Faculty of Engineering

Department of Textile Engineering

REPORT ON

A case study on Idle time identification and reducing idle time through work study and line balancing to increase the productivity in sewing section of knit garments.

Course Title: Project Thesis
Course Code: TE 4214

Submitted By:

Arif Hossain Shovo (ID: 151-23-174)
Somit Bhuiyan (ID: 151-23-178)
Razaul Karim (ID: 151-23-41 85)

Supervised By

Kazi Rezwan Hossain
Lecturer

This Report Presented in Partial Fulfillment of the Requirements for the **Degree of Bachelor of Science in Textile Engineering.**

Advance in Apparel Manufacturing Technology
December 2018

Declaration

We are declaring that this is a project thesis report is submitted for fulfillment of the requirement of BSc in Textile Engineering Degree of Daffodil International University. We completed the paper with the help of a knit composite industry. We collected all information, reports from the industry. All information in this paper is genuine & correct. We also declare that neither this report nor any part of this report has been submitted elsewhere for award of any courses.

Arif Hossain Shovo (ID: 151-23-174)

Somit Bhuiyan (ID: 151-23-178)

Razaul Karim (ID: 151-23-4185)

Department of Textile Engineering
Daffodil International University

Acknowledgement

At the very beginning we acknowledge the infinite blessing and profound kindness of "Almighty Allah"- the supreme authority of the universe.

Kazi Rezwan Hossain, Lecturer, Department of Textile Engineering, Daffodil International University, our supervisor, to whom we are extremely grateful for his tremendous support and guidance throughout our project. Being working with him we have not only earned valuable knowledge but was also inspired by his innovativeness which helped to enrich our experience to a greater extent. His ideas and way of working was truly remarkable. We believe this project could not be finished if he did not help us continuously.

We would like to thank **Professor Dr. Md, Mahabubul Haque**, and Head of the Department of Textile Engineering, Daffodil International University, who has inspired us to take and continue this project. We would like to thank factory officers for giving important information on Industrial engineering Department in Textile sector.

We would like to thank the management of the Magpie Composite Ltd. for giving us the opportunity to perform the Thesis on garments merchandising successfully and also their valuable suggestions. Our heartfelt thanks to **M. Arifur Rahman**, Managing Director of Magpie Composite Ltd. And also **Md. Wadud Khan** GM (knitting) for his generous support and guidance and valuable suggestions.

Dedication

To our parents who brought us to the earth & who give us chance to study in Textile Engineering and support us all time.

Abstract

Bangladesh's export revenue carries more than 76% contribution from the Textile and Apparel industries. In sewing floor there are several problems which hamper the productivity and efficiency and thus we do not get desired output. This paper, we discussed about the idle time which occurs in sewing line, how these idle times can be reduced by proper line balancing and time study. If idle time can be reduced then the productivity and efficiency of the sewing line can also be increased. Line balancing and time study are important stage in any garment industries. In this paper, we are comparing the productivity and efficiency of three different style sewing line. From the evaluation of the reports, we are trying to minimize the idle time of a line. The objective of this study is to learn about the idle time minimization and how much the productivity and efficiency are affected by means of suitable use of time study, method study, capacity find out about and via appropriate line balancing. If we capable to reduce the idle time it will help to optimize the productivity, efficiency and man, machine, material will be properly used.

Table of Contents

LIST OF TABLES

LIST Of ABBREVIATION

- UCL-Upper Control Limit
- LCL-Lower Control Limit
- SMV-Standard Minute Value
- SAM-Standard Allowed Minutes
- BPT-Basic Pitch Time
- GSM-Gram per Square Meter

Chapter 1

Introduction

1.1 Introduction

Textile industry is one of the world's significant businesses also, the piece of clothing industry is a considerable one inside the inventory network of material industry. The generation procedure pieces of clothing are isolated into four primary stages: planning or garments design age, texture cutting, sewing, and pressing or pressing. The most basic stage is the sewing stage, as it for the most part includes an incredible number of tasks. The sewing line comprises of an arrangement of workstations in which a particular assignment in a predefined grouping is handled. As a rule, one to a few undertakings is gathered into one workstation. [1] Errands are doled out to administrators contingent upon the requirements of various work ability levels. At long last, a few workstations in arrangement are shaped as a sewing line. Shop floor directors are worried about the equalization of the lines by doling out the undertakings to workstations as similarly as could be expected under the circumstances. Unequal remaining task at hand among workstations of a sewing line will lead to the expansion of both WIP and holding up time, showing the expansion of both creation process duration and cost. In hone, the sewing line chiefs or generation controllers utilize their experience to dole out undertakings to workstations dependent on the undertaking grouping, work expertise

levels and the standard time required to finish each errand. Subsequently, the line balance execution can't be ensured starting with one chief then onto the next with diverse task inclination or potentially work involvement. Bangladesh's fare income conveys over 80% commitment from the Garments, Attire, and Knitwear Industry [2] The business itself is one of the greatest Garments Industry on the planet alongside Thailand, India, and Mexico. Beginning from Buttons, marks, clothing papers, strings, and every single other item are found here. Indeed, even administrations like kicking the bucket, washing, and pressing are additionally found toward the sides of Mechanical regions of Bangladesh. [3]

As the request for readymade articles of clothing increments quickly over the worldwide advertise, Bangladesh's position as the world's moment biggest readymade article of clothing exporter proceeds to hold solid. The Bangladesh government fair set a $37 billion trade target for the 2016-17 financial year, of which over $30 billion will be contributed by the ready-made piece of clothing division – the country's biggest source for trade profit. Agreeing to the information from Bangladesh's Send out Advancement Bureau, the piece of clothing and attire industry in Bangladesh created $28.09 billion sends out within the financial year 2015-16 with a 10.21% development from the past year. The development was basically ascribed to political calmness amid the year, expanded efficiency, entrepreneurs' strength and advancement of workers' security guidelines in industrial facilities. The readymade piece of clothing (RMG) industry in Bangladesh is the biggest and most famous fabricating division and GDP donor. Bangladesh trades around $30 billion readymade articles of clothing each year. [4]

Line Balancing is leveling the outstanding task at hand over all procedures in a live stream to expel bottlenecks and overabundance limit. Line adjusting is utilized to make generation line more adaptable to ingest outside and interior anomalies. On account of material, line adjusting implies the arrangement of a sewing machine as indicated by style and plan of a particular item. It is done to expanding the efficiency.

When you consider mass creation, pieces of clothing are delivered in lines or part of machines rather than a single machine. A line might be the mechanical production system, particular line or segment, a line set with on the web and disconnected completing and pressing. A line incorporates many workstations with various work substance. Generation every hour is changed contingent upon work content (standard minutes of specific assignment/activity), arrangement of aggregate labor to a specific task, administrator expertise level and machine limit. Activity with most reduced generation every hour is called as bottleneck task for that line.

Articles of clothing manufacturing plants those pursue the line generation framework must have fallen a circumstance where administrators need to sit tight for the work between package. This holding up time is called inactive time. This inactive time is a non-working time between working altogether between two packages. Inert time diminish the productivity of the creation and effectiveness of the laborer too. This is the reason a manufacturing plant more likely than not locked in with a colossal misfortune in numerous generation hours in multi-day.

