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A Comparative Method Study for Printing Time Reduction in Knitwear Manufacturing Company in Bangladesh: A Case Study

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Method Study is the systematic approaches that record, analysis & critical examined the existing work system & then proposed an easier ways of doing that work so that unnecessary activities are reduced. It mainly focuses most effective use of plant, equipment, human effort & human work evaluation. Under method study every activity critically observed and their corresponding working time is taken then examines the activities whether it is necessary or not. In this study a knitwear printing process is practically observed very intensively then setting the parameters for calculating standard printing time and proposed a new method and accordingly a new layout for reducing printing time & printing operator's cycle time.

Keywords: Method Study, Printing Parameters, Waste, layout, Hand Dryer

1. Introduction

The Knitwear manufacturing industry is a large and most export oriented field of Bangladesh in terms of output, export and employment**.** At present these manufacturing industries are earning foreign currency about three quarters of total exports and the industry is a symbol of the country's dynamism in the world economy. Printing section is one of the major areas in knitwear manufacturing industries. Manufacturing cost of knitwear products partially depends on printing cost. The survival competition in term of manufacturing cost versus selling price of these fields is increasing day by day in competitive global market. As knitwear industry is labor incentive field so there is little chance to improve these field by technological change rather there are vast scopes of improvement of these areas by method study. Jeffrey and David (2005) have mentioned that according to Lean manufacturing system overproduction, inventory, waiting, transportation, motion, over processing and defects are the manufacturing wastage. These wastes make the manufacturing processes inefficient that directly hampered the productivity. So it is high time to make the manufacturing processes waste free and dynamic.

It may be possible to reduce any kind of non value added activities from the manufacturing processes. As the Knitwear Industry is a symbol of the country's economy and there are ample opportunities to improve this field so the author feels great interest to work in this area. Comfit Composite Knit Limited is one of the most typical knitwear composite factories in Bangladesh where Knitting, Dyeing, Cutting, Printing, Sewing and Finishing departments are available. Printing is one of the most important departments of this factory. In printing process printer man, layer man, screen cleaner, fabric spreader and pick up man are available who working together to

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complete printing process. In this study it is found that in printing process an Auto Run Dryer is used to dry the printed fabric. It takes minimum two cycles and around six minutes to dry the printed fabrics completely. During this period both printing operators and the printed fabrics are waited simultaneously though both are available there. It consumes high working hour through giving small output. Beside due to improper line layout operator's over movement is occurring there. After observing the existing printing system, the objectives of this study are settled as-

- Observe current layout for improvement
- Printing time reduction
- Printing operator's cycle time reduction

2. Literature Review

Bangladesh has emerged as an important supplier of quality readymade garments in the global market. The spectacular growth of garment sector in Bangladesh in recent years has dramatically changed the landscape of export composition of the country. Uddin and Jahed (2007) said that Bangladesh is now experiencing almost 76% export contribution from readymade garments (RMG).The sector has now occupied an important place in Bangladesh national economy. Nevertheless, all are not well in this sector. It faces numerous challenges. Rajesh (2002) have mentioned some factors that are affecting productivity like as Level of technology, Product style, price point and Production volume, Training of work force and management, Motivation level of work force & management, Awareness of optimal productivity level, Labor turnover and absenteeism, Production scale, Lead time, Industrial Engineering, Labor relations. Though this paper focuses various factors for productivity improvement but method study is not directly emphasis on regarding this issue. Lynn et al. (2005) have mentioned that in Cambodia's most of the garments factories are required both technical and managerial training especially in mid level management for improving labor productivity. They highly emphasis that training programs for skill enhancement of these factories are very poor hence the machines are typically operated inefficiently and equipment maintenance is often Inadequate also lack of investment in maintenance plus ineffective spare parts stock control that occurs lost time and hampered the labor productivity directly. This paper mentioned that Improvements in productivity of 15–20 percent can be achieved with the right attitude and climate. They are not strictly focused on method study for improving labor productivity. Panneerselvam (2006) have mentioned that Lean manufacturing is a systematic approach to identify and eliminate wastes of all non-value added activities through continuous improvement that is being adopted by world class, high performance firms to produce remarkable results. It is also called as a manufacturing system in which friction is absent. Global competition is forcing companies to improve quality, reduce delivery time and lower cost. The traditional manufacturing way of thinking has been "Cost + Profit = Selling price" but in the competing global environment, customers, more or less influence the selling price of a product. Hence the lean way of thinking is "Selling price – Cost = Profit" Under this redefined scenario, the only way to survive in the market is to decrease cost by eliminating all forms of wastes. Lean focuses seven wastes such as overproduction, inventory, waiting, transportation, motion, over processing and defect. Farhana (2009) have mentioned that for competitive global market now owners of Garments Company are trying to implement modern lean manufacturing philosophy for reducing manufacturing cost of the product. This paper focuses that cost can be reduced by implementing lean tools such as JIT, Kanban, 5s, Pull production, Kaizen and TPM.

