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Identification of Factors Affecting the Productivity in Apparel Industry in Sri Lanka

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ABSTRACT

The main objective of this study was to identify the root causes which affect the productivity in apparel industry. The factory productivity was calculated by dividing the actual output by the planned output and it was selected as the dependent variable of the study. There were some major factors identified as the independent variables such as Quality Issues, Production Issues, Cutting Issues, Machinery Issues and the Absent Rate of Laborers. All the factors were calculated in Standard Hours (SAH) using secondary data. A multiple regression analysis was used to obtain the prediction model for the productivity. The model assumption was checked and the productivity data were found to follow a normal distribution. Then the correlation was checked to identify the relationship between the independent and dependent variables. Finally a model was fitted for the factory productivity. The model revealed that Quality issues, production issues and accessory issues were significantly affect their productivity.

KEYWORDS: Standard Hours (SAH), Multiple Regression Model, Productivity

1 INTRODUCTION

Sri Lanka's apparel industry began to grow significantly in the 1980s as an alternative to India's garment manufacturers, due to the open market economic policy of the government and the resultant trade and investment friendly environment. Under the Multi Fibre Agreement, quota regime Sri Lanka became an attractive new venue for businesses.

The term "Productivity" denotes the productiveness of the factors of production that is labor and capital, in the creation of wealth. As regards the selection of the right productivity indicators, physical measures like the ratio of output to labor input is suggested for single or similar product industry. In an industry with multiple products of close similarity, output is converted into equivalent physical standard. The ILO action manual (1998) suggests the use of partial productivity measures like labor and machine productivity for the plant level measurement of productivity in apparel industry.

Moreover, the amount of production in the apparel industry fluctuates due to many causes that occur during the production process. For instance poor performance of labor, quality issues would reduce the planned production.

Therefore, the objectives of this study are to examine the difference between actual and planned amount of production during study period and to find out the root causes affecting productivity variation at one of the leading apparel industries in Sri Lanka.

The results would allow the company to identify the failures that affect smooth functioning of the production process and thereby implement the necessary actions to increase the efficiency of the production.

2 LITERATURE REVIEW

Productivity performance of the apparel industry across the globe varies drastically. The report by Kurt Salmon Associates (1999) provides productivity ratings for the apparel manufacturing industry in 55 countries. The report claims that the countries with high productivity ratings like Germany, USA, France and UK are 250% more productive than the least productive countries covered in the study. The subject of apparel manufacturing productivity received major attention in the Western world during 1960s and 1970s. This was

mainly due to the need to bring down the cost of manufacturing to the face international competition. The report by the National Economic Development Office (1969), aimed at benchmarking the performance of British Apparel industry vis a vis the European and American manufacturers, brought out useful insights into the productivity performance achieved then. With regard to shirts, British firms took on an average 34 minutes to produce as reported by the international sample. (with regard to the apparel productivity in the US, the American Apparel Manufacturers Association (1976) report illustrates productivity improvement potential estimates by consultant member of the association in six standard garments between the years 1960 and 1975). These garments were assumed to have been produced with the most modern equipment and construction techniques available in 1960 and 1975. With regard to dress shirts, direct labor productivity estimates of 3.76 and 5.50 pieces per hour were quoted for 1960 and 1975 respectively. Capelin reported that engineering methods and mechanical development in 1950s made a significant contribution to bring down the standard minute value of dress shirts to 12 minutes. This performance still remains a productivity benchmark after almost four decades.

The storage and handling of raw materials, components and products are an integral part of the most production processes. If it is done efficiently, it can ensure that work flows smoothly and helps to avoid delays and bottlenecks. However, storage and handling by the manufacturer are not sources of additional value or profit because goods do not acquire any new qualities instead the opposite happens: materials are damaged and lose their value, accidents occur and your scarce capital is tied up in unnecessary stock.

3 RESEARCH PROBLEM

The exact problem for the research was identified by considering the garment manufacturing process at MAS Active cluster.