For a model, there are 50 machines in a line and 15 specialists are not working without additional package but rather the package is working accurately. Assume that every one of them sits tight 40 seconds for the following group. In the event that they deliver 500 pieces in multi-day then the aggregate inactive time for single administrator will be 2000 seconds. [5]

The creation procedure of pieces of clothing is isolated into four fundamental stages: planning or attire design age, texture cutting, sewing, and pressing or pressing. The most basic stage is the sewing stage, as it by and large, includes an incredible number of tasks. The sewing line comprises an arrangement of workstations in which a particular undertaking in a predefined grouping is prepared. When all is said in done, one to a few errands is gathered into one workstation. Undertakings are doled out to administrators contingent upon the imperatives of various work aptitude levels. At last, a few workstations in the grouping are shaped like a sewing line. Shop floor supervisors are worried about the parity of the lines by doling out the errands to workstations as similarly as would be prudent. The unequal outstanding task at hand among workstations of a sewing line will prompt the expansion of both WIP and holding up time, showing the increment of both generation process duration and cost. Practically speaking, the sewing line chiefs or creation controllers utilize them experience to allot errands to workstations dependent on the undertaking arrangement, workability levels and the standard time required to finish each undertaking. Therefore, the line balance execution can't be ensured from one director to another with various task inclination as well as work involvement. Assembling an item continuously requires diverse kinds of sewing machines and distinctive yarn hues, making it hard to allocate a specialist to perform tasks on only a solitary machine. In Garments Industry an item is produced through a progression of tasks. Every task must be performed on a machine (sewing machine) with a particular machine setting, i.e. yarn shading, machine connection. Assembling an item dependably requires distinctive kinds of sewing machines and diverse yarn hues, making it hard to allocate a laborer to perform activities on only a solitary machine. [6] There is a most extreme number of machines that every specialist can use for a specific item. Figure 1, for instance, means the line design of the issue considered in this examination of which every laborer can use at most three unique machines. For the simplicity of working, indistinguishable machines of various settings will be regarded as various machines. The laborer in this way needs not to change the setting each time he/she plays out an activity. The improvement show considers specialists' ability levels and also the requirement on the number of machines at each station (specialist). Each task can be named an expertise compose. Every laborer in the group is assessed for every one of these abilities on state administered tests. The evaluations dependent on time required to perform such ability to meet worthy quality level is given to every laborer for every ability. This rating framework takes into consideration uncouth laborers who can't perform certain abilities also. The arrangement approach is separated into two stages. In the principal stage, a multi-organize whole number programming model is created to dole out tasks, relating machines and their settings to stations considering standard task times, station by station. Parallel stations are permitted in order to enhance by and large line cycle to and also to utilize the required number of specialists. At that point in the second stage, another number programming model is utilized to appoint specialists to stations dependent on their aptitudes to limit the by and large line process duration. [7]

1.2 Concept of line balancing

The Line adjusting is "plan a smooth generation stream by designating procedures to laborers in order to permit each specialist to finish the dispensed outstanding task at hand inside a given time. Line adjusting is the issue of allocating different assignments to workstations while upgrading at least one targets without damaging any limitations forced hanging in the balance.

1.3 Workstation

It is a relegated area where a given measure of work is performed. Typically, a workstation is kept an eye on by one administrator as it were. Once in a while, workstations are kept an eye on by a few administrators, e.g. a flying machine generation line. [8]

1.4 Cycle Time (CT)

Process duration might be characterized as the proportion between the compelling time accessible per period and the generation volume per period. Powerful time accessible = (Time per period) X per period (%Utilization of period) the process duration may likewise be deciphered in the accompanying ways: It is the time between sequential discharges of completed get together fragile the last station of the line. It is the time between sequential arrivals of semi - completed items between any two nearby stations. [9]

1.5 Why we use line balancing

All processing plants that have a line, for example, customary sequential construction system and new mechanical production systems, for example, heuristic furthermore, U-type and furthermore blended model utilized a couple of strategies, for example, work sharing, hereditary calculations, and fluffy rationale and furthermore reenactment technique to enhance a couple of parameters of line control in another hand, chief like has a profitability and high return in their processing plant and for this objective get assistance from past strategy to find a machine, manager, dole out business to a machine to choose the best decision for control and work by machine. In a scarcely any organization one business control, at least 2 then 2 machines and this outcome is the yield of line adjusting. In another word the organization utilized line adjusting for grow up the rate of generation and lessening labor, inactive time and cradle close to the machine, likewise utilized line adjusting for delivered more than 2 products. Assembly lines are the most critical segments of large-scale manufacturing systems. [10] The enhanced work efficiency is their fundamental essentialness for makers who need to create high volume items in a quick and practical way. A mechanical production system comprises of a few progressive workstations in which a gathering of getting together tasks (undertakings) is performed in a restricted span (process duration). The efficiency level of a sequential construction system by and large relies upon adjusting execution. Sequential construction system adjusting (ALB) is the issue of doling out assignments to progressive workstations by fulfilling a few limitations and advancing an execution measure. This execution measure is generally the minimization of the number of workstations used over the sequential construction system. [11]

Chapter 2

Literature Review

2.1 Line Balancing:

Line Balancing is leveling the outstanding task at hand over all procedures in a line stream to evacuate bottlenecks and overabundance limit. Line adjusting is utilized to make the creation line more adaptable to ingest outer and inner inconsistencies. On account of material line adjusting implies the position of sewing machine as indicated by style and structure of a particular item. It is done to expanding the efficiency.

When you consider mass creation, pieces of clothing are delivered in lines or part of machines rather than single machine. A line might be mechanical production system, secluded line or area, a line set with on the web and disconnected completing and pressing. A line incorporates many work stations with various work substance. Generation every hour is vary contingent upon work content (standard minutes of specific errand/task), arrangement of aggregate labor to a specific activity, administrator aptitude level and machine limit. Task with least creation every hour is called as bottleneck activity for that line. [12]

Sequential construction system adjusting is the issue of doling out different assignments to workstations, while improving at least one goals without disregarding any confinements forced hanging in the balance. [13] ALBP has been a functioning field of look into over the previous decades because of its importance to enhanced businesses, for example, piece of clothing, footwear and hardware. Ghosh and Gagnon (1989) and additionally Erel and Sarin (1998) gave nitty gritty surveys on these points. [14] Setups of mechanical production systems for single and different items could be separated by three line composes, single-display, blended model and multi model. Single-show collects just a single item, and blended model amasses different items, though a multi model produces an arrangement of groups with middle of the road setup tasks (Becker and Scholl, 2006). This paper takes care of single-demonstrate line offsetting issue with genuine application. Boysen, Fliedner, and Scholl (2007, 2008) characterized ALBPs and brought up that there were less than 5% articles expressly explaining line adjusting of true gathering frameworks. Therefore, for down to earth thought, this paper centers around the genuine instance of a sequential construction system in piece of clothing fabricating. Configurations of mechanical production systems for single and different items could be isolated by three line composes, single-demonstrate, blended model and multi-display. Single - show collects just a single item, and blended model gathers various items, while a multi-display delivers an arrangement of groups with middle of the road setup tasks. A single-demonstrate line offsetting issue with genuine application was tackled in this project. [15]

ALBP with different destinations are characterized into three sorts

ALBP-I: Minimizes the quantity of workstations, for a given process duration.

ALBP-II: Minimizes the process duration, for a given number of workstations.

ALBP-III: Maximizes the outstanding task at hand smoothness, for a given number of workstations.

In sort I issues, the ALBP of allotting undertakings to workstations is figured with the target of

limiting the quantity of workstations used to meet an objective process duration. It can result in low work costs and diminished space prerequisites. Sort II issues boost the generation rate of a sequential construction system. Since this objective requires a foreordained number of workstations, it very well may be viewed as the partner of the past one. When all is said in done, shop chiefs are worried about the outstanding burden value among all laborers. The issue of outstanding task at hand smoothing in mechanical production systems dispenses assignments among a given number of workstations, so the outstanding task at hand is appropriated as uniformly as would be prudent. This issue is known as Type III problem. Our task was centered around type-1 line adjusting issue. Applicable information acquired from an attire industry was utilized to plan the arrangement. The goal of the task was to adjust the process duration for different activities and minimization of workstations. [16]

2.2 Importance of Line Balancing

- Line adjusting thinks about new machine required for new style and structure.
- It winds up less demanding to circulate specific occupation to every administrator.
- It winds up conceivable to convey products at perfect time.
- Good line adjusting increment creation.
- Line adjusting contrasts the required hardware and the current one and analyze balance.
- It additionally helps in the assurance of real work required.
- Reduces generation time.
- Profit of a plant can be expanded by legitimate line adjusting.
- Proper line adjusting guaranteed ideal generation.
- It decreases blames in the completed articles of clothing. [17]