Ibrahim (2000) have mentioned various relationships between productivity, labor efficiency, resources utilization and product quality of a manufacturing sector. Though this paper have mentioned the above four factors but have not reported about how to improve the productivity and labor efficiency. This paper have reported only how to measure this parameters. Shumon, Zaman & Rahman (2010) have focused that the productivity and efficiency of garments manufacturing sector can be improved by proper line balancing. This paper mentioned that due to cycle time and operator skill variations some skill operators are shared more than one operation and operates more than one machine to reduce the WIP in the production line. Though under the mentioned way line productivity and efficiency are increased but they have not focused importance of method study for productivity and efficiency improvement. If the operational method is changed by method study then the cycle time of each operation must be reduced and the productivity and efficiency will be also improved. This paper did not focus about this importance finding here. Shanmugasundaram and Panchanatham (2011) have mentioned some factors that are responsible for affecting the higher productivity in Indian apparel Industry such as labor absenteeism, labor turnover, poor working conditions, training facilities for the employees, poor quality of raw materials and accessories, frequent changes of styles, technological changes in the field, change from high volume to low Volume orders, usage of modern machines and deviation from standard time in manufacturing. This paper specially highlighted three major factors for affecting labor productivity which are absenteeism of the employees, working conditions of the units and change from high volume to low volume orders. Though the authors of this paper have focused various factors for affecting labor productivity but have not focused about the method study that is very effective to improve labor productivity by reducing processing time of each operation.

The reminder of this paper is organized as follows. Section 3 defines the research methodology, mathematical statement, schematic diagram of current layout and proposed layout. Section 4 defines the result analysis, data table and mathematical result analysis. Finally section 5 defines the conclusion of this paper.

3. Methodology

Minimization of printing time and printing operator's cycle time are the main targets of this study. To achieve these objectives of this study existing printing process is critically observed then segregate the work elements and setting the printing parameters. To measure the work elements, time study is performed there. After critically examined the work elements and analysis their cycle time, new printing method is proposed and accordingly new layout is also proposed.

3.1 Mathematical Statement

In the printing process spreading, laying and pick up times are directly dependant on the size of fabric that is to be printed. If the fabric size is large then the spreading, laying and pick up times are relatively large than the medium and small size. But the color impression time and drying time are directly proportional with the size of design to be printed rather than fabric size. If the size of design is large color impression time and drying time will be also large compare to medium and small design. Parameters which are considered for mathematical calculation of printing time are-

1. Fabric Spreading time (S_t)
2. Laying time (L_t)
3. Color impression time (C_t)
4. Drying time (D_t)
5. Pick up time (P_t)

Printing time, $P_0 = (S_t + L_t + C_t + D_t + P_t)$, Where,

$S_t = [\{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\} + \{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\}* A\%]$

$L_t = [\{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\} + \{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\}* A\ \%]$

$C_t = [\{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\} + \{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\}* A\%]*F_c$

$D_t = [\{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\} + \{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\}* A\%]*F_d$

$P_t = [\{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\} + \{(\sum_{i=1}^{n} Xi/n) * (\sum_{i=1}^{n} Ri/n)/100\}* A\%]$

Where,
A= Allowance
Xi = Cycle time in second of i^{th} cycle,
n = Number of cycles
Ri = Estimated rating of i^{th} cycle time
F_c = Frequency of Color impression
F_d = Frequency of Drying

