Proceedings of the 8th Symposium on Applied Science, Business & Industrial Research – 2016
ISSN 2279-1558, ISBN 978-955-4709-52-2

Determinants of Production Line Efficiency: A Case of Sri Lankan Apparel Industry

Ekanayake SMEWPM* and Dissanayake KDDN

Department of Industrial Management, Faculty of Applied Sciences, Wayamba University of Sri Lanka
*pubudulekanayake@gmail.com .

ABSTRACT

The production line efficiency in apparel industry is a salient indicator of success. However, only a few production lines achieve the expected production line efficiency causing some critical issues especially in production planning and meeting delivery schedules. Also, this reduces the competitiveness of the industry in the global marketplace due to the presence of cost effective competitors. Therefore, identifying the factors which affect the production line efficiency become vital. Thus, this research attempts to identify them and provide solutions. Based on the previous literature and the observations, number of running machines, number of machine operators, number of absenteeism per day per production line, layout change, machine repairing time, number of machine breakdowns were considered as the factors causing the production line efficiency. This study selected 5 production lines as the sample out of 21 representing the lines with different line efficiency. The study used secondary data. Descriptive statistics and multiple regression analysis were used for the analysis. The results show that the number of machine operators, total repairing time, and the number of running machines and the number of absenteeism per day show a negative effect on production line efficiency.

KEYWORDS: Efficiency, Line Efficiency, Absenteeism, Layout

1 INTRODUCTION

Production efficiency can be measured using the same calculation procedure which is used to calculate the productivity. It is the ratio of the output to input. For a garment factory it is vital to have good production floor efficiency in order to succeed in many ways. Most of the garment factories now use production lines to produce/manufacture their garments and calculate daily production line efficiency in order to have a better idea about the flow of the productions in the factory. Hence it is vital to identify the factors influencing production line efficiency in a garment factory with the aim of enhancing the production line efficiency.

The research focused on a major problem that the company faces currently. It is low production line efficiency in the production floor and proposing solutions to the existing problem would be done through this research.

For the selected garment factory, they have been expecting 60 average production line efficiency from a particular production line. However, only a few production lines achieved the expected average production line efficiency where all the other production lines failed to deliver the expected production line efficiency. There are 21 production lines in the production floor and most of them deliver average production line efficiency around 45. This is a huge impact on the daily production processes as the factory tends to plan the flow of the production/garments according to the expected production line efficiency that is 60. Hence production planning should be rescheduled regularly and in some cases shipment dates should also be rescheduled due to the low production line efficiency in the garment factory.

The objective of this study is to identify the factors that would affect the production line efficiency of the production floor and with the results obtained by analyzing the collected data the solutions will be discussed to increase the production line efficiency by addressing the highlighted factors. As most of the activities in the garment factory depend on the production line efficiency of the production floor, it would be good if a

study performed to identify the factors which cause the production line efficiency.

2 LITERATURE REVIEW

Bruce (2002) mentions that the productivity can be used as a measurement for the efficiency of an organization. More particularly in this research the production line productivity is used as the major measurement of the production line efficiency. Here the output to input ratio is considered as the productivity of the production line for a particular day. Simply the number of garments produced is considered as the output and the number of running machines, the number of machine operators, fabric types, etc. can be used as the inputs for the equation (Sabhya, Subhod & Ripon, 2012).

In a study done to measure the production efficiency of the readymade garments, taking a few garment factories for the sample across India, the number of machines and the number of machine operators were considered as the input variables. The study depicts that the utilization of the current inputs could be increased by 25%. Further according to the study, efficiency of the firm could be improved by adjusting the plant-size as most of the firms were found to be operated under decreasing return to scale (Joshi & Singh, 2009).

Machine layout changes cause increasing the daily productivity and further it causes minimizing the manufacturing lead time, Work In Process (WIP) and pitch time which ultimately increase the efficiency of the garment productivity (Kumar & Sampath, 2012). The study done for a traditional machine layout and the modular machine layout shows that there is a significant increase in efficiency in the modular layout compared to the traditional layout. Finally the conclusion could be given that balanced production line helps increasing the production line efficiency (Sudharshan & Nageshwara, 2014).