2.3 Steps to balance the line:

The method of line balancing can be changed from factory to factory and depends on the garments manufactured; but at any instance, line balancing concerns itself with two distinct applications: “Opening the line” and “Operating the line”. [18]

- Calculation of labor requirements
- Operation breakdown
- Theoretical operation balance
- Initial balance

– Opening the line

- Balance control

– Operating the line

2.4 Possibility in line balancing

These days gathering lines move towards cellular fabricating in terms of the assortment of generation. As a result of this, utilization of uncommon hardware and/or proficient laborers, which are able to perform more than one prepares, is expanding. In arrange to advantage from ceaseless preparations preferences, this hardware and laborers must be included to the line in a way by which tall proficiency measures (most extreme utilization, least number of stations) can be achieved. This hypothesis is backed by Hairstylists (1986), he expressed that whereas planning the line, the list of an errand to be done, assignment times required to perform each errand and the priority relations between them are analyzed. Whereas errands are being gathered into stations based on this examination, the taking after objectives are regarded. [19]

2.5 Idle Time:

Articles of clothing processing plants those pursue the line generation framework must have fall a circumstance where administrators need to sit tight for the work between package. This holding up time is called inert time. This inert time is a non-working time between working essentially between two packages. Inert time decrease the proficiency of the creation and effectiveness of the specialist moreover. [20]

2.6 Why idle time occurred:

- Line setting
- Machine problem
- Unavailable cutting bundle
- Sewing quality problem
- Cutting quality problem
- Load shedding
- Problem in planning
- More material handling time

2.7 Essentiality of recording of idle time:

Industrial facilities endeavor to enhance their productivity however once in a while they can't in finding a route for effectiveness enhancement. For them taking a shot at diminishing inactive time is an open door for enhancing manufacturing plant proficiency. The greater part of the article of clothing plants neglect estimating the inert time. They simply let it go. One reason may be administration needs to shroud their wasteful aspects in not to have a fair line with enough WIP at every workstation. [21]

2.8 SMV/SAM:

SMV means standard minute value which describes about the standard time required to complete a given task by best possible method.

Defining Standard Time: Standard Time {also referred to as the "Standard Allowed Minute (SAM)" or "Standard Minute Value (SMV)"}, is the time required for a qualified worker working at "Standard Performance" to perform a given task. The SAM or SMV includes.

Additional contingencies allowances to recover the lost time due to personal needs, fatigue and unavoidable delays.

SMV= Basic time + Allowance.

Basic Time:

The basic time for the operation is found by applying concept of rating to relate the observed to that of a standard place of working [23].Calculated as follows.

Basic time = observed time * observed rating / 100

Example. Rating

50 75 100 125

Observed time 1.3, 0.8, 0.6, 0.5

Basic Time = 1.3*50 /100 0.8*75 /100 0.6*100/100 0.5*125/100

= 0.6 0.6 0.6 0.6

2.9 Productivity

Productivity According to Bog, Brush (2002) in his article Diary of mechanical innovation, efficiency may be a degree of the productivity and adequacy to which organizational assets (inputs) are utilized for the creation of items and/or administrations (yields). Efficiency estimation is both a degree of input utilization and an appraisal as to whether or not input utilization is developing speedier than output. [23]

2.10 Required types of sewing machines:

Basically, in the case of both short & long pant almost same types of sewing machines are required. But according to buyer requirement for the different design purpose very few machines can be changed. However, if anyone need can complete a short or long pant by lock stitch machine. In our experiment we have seen that almost same types of sewing machine are used in both short & long pant. Here the lists of required types of sewing machine including figure & application areas are given.

1. Single needle lock stitch.
2. Double needle lock stitch.
3. Over lock.
4. Feed of the arm.
5. Bar tacking m/c
6. Chain stitch
7. Velcro attaching m/c

2.11 Calculation of SAM through Time Study:

Stage 1: Select one task for which you need to compute SAM.

Stage 2: Take one stop watch. Remain by side of the administrator. Catch process duration for that task. (process duration – add up to time taken to do all works expected to finish one task, i.e. time from get some portion of first piece to next get of the following piece). Do time think about for back to back five cycles. Dispose of whenever found unusual time in any cycle. Ascertain normal of the 5 cycles. Time you got from time think about is called process duration. To change over this process duration into fundamental time you need to increase process duration with administrator execution rating. [Basic Time = Cycle Time X Execution Rating]

Stage 3: Performance rating. Presently you need to rate the administrator at what execution level he was doing the activity seeing his development and work speed. Assume that administrator execution rating is 80%. Assume process duration is 0.60 minutes. Essential time = (0.60 X 80%) = 0.48 minutes

Stage 4: Standard permitted minutes (SAM) = (Basic moment + Bundle remittances + machine and individual stipends). Include package remittances (10%) and machine and individual recompenses (20%) to fundamental time. Presently you got Standard Minute esteem (SMV) or SAM. SAM= (0.48+0.048+0.096) = 0.624 minutes.

The equation utilized for ascertaining accessible limit of the sewing line has been given beneath. The accessible limit of a line is introduced in minutes or hours.

2.12 Time study:

Time study is the investigation of a particular employment by a qualified specialist to locate the most conservative technique as far as time and exertion. The examination tallies the time vital for the activity or given assignment by utilizing most ideal technique. [24]

2.13 Work study:

Work study is the breaking down of a technique for conveying activities. It measures the assets, standard set up execution an action of a give work. Work think about expands the profitability. [25]

2.14 Objectives

- Lower cost.
- Increase productivity.
- Increase profitability.
- Increase job security.
- To make the work easier.
- Establish fair task for everyone.
- Check achievements against standard.

2.15 Bottleneck:

A bottleneck in a procedure happens when input comes in quicker than the subsequent stage can utilize it to make yield. we have recognized the bottleneck forms named make and join care name, back neck versatile tape joint, coordinate sleeve match and sleeve and body, sleeve fix, stitch crude edge cut, security tack and string cut body turn in Annexure 3: set apart with light dark colored color. Production has been obstructed in these seven work stations and substantial work in process (WIP) has been stick in these bottleneck forms. [26]

2.16 Bottleneck in Production:

2.16.1 Bottleneck before input in line:

- If cutting material isn't provided in time from another segment and sub store.
- If material comes delay.
- Bundle sequential number misstep.
- Bundling botch.
- Wrong package supply.

2.16.2 Bottleneck in line:

- Worker determination off-base.
- Wrong works stream/succession of works.
- Non-balance distribution of components.
- Works carelessness by specialists.
- Workers non-appearance.
- machine unsettling influences/out of request.
- Lack of supply

2.16.3 Way of reducing bottle neck:

- To organize pre-creation meeting.
- To get ready design sheet before contribution to the line.
- To check textures and embellishments before issuing in the line.