3.2 Current Layout

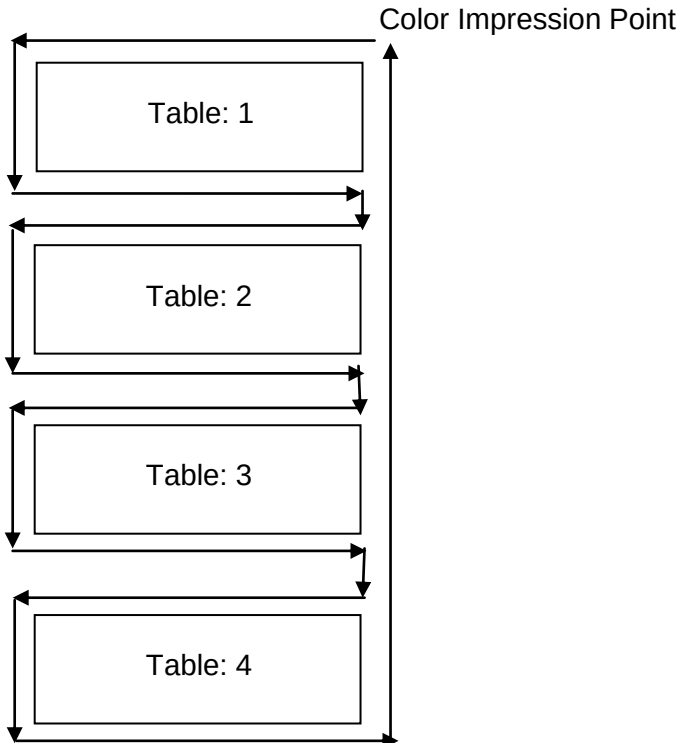

Fig. 3.2.1: Schematic diagram of current layout

It is found that four printing tables are used in every printing line. There are different types of colors are impressed to obtain expected design. Color sequence flows mandatory. When impression of a specific color is needed one more time, after completion of every color impression cycle a printing operator needs to wait for drying

the printed fabric where Auto Run Dryer is responsible for drying. When one color impression is finished then second color is impressed by another printer man. It is noticed that printing operator's waiting time and working area are too large. Schematic diagram of current layout is mentioned in figure 3.2.1

3.3 Proposed Layout

From the current layout it is clear that over movement is visible there. To overcome this, a cellular layout is setup there where two printing operator are always fixed for two side of a particular printing table and responsible to impress sequentially all kinds of colors that are required to obtain expected design. Hand Dryer is used instead of Auto Run Dryer to provide heat quickly at the printed area for drying. Operator of a Hand Dryer always follows the printing operator through drying the printed fabric. So color impression and drying are occurred simultaneously on printed fabric and printing operator waiting time due to drying is eliminated.

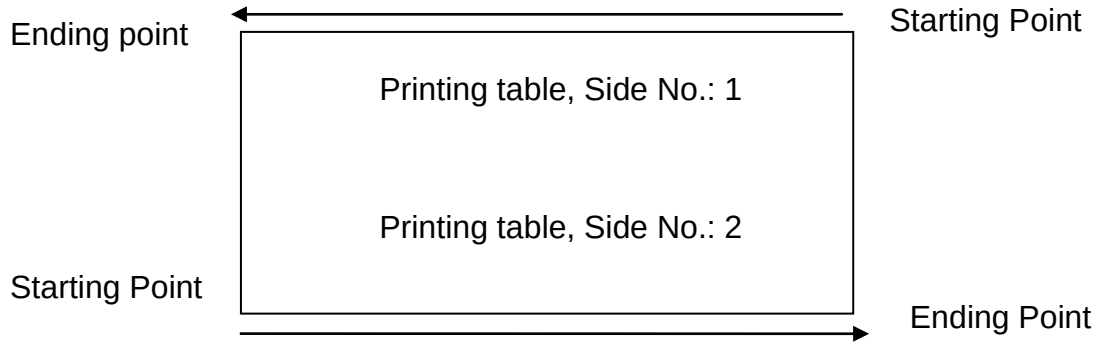

Fig. 3.3.1: Schematic diagram of proposed layout

4. Results Analysis

For addressing the results of this study data are collected from Comfit Composite Knit Limited of its printing section which is mentioned below in tabular form in Table 4.1. Data specifications are Buyer-H & M, Product Style-I am awesome, Print Color-White, Screen Size & Print size-medium, Color impression frequency-1, Print type-Rubber.

