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AN IMPROVED LABOUR PRODUCTIVITY IMPROVEMENT METHOD AS A CONTINUOUS IMPROVEMENT TOOL FOR APPAREL MANUFACTURING

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ABSTRACT

The purpose of this study is to introduce an Improved Method for Sri Lankan apparel industry as a continuous tool for improving the labour productivity through analyzing the activities and motions of sewing sections' employees. The Improved method consists six steps: Identifying the work units, Motion Study, Activity Sampling, Data Analysis, Eliminating/ reducing unnecessary motions and activities, and Measure the labour efficiency. After measuring the labour efficiency, researcher comes back to the first step for further improvements as a continuous improvement tool. Data analysis and implementation of appropriate solutions are the critical part of this study. Percentage distribution of each activity of the job cycle can be analyzed well using the activity sampling technique. The results showed that talking privately, discussing work related things, idle siting, judgments, cutting excess threads are the critical Non-value added activities. Both Necessary Non-Value Added Activities and Non-Value Added Activities have to be eliminated from the process. Bottleneck of the motions can be identified through motion study. Activity Sampling Technique and Motions Study are the most significant steps of this study. Therefore, this is mainly primary data driven research. These techniques of analysis can be applied to other sectors of manufacturing regardless of nature of the product and working conditions.

Keywords

Activity Sampling Technique, Labour Productivity, Lean Manufacturing, Continuous Improvement

1. Introduction

The export apparel industry is the most significant contributor for Sri Lankan economy ("Sri Lanka - Textiles | export.gov," n.d.). This industry mainly depends

on the quality of the work force and the quantity of the work force. Thus, workforce is the heart of apparel industry.

Sewing operators are the valuable workforce of this industry and they are engaged in sewing and its associated activities (Ahmed, 2017). Although, the sewing operators are provided time for allowances due to fatigue, personal needs and machine attention, sewing they also spend their time in gossiping, repairing alter, waiting for work and intentionally being idle, which are wastages of time (Ahmed, 2017). Analyzes of these activities are highly effective for particular company for productivity improvement (Hamzah, 2012). Because some of their routine activities are value added activities and some of them are not.

Stojanov, Liu, & Ding, (2016) presented a methodology for overall analysis of the factors important for the performance of the garment assembly line; the performance factor assessment method (PFAM), that consists of five steps. This is the method which is improved and modified to the Sri Lankan context in this study to improve labour productivity.

1.2 Problem Statement

This study was carried out in the ABC industries and according to the company records, in 2018 Jan- July, Band 06 showed the lowest efficiency. When compared with 2017 efficiency levels of the same band, it showed efficiency decrease in 2018 and trend line showed a higher negative slop when compared to 2017(company records). Therefore, efficiency level has to be improved in a flexible manner. When considering the labour performance measurement tools, there cannot be seen proper labour performance improvement tool. Although they use many strategies and techniques to retain their target levels, there are many problems with existing labour performance improvement tools. It is better to having continuous labour performance improvement tool to improve labour efficiency continuously. Following research questions were addressed by the researcher in order to solve the above problem.

1. What are the barriers and weaknesses of the existing labour performance improvement strategies of the ABC Industries Pvt. Ltd.?
2. Will the suggested new method overcome the weaknesses of existing labour performance improvement strategies?

1.3 Research Objectives

1. To identify barriers and weaknesses of the existing labour performance improvement strategies of the ABC Industries Pvt.Ltd.
2. To suggest a new method to overcome the weaknesses of existing techniques for improving the labour performance.

2. Literature Review

Many researchers have focused on unnecessary activities eliminating through work study techniques specially, activity sampling technique. Researchers focused on value added activities and non-value added activities and those non-value added activities reduction methods in different industries (Hines & Rich, 1997). Activity sampling technique is the most suitable technique that measures the percentage of value added activities and non-value added activities clearly (Patil, Kolte, Chandurkar, & S Rajkumar, 2018).

Based on whether value is added to the product or not, the activities can be divided into value added (VA), Non-value added (NVA) and Necessary Non Value added (NNVA) activities (Stojanov et al., 2016). Waste is not only associated with waste of materials in the production, but also other activities that do not add value such as repairs, waiting time and delays (Islam, 2016). These issues contribute to a reduction in the value of productivity and could reduce company performance and this relates to concept of lean manufacturing (Sayid Mia, 2017). The main aim of motion study is to find the procedure of least wastage of labour (Bon & Daim, 2010). The important objectives of the motion study are to improve the process of doing work, to improve the design of work place layout, to find the best way of doing a job etc.("Motion Study,"2016).