- To present the design sheet to upkeep segment least 2-3 days before for Better planning.
- To check design before supply in the line.
- To lessen overplus works from specialists.
- To select right specialists for right works.
- To keep supply gainable in time.
- To keep up sequential number.
- Reject articles of clothing ought not forward.
- Supply ought to be sent in the wake of checking.
- To ready when packaging (keep up sequential number)
- By enhancing strategy.
- By enhancing laborers portrayal

2.17 Some Important formula

Line Labor Productivity:

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

Line Machine Productivity:

$$\text{Line Machine Productivity} = \frac{\text{Total number of output per day per line}}{\text{Number of machines used}}$$

Line Efficiency:

$$\text{Line Efficiency} = \frac{\text{Total output per day per line} * \text{SAM}}{\text{Total manpwer per line} * \text{total working minutes per day}} * 100\%$$

Theoretical Manpower:

$$\text{Theoretical Manpower} = \frac{\text{Target per houre}}{\text{Process capacity per houre}}$$

Target:

$$\text{Target} = \frac{\text{Total manpower per line} * \text{Total working minute pewr day}}{\text{S.A.M}} * 100\%$$

Standard Pitch Time (S.P.T) = Basic Pitch Time (B.P.T) + Allowances (%)

SMV

SMV = Basic time + (Basic time * Allowance)

Basic time

Basic time = Observed time * Rating

Observed time

Observed time = Total Cycle time / No of cycle

Earn minute

Earn minute = No of Pc's (Production) * Garments SMV

Available minute

Available minute = Work hour * Manpower

Factory capacity

Factory capacity = (Work hour / SMV) * Total worker * Working day * Efficiency

Efficiency

Efficiency = (Earn minute * Available minute) * 100

Chapter 3

Materials and Methods

3.1 Materials and Methods:

All the data of the thesis paper is collected from a knit composite industry and all the data are actual. In order to balance a production line in sewing floor a garment order is chosen which was started in that line, knowing total amount of order, style description, GSM and fabric type. Two important ways have been considered, one is possible standard method for each process and another is time study technique to know the time required for particular operation. We have recorded the time to complete each process for each and every worker to find out the number of workstation and individual capacity.[27] To find out the (standard minute value) S.M.V, process wise capacity has been calculated, in addition to that we have calculated the target, Basic pitch time, upper control limit (UCL), lower control limit (LCL), actual capacity line graph. After taking necessary data from the line we collected two layouts, before line balancing and after line balancing for each selected style. At first, we marked the bottleneck processes which were our prime concern and then seek solution to minimize the problem. In this thesis we proposed a method to minimize idle time by sharing workload among equally adept and changing work station. Line has been balanced considering the bottleneck and balancing process. After balancing we have compared the line graph between after balancing the line and before balancing the line to know the status of idle time. [28]

A clothing article of clothing request is picked which was begun in that line, knowing aggregate sum of request, style depiction, texture compose and shading. Two essential qualities have been thought of one as, is conceivable standard strategy for each procedure and another is extensive time in the middle of the info has been bolstered to the time think about took to record the genuine individual limit of every laborer. [29] We have recorded an opportunity to make each procedure for every last laborer to discover the quantity of administrator and assistant, kind of machines and person limit. To discover the (standard minute esteem) S.M.V, process astute limit has been computed, what's more to that we have computed the objective, benchmark limit, genuine limit line diagram, work efficiency and line productivity utilizing code blocks. Subsequent to taking important information from the line we proposed an appropriate line adjusting method for the line. At first, we featured the bottleneck forms which were our prime concern and afterward look for answer for limit the issue. In this task we proposed a strategy to adjust the line by sharing remaining burden among similarly proficient laborers who is involved in both the bottleneck procedure and adjusting process. [30] A piece of clothing request is picked which was begun in that line, knowing aggregate sum of request, style portrayal, texture compose and shading. Two essential qualities have been thought of one as, is conceivable standard technique for each procedure and another is extensive time in the middle of the information has been sustained to the time contemplate took to record the genuine person limit of every laborer. We have recorded the opportunity to make each procedure for every last laborer to discover out the quantity of administrator and partner, kind of machines and individual limit. To discover the (standard minute esteem) S.M.V, process insightful limit has been figured, notwithstanding that we have figured the objective, benchmark limit, genuine limit line chart, work profitability and line effectiveness. [31] Subsequent to taking fundamental information from the line we proposed an appropriate line adjusting procedure for the line. At first, we featured the bottleneck forms which were our prime concern and after that look for answer for limit the issue. In this task we proposed a strategy to adjust the line by sharing outstanding task at hand among similarly proficient laborers who is involved in both the bottleneck process and adjusting process. [32] Line has been adjusted thinking about the bottleneck and adjusting process where the adjusting procedure has shared the overabundance time after the benchmark generation in the bottleneck procedure. In the wake of adjusting, new labor has been proposed and last limit of every laborer has been reallocated. We have looked at the line chart in the wake of adjusting the line, work efficiency also, line effectiveness. At last a proposed generation format has been demonstrated with adjusted limit. [33]

Chapter 4

Data Analysis & Calculation

4.1 Before Balancing:

Floor: Unit 4
Line: 8
Buyer: KIABI
Style: GTVAB
Item: T- Shirt
GSM: 160
Fabrication: 100% cotton

SL NO.	Task	Mc type	Work station	Time	Target	Idle Time
1	SHOULDER JOIN	4 TOL	1	20	180	16
2	NECK RIB TACK	SNLS	1	20	180	16
3	NECK RIB SERVICING	4TOL	1	20	180	16
4	NECK RIB TACK W/BODY	SNLS	1	20	180	16
5	NECK JOIN	4TOL	1	32	112.5	4
6	FRONT NECK TOP STC	FL	1	20	180	16
7	BACK NECK PIPING	FL	1	18	200	18
8	BACK NECK PIPING END TACK	SNLS	1	18	200	18
9	BACK NECK TOP STC W/LABEL	SNLS	1	20	180	16
10	SLEEVE HEM	FL	1	18	200	18
11	SLEEVE JOIN	4TOL	1	32	112.5	4
12	SIDE SEAM	4TOL	1	36	100	0
13	SLEEVE OPEN INTACK	SNLS	1	18	200	18
14	SLEEVE OPEN IN SAFETY TACK	SNLS	1	18	200	18
15	BODY HEM	FL	1	20	180	16
16	CARELABLE MAKE	4TOL	1	18	200	18
17	CARELABLE JOIN	4TOL	1	18	200	18
18	HANGER LOOP JOIN	SNLS	1	28	128.58	8
	Total		18	394		254

Table No:4.1 (Data table of style GTVAB)

BPT= SMV/ Work Station

= 394/18X60

= 0.365 min

=21.9 sec

UCL= maximum time required for the task + 15%

= 36+15%

=41.4 sec

LCL= minimum time required for the task + 15%

=18+15%

=20.7sec

Target output= 60/0.365

=60/0.365

= 164

Balancing= (Minimum output/ target output) X 100%

= (112.5/200) X100%

= 56%

SL NO.	Task	New work station	New time	Target	New idle time
1	SHOULDER JOIN	1	20	180	0
2	NECK RIB TACK	1	20	180	0
3	NECK RIB SERVICING	1	20	180	0
4	NECK RIB TACK W/BODY	2	20	180	0
5	NECK JOIN	2	16	225	4
6	FRONT NECK TOP STC	1	20	180	0
7	BACK NECK PIPING	1	18	200	2
8	BACK NECK PIPING END TACK	1	18	200	2
9	BACK NECK TOP STC W/LABEL	1	20	180	0
10	SLEEVE HEM	1	18	200	2
11	SLEEVE JOIN	2	16	225	4
12	SIDE SEAM	2	18	200	2
13	SLEEVE OPEN INTACK	1	18	200	2
14	SLEEVE OPEN IN SAFETY TACK	1	18	200	2
15	BODY HEM	1	20	180	0
16	CARELABLE MAKE	1	18	200	2
17	CARELABLE JOIN	1	18	200	2
18	HANGER LOOP JOIN	2	14	257.14	6
	Total	23	330		30

4.2 After balancing:

Table No:4.2(Data table for style GTVAB-after Balancing)

BPT= SMV/ Work Station

= 330/23X60

= 0.239 min

=14.34 sec

UCL= maximum time required for the task + 15%

= 20+15%

=23 sec

LCL= minimum time required for the task +15%

= 14+15%

= 16.1 sec

Target output= 60/0.239

=60/0.239

= 251

Balancing= (Minimum output/ target output) X 100%

= (180/257.14) X100%

= 70%

4.3 Before Balancing:

Floor: Unit 3
Line: 1
Buyer: KIABI
Style: OFAC4
Item: Trouser
GSM: 160
Fabrication: 99% cotton 1% viscose