A study conducted to identify the relationship between absenteeism and production efficiency shows that there is a negative association between both dependent and independent variables when the production process is highly manual and also when the absence cannot be anticipated in advanced (Moch & Fitzgibbons, 1985).

The absenteeism of machine operators of a garment factory is negatively related to the labor efficiency, but it is positively related to the product quality (Katz, Kochan, and Gobeille, 1982). Again in a study done by Staw and Oldham (1978) shows that the absenteeism and the performance relationship could be negative or positive, and the literature further conveys the message that very low attendance rate might technically not functioning normally and reduce the job performances.

Pandya and Udeshi (2010) found that there is a significant role played by the number of machines used for the production and types of the machines used for the production, for the final output. Labor productivity also depicts the labor efficiency and it is shown by the ratio of output to the number of man hours put.

In the research the production line efficiency is considered as the dependent variable and the independent variables are Number of Running Machines, Number of Machine Breakdowns per Day, Total Repairing Time per Day, Number of Machine Operators, Number of Absenteeism per Day, Change of the Layout and the Product Type.

3 METHODOLOGY

The factors which have the impact on the production line efficiency are identified based on the literature. Secondary data were used for the analysis mainly from the Daily Report which was prepared at the end of every day. Among the 21 production lines, 5 production lines were selected for the study by considering the production line efficiency. Selected five lines represent the lines at different levels of the efficiencies. Descriptive analysis was performed for the selected variables which are layout change, product type, mean machine repairing time

and mean machine breakdowns, and the 113 data elements for each production line were collected. Hence totally 565 data were collected for the selected sample. Then the analysis was carried out for numerically independent variables which were the Number of Running Machines, the Number of Machine Breakdowns per Day, Total Repairing Time per Day, the Number of Machine Operators, and the Number of Absenteeism per Day. Then the multiple regression analysis was carried out.

4 DATA COLLECTION AND ANALYSIS

4.1 Descriptive Analysis

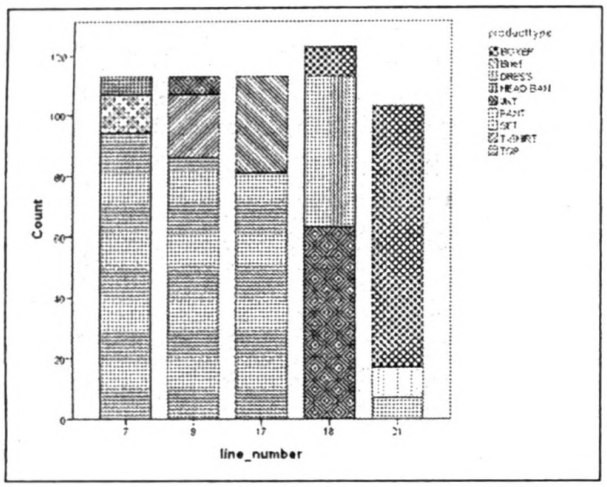

Figure 1: Product Types Produced by Sample Production Lines

Fig. 1 depicts the product types that have been produced by each production line which was selected for the sample. Most of the production lines in the sample produced the "Set" product type. This highlighted that most of the selected production lines used the same type of machines during the data collection period.

Fig. 2 depicts that when the machine layout is being changed there would be more machine breakdowns for the product type "T-Shirt". However if there is less machine layout changes, the product type "JKT" has the highest machine break down rate. Hence it depicts that there is a significant difference in machine breakdowns when it comes to a different kind of product type with the change of the machine layouts.

