

# Methods of Improving Productivity in Apparel Industry

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**Abstract:** Productivity plays an important role in any garment industry. There are various reasons for which the productivity decreases and there are many known methods to improve the productivity. Choosing a correct and effective method plays a crucial role. A garment manufacturing unit is considered for study and analysis. The study helped in identifying the problems in the industry. The study reported that productivity is low due to time study analysis not being followed for the sewing operations. Secondly, employees are not motivated in the workplace. In order to improve the productivity, time study and motion study are the effective methods. Work study is known to be a highly effective productivity improvement method. Determining the standard work cycle time is one of the most important step used in work study, which helps in great deal in improving activities. The time study and method study was carried out and was found that the employees are not motivated in the workplace and that has resulted in low productivity and efficiency. Subsequently with the help of management various monetary and non-monetary incentives to employees were suggested in addition to salary on weekly or monthly basis. The introduction of the incentive schemes has motivated the employees to work more efficiently. The time and motion study carried out in the industry has improved the productivity by 33% and on an average; an operator makes 32 pieces per hour.

**Keywords:** Time study, Motion study, Work study, Flow process chart, Time standards, Productivity, Employee motivation, Incentive schemes.

## 1. Introduction

The study was carried out at a garment industry “Lango Garments”. It is established in the year 2007. The industry produces 15,000 garments per day and has well-equipped in-house factory of 40,000 sq. ft. operating with 150 machinery.

The productivity of the industry was studied and it was observed that the time study analysis is not being followed for the sewing operations. Hence, the study aims to identify the bottleneck operations and suggest appropriate methods to improve the productivity of the industry to overcome the problems.

Productivity is obtained by dividing output by one of the factors of production. Work study may be a method of enhancing the productivity of the firm by eliminating the waste and unnecessary operations. It identifies non-value adding operations by analyzing all the factors affecting the operation. Method study and work measurement are a part of time and

motion study. Work measurement is additionally called by the name ‘Time study’. Work measurement is completely essential for both the design and control of operations. Highly motivated employees focus their efforts on achieving the precise goals. It’s the manager’s job, therefore, to motivate the employees to get them to take up and try the simplest job. Highly motivated employees call in sick less frequently, are more productive, and are less likely to convey bad attitudes to customers and associates. The motivation given has to be justified and should be rational. It should be ready to fulfill the aim of productivity improvement otherwise it’s going to result into huge loss to the organization and should even cause unethical work practices. Rewards and incentives within the workplace have benefits for both employees and employers. These incentives encourage friendly competition between workers when linked to job performance. The sharing of a company’s profits gives incentive to employees to supply a top quality product, perform a top quality service, or improve the standard of a process within the corporate. Non-financial incentives help in satisfying psychological, social and emotional needs of the workers. Few examples for incentives include attendance bonus, group incentives, and monetary awards, allow flexibility and allowances, giving an opportunity to steer, work-life balance, helpful services, healthy food etc.

## 2. Literature Review

### A. Productivity

According to J. R. Hicks, “Production is an activity whether physical or mental, which is directed to the satisfaction of other people’s wants through exchange. “Productivity is defined as the ratio between output and input. Output determines the quantity produced and input determines the various resources employed like man, material, machines etc., (Ramesh Babu-2012). Productivity refers to the efficiency of production system. It is an indicator of how well the factors of production are utilized. (Glock and Kunz-2005).

$$\text{Productivity} = \text{Output/Input}$$

### B. Work Study

“Work study is a generic term for those techniques, method study and work measurement which are used in the examination

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of human work in all its contexts. And which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement.” (George Kanawaty, 1955).

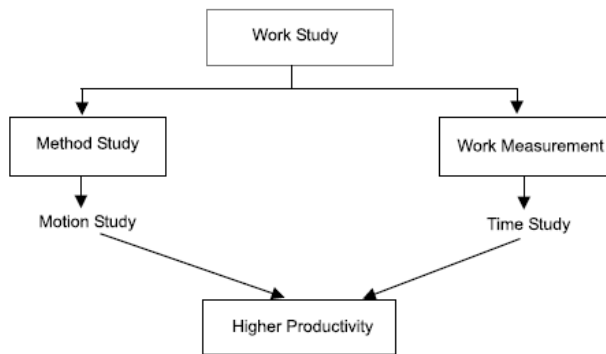


Fig. 1. Framework of work study

#### 1) Method study

“Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means or developing and applying easier and more effective methods and reducing cost.” (George Kanawaty, 1955).

#### 2) Recording techniques for method study

Following the selection of the work to be analyzed, the next step in the basic procedure is to record all details pertaining to the existing method. It is important to provide a method for tracking all the required information regarding the current method in order to imagine the activities chosen for investigation in their entirety and to improve them by subsequent critical review. Records are extremely useful for comparing the success of the proposed improved process before and after.

#### 3) Types of charts

It can be broadly divided into

- i. Macro motion charts
- ii. Micro motion charts.

##### i. Macro motion charts:

Following four charts are used under this type:

##### 1. Operation Process Chart

It's also known as an outline phase diagram. By documenting only, the main operations and inspections involved in the process, an activity process map provides a bird's eye view of the entire process.

##### 2. Flow Process Chart

The flow process map depicts the flow of work for a product or a portion of it through a work center or department, with activities recorded using appropriate symbols. It is an amplification of the operation process map, which depicts operations such as inspection, storage, delay, and transportation.

##### 3. Two Handed Process Chart

The most accurate form of flow chart is a two-handed (operator process chart), in which the movements of the workers' hands are reported in relation to one another. The two-handed method map is typically limited to work done at a single

location. This also provides a graphical representation of the worker's manual tasks in a coordinated manner.

#### 4. Multiple Activity Chart

It's a graph in which the actions of multiple subjects (worker or equipment) are reported on a standard time scale to demonstrate their interdependence.

#### 4) Motion study

Motion research is a form of process study in which the motion of an operator or a piece of work is examined using the prescribed methods.

#### 5) Time study

Work measurement is another name for time study. It is needed for both operational planning and control. Time research is described by the British Standard Institute as "the application of techniques designed to determine the time required for a skilled worker to perform a specified job at a defined level of efficiency." (Glock and Kunz, 2005).

#### C. Employee Motivation

Motive is described by Webster's Dictionary as "something that causes an individual to act." Employee motivation refers to how dedicated an employee is to his or her job, how involved he or she feels in the company's goals, and how motivated he or she feels in their everyday tasks.

Employees who are highly motivated concentrate their energies on achieving particular objectives. As a result, it is the manager's responsibility to inspire workers and encourage them to do their best work. Employees who are motivated are less likely to call in sick, are more active, and are less likely to express negative attitudes to customers and coworkers. Job motivation may be extrinsic or intrinsic, which means that an employee's motivation stems from within. (Stephen, 2016)

#### 1) Incentives

Despite the promotion of alternative motivators, money continues to play a significant role in the mix of motivators. Employees who participate in benefit sharing receive a share of the profit in addition to their daily pay.