SL NO.	Task	Mc type	Work station	Time	Target	Idle Time
1	Leg Dart Make	SNLS	1	30	120	30
2	leg lower pannel join	4TOL	1	26	138	34
3	Bacxk and front rise join	4TOL	1	30	120	30
4	J fly upper tack	SNLS	1	20	180	40
5	J fly lower tack	DNLS	1	24	150	36
6	BONE POCKET MAKE	SNLS	1	30	120	30
7	Bone top stitch	SNLS	1	30	120	30
8	Bone join	4TOL	1	30	120	30
9	Bone corner tack	SNLS	1	56	64	4
10	Bone pocket join	SNLS	1	60	60	0
11	2nd pocket join	SNLS	1	52	69	8
12	Pocket side servicing	4TOL	1	28	128	32
13	Pocket 1/16 top stitch	SNLS	1	56	64	4
14	Pocket mouth close	4TOL	1	30	120	30
15	Pocket upper tack	SNLS	1	27	133	33
16	Back & front rise top stitch	FL	1	28	128	32
17	Inseam panel join	4TOL	1	44	81	16
18	Back pocket hem	FL	1	20	180	40
19	Back pocket join	SNLS	1	50	72	10

20	Back pocket 1/4 top stitch	SNLS	1	30	120	30
21	Back cone pocket	SNLS	1	28	128	32
	corner tack					
22	Back bone pocket join	SNLS	1	30	120	30
23	Back bone pocket servicing	4TOL	1	26	138	34
24	Back bone pocket 1/16 top stitch	SNLS	1	30	120	30
25	Back deco. 1/4 top stitch	SNLS	1	29	124	31
26	Back patch level join	SNLS	1	25	144	35
27	Inseam join	4TOL	1	48	75	12
28	Inseam top stitch	FL	1	60	60	0
29	Side seam	4TOL	1	56	64	4
30	Side cot stitch	SNLS	1	60	60	0
31	Cuff rib tack	SNLS	1	20	180	40
32	Cuff join	4TOL	1	44	81	16
33	Cuff top stitch	FL	1	21	171	39
34	waist rib tack	SNLS	1	20	180	40
35	Elastic Tack	SNLS	1	20	180	40
36	Elastic Tack w/rib	SNLS	1	60	60	0
37	Waist belt servicing	4TOL	1	22	163	38
38	Waist belt join	4TOL	1	30	120	30
39	Waist belt piping	KS	1	30	120	3
40	Waist piping mouth tack	SNLS	1	23	156	32
41	Waist piping mouth close	SNLS	1	24	150	36
42	Drawstring mouth tack	SNLS	1	22	163	38
43	Main & size level join	SNLS	1	20	180	40
44	2 cm bar tack	BT	1	40	90	20
45	.5 cm bar tack	BT	1	30	120	30
Total			45	1524		1176

Table No:4.3(Data Table of Style: QFAC4-Before Balancing)

BPT=SMV/Work Station

=1524/(45*60)

=0.564 min

=33.87 sec

UCL= Maximum time required for the task+15%

=60+15%

=69 sec

LCL= Minimum time required for the task+ 15%

=20+15%

=23 sec

Target output=60/.564

=106

Balancing= (Minimum output/ target output) X 100%

=(60/106) X 100%

=56.60%

4.4 After balancing:

SL NO.	Task	New work station	New time	Target	New idle time
1	Leg Dart Make	1	30	120	0
2	leg lower panel join	1	26	138	4
3	Back and front rise join	1	30	120	0
4	J fly upper tack	1	20	180	1 0
5	J fly lower tack	1	24	150	6
6	BONE POCKET MAKE	1	30	120	0
7	Bone top stitch	1	30	120	0
8	Bone join	1	30	120	0
9	Bone corner tack	2	28	128	2
10	Bone pocket join	2	30	120	0
11	2nd pocket join	2	26	138	4
12	Pocket side servicing	1	28	128	2
13	Pocket 1/16 top stitch	2	28	128	2
14	Pocket mouth close	1	30	120	0
15	Pocket upper tack	1	27	133	3
16	Back & front rise top stitch	1	28	128	2
17	Inseam panel join	2	22	163	8
18	Back pocket hem	1	20	170	1 0
19	Back pocket join	2	25	144	5
20	Back pocket 1/4 top stitch	1	30	120	0
21	Back cone pocket corner tack	1	28	128	2
22	Back bone pocket join	1	30	120	0
23	Back bone pocket servicing	1	26	138	4
24	Back bone pocket 1/16 top stitch	1	30	120	0
25	Back deco. 1/4 top stitch	1	29	124	1
26	Back patch level join	1	25	144	5

27	Inseam join	2	24	150	6
28	Inseam top stitch	2	30	120	0
29	Side seam	2	28	128	2
30	Side cot stitch	2	30	120	0
31	Cuff rib tack	1	20	180	1 0
32	Cuff join	2	22	163	8
33	Cuff top stitch	1	21	171	9
34	waist rib tack	1	20	180	10
35	Elastic Tack	1	20	180	10
36	Elastic Tack w/rib	2	30	120	0
37	Waist belt servicing	1	22	163	8
38	Waist belt join	1	30	120	0
39	Waist belt piping	1	30	120	0
40	Waist piping mouth tack	1	28	128	2
41	Waist piping mouth close	1	24	150	6
42	Drawstring mouth tack	1	22	163	8
43	Main & size level join	1	20	180	10
44	2 cm bar tack	2	20	180	10
45	.5 cm bar tack	1	30	120	0
Total		58	1181		169

Table No:4.4((Data Table of style: QFAC4-After Balancing))

BPT=SMV/Work station

=1181/58*60

=.339 min

=20.36 sec

UCL=Maximum time required for the task +15%

=30+15%

=34.5 sec

LCL= Minimum time required for the task+ 15%

=20+15%

=23 sec

Target output=60/.339

=177

Balancing= (Minimum output/target output) * 100%

= (120/177) *100%

=67.79%

4.5 Before Balancing:

Floor: Unit 2
Line: 4
Buyer: KIABI
Style: HBBIR
Item: Babies Tank Top
GSM: 160
Fabrication: 100% cotton

SL NO.	Task	Mc type	Work station	Time	Target	idle Time
1	LINING ATTACH WITH FRONT PART	Helper	1	20	180	22
2	SHOULDER JOIN	4TOL	1	21	170	21
3	NECK PIPING O/L	4TOL	1	22	163	20
4	NECK PIPING O/L CUT	Helper	1	18	200	24
5	NECK PIPING TOP STICH	FL	1	20	180	22
6	LINING ATT. AT PLACKET	Helper	1	22	163	20
7	PLACKET IRON	Helper	1	20	180	22
8	PLACKET MAKE	SNLS	1	24	150	18
9	BODY MARK FOR PLACKET JOIN	Helper	1	20	180	22
10	PLACKET JOIN	SNLS	1	40	90	2
11	PLACKET TOP STITCH	SNLS	1	18	200	24
12	PLACKET END TACK	SNLS	1	21	170	21
13	POCKET SERVICING	4TOL	1	15	240	27
14	POCKET HEM	FL	1	16	225	26

15	POCKET IRON	Helper	1	20	180	22
16	BODY MARK FOR POCKET JOIN	Helper	1	21	170	21
17	POCKET JOIN	SNLS	1	42	85	0
18	ARM HOLE PIPING BY O/L	4TOL	1	36	100	6
19	ARM HOLE TOP STITCH	FL	1	20	180	22
20	TACK BEFORE SIDE SEAM	SNLS	1	36	100	6
21	SIDE SEAM W/LABEL	4TOL	1	40	90	2
22	ARMHOLE SAFETY	SNLS	1	20	180	22
	TACK					
23	BODY HEM	FL	1	18	200	24
24	BODY MARK FOR PATCH LABEL JOIN	Helper	1	20	180	22
25	PATCH LABEL JOIN	SNLS	1	38	95	4
26	MAIN & SIZE LABEL MAKE	SNLS	1	20	180	22
27	MAIN & SIZE LABEL JOIN	SNLS	1	20	180	22
28	TRIMING	Helper	1	42	85	0
Total			28	690		486

Table No:4.5 (Data table of style-HBBIR, Before Balancing)

BPT=SMV/Work Station

=690/(28*60)