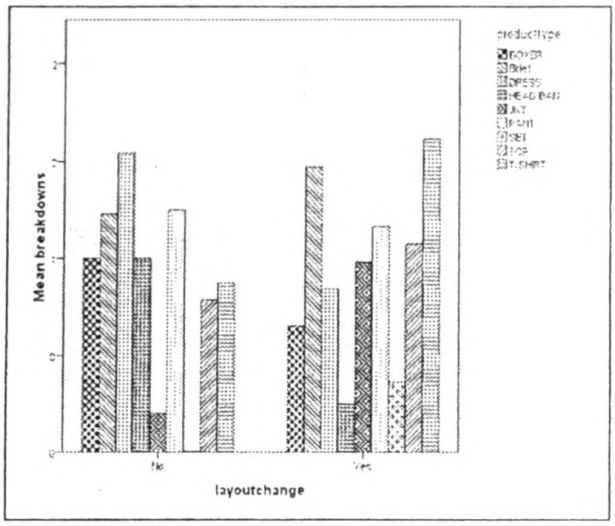

Figure 2: Mean Breakdowns vs. Machine Layout Change according to the Product Type

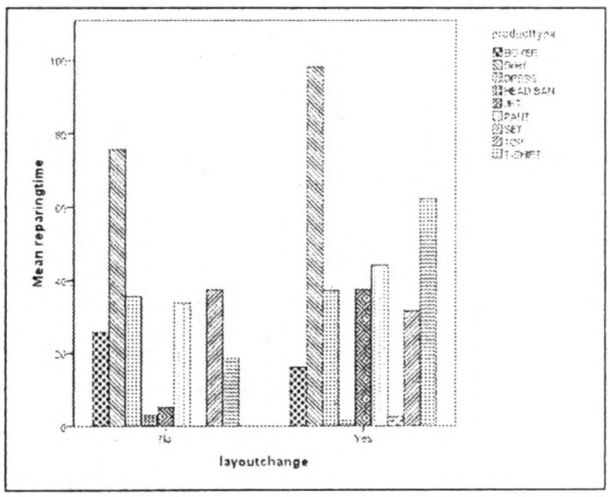

Figure 3: Mean Machine Repairing Time vs. Machine Layout Change according to the Product Type

In the Fig. 3, mean machine repairing time for the product type "Brief" is considerably higher compared to the other product types regardless of the change of the machine layout. However, the chart signifies that the behavior of the different product types could differ according to the change of the machine layout.

4.2 Multiple Regression Analysis

The multiple regression analysis was carried out considering the dependent variable and the numerical independent variables. The analysis performed for the collected data, by considering the line-wise and compositely.

Square of R value in the model summary for the analysis is 0.86 which concludes that these analyzed results can be used for the predictions.

For the composite analysis, the production line efficiency can be derived as shown in the following equation:

Production Line Efficiency = 77.766 – 0.092 (Total repairing time) – 0.821 (Number of machine operators) – 0.386 (Number of running machine) – 1.989 (Number of absenteeism) (1)

Above equation concludes that the above highlighted variables significantly and negatively influence the Production Line Efficiency.

Results for the line-wise analysis:

Production line A efficiency = 44.067 + 4.284 (Number of Absenteeism) (2)

Production line B efficiency = 38.586 - 0.063 (Total repairing time) – 0.621(Number of Running Machine) (3)

Production line C efficiency = 15.129 – 0.097 (Total repairing time) + 1.791 (Number of running machine) (4)

Production line D efficiency = 35.299 - 0.068 (Total repairing time) – 0.321 (Number of machine operators) (5)

Production line E efficiency = 88.789 – 0.148 (Total repairing time) – 2.141 (Number of machine operators) + 1.762 (Number of running machine) (6)

When considering the results obtained from each production line separately, there seems to be a variation of the number of independent variables which has the impact on the dependent variable.

In the descriptive analysis it was clearly highlighted that regardless of the machine layout changes, mean machine repairing time and mean machine breakdown per day for the product type "Brief" is higher and it was because of the machine types that were used to produce the garment/product type. However, for other product types there was not any significant situation for machine breakdowns and machine repairing time when there was a machine layout change. Hence machine layout could be a factor for the efficiency for a particular product type.

