.4		
sewing	24	VA	135.6	1	135.6		
sewing	25	VA	134.1	1	134.1		
sewing	26	VA	125.5	1	125.5		
sewing	27	VA	100.4	1	100.4		
sewing		Transportation	12.0			13	33
sewing	28	VA	133.6	1	133.6		
sewing	29	VA	98.8	1	98.8		
sewing	30	VA	138.8	1	138.8		
sewing	31	VA	122.0	1	122.0		
sewing	32	VA	128.4	1	128.4		
sewing	33	VA	116.8	1	116.8		
sewing	34	VA	114.0	1	114.0		
sewing	35	VA	53.6	1	53.6		
sewing	36	VA	96.0	1	96.0		
sewing	37	VA	83.2	1	83.2		
sewing	38	VA	73.2	1	73.2		
sewing	39	VA	50.0	1	50.0		
sewing	40	VA	110.8	1	110.8		
sewing	41	VA	111.2	1	111.2		
sewing	42	VA	122.8	1	122.8		
sewing	43	VA	96.4	1	96.4		
sewing	44	VA	190.8	2	95.4		
finishing	45	VA	388.1	3	129.4		
finishing	46	VA	218.7	2	109.4		
finishing	47	Inspection	112.2	1	112.2		
packing	48	NNVA	130.0	1	130.0		
packing	49	NNVA	78.8	1	78.8		
		Total=	**6089.9**	**54**		**182**	

Appendix K: VSM data (time unit second) for current state

Activity Name	Activity detail	Start date & time	End date & time	Process time	VA	NNVA	NVA	Waiting	Transportation
Order processing									
E-mail communication		28-01-18		900.0	400.0	500.0			
Sample received		10-02-18							
Check with order information				300.0					
E-mail communication				360.0					
Communication to quality control and sample				180.0					
	Waiting								
Specification									
Customer communication									
Confirm with Production Manager		12-02-18		420.0					
Material information and check raw materials				480.0					
Deliver to production control, planning		12-02-18							
	Waiting								
Production and purchase planning		12-02-18		3600.0					
Purchase few raw materials from local market									
	Lining	13-02-18	17-02-18						
	Metal accessories	13-02-18	17-02-18						
	Tissue	13-02-18	17-02-18						
	Carton	13-02-18	17-02-18						
	Poly	13-02-18	17-02-18						
	Glue	13-02-18	17-02-18						
	Zipper	13-02-18	17-02-18						
	Thread	13-02-18	17-02-18						
	Leather	13-02-18	17-02-18						
Ware house									
	Check against PO			1200.0			1200.0		
	Grouping for store keeping			900.0		900.0			
	Counting & inspecting			3600.0			3600.0		
	Waiting			1800.0			1800.0		
	Inventory register entry			840.0			840.0		
	Shelf/placing			1200.0			1200.0		
	Waiting								
	Transport to cutting			300.0			300.0		
				16080.0	**400.0**	**1400.0**	**8940.0**		
Receive raw materials for sample									
	sample make	18-02-18							
	Waiting								
Article no. V-5									
Cutting									
Article no. V-5	Material cutting In	19-02-18	07-03-18						

	Leather selection and tracing			300.0			300.0		
	cutting all leather part			140.7	140.7				
	grouping			180.0			180.0		
	transport to splitting			20.0					20.0
	taking lining from roll and arrange for cutting			300.0			300.0		
	cutting all lining part			199.8	199.8				
	grouping			120.0			120.0		
	waiting			52.0				52.0	
	transport			15.0					15.0
	reinforcement cutting			51.0	51.0				
	transport			18.0					18.0
	splitting work			30.8	30.8				
	transport			25.0					25.0
	skiving work			67.8	67.8				
	transport			15.0					15.0
	pattern paper cutting for packing			18.2	18.2				
	Transport to packing			60.0					60.0
				1613.3	**508.3**		**900.0**	**52.0**	**153.0**
Label and price sticker received from customer		27-02-18							
Sewing									
	Layout (article no. V-5)	01-03-18							
table allocation and man-power assign	Sewing in	03-03-18	31-03-18						
	sewing work			3623.4	2608.4			704.0	311.0
Article no. V-5	finishing and inspection	08-03-18	31-03-18	228.6			223.6		5.0
**time study as in appendix	packing			208.8		208.8			
	shipment sent	31-03-18							
				4060.8	**2608.4**	**208.8**	**223.6**	**704.0**	**316.0**
Article no. V-6									
Cutting									
	Material cutting In	08-03-18	25-03-18						
	Leather selection and tracing			450.0			450.0		
	cutting all leather part			219.5	219.5				
	grouping			60.0			60.0		
	waiting			195.0				195.0	
Article no. V-6	transport to skiving and splitting			20.0					20.0
	taking lining from roll and arrange for cutting			450.0			450.0		
	cutting all lining part			324.6	324.6				
	grouping			60.0			60.0		
	waiting			180.0				180.0	
	transport			15.0					15.0
	reinforcement cutting			178.3	178.3				

	transport			18.0					18.0
	splitting work			30.8	30.8				
	grouping			60.0			60.0		
	waiting			145.0				145.0	
	transport			5.0					5.0
	skiving work			152.4	152.4				
	grouping			80.0			80.0		
	transport			15.0					15.0
	pattern paper cutting for packing			27.4	27.4				
	Transport to packing			55.0					55.0
				2741.0	**933.0**	**0.0**	**1160.0**	**520.0**	**128.0**
Sewing									
	Layout (article no. V-6)	01-04-18	30-04-18						
Article no. V-6 **time study as in appendix	sewing work			9156.4	5493.1	49.2		2696.0	918.0
	finishing and inspection	08-04-18	30-04-18	617.9			612.9		5.0
	packing			208.8		208.8			
	shipment sent	30-04-18							
				9983.1	**5493.1**	**258.0**	**612.9**	**2696.0**	**923.0**
			Grand Total=	**68956.3**	**19885.5**	**3733.6**	**23673.0**	**7944.0**	**3040.0**