=0.41 min

=24.64 sec

UCL= Maximum time required for the task+15%

=42+15%

=48.3 sec

LCL= Minimum time required for the task+ 15%

=15+15%

=17.25 sec

Target output=60/.41

=146

Balancing= (Minimum output/ target output) X 100%

= (85/146) X 100%
=58.23%

4.6 After balancing:

SL NO.	Task	Mc type	New work station	New time	Target	New idle time
1	LINING ATTACH WITH FRONT PART	Helper	1	20	180	4
2	SHOULDER JOIN	4TOL	1	21	171	3
3	NECK PIPING O/L	4TOL	1	22	163	2
4	NECK PIPING O/L CUT	Helper	1	18	200	6
5	NECK PIPING TOP STICH	FL	1	20	180	4
6	LINING ATT. AT PLACKET	Helper	1	22	163	2
7	PLACKET IRON	Helper	1	20	180	4
8	PLACKET MAKE	SNLS	1	24	150	0
9	BODY MARK FOR PLACKET JOIN	Helper	1	20	180	4
10	PLACKET JOIN	SNLS	2	20	180	4
11	PLACKET TOP STITCH	SNLS	1	18	200	6
12	PLACKET END TACK	SNLS	1	21	171	3
13	POCKET SERVICING	4TOL	1	15	240	9
14	POCKET HEM	FL	1	16	225	8
15	POCKET IRON	Helper	2	10	220	14
16	BODY MARK FOR POCKET JOIN	Helper	1	21	171	3
17	POCKET JOIN	SNLS	2	21	171	3
18	ARM HOLE PIPING BY O/L	4TOL	2	18	200	6
19	ARM HOLE TOP STITCH	FL	1	20	180	4
20	TACK BEFORE SIDE SEAM	SNLS	2	18	200	6
21	SIDE SEAM W/LABEL	4TOL	2	20	180	4
22	ARMHOLE SAFETY TACK	SNLS	1	20	180	4
23	BODY HEM	FL	1	18	200	6
	BODY MARK FOR					

24	PATCH LABEL JOIN	Helper	1	20	180	4
25	PATCH LABEL JOIN	SNLS	2	19	189	5
26	MAIN & SIZE LABEL MAKE	SNLS	1	20	180	4
27	MAIN & SIZE LABEL JOIN	SNLS	1	20	180	4
28	TRIMING	Helper	2	21	171	3
Total			36	543		129

Table No:4.6(Data table of Style-HBBIR, After Balancing)

BPT=SMV/Work station

=543/36*60

=.251 min

=15.08 sec

UCL=Maximum time required for the task +15%

=24+15%

=27.6 sec

LCL= Minimum time required for the task+ 15%

=10+15%

=11.5 sec

Target output

= 60/.259

= 239

Balancing

= Min output/ Target Output *100

=150/220*100

=68.6%

Chapter 5

Result & Discussion

5.1 Result & Discussion

From the above discussion it is easily noticeable that there were remarkable differences of idle time, capacity and balancing percentage before and after balancing of the line.

We have to reduce idle time by this method and result is given below:

1. Conducting motion study and correcting faulty motions,
2. Hourly operator capacity checks,
3. Use best possible line layout,
4. Reduce line setting time,
5. Continuous feeding to the sewing line,
6. Training to sewing operators,
7. Setting individual operator target,
8. Installing better equipment,
9. Inline quality inspection at regular interval

For the first style (GTVAB) we can see that because of line balancing the idle time is decreased from 254 sec to 30 sec. Capacity lying between UCL and LCL whereas before balancing most of the task capacity was lying below the LCL. Balancing percentage increased into 20% after balancing the line.

For the second style (QFAC4) we can see that because of line balancing the idle time is decreased from 1176 sec to 169 sec. Capacity lying between UCL and LCL whereas before balancing some of the task's capacity was lying below the LCL. Balancing percentage increased into 12% after balancing the line.

For the first style (HBBIR) we can see that because of line balancing the idle time is decreased from 486 sec to 129 sec. Capacity lying between UCL and LCL whereas before balancing few tasks capacity was lying near and below the LCL. Balancing percentage increased into 5% after balancing the line.