Employees and employers alike benefit from job bonuses and rewards. When linked to job results, these incentives promote friendly competition among associates. Employees are motivated to create a high-quality product, provide high-quality service, or increase the quality of a company's process by sharing profits.

Non-monetary benefits are those that help workers meet their psychological, social, and emotional needs. Attendance bonuses, community rewards, and cash prizes are only a few examples of incentives. Others include allowing flexibility and allowances, providing a chance to lead, promoting work-life balance, providing supportive resources, and providing nutritious food.

### 3. Methodology

Production in the apparel manufacturing industry plays a major role in deciding the profit/loss of the company. There are various reasons that affect the target output or production. Identifying the reasons troubling productivity and the methods used to overcome the problems, by utilizing the available

manpower in a more effective way are discussed in methodology.

In order to achieve the objectives of the project, the methodology flow chart has been designed. The methodology followed in the study is explained in the Figure 2 and 3.

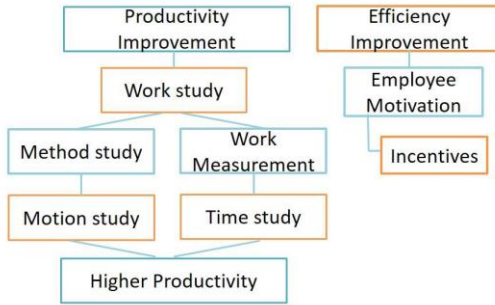


Fig. 2. Methodology outline chart

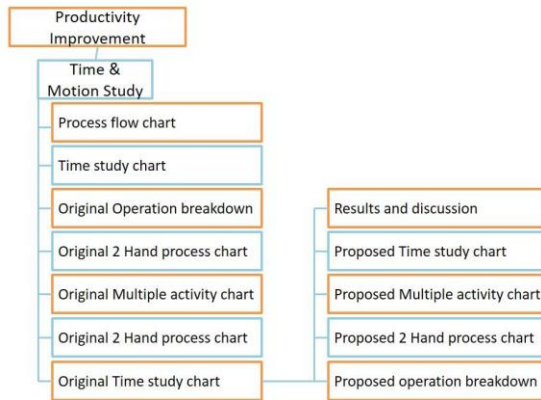


Fig. 3. Methodology flowchart

A. Productivity Improvement

In order to improve the productivity in the industry following methods are followed.

1) Style Analysis

This polo T-shirt shown in Figure 4 is exclusively designed for men’s upon considering the comfort. It is made up of 100% cotton, Pique fabric with 160 GSM. It has sizes from M, L, and XL. This polo T-shirt has the following parts,

- a. Front part
- b. Back part
- c. Sleeves – 2 No’s
- d. Collar
- e. Placket
- f. Side label
- g. Contrast cuff



Fig. 4. Men’s T-Shirt

2) Process Flow Chart and Operation Breakdown Table

A process analysis can be used to improve understanding of how the process operates and to determine potential targets for the process improvement through removing waste. Thus, the chart shows the flow of operations which needs to be done in order to complete the sewing of the polo neck T-shirt. It shows the process flow of both machine and non- machine operations of each part of the polo T-shirt. Process layout of polo T-shirt is shown in Table 1. The stitches and machines required to construct Polo Neck T-shirt is shown in Table 2.

Table 1  
Process layout of polo-shirt

SL. No.	Operation	M/C	Man power	
			Helper	Operator
1	Marking placket position on front panel	Helper	1	
2	Placket rolling	Helper	1	
3	Placket cutting	Helper	1	
4	Placket joint in front panel	SNLS		1
5	Nose tuck of placket in front panel	SNLS		1
6	Finishing the edges	OL		1
7	Body match of placket	Helper	1	
8	Shoulder joint	SNLS		1
9	Shoulder top stitch	SNLS		1
10	Care label joint	SNLS		1
11	Collar marking to front panel	Helper	1	
12	Collar joining	SNLS		1
13	Collar over locking	OL		1
14	Neck Piping	FL		1
15	Neck top bound stitch	SNLS		1
16	Main label joint to neck	SNLS		1
17	Lower placket finish	SNLS		1
18	Upper placket finish	SNLS		1
19	Placket tuck (upper & lower placket finishing)	SNLS		1
20	Placket trimming	Helper	1	
21	Placket front box making	SNLS		1
22	Body panel hemming	OL		1
23	Side band seaming	OL		1
24	Sleeve matching	Helper	1	
25	Shoulder piping	Helper	1	
26	Sleeve join seam	OL		1
27	Side band tacking	SNLS		1
28	Side band top stitch	SNLS		1
29	Side seam	OL		1
30	Side Label seam	OL		1
31	Sleeve tuck	SNLS		1
			8	23
			<b>Total Man Power = 31</b>	

Table 2  
Stitches and machines needed to make Polo T-shirt

SL. No.	Operations	Stitch Type	Machines
1	Placket Rolling	1N Lock Stitch	SNLS
2	Placket Join	1N Lock Stitch	SNLS
3	Nose Tuck	1N Lock Stitch	SNLS
4	Shoulder Join seam	Over edge Stitch	OL
5	Collar Join seam	1N Lock Stitch	SNLS
6	Collar Finishing	Over edge Stitch	OL
7	Upper Placket Top stitch	1N Lock Stitch	SNLS
8	Lower Placket Top stitch	1N Lock Stitch	SNLS
9	Back Neck Top stitch	1N Lock Stitch	SNLS
10	Placket top stitch	1N Lock Stitch	SNLS
11	Placket Box stitch	1N Lock Stitch	SNLS
14	Sleeve Cuff Joining	Over edge Stitch	OL
15	Cuff Top Stitch	Chain / Flat bed Stitch	FL
16	Sleeve Joining	Over edge Stitch	OL
17	Arm Hole Top stitch	Chain / Flat bed Stitch	FL
18	Side Seam	Over edge Stitch	OL
19	Body panel Hemming	Flat lock	FL
20	Sleeve tuck seam	1N Lock Stitch	SNLS
21	Button Hole stitch	Button Holing	BH
22	Button seam	Button Attaching	BA
23	Side label	Label seam	OL
		<b>Total Machine</b>	<b>23</b>

3) SAM allocation

Based on the motion study and cycle time of an operation, a standard time is allocated for every operation known as SMV (standard minute value). Each operation was measured in seconds and is recorded. Time study sheet is showing the different types of processes, standard time for each operation in minutes, with allowance added 15%, SMV and SAM for Polo T-shirt. Table 3 shows the operation breakdown with SMV.