From Table 4.1:
Spreading time, S_t = 2.63 Sec.
Laying time, L_t = 33.14 Sec.
Color impression time, C_t = 6.00 Sec.
Drying time by Auto Run Dryer D_t = 384.56 Sec.
Picked up time, P_t = 3.47 Sec.

Therefore, if color impression frequency is one then total printing time of existing system, $P_c = (S_t + L_t + C_t + D_t + P_t)$ = (2.63*35+33.14*35+6*35+384.56+3.47*35) = **1967.96 Sec.** Where, 35 is the total number of fabrics that are printed as a single batch in a printing table.

Hence, a Printing operator's color impression cycle time in existing system = Color impression time per piece fabric * Total number of fabrics + Drying time by Auto Run Dryer = 6*35+384.56 = **594.56 Sec.**

Again from Table 4.1 Drying time per piece fabric by Hand Dryer, D_t = 5.34 Sec. in proposed system. Therefore, if the color impression frequency is one then total printing time of proposed system is, $P_p = (S_t + L_t + C_t + D_t + P_t)$ = (2.63*35+33.14*35+6*35+5.34*35+3.47*35) = **1770.30 Sec.**

And a Printing operator's color impression cycle time in proposed system = Color impression time per piece fabric * Total number of fabric = 6*35 **= 210.00 Sec.**

Table 4.1: Data for Various Operations

Sl. No.	Spreading		Laying		Color Impression		Drying by Hand Dryer		Pick up		Drying time by Auto Run Dryer
	T	R	T	R	T	R	T	R	T	R	T
1	2.2	100	39.45	80	5.91	90	5.9	80	2.75	100	385.55
2	2.23	100	25.12	90	5.02	100	5.2	90	3.45	90	384.43
3	2.32	100	28.23	90	5.85	90	5.7	80	2.98	100	384.46
4	2.61	90	39.25	80	5.91	90	5.26	90	3.15	90	383.96
5	2.29	100	49.15	70	5.96	90	5.14	90	3.25	90	385.55
6	2.25	100	52.1	60	5.68	90	5.43	90	3.78	100	384.43
7	2.23	100	32.28	80	5.96	90	5.52	80	3.52	70	384.46
8	2.16	100	41.45	70	5.36	100	5.32	90	3.45	90	383.96
9	2.87	90	30.26	80	5.94	90	5.45	90	3.55	90	385.35
10	2.6	90	40.23	70	5.59	90	5.53	80	3.59	90	383.45
Total	23.76	970	377.52	770	57.2	920	54.5	860	33.47	910	3845.6
TR.	10	10	10	10	10	10	10	10	10	10	10
Avg.	2.38	97	37.752	77	5.72	92	5.45	86	3.347	91	**384.56**
NT.	2.3		29.07		5.26		4.68		3.05		
A	14%		14%		14%		14%		14%		
ST.	**2.63**		**33.14**		**6.00**		**5.34**		**3.47**		

For Table 4.1, T = Time in second, R = Performance rating, TR = Total No. of readings, Avg. = Average, NT = Normal time, A = Allowance, ST = Standard time.

Finally, the results are summarized in Table 4.2 into the tabular form.

Table 4.2: Summarized Result

Descriptions	Unit	Existing System	Proposed System	Time Reduction	Time Reduction %
Total Printing time	Sec.	1967.96	1770.30	197.66	10.04%
Printing operator's color impression cycle time	Sec.	594.56	210.00	384.56	64.68%

5. Conclusion

Now a day, it is really a great challenge for the knitwear manufacturer of Bangladesh to manufacture the knitwear garment economically facing varieties risks. There may be printing section of every knitwear factory. As knitwear manufacturing Industry is mostly based on the human performance and little chance to develop the technical aspect. For this reason time is the major constraint to utilize the workforce with limited resources. This problem may be alleviated by following a better production system. In this case work measurement and method study is noble idea. The essence of this study is recommended that this approach is working well in Comfit Composite Knit Limited and should be fully practice at their factory and may be suggested to other knitwear manufacturing industries of Bangladesh.

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