5.2 Result Summary:

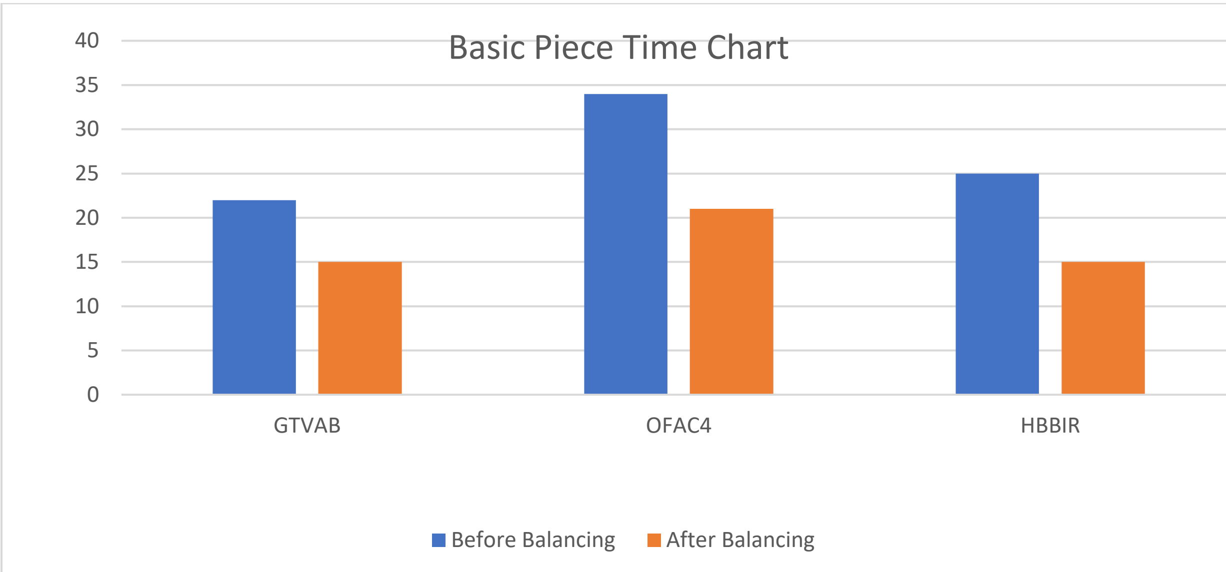

Figure (5.2.1): Data graph of Basic Piece Time

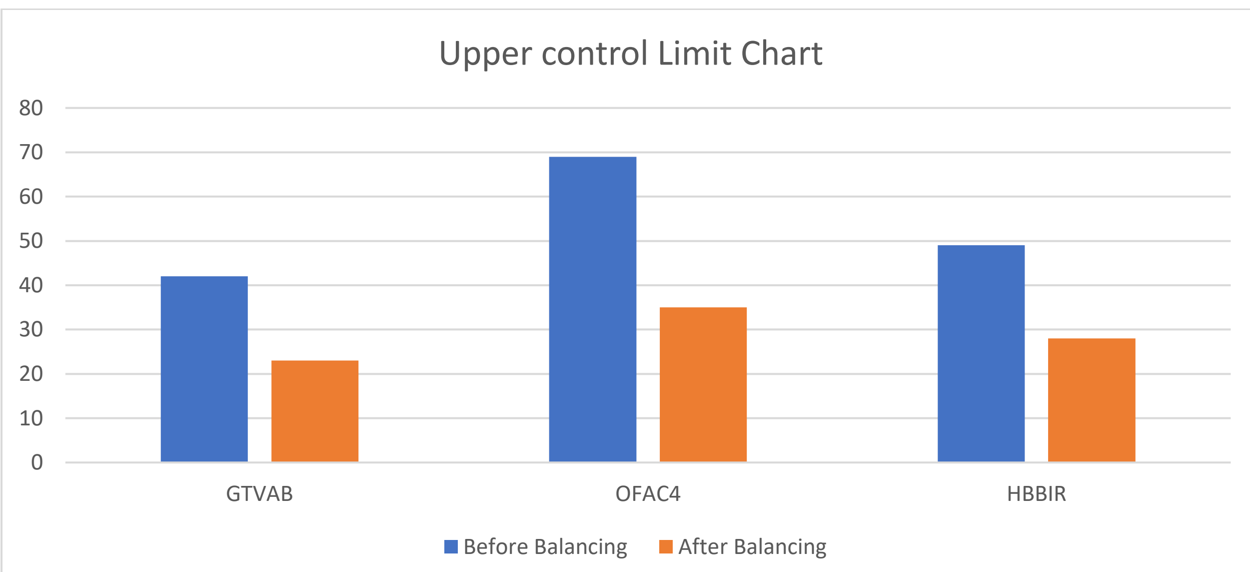

Figure (5.2.2): Data graph of Upper Control Limit

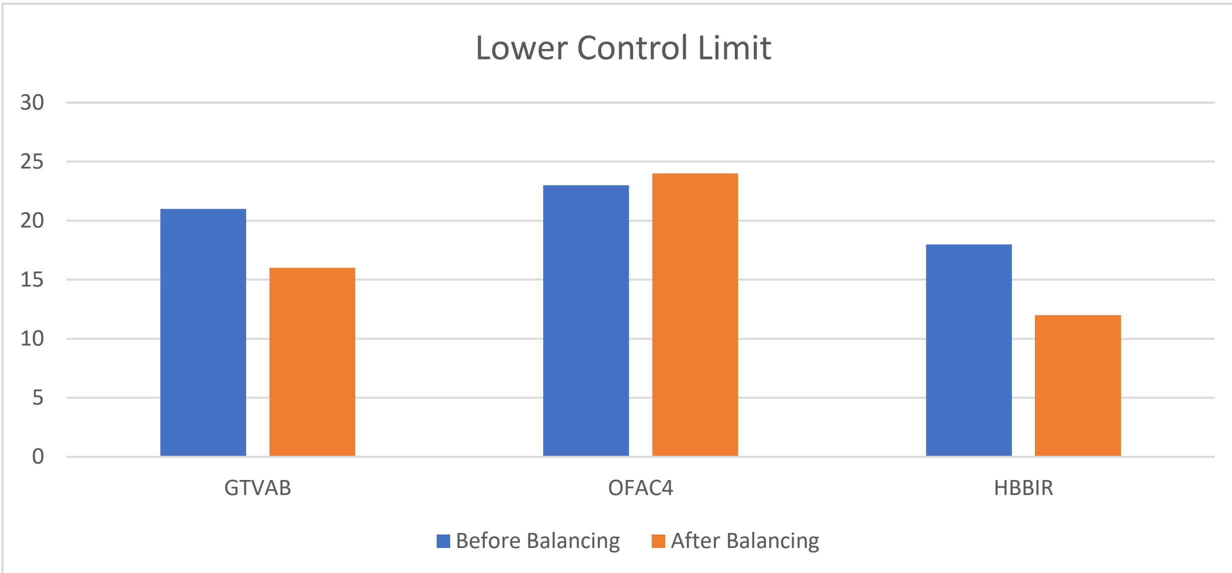

Figure (5.2.3): Data graph of Lower Control Limit

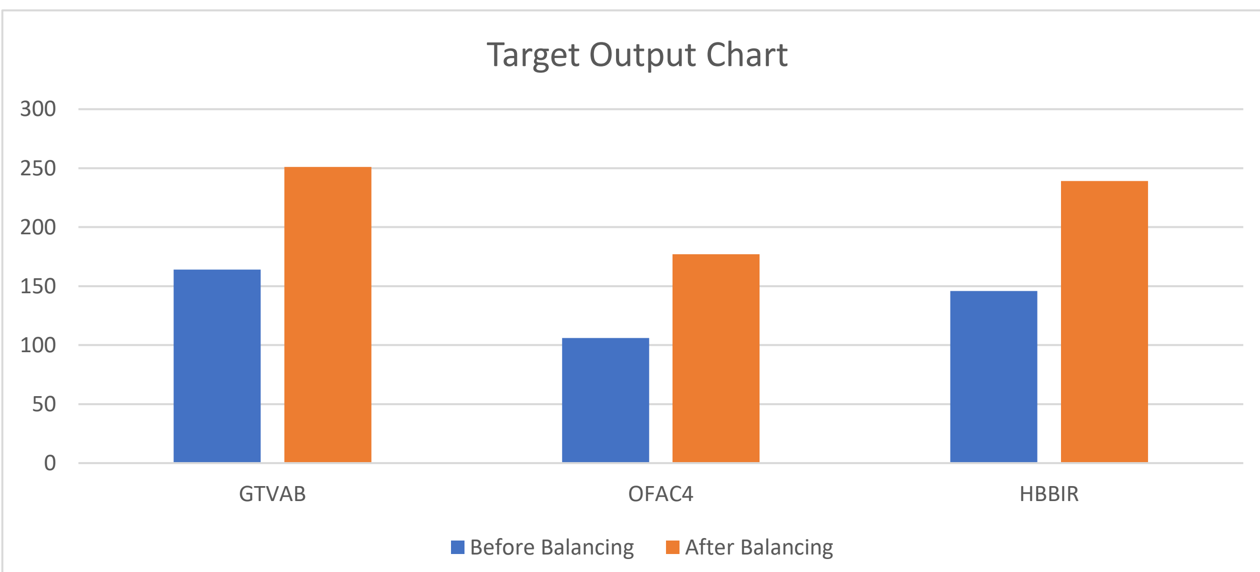

Figure (5.2.4): Data graph of Target Output

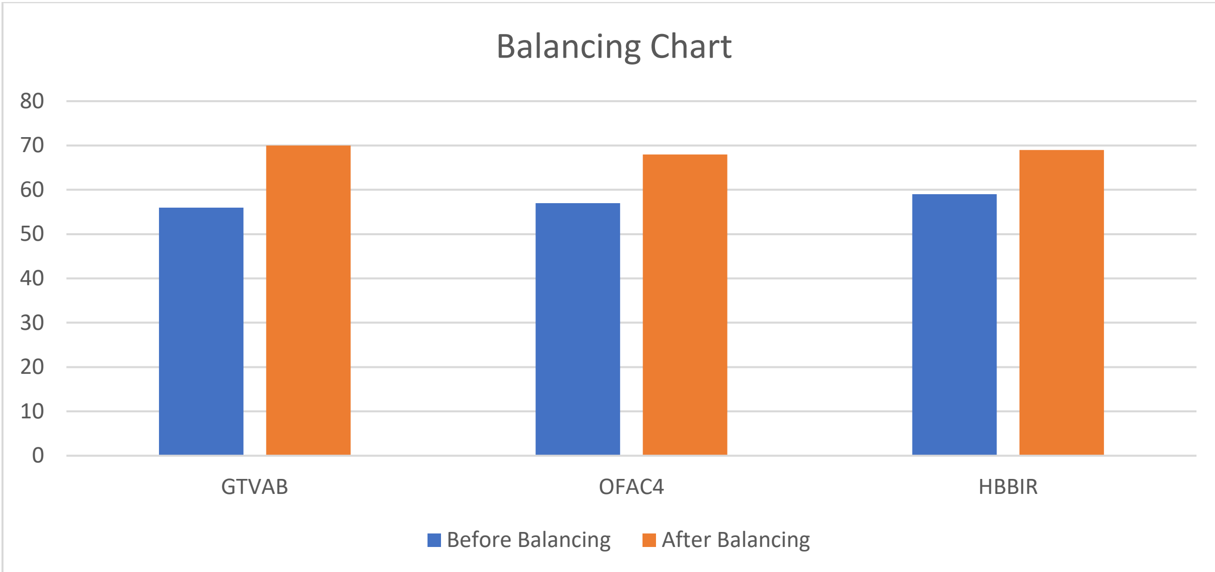

Figure (5.2.5): Data graph of Balancing

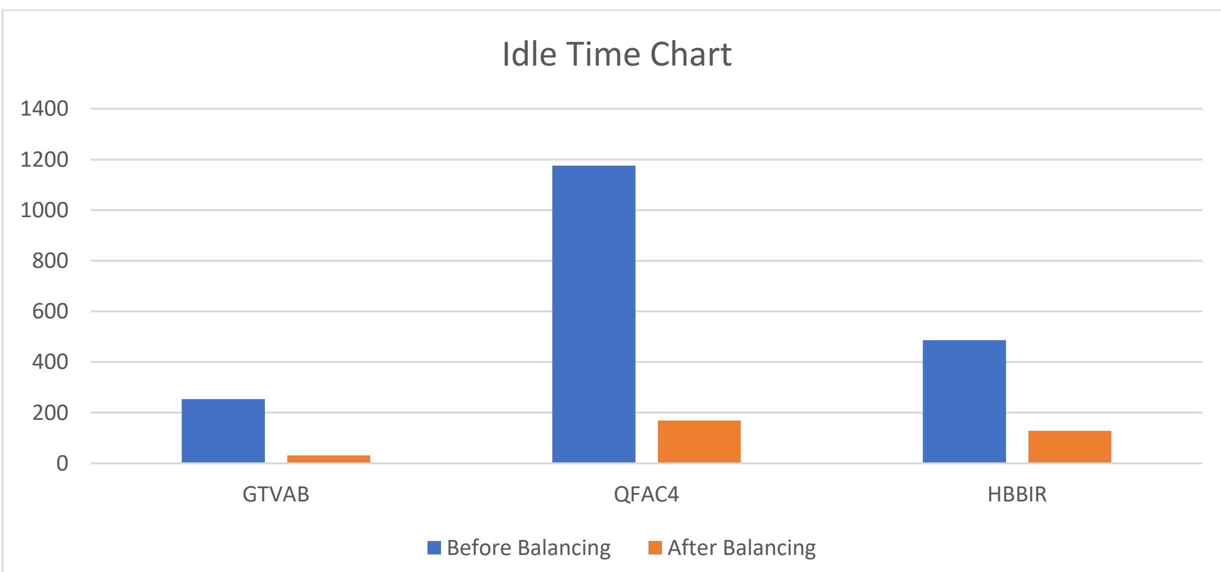

Figure (5.2.6): Data graph of Idle Time

Chapter 6

Conclusion

6.1 Conclusion

Line Balancing is the most important stage in garments industries. This thesis paper contains the data of a knit composite industry. Actually, we are describing the process how line balancing affects the idle time. Mainly we are analyzed the breakdown report of the industry. From the analysis of the reports, we find idle time can be reduced by line balancing. we analysis the reports about how idle time is reduced, how the capacity is increased, LCL & UCL are decreased, BPT is also decreased due to line balancing. Line balancing helps to increase the production rate as well as the profitability. If the lines are not balanced then it could be a huge problem for the factories. So, line balancing is the most important matter in the garments production. There are some limitations during collecting data in the sewing floor. And other one the affecting percentages can be higher/lower because we are analyzed just for three styles. It can be changed for a large number of styles. We think this thesis report important for garments industry and textile students to know how line balancing is helped to reduce the idle time of a worker. Hopefully this will help us in the future.

Chapter 7

Reference

7.1 Reference:

1. Textile Industry, https://www.studymode.com/essays/Textile-Industry-1933615.htm, https://www.ukessays.com/essays/marketing/textile-industry-sector-in-india-marketing-essay.php
https://bizfluent.com/about-5176090-problems-textile-industry.html
http://ravanda.ru/i-exam/1057

2. Line Layout, https://www.allaboutlean.com/line-layout-i-s-u-l-lines
https://www.journalofaccountancy.com/issues/2011/nov/20114289.html
3. Bangladesh Garments, Apparels, Knitwear Information
http://bangladeshgarments.blogspot.com/
4. Garments Export, https://www.dawn.com/news/776821/bangladesh-eyes-20bn-in-garment-exports
http://attiresource.com/bangladesh-textile-industry/
http://fashion2apparel.blogspot.com/2017/02/top-10-retailers-fashion-brands.html
5. Line balancing https://www.studymode.com/essays/62259348-8-Line-Balancing-Problems-66887098.html
6. Labor Interview, https://coverlettersandresume.com/labourer/laborer-interview-questions-and-answers/
7. https://www.acefitness.org/education-and-resources/professional/expert-articles/5561/6-benefits-of-using-weightlifting-machines

8. line balancing, https://docs.sonarqube.org/latest/user-guide/issues/
9. Cycle time, https://sentence.yourdictionary.com/accompanying