Table 3  
Operation breakdown with SMV for Polo T- shirt

SL. No.	Operation	Standard Time (sec)	Allowance 15%
1	Marking placket position	26	3.9
2	Placket rolling	36	5.4
3	Placket cutting	28	4.2
4	Placket joint in front panel	62	9.3
5	Nose tack of placket in front panel	25	3.75
6	Finishing the edges	26	3.9
7	Body match of placket	20	3
8	Shoulder joint	50	7.5
9	Shoulder top stitch	44	6.6
10	Care label joint	22	3.3
11	Collar marking to front panel	30	4.5
12	Collar joining	40	6
13	Collar over locking	36	5.4
14	Neck Piping	38	5.7
15	Neck top bound stitch	55	8.25
16	Main label joint to neck	32	4.8
17	Lower placket top seam finish	44	6.6
18	Upper placket top seam finish	54	8.1
19	Placket tack (upper & lower placket finishing)	32	4.8
20	Placket trimming	21	3.15
21	Placket front box making	31	4.65
22	Body panel hemming	32	4.8
23	Side band seaming	36	5.4
24	Sleeve matching	30	4.5
25	Shoulder piping	20	3
26	Sleeve join seam	45	6.75
27	Side band tacking	40	6
28	Side band top stitch	35	5.25
29	Side seam	40	6
30	Side label seam	15	2.3
31	Sleeve tack	20	3
Total Estimated SMV		17.75 (min)	2.66 (min)

No. of Operator: 31

Standard Minute Value (SMV): 17.75 (min)

SAM = (SMV + 15% allowance)  
= 17.45 + 2.66 = 20.41 (min)

Target per hour:  $(31 \times 60) / 20.41 = 91.13$  pcs/hr.

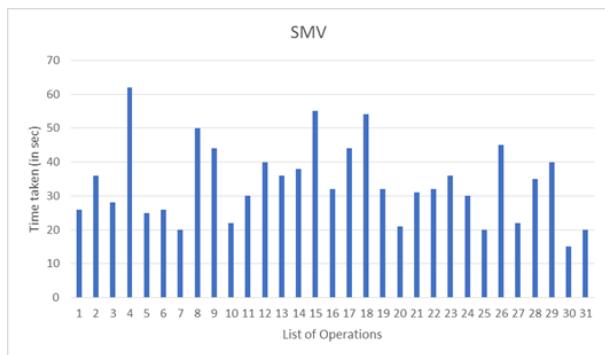


Fig. 5. Estimated standard minute values

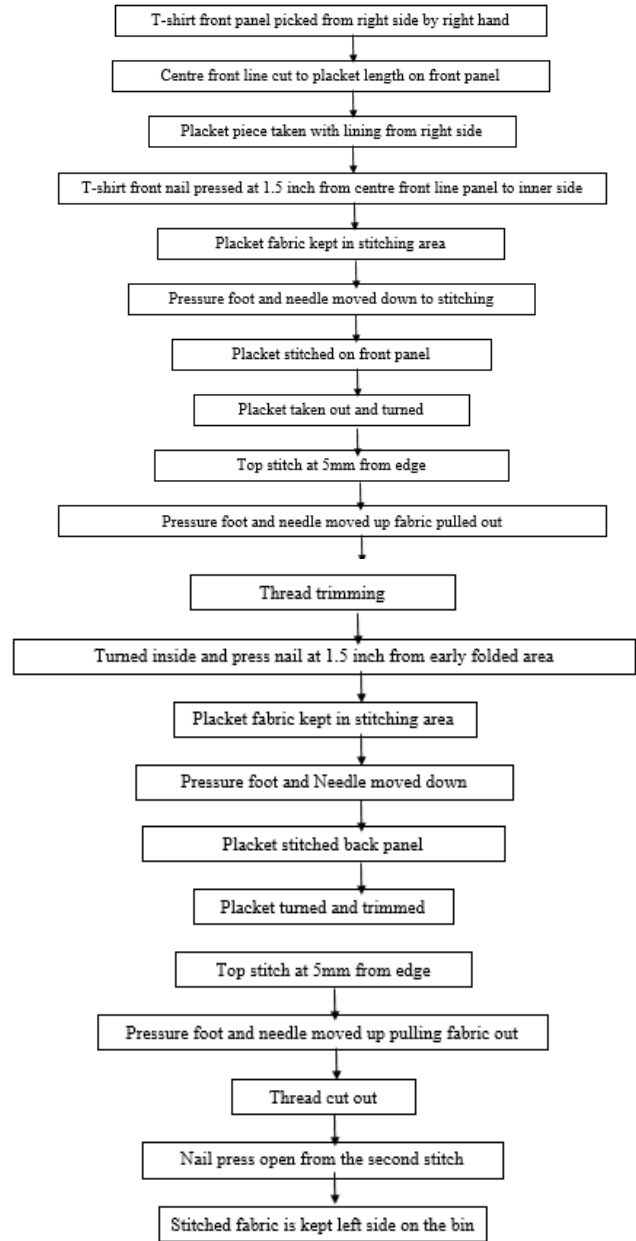
The Figure 5 shows that there are thirty-one (31) operation breakdowns where most of the values for SMV are below 50. The target per hour of a qualified operator will be 91 pieces. On the other hand, operation SMV above 60, are observed as

placket finishing, and side seam operation which are 220 and 130 seconds respectively when the whole operation is combined.

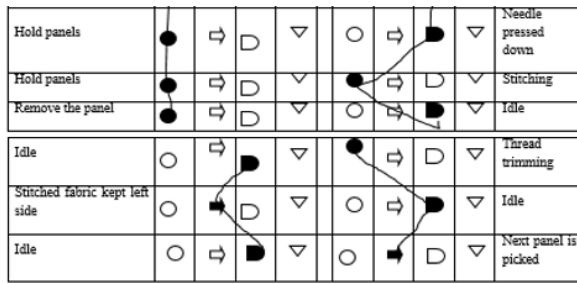
4) The Original Method

An operation of placket making with side seam of a Polo T-shirt has been taken and it is required to study the existing original method using work study and thereby propose a new method which is more efficient and less time consuming. The existing method is the traditional method in practice for making polo T-shirt front placket and side seam which is followed.

a) Operational breakdown for placket







Place on machine and align	Idle
Hold the fabric	Tacking
Band turned	Idle
Stitching	Idle
Remove fabric from the machine	Idle
Thread trimming	Idle
Place the stitched fabric at other bin	Idle
Next panel is picked	Idle

e) Multiple Activity Chart for Placket

A multiple activity chart for placket is shown in Table 6.

Table 6  
Multiple activity chart for placket

MAN	MACHINE
Front picked	Idle
Marking for placket	Idle
Front panel cut for placket	Idle
Placket piece taken	Idle
Placket and panel aligned	Idle
Nail pressing is done for front panel	Idle
Panel placed it in stitching area	Idle
pressure foot & needle down	Idle
Idle	Bar-tack, stitch on 5 mm from edge
Idle	Stitching complete
Pressure foot and needle moved up	Idle
Remove fabric from machine	Idle
Trim the thread	Idle
Nail press at 1.5 inch	Idle
Place fabric in the stitching area	Idle
Pressure foot and needle put down	Idle
Idle	Bar tack, stitch on 5 mm from edge
Idle	Stitch complete
Pressure foot and needle moved up	Idle
Remove and discard the panel	Idle
Nail press open at second seam	Idle
Place the stitched fabric at other side	Idle

f) Multiple Activity Chart for Side Seam

A multiple activity chart for side seam is shown in Table 7.