The overall process of garment manufacturing is the same at all manufacturing plants within the cluster. Once the planning team of the plant set the quantity and the date of delivery the production process will commence. The plant will decide working hours to achieve the target date of the shipment. But at the end of the process, there could be a significant gap between the actual one and the planned one due to some reasons. Though the same garment is fed on most days, the performance can change from one day to another.

4 METHODOLOGY

Secondary data from Oct. 27 – Dec. 27, 2015 from one of the leading apparel industries in Sri Lanka were used in this research. Dependent variable and the independent variables that affect productivity variation were identified from the literature review. Those are factory productivity, Quality Issues, Production Issues, Cutting Issues, Accessory Issues, Absent Rate of Labors, and Machinery Issues respectively. Productivity is the ratio between actual and planned output. Quality issues can happen due to poor knowledge. The poor performances of labors cause the production issues. Usually cut panel issues are named as cutting issues. Accessory issues can happen due to supplier issues. Machine breakdowns are called as machinery issues. Considerable factors were shortlisted according to the availability of the data. The productivity data were calculated from the Andon Chart which was displayed at the Industrial Engineering department. The actual production and the planned production were mentioned in the Chart separately. Then, the productivity was measured by using those data separately. The data for the independent variables were also included in the Andon Chart. Time series plot of productivity was constructed to observe fluctuation during the period of study. The normality of the dependent

variable was examined using Anderson darling test. Then, the multiple regression model was fitted to productivity using stepwise regression method to identify the causes that affect production variations. Moreover, independent variables were tested for multicollinearity. Finally, the residual plots were used to check the adequacy of the fitted model.

5 RESULTS AND DISCUSSION

Following Fig. 1 shows the variation of the factory productivity during the study period.

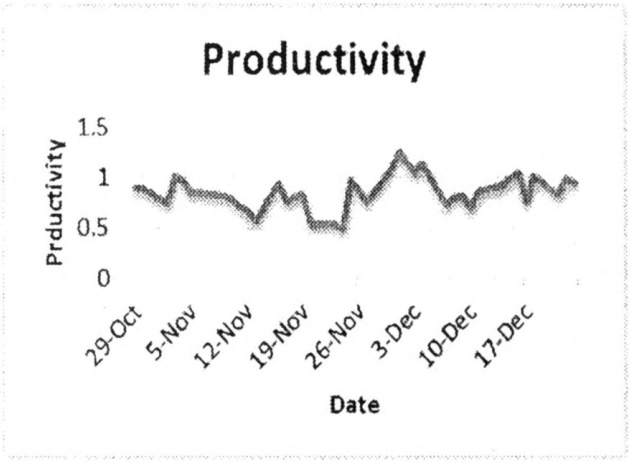

Figure 1: Productivity Variation

According to the Fig. 1 productivity fluctuated between 0.5 and 1 except early December. That is, the company was unable to produce planned production except for a few weeks during the study period due to various causes. However, the first week of December shows high productivity compared to the remaining period and this was due to high demand made by customers during the Christmas season.

Fig. 2 below shows the Anderson darling test of normality of productivity data. The corresponding hypotheses are as follows.

H_0: Productivity data are normally distributed

H_1: Productivity data are not normally distributed

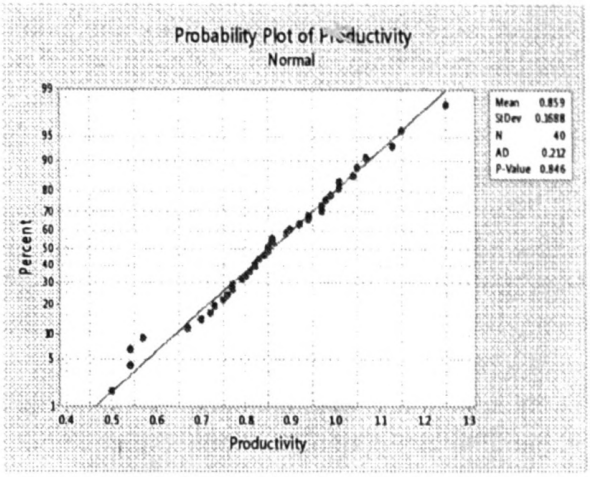

Figure 2: Test of normality of Productivity data

As the P – Value = 0.846 > 0.05 there is no significant evidence to reject the null hypothesis. Therefore, it can be concluded that productivity data follow a normal distribution at 5% level of significance.