10. Strategic Objective, https://www.clearpointstrategy.com/56-strategic-objective-examples-for-your-company-to-copy/
11. Relationship between Employee Commitment and Job Attitude and Its Effect on Service Quality, http://file.scirp.org/Html/10-2120140_30131.htm
12. Line balancing problem https://www.studymode.com/essays/62259348-8-Line-Balancing-Problems-66887098.html
13. Forecasting, https://www.universalclass.com/articles/business/the-art-and-science-of-forecasting-in-operations-management.htm
14. over the last decades,
http://context.reverso.net/%D0%BF%D0%B5%D1%80%D0%B5%D0%B2%D0%BE%D0%B4/%D0%B0%D0%BD%D0%B3%D0%BB%D0%B8%D0%B9%D1%81%D0%BA%D0%B8%D0%B9-%D1%80%D1%83%D1%81%D1%81%D0%BA%D0%B8%D0%B9/over+the+last+decades
15. Production system, https://www.process.st/production-systems/

16. Assembly Line Balancing Problem of Sewing Lines in Garment, https://www.scribd.com/document/355822073/Assembly-Line-Balancing-Problem-of-Sewing-Lines-in-Garment
17. Organizational Structures: their Advantages and Disadvantages, http://www.yourarticlelibrary.com/organization/8-types-of-organisational-structures-their-advantages-and-disadvantages/22143
18. Factory method pattern, https://en.wikipedia.org/wiki/Factory_method_pattern
19. objective structured clinical examination, https://en.wikipedia.org/wiki/Objective_structured_clinical_examination
20. Setup and hold time, http://www.vlsi-expert.com/2011/04/static-timing-analysis-sta-basic-part3a.html
21. Productivity, https://www.britannica.com/topic/productivity
22. Standard Minute Value, http://science.answers.com/Q/What_is_standard_minute_value_in_garments http://www.textilemerchandise.com/2017/03/28/what-are-the-difference-between-smv-sam/
23.Efficiency and Productivity, http://www.differencebetween.info/difference-between-efficiency-and-productivity
24.Time Study, https://www.mbaknol.com/operations-management/work-study/
25.Work Study, https://www.mbaknol.com/operations-management/work-study/
26. Removing Operational Bottlenecks, http://blog.readytomanage.com/removing-operational-bottlenecks/
27. Composites and Industry, https://www.compositesworld.com/articles/composites-and-industry-40-where-are-we
28. Capacity, bottleneck, process capacity, flow rate and utilization, https://lecturenotesblog.wordpress.com/2013/07/04/capacity-bottleneck-process-capacity-flow-rate-and-utilization/
29. Managing Instructional Time, http://www.ascd.org/publications/books/103008/chapters/managing-instructional-time.aspx
30 Tired of Being The Bottleneck, https://www.sweetprocess.com/tired-of-being-the-bottleneck-heres-how-to-determine-the-first-repetitive-task-that-needs-a-documented-procedure/
31. Understanding Profit and Revenue Simulation, https://docs.oracle.com/cd/E16582_01/doc.91/e39354/work_profit_simulator.htm#EOAXO213
32. Each Key Process Participant Should Have a Backup, https://businessanalystlearnings.com/blog/2014/11/6/when-processes-become-problematic-3-ways-to-correct-bottlenecks
33. Estimate Line efficiency of Garment Production, http://www.garmentsmerchandising.com/how-to-estimate-line-efficiency-of-garment-production/