Table 7  
Multiple activity chart for side seam

MAN	MACHINE
Panel picked	Idle
Panel placed at side seam	Idle
Panel placed it in stitching area	Idle
Pressure foot and needle moved down	Idle
Idle	Bar-tack, stitch on 5 mm from edge
Idle	Stitching complete
Pressure foot and needle moved up	Idle
Remove fabric from the machine	Idle
Trimming	Idle
Band picked from side	Idle
Band assemble	Idle
Kept the panel at the stitching area	Idle

g) Time Study Chart for Placket

A time study chart for placket is shown in Table 8.

Table 8  
Time study chart for placket

TIME STUDY CHART							
OPERATION NAME: Placket Making							
MACHINE USED: SNLS							
No	Operation	Observed Time			Total SMV	Avg SMV	Total SMV
		1	2	3			
1	T-shirt front panel picked from right side by right hand	1.2	1	1.5	3.7	1.2	1.23
2	Centre front line cut to placket length on front panel	3	3.5	3.4	9.9	3.3	3.30
3	Placket piece taken with lining from right side	1.2	1	1.5	3.7	1.2	1.23
4	T-shirt front nail pressed at 1.5 inch from centre front line panel to inner side	8	8.5	8	24.5	8.17	8.17
5	Placket fabric kept in stitching area	2	2.3	2.2	6.5	2.17	2.17
6	Pressure foot and needle moved down to stitching	1	1.2	1	3.2	1.07	1.07
7	Placket stitched on front panel	15	14.8	15.5	45.3	15.1	15.10
8	Placket taken out and turned	5	5.5	5.5	16	5.33	5.33
9	Top stitch at 5mm from edge	21	20	22	63	21	21.00
10	Pressure foot and needle moved up fabric pulled out	3.5	3	3.2	9.7	3.23	3.23
11	Thread trimming	2.3	2	2.2	6.5	2.17	2.17
12	Turned inside and press nail at 1.5 inch from early folded area	12	15	14.7	41.7	13.9	13.90
13	Placket fabric kept in stitching area	3	3.7	3.3	10	3.33	3.33
14	Pressure foot and Needle moved down	1	1.2	1.2	3.4	1.13	1.13
15	Placket stitched back panel	15.5	14	15	44.5	14.83	14.83
16	Placket turned and trimmed	5	4.8	5.5	15.3	5.1	5.10
17	Top stitch at 5mm from edge	22	21	21	64	21.33	21.33
18	Pressure foot and needle moved up pulling fabric out	3	3.5	3.5	10	3.33	3.33
19	Thread cut out	2.2	2.2	2.5	6.9	2.3	2.30
20	Nail press open from stitch	8.7	7.7	7.2	23.6	7.87	7.87
21	Stitched fabric is kept left side on the bin	1.5	1.2	1	3.7	1.23	1.23
						<b>Total</b>	<b>138</b>

Calculations:

Standard Minute Value (SMV): 138 sec

Calculation of SAM:



Allowance: 15%

SAM (Standard Allowed Minutes) = Basic Time + Total Allowances

$$\begin{aligned} \text{SAM} &= (\text{SMV} + 15\% \text{ allowance}) \\ &= 138 + 15\% \\ &= 138 + 21 \\ &= 159 \text{ Sec} \end{aligned}$$

Therefore, SAM = 159 sec = 2.6 min

$$\begin{aligned} \text{Maximum output} &= (\text{Working time}/\text{Maximum process time}) \\ &= (60/2.6) \\ &= 23 \text{ Pcs} \end{aligned}$$

$$\begin{aligned} \text{Productivity per Operator} &= \text{Total output} / \text{Total manpower} \\ &= 23 \text{ Pcs}/21 \text{ Operator} \\ &= 1.09 \text{ Pcs}/\text{Operator is the output.} \end{aligned}$$

*h) Time Study Chart for Side Seam*

A time study chart for side seam is shown in Table 9.

Table 9  
Time study chart for side seam

TIME STUDY CHART							
OPERATION NAME: SIDE SEAM							
MACHINE USED: SNLS							
No	Operation	Observed Time			Total SMV	Avg SMV	Total SMV
		1	2	3			
1	Fabric is picked from the right side by right hand	3	3.3	3.2	9.5	3.17	3.17
2	Assemble of fabric from right hand to left hand	2.1	2.2	2.1	6.4	2.13	2.07
3	Panels are aligned for the side seam	2	2.5	2.4	6.9	2.3	2.30
4	Kept the panel at the stitching area	4.6	5.7	6	16.3	5.43	5.43
5	Pressure foot and needle moved down	2.14	2.07	3	7.21	2.4	2.40
6	Edge stitch at 5mm from edge of the panel	6.2	7.3	6.8	20.3	6.77	6.60
7	Side label is placed on side on position and hold	2	2.5	3	7.5	2.5	2.50
8	Pressure foot and needle moved down	2.14	2.07	3	7.21	2.4	2.40
9	Edge stitch at 5mm from edge of the panel	30	32	35	97	32.3	32.33
10	Side label is stitched	6	7.5	8.8	22.3	7.43	7.43
11	Pressure foot and needle moved up pulling the fabric out	6	7.2	7.5	20.7	6.9	6.67
12	Thread trimming	5	5.1	5.2	15.3	5.1	5.10
13	Band is picked from the side	3	3.3	3.2	9.5	3.17	3.17
14	Band is assembled in the panel	2.1	2.2	2.1	6.4	2.13	2.07
15	Kept the panel at the stitching area	2	2.5	2.4	6.9	2.3	2.30
16	Pressure foot and needle moved down	2.14	2.07	3	7.21	2.4	2.40
17	Edge stitch at 5mm from edge of the panel and band	6	7.5	8.8	22.3	7.43	7.43
18	Band tacking is done and turned	6.5	7.2	8.3	22	7.33	7.33
19	Band stitch finished	6	7.5	8.8	22.3	7.43	7.43
20	Pressure foot and needle moved up	2.14	2.07	3	7.21	2.4	2.40
21	Pulling the fabric out	4.56	5.5	4.5	14.6	4.85	4.69
22	Thread trimming	3	3.2	3.5	9.7	3.23	3.23
23	Fabric kept on the left side bin	3.3	3.5	3.7	10.5	3.5	3.50
					<b>Total</b>	<b>124.36</b>	

*Calculations:*

Standard Minute Value (SMV): 124.36 sec

Calculation of SAM:

Allowance: 15%

SAM (Standard Allowed Minutes) = Basic Time + Total Allowances

$$\begin{aligned} \text{SAM} &= (\text{SMV} + 15\% \text{ allowance}) \\ &= 124.36 + 15\% \\ &= 124.36 + 18.65 \\ &= 143.01 \text{ Sec} \end{aligned}$$

Therefore, SAM = 143.01 sec = 2.4 min

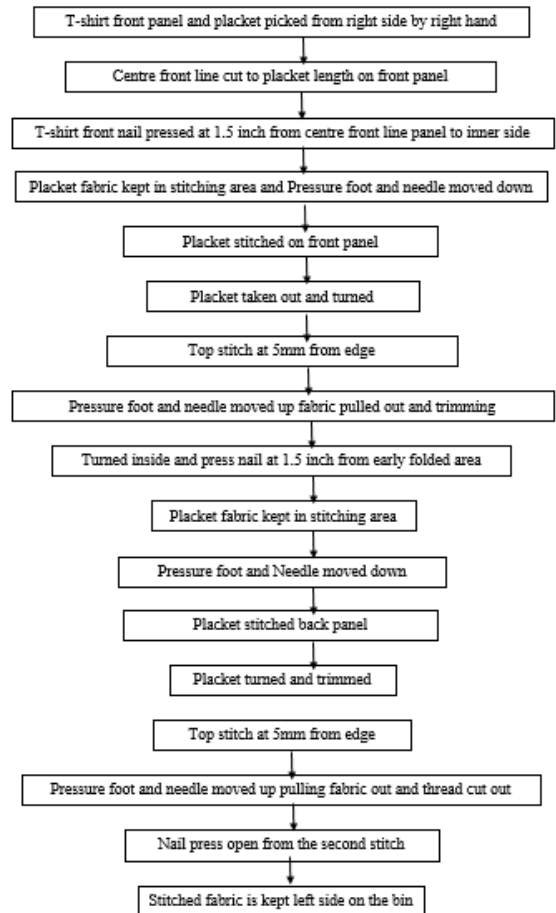
$$\begin{aligned} \text{Maximum output} &= (\text{Working time}/\text{Maximum process time}) \\ &= (60/2.4) \\ &= 25 \text{ Pcs} \end{aligned}$$

$$\begin{aligned} \text{Productivity per Operator} &= \text{Total output}/\text{Total manpower} \\ &= 25 \text{ Pcs}/23 \text{ Operator} \\ &= 1.08 \text{ Pcs}/\text{Operator is the output.} \end{aligned}$$

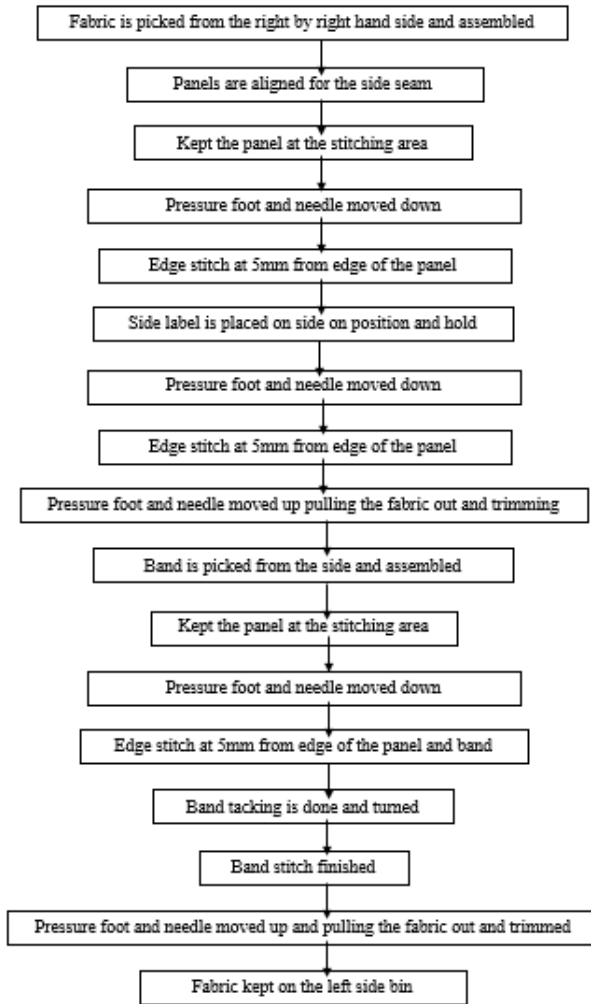
*5) The Proposed Methods*

The operation of placket making with side seam of a polo T-shirt was considered and thereby studied the existing original method using work study and hereby proposed a new method which is more efficient and less time consuming.

*a) Operational breakdown for placket*



b) Operation breakdown of side seam



c) Two handed process chart (for placket)

A Two handed process chart for placket is shown in Table 10.

Table 10  
Two handed process chart (for placket)

Left Hand Side	○	⇨	D	▽	○	⇨	D	▽	Right Hand Side
Placket picked	●	⇨	D	▽	●	⇨	D	▽	Front panel picked
Hold front	●	⇨	D	▽	●	⇨	D	▽	Front panel marking and cut for placket
Placket and panel aligned	●	⇨	D	▽	●	⇨	D	▽	Placket and panel aligned
Hold front	●	⇨	D	▽	●	⇨	D	▽	Nail pressing is done for front panel
Place on machine and align	○	⇨	D	▽	●	⇨	D	▽	Place front and align
Hold front	●	⇨	D	▽	○	⇨	D	▽	Needle down
Hold front	●	⇨	D	▽	●	⇨	D	▽	Bar tacking
Move front along	○	⇨	D	▽	○	⇨	D	▽	Maintain the correct distance
Hold stitched fabric	●	⇨	D	▽	○	⇨	D	▽	Needle moved up
Remove front	○	⇨	D	▽	●	⇨	D	▽	Trim the thread
Hold folded front	●	⇨	D	▽	●	⇨	D	▽	Nail pressing
Position the panel	●	⇨	D	▽	○	⇨	D	▽	Needle moved down
Hold the panel	●	⇨	D	▽	●	⇨	D	▽	Bar tacking
Move panel along	○	⇨	D	▽	○	⇨	D	▽	Maintain correct distance

Hold stitched fabric	●	⇨	D	▽	○	⇨	D	▽	Needle moved up and trimming
Hold stitched panel	●	⇨	D	▽	●	⇨	D	▽	Nail pressing
Stitched fabric kept left side bin	○	⇨	D	▽	●	⇨	D	▽	Next piece of front panel taken

d) Two handed process chart (for side seam)

A Two handed process chart for side seam is shown in Table 11.