Stojanov et al. (2016) presented in his article methodology for overall analysis of the factors important for the performance of the garment assembly line. The performance factor assessment method (PFAM) consists five steps, three of which entail data analysis. The steps are Introduction of the study, Selection of work units, Method study, Work Sampling, Motion study respectively. Introduction to the study included a presentation of the proposed research method to the organization/company where the research was to be conducted (Stojanov et al., 2016).

3. Methodology

Firstly, the labour performance improvement techniques/ Key performance indicators of the company were identified through the interviewing the number of ten executives of the Industrial Engineering department. Then barriers and weaknesses of those techniques were also identified using the same approach.

Requirement of the Improved Model for labour performance evaluation was identified through the same method. After that, the factors that should include in the improving method through the brainstorming session and PFAM was identified and then improved and modified according to the Sri Lankan context. The Improved model consists of six steps: identifying the work units, Motion Study, Activity Sampling, Data Analysis, and Eliminating/ reducing unnecessary motions and activities, and Measuring labour efficiency. First the sewing related activities were identified conducting activity sampling technique from 40

employees who were working for 6th band. Then, Pilot study was conducted to calculate "p" and "q" in the following equation to determine the optimum number of observations. After that random observation times were identified using table of random numbers. Then observations were conducted. Finally, analysis and evaluation were performed. Unnecessary motions were identified and eliminated through the time and motion study.

Pareto Analysis chart was used to weight activities which were observed from the activity sampling technique. Pareto analysis was used to identify vital causes for NVAAs and NNVAAs. Five- why analysis and fish bone diagrams was used to analyze the reasons for causes that were identified through Pareto analysis. Efficiency measurement has been done after eliminating all the possible causes for inefficiencies.

To determine the time interval between each observations table of random numbers was used. The optimum number of observations was calculated using the following formula. To calculate "p" and "q" pilot study was conducted by following activity sampling technique. (Stojanov et al, 2016).

$$\sigma p = \sqrt{\frac{pq}{n}}$$

Where,
σp = standard error of proportion
P= percentage of value added time
q= percentage of non-value added time
n= number of observations or sample size to be determined
The confidence level used in most of the cases is 95% with a 5% margin of error.

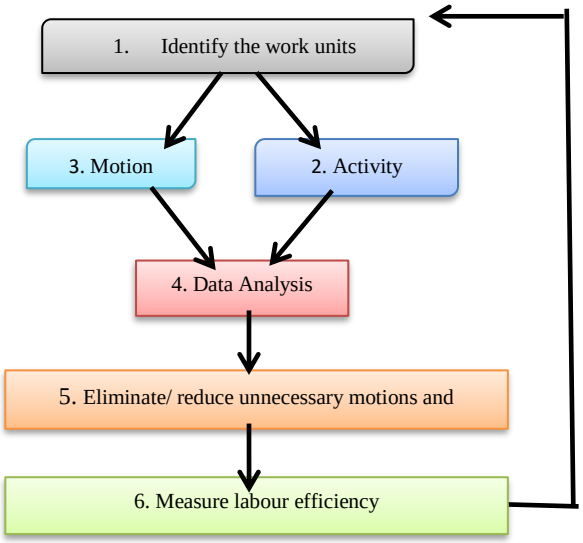

Figure 1 - The Improved Labour Productivity Improvement Model

4. Results and Discussion

First, the Key Performance Indicators (KPIs) that measures labour performance of the sewing section were identified. They are Product Finished Date, sewing efficiency, Absenteeism, Labour turn over, Cut to Ship ratio, Line feeding time and Quality rate. The strategies/ techniques that are used to achieve targets of above KPIs are target achievement incentives, Rewards for highest efficiency band, Over Time incentives, Proper Supervision and Pre- planning and pre-play layout.

Weaknesses of the current strategies were most of the strategies are cash based strategies, lack of user acceptance, cannot identify bottle necks directly, low citizenship behavior, high possibility to arise supervisor- employee conflicts, cannot identify behaviour of the employees, cannot identify employee problems related to their operations. The suggestions to develop a new method were low cost improvement tool, ease of implementation, user acceptance, low conflicts among supervisors and employees, detailed analysis method, improve citizenship behavior, low conflicts among managers, supervisors and sewing operators. Then Improved Model was implemented and using pilot study p=30 and q=70 was calculated and according to that minimum no. of observations was 336 observations per person.