Multiple regression analysis indicates that four factors are in negative relationship with the dependent variable that is production line efficiency for the composite analysis. They are:

- Total repairing time
- Number of machine operators
- Number of running machines
- Number of absenteeism per day

However, the equation depicts that the number of absenteeism has the highest negative impact on the production line efficiency compared to other three independent variables generated in the equation. Most of the times the absenteeism is counted as it caused replacing someone and the replacement becomes a problem as it creates much delay in the production. Equation (1) could help to identify that by reducing values from each factor would result in increasing the production line efficiency. However, for some production lines there could be some factors having positive relationship with the production line efficiency even though they showed negative relationship in the equation which was generated in the composite analysis. Number of Absenteeism shows a positive relationship in (2) while it shows a negative relationship in (1).

Again in some cases in the line-wise analysis, there are some independent variables which have positive relationship with the production line efficiency while in another, there is a negative relationship with the production line efficiency. In line-wise analysis in (3) and (6), the Number of Running Machine has a negative relationship with the Production Line Efficiency while in (4), it shows a positive relationship.

In these situations the optimal value of the independent variables has to be obtained

for the solutions which ultimately help increasing the production line efficiency.

For the highlighted factors from the advanced analysis by providing a combination of solutions would do a better service for the factory. Their main focus should be to reduce the number of absenteeism by providing better leave taking mechanism while they are training the employees to be multi-skilled. Although it costs a bit, it could be a great investment that identifies the places where they could automate the process which would give them a huge advantage over many highlighted issues.

5 CONCLUSION

This research is focusing on the production line efficiency of a garment factory by considering the secondary data for the selected factors which were identified by the previous research and from the expertise.

Analysis was done for the selected five production lines from the 21 production lines. The sample consists of production lines which have the highest production line efficiency, average production line efficiency and the lowest production line efficiency in the garment factory.

From the descriptive analysis, it clearly highlights that regular change of the machine layout would not ultimately affect the production line efficiency unless it is a particular product type. According to the results obtained from the multiple regression analysis, the significant factors that affect the production line efficiency includes total repairing time, number of machine operators, number of running machines and number of absenteeism per day. All factors which are affecting negatively for the model demand firms to minimize the situation with respect to each variable.

Hence there would be a combination of solutions rather than trying to have a single solution for the each factor that was highlighted. Hence having a proper leave mechanism and giving proper training mechanism to employees specially the machine operators, mechanics, helpers and the work-study officers would be good solutions as they cost nothing. Further implementing automated systems where possible to increase the production line efficiency will be an added advantage. Further finding the optimal number of machines to be used in a production line in order to achieve good production line efficiency could be done.

This research leads towards many future researches as studies can be performed to identify the causes for some of the significant factors in this research. And further the research to identify the factors for efficiency in each department can be performed.

REFERENCES

- Bruce, M. (2002). A Consolidate Approach to Productivity Assessment. Industrial Technology.
- Joshi, R., & Singh, S. (2009). Measuring Production Efficiency of Readymade Garment Firms. *Journal of Textile and Apperal, Technology and Management.* Journal of the Textile Institute, 6(2).
- Katz, Kochan, and Gobeille. (1982). Industnal Relations Performance, Economic Performance and Quality of Working Life Efforts: An Inter-Plant Analysis. *Unpublished.*
- Kumar & Sampath. (2012). Garment Manufacturing through Lean Initiative - An Empirical Study on WIP Flictuation in T-Shirt Production Unit. *International Journal of Lean Thinking,3(2).*
- Moch, M. K., & Fitzgibbons, D. E. (1985). The relationship between absenteeism and production efficiency: An empirical assessment. *Journal of Occupational Psychology, 58(1), 39-47.*
- Pandya, A., Udeshi. D. (2010). *Impinge of Time and Motion on Productivity in Apparel Manufacturing Units.* Textile Review.

- Sabhya, Subhod & Ripon. (2012). *Application Of Industrial Engineering in Garments Sewing Floor.* Daffodil International University, Department of Textile Engineering. Dhaka: Daffodil International University.
- Staw, B. M, and Oldham, G. R. (1978). Reconsidering Our Dependent Vanables: A CritIque and Empincal Study. *Academy of Management Journal 21(4).*
- Sudharshan & Nageshwara. (2014). Productivity Improvement Through Modular Line In Garment Industries. *5th International and 26th All India Manufacturing technology, Design and Research Conference.* Assam.