Table 11  
Two handed process chart (for side seam)

Left Hand Side	○	⇨	D	▽	○	⇨	D	▽	Right Hand Side
Panels is transferred	○	⇨	D	▽	●	⇨	D	▽	Panel picked
Place on machine and align	●	⇨	D	▽	●	⇨	D	▽	Place panels and align
Hold panels	●	⇨	D	▽	○	⇨	D	▽	Needle pressed down
Hold panels	●	⇨	D	▽	●	⇨	D	▽	Stitching
Move front panel along	○	⇨	D	▽	○	⇨	D	▽	Maintain correct distance
Side label seaming	●	⇨	D	▽	●	⇨	D	▽	Side label placing
Hold stitched panels	●	⇨	D	▽	○	⇨	D	▽	Needle up
Remove front panel	●	⇨	D	▽	●	⇨	D	▽	Trim thread
Band assemble	●	⇨	D	▽	●	⇨	D	▽	Band picked from side
Kept the panel at the stitching area and align	●	⇨	D	▽	●	⇨	D	▽	Kept the panel at the stitching area
Hold panels	●	⇨	D	▽	○	⇨	D	▽	Needle pressed down
Move panel along	○	⇨	D	▽	○	⇨	D	▽	Maintain correct distance
Hold panel	●	⇨	D	▽	○	⇨	D	▽	Band turned
Hold panels	●	⇨	D	▽	○	⇨	D	▽	Needle pressed down and stitching
Remove the panel	●	⇨	D	▽	●	⇨	D	▽	Thread trimming
Stitched fabric kept left side	○	⇨	D	▽	○	⇨	D	▽	Next panel is picked

e) Multiple Activity Chart for Placket

A multiple activity chart for placket is shown in Table 12.

Table 12  
Multiple activity chart for placket

MAN	MACHINE
Front panel and placket picked	Idle
Marking for placket and Front panel cut for placket	Idle
Nail pressing is done for front panel	Idle
Panel placed it in stitching area	pressure foot & needle down
Idle	Bar-tack, stitch on 5 mm from edge
Idle	Stitching complete
Remove fabric from machine	Pressure foot and needle moved up
Trim the thread	Idle
Nail press at 1.5 inch	idle
Place fabric in the stitching area	Pressure foot and needle put down
Idle	Bar tack, stitch on 5 mm from edge
Idle	Stitch complete



Pressure foot and needle moved up	Remove the panel
Nail press open at second seam	idle
Place the stitched fabric at other side	Idle

f) Multiple Activity Chart for Side seam

A multiple activity chart for side seam is shown in Table 13.

Table 13  
Multiple activity chart for side seam

MAN	MACHINE
Panel picked and placed at side seam	Idle
Panel placed it in stitching area	Pressure foot and needle moved down
Idle	Bar-tack, stitch on 5 mm from edge
Idle	Stitching complete
Remove fabric from the machine	Pressure foot and needle moved up
Trimming	Idle
Band picked from side and assemble	Idle
Kept the panel at the stitching area and align	Idle
Hold the fabric	Tacking
Band turned	Stitching
Remove fabric from the machine	Idle
Thread trimming	Idle
Place the stitched fabric at other bin	Idle
Next panel is picked	Idle

g) Time Study Chart for Placket

A time study chart for placket is shown in Table 14.

Table 14  
Time study chart for placket

TIME STUDY CHART							
OPERATION NAME: Placket Making							
MACHINE USED: SNLS							
No	Operation	Observed Time			Total SMV	Avg SMV	Total SMV
		1	2	3			
1	T-shirt front panel and placket picked	3.2	3.5	2.8	9.5	3.17	3.17
2	Centre front line cut to placket length on front panel	3.1	3.1	3.5	9.7	3.23	3.23
3	T-shirt front nail pressed at 1.5 inch from center front line panel to inner side	6.1	6.2	6.1	18.4	6.13	6.13
4	Placket fabric kept in stitching area and pressure foot and needle moved down	2	2.5	2	6.5	2.17	2.17
5	Placket stitched on front panel	12	12.2	12.7	36.9	12.30	12.30
6	Placket taken out and turned	5.8	6.5	6.7	19	6.33	6.33
7	Top stitch at 5mm from edge	15	15	15.6	45.6	15.20	15.20
8	Pressure foot and needle moved up fabric pulled out and trimming	2.7	2.8	2.6	8.1	2.70	2.70
9	Turned inside and press nail at 1.5 inch from early folded area	9	9.7	10.2	28.9	9.63	9.63
10	Placket fabric kept in stitching area and pressure foot and needle moved down	2.1	2	2.2	6.3	2.10	2.10
11	Placket stitched back panel	12.5	12	12.2	36.7	12.23	12.23
12	Placket turned and trimmed	3	3.5	3.2	9.7	3.23	3.23
13	Top stitch at 5mm from edge	15	14.8	14.6	44.4	14.80	14.80
14	Pressure foot and needle moved up pulling fabric out and trimming	2.7	2.8	2.6	8.1	2.70	2.70
15	Stitched fabric is kept left side on the bin	1	1.1	1.2	3.3	1.1	1.1
					<b>Total</b>	<b>97.03</b>	

Calculations:

Standard Minute Value (SMV): 97 sec

Calculation of SAM:

Allowance: 15%

SAM (Standard Allowed Minutes) = Basic Time + Total Allowances

SAM = (SMV + 15% allowance)

= 97 + 15%

= 97 + 14.5

= 111 Sec

Therefore, SAM = 111 sec = 1.8 min

Maximum output = (Working time/Maximum process time)

= (60/1.8)

= 33.33 Pcs

Productivity per Operator = Total output / Total manpower

= 33 Pcs/15 Operator

= 2.2 Pcs/Operator is the output.

h) Time Study Chart for Side Seam

A time study chart for side seam is shown in Table 15.

Table 15  
Time study chart for side seam

TIME STUDY CHART							
OPERATION NAME: SIDE SEAM							
MACHINE USED: SNLS							
No	Operation	Observed Time			Total SMV	Avg SMV	Total SMV
		1	2	3			
1	Fabric is picked and assembled	3	3.3	3.2	9.5	3.17	3.17
2	Kept the panel at the stitching area and pressure foot and needle moved down	4.6	5.7	6	16.3	5.43	5.43
3	Edge stitch at 5mm from edge of the panel	6.2	7.3	6.8	20.3	6.77	6.60
4	Side label is placed and pressure foot and needle moved down	2	2.5	3	7.5	2.5	2.50
5	Edge stitch at 5mm from edge of the panel	30	32	35	97	32.3	32.33
6	Side label is stitched	6	7.5	8.8	22.3	7.43	7.43
7	Pressure foot and needle moved up pulling the fabric out and trimming	6	7.2	7.5	20.7	6.9	6.67
8	Band is picked from the side and assembled	3	3.3	3.2	9.5	3.17	3.17
9	Kept the panel at the stitching area and pressure foot and needle moved down	2	2.5	2.4	6.9	2.3	2.30
10	Edge stitch at 5mm from edge of the panel and band	6	7.5	8.8	22.3	7.43	7.43
11	Band tacking is done and turned	6.5	7.2	8.3	22	7.33	7.33
12	Band stitch finished	6	7.5	8.8	22.3	7.43	7.43
13	Pressure foot and needle moved up and Pulling the fabric out	2.14	2.07	3	7.21	2.4	2.40
14	Thread trimming	3	3.2	3.5	9.7	3.23	3.23
15	Fabric kept on the left side bin	3.3	3.5	3.7	10.5	3.5	3.50
					<b>Total</b>	<b>100.92</b>	