According to the person correlation analysis only the production issues were linearly correlated with productivity while other factors were not.

Significance of the overall model was tested through analysis of variance and the results are shown in Table 1 and the corresponding hypotheses are given below.

H_o: All the coefficients are equal to zero

H_1: At least one coefficient is not equal to zero

Table 1: Analysis of variance

Source	F-Value	P-Value
Regression	3.59	0.038
Quality Issues	3.48	0.040
Production Issues	6.56	0.015
Accessories issue	6.93	0.020

According to Table 1 the p-value of the regression model is 0.038<0.05. Therefore, the null hypothesis was rejected. That is, the overall model was significant in predicting productivity at 5% level of significance level. The coefficient of determination, R^2 is calculated and it is given in Table 2.

Table 2: Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.158647	76.24%	67.71%	62.46%

According to the R^2 value, it can be said that 76.24% of variation in productivity can be explained by the fitted model.

Moreover, following Table 3 shows the results of the test of significance of model parameters.

Table 3: Coefficients of model parameters

Term	p-Value	VIF
Constant	0.000	
Quality Issues	0.040	1.26
Production Issues	0.015	1.26
Accessories issue	0.020	1.26

The following hypotheses were tested to check the significance of the parameters of the model.

H_o: $\beta_i = 0$ for i=1, 2, 3

H_1: $\beta_i \neq 0$ for i=1, 2, 3

For all variables, P – values were less than 0.05. Therefore, there was sufficient evidence to reject the null hypothesis. Hence, it could be concluded that quality issues, production issues and accessory issues were significant at 5% level of significance.

Since all VIF values were less than 5, there was no multicollinearity among independent variables. Final model fitted for productivity was shown below.

Regression Model

Productivity = 0.8422-0.00142 Quality Issues - 0.0107 Production Issues - 0.00308 Accessory issues

The model shows that all three issues were negatively related with productivity. However, the contribution from each variable to model was relatively small. This may be due to some other factors which are not considered here, that affect productivity variation. The following Figure 3 illustrates the scatter plot of residuals obtain from the regression model.

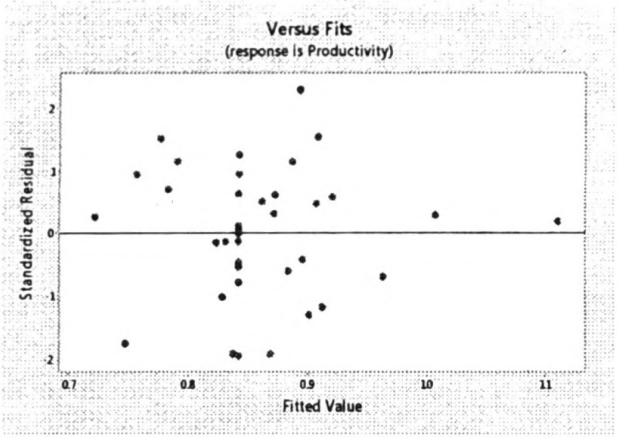

Figure 3: Scatter plot for residuals

According to the Fig. 3, it can be seen that data are scattered around 0 without any systematic pattern. So, it can be concluded that the residuals are independent and has a constant variance. Therefore, it can be concluded that model adequately fit the data.

6 CONCLUSION

After a study of an apparel manufacturer in Sri Lanka, "Investigating factors affecting the productivity variation" was selected and was conducted by following a proper methodology.

From this study several root causes such as Cutting issues, Machinery issues, Quality Issues, Production Issues, Accessory Issues and Absent Rate of Labors were identified as the reasons for the productivity variation. Quality issues, production issues and accessory issues were found to be significant after analyzing the data. Based on the findings the management team can suggest alternative solutions in order to mitigate difficulties encountered in manufacturing process and thereby to achieve their target production.

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