Table 1: Determining the sequence of time for random observations

Random numbers	Arranged in numerical order	Random numbers 10 min	Time interval	Random numbers	Arranged in numerical order	Random numbers 10 min	Time interval
20	0	0	8.00 a.m.	3	19	190	11.10 a.m.
15	3	30	8.30 a.m.	37	20	200	11.20 a.m.
33	4	40	8.40 a.m.	0	24	240	12.00 p.m.
19	6	60	9.00 a.m.	41	26	260	12.20 p.m.
12	8	80	9.20 a.m.	8	31	310	1.10 p.m.
13	9	90	9.30 a.m.	35	33	330	1.30 p.m.
4	11	110	9.50 a.m.	9	35	350	1.50 p.m.
26	12	120	10.00.a.m.	31	37	370	2.10 p.m.
39	13	130	10.10 a.m.	6	39	390	2.30 p.m.
11	15	150	10.30 a.m.	24	41	410	2.50 p.m.

Identified activities are categorized in to Value added activities (VAAs), Non value added activities (NVAAs) and Necessary non value added activities.

Table 2: Frequency percentage of each activity by activity sampling technique

VAAs	Percentage	NNVAAs	Percentage
Take piece for sewing	4.89%	Walking for bring bundle	0.86%
Leaving sewed piece	4.65%	Waiting for piece	0.61%
Sewing	12.23%	Fatigue	0.31%
Checking quality	1.90%	Physiological needs	0.98%
Ironing	2.32%	Machine repairing	0.12%
Arrange the piece necessary	7.58%	Cleaning	2.32%
Turn piece into another side	1.22%	Corrections	3.18%
Take piece for tagging/labeling	0.24%	Standing for take the bundle	0.49%
Labeling/Tagging	1.53%	Machine arrangement	0.37%
Filling(bundles)	0.18%	Help others	2.14%
Marking checked piece	0.61%	Walking for getting help	0.73%
Take piece for checking	0.92%	Discussing work related thing	5.26%
Leaving checked piece	0.31%	Cutting excess threads	3.98%
Marking before ironing	1.47%	Put needle to machine	0.06%
Iron is placed after ironing	0.31%	Put thread into needle	1.16%
Leaving ironed pieces	0.31%	Needle break	0.24%
Take piece for ironing	0.24%	Adjust thread tension	1.10%
NVAAs- Idle	31.67%	Arrange workplace necessary	2.45%
Employee is not at the seat		Machine breakdown	0.37%
Use electronic devices		Person changing one machine to another	0.18%
Judgment, talking privately		adjust the thread real necessary	0.18%
Problem(discussing)		sewed pieces placed on another side	0.12%

Percentage of VAAs is nearly 39 %, NVAAs nearly 32% and NNVAAs 27%. 48 routine activities of sewing operators of the band 6 were identified and frequency percentages of those activities were calculated. Percentage of sewing of the company was 12.23%.

After that Pareto analysis was done and according to Pareto analysis chart of NNVAAs, discussing work related things shows the greatest position in the particular line. Cutting excess threads and corrections shows the second and third positions respectively.

According to Pareto analysis chart of NVAAs, talking privately, Idle (sitting), Judgment, and employee is not at the seat are the possible causes of 80% of NVAA inefficiencies. Root causes for those activities were identified through Five- why analysis. Fish bone diagram was used to find all the root causes that were affecting for low labour productivity. The five-why analysis showed that, unskilled-operators, margin not followed properly during stitching, improper feeding, improper threads tension, excessive pressure on pressure foot, insufficient thread with respect to the length of the stitch, machine speed is too high, the stitch is too long for the type of in work, poor quality fabric and poor quality threads as root-causes for defects.

Motion study was conducted for a waist band attachment. Although there were machines attached extended area to sew for a sewing operators, they do not use that area. After using that area there were savings of 7 seconds per each piece.

5. Conclusion

According to the findings of this study, there were many cash based strategies to maintain target level of the company. The improved method is a low cost implementation tool and it can be implemented easily. The only requirement for this method is a work study man. The company conducts motion study only when there is a considerable target loss. But implementing this method as a routine method, leads to identify unnecessary motions. According to probability equation minimum required number of observations was 336 observations. The accuracy can be increased by taking large samples (N Wickramasekara & Perera, 2016). To enhance the accuracy of the research 400 observations was collected from a person.

To identify sustainability and consistency of the tool, it can be implemented another turn. The improved method is a low cost implementation tool and it can be implemented easily. This method of analysis can be applied to other sectors of manufacturing regardless of nature of the product and working conditions.

6. Limitations and Future research

There can be find several limitations under this research study. The Efficiency level is calculated as a frequency percentage and calculating the percentages

through activity sampling technique, allowance time is not considered. The findings of this research are only related to machine operators in the apparel industry in Sri Lanka. In order to generalize these findings to other industries similar research would need to be carrying out with different samples from different industries.

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