Calculations:

Standard Minute Value (SMV): 100.92 sec

Calculation of SAM:

Allowance: 15%

SAM (Standard Allowed Minutes) = Basic Time + Total Allowances

SAM = (SMV + 15% allowance)

= 100.92 + 15%

= 100.92 + 15.13

= 116.05 Sec

Therefore, SAM = 116.05 sec = 1.9 min

Maximum output = (Working time/Maximum process time)  
 = (60/1.9)  
 = 31.6 Pcs  
 Productivity per Operator = Total output / Total manpower  
 = 31.6 Pcs/15 Operator  
 = 2.1 Pcs/Operator is the output.

**B. Employee Motivation**

Incentives can be given to employees in order to encourage them to work more effectively. Incentives include attendance bonus, group incentives, and monetary awards, allow flexibility and allowances, giving a chance to lead, work-life balance, helpful services, healthy food etc. A chart of incentive scheme can be prepared with the help of management. It shows various monetary incentives that can be given to employees depending upon their productivity and output. The monetary and non-monetary incentives can be given to employees in addition to salary on weekly or monthly basis.

**4. Results and Discussion**

The results obtained after implementing the proposed method and employee motivation schemes are discussed.

**A. Productivity Improvement**

By following the methodology, the following results are obtained. The results are measured and shown in the form of graphs for better understanding.

**1) Operation Breakdown Chart for Placket and Side Seam**

The following graph shows the comparison of the operation breakdown steps between the original method and proposed method for placket and side seam finishing.

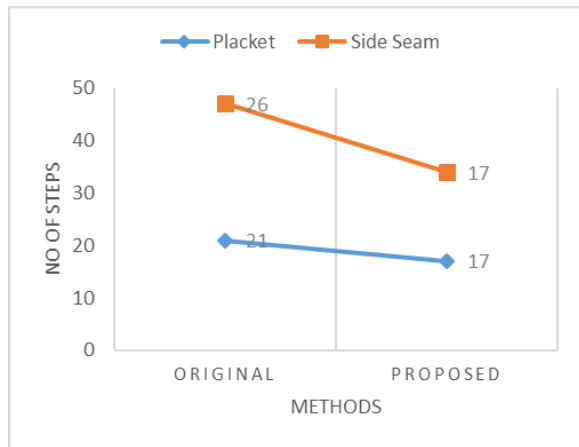


Fig. 6. Operation breakdown for placket and side seam

From Figure 6, it is observed that the operation breakdown steps are decreased from 21 to 17 for placket and from 26 to 17 for side seam. Time and motion study is carried out by combining various operations and thus the number of operations are reduced.

**2) Two Handed Process Chart for Placket and Side Seam**

The following graph shows the comparison of the two handed process chart between the original method and proposed method for placket and side seam finishing.

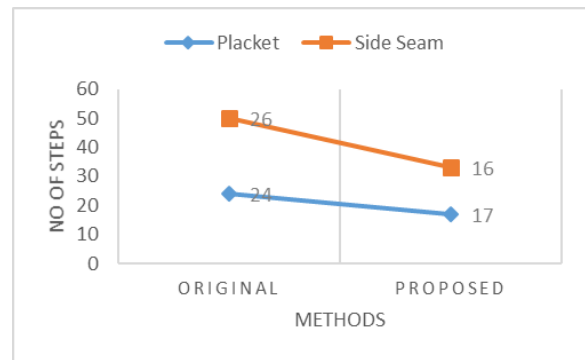


Fig. 7. Two handed process chart for placket and side seam

In this graph its clearly shows that the hand movements are decreased from 26 to 16 for placket and 24 to 17 for side seam. When we do the time and motion study we are combining various operations for both hands and thus the number of motions for both right and left hand motions are reduced.

**3) Time Study Chart for Placket and Side Seam**

The following graph shows the comparison of the time study chart between the original method and proposed method for placket and side seam finishing.

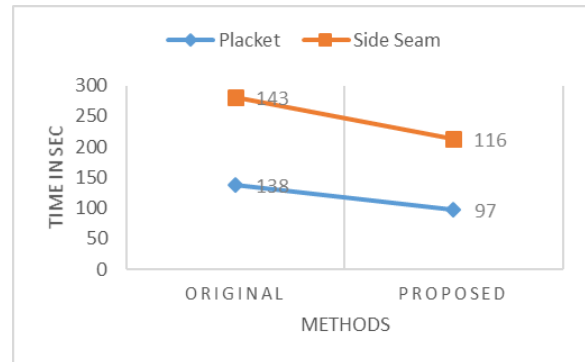


Fig. 8. Time study chart for placket and side seam

From Figure 8, it is observed that the time taken to complete the operation is comparatively reduced in the proposed method. This is because of following the time and motion study by combining various operations.

**4) Output per Hour before and After Motion Study – Placket**

Figure 9 shows the comparison of the output per hour before and after motion study for placket and side seam.

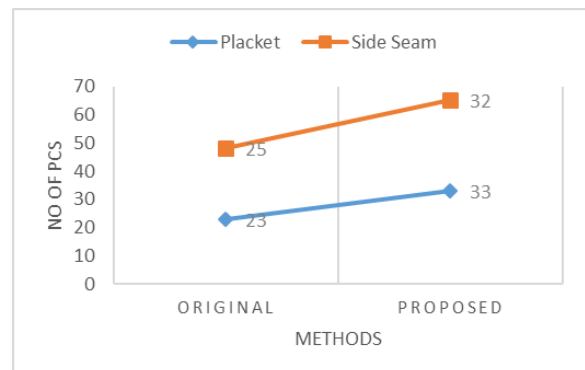


Fig. 9. Output per operator for placket and side seam

From the Figure, it is observed that the output per hour for each operator for both placket and side seam in original method is lower than the proposed method. As we can see that the output is increased dramatically after we implemented the time and motion study.

5) *Percentage of Efficiency Before and After Motion Study*

The following Figure 10 shows the percentage of efficiency before and after motion study for placket and side seam.

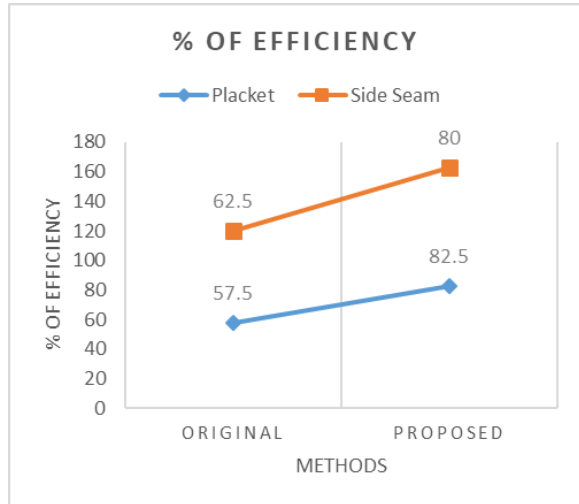


Fig. 10. Percentage of efficiency before and after motion study

It is observed that the efficiency percentage of both the operations is increased dramatically after the implementation of the new proposed method.

B. *Employee Motivation - Incentive Schemes*

A chart of incentive scheme is prepared with the help of management. It shows various monetary incentives that can be given to employees depending upon their output. The monetary and non-monetary incentives are given to the employees in addition to salary on weekly or monthly basis.

1) *Attendance Bonus*

Various monetary incentives can be awarded to the employees who maintain good and regular attendance. Figure 11 shows the attendance bonus extended to the employees at different period.



Fig. 11. Attendance bonus

With the help of management, the employees who holds full attendance for one month is awarded with Rs.500, for three months Rs. 2000. For a period of 6 months, the bonus is Rs. 5000. If they maintain full attendance for one whole year they will be awarded with one-month salary in order to motivate them to work more efficiently.

2) *Group Incentives*

In order to promote the group activities and team work the monetary incentives can be awarded based on the whole team achievement. Figure 12 shows the group incentives extended to

the employees.

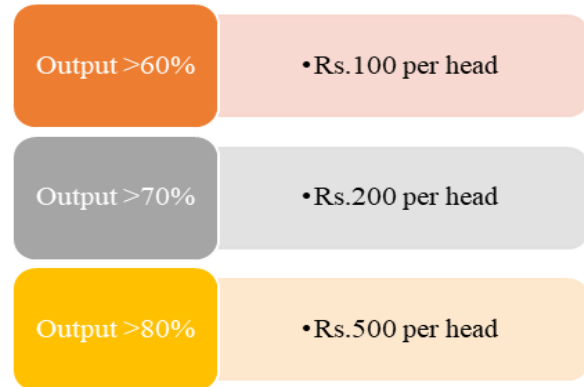


Fig. 12. Group incentives

The employees are divided into various teams depending on their type of operations carried out in the industry. Based on the productivity achieved by each team the incentives are given by the management to promote team work and to increase healthy competition between the teams. The team who achieves output efficiency above 60% is awarded with Rs. 100 per head in the team. For output efficiency above 70%, the team is awarded with Rs. 200 per head and for output efficiency above 80%, each member in the team is awarded with Rs. 500. Through the incentive schemes, the team work is enhanced and employees are motivated.

3) *Allowances*

Employees can take leave any day they want. But the days should not exceed the allowance of 10% which is 3 days a month; with prior notice, they will be awarded leave with salary. Exceeding 3 days without prior notice will result in cutting salary for one day extra.

Experienced employees are assets of any industry. In order to control switching of industries and to keep permanent labor within the premises, extra allowances for long job tenure were suggested and management accepted to extend this allowances to well experienced employees. Figure 13 shows the monetary awards extended to employees. For operators with 3 years' job tenure, an award of Rs. 36000 was extended at the end of third year along with Diwali bonus for better use. Employees with more than five years of experience, an amount of Rs. 60000 is awarded as a bonus. After this the entire cycle is repeated again.

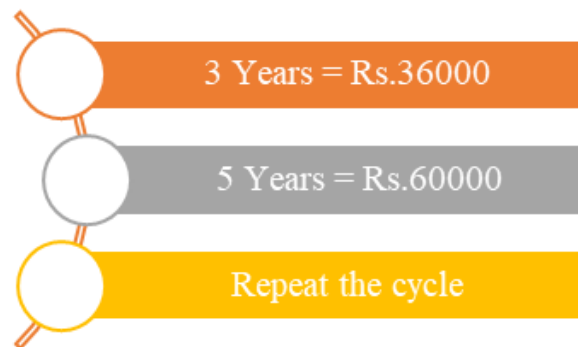


Fig. 13. Monetary awards

To encourage the working women, a scheme “Gold for Marriage” was suggested. This award was extended to women who are efficient and good performers in the company. Figure 14 shows the gold for marriage scheme. If the employee works in the company for 1 year, 2-gram gold will be awarded. 4 grams for 2 years and for women working in the company for about 4 years, 6-gram gold will be awarded. This method increases the trust and good relationship between the employees and the management.

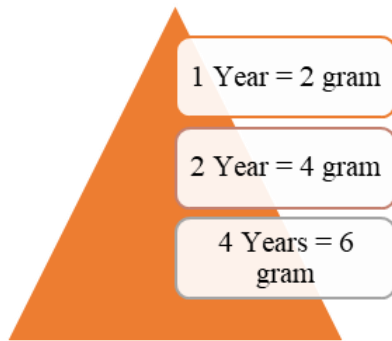


Fig. 14. Gold for marriage

#### 4) *Chance to Lead*

Weekly once any one person is chosen from the group to lead the group activities. They will assist the supervisor in all matters. During the supervisor's absence in the company, the group leaders will take up the responsibility and guide the rest of the people in the group. In this way, all the members in the team are motivated and gets a chance to lead and every member in a team will be aware of entire work and their responsibilities.

#### 5) *Helpful Services*

Opening the bank account and depositing the salary in bank for all staffs were extended to the employees who work in the industry for more than 6-month time period. Opening savings account and deposit 5% of their salary separately which helps them to meet the immediate and unforeseen expenses.

#### 6) *Work-Life Balance*

A small day trip is arranged once in every 4 months including all staffs and labors who work within the company. The employees were permitted to bring their family. This will

improve the work life balance.

## 5. Conclusion

Production is one of the most important department in any industry, as it plays a major role in deciding the profit or loss. Therefore, the study was carried in an apparel industry in Tiruppur to increase the productivity without disturbing the input investment. It is challenging to identify the reasons for finding out why productivity is not meeting the planned target even though everything is planned and executed according to the buyer's requirement. The study carried out by analyzing the productivity and the methods to improve the productivity through time and motion study. It is found that the time study, altering the operations, reducing the waiting time of the machine, helps in improving the efficiency of operators in the line, which in turn resulting in increased production.

Employee motivation plays greater part in increased production. As a result, various incentive schemes are introduced to motivate the employees based on their efficiency, sincerity and productivity.

Thus, the productivity in sewing department is improved by using work study method. The various process and procedures are improved and numerous steps are reduced by using motion study. The efficient use of man machine and materials is achieved by time and motion study. The employees are well motivated.

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