



Factors Affecting Raw Material Inventory Holding: A Case Study of Sri Lankan Rubber Industry

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ABSTRACT

The Sri Lankan rubber industry is considered as the most significant and dynamic contributor to the country's economy. This research was carried out as a case study in the Sri Lankan rubber industry with the objective of identifying factors affecting raw material inventory holding. For this study, one of the leading rubber tire manufacturers in Sri Lanka was selected and a quantitative approach was taken to identify the factors and modeling the relationship between inventory holding period (in days) and the identified factors. The main raw material considered throughout this research is natural rubber RSSIII (Ribbed Smoked Sheet), since it is considered as the single largest cost factor of a tire. For this research one hundred import order schedules were selected as the sample over four years. According to the analysis, the major contributors for raw material inventory holding are economic order quantity (EOQ), excess ordering, the rate of consumption and the price of the raw material. According to the advance analysis, this research estimated a regression model between the dependent variable and independent variables. EOQ and consumption rate have a negative significant relationship whereas excess ordering and the price of the raw material have a positive significant relationship with respect to raw material inventory holding period (dependent variable). This research emphasizes the importance of implementing Just In Time (JIT) purchasing with forward contracting with the reliable suppliers and JIT production as the best feasible solution to minimize the raw material inventory holding problem.

KEYWORDS: Raw Material, Inventory Holding, Sri Lankan Rubber Industry, Just In Time (JIT)

1 INTRODUCTION

A huge growth of the rubber sector has allowed Sri Lankan rubber manufacturers to compete in regional and global markets at both industrial and consumer levels, offering value added natural rubber products such as solid tires, surgical gloves, automotive parts, mats and hoses. The export earnings of Sri Lanka from value added rubber products are growing rapidly compared to that of raw natural rubber. Tires and tubes contribute more than fifty percent of the total earnings from the value added rubber products (Ministry of Enterprise Development and Investment Promotion et.al, 2009).

The study of Piyasena and Ahamat (2006) stated that raw materials account for about 80% of total production costs via in rubber industry and the major contributor for raw materials is natural rubber. Therefore, raw materials have become a significant

factor in this industry. Due to the reasons such as seasonal impacts and external threats, manufacturing companies tend to hold inventory in excess volumes as a protection mechanism. Raw material inventory holding means the level of inventory kept in the warehouse since the day of purchasing till it is issued. Therefore, inventory holding has become a significant problem for the rubber industry.

Thus, this research is based on a case study of a selected tire manufacturer in Sri Lankan rubber industry and the main objective of this research is to identify the factors affecting raw material inventory holding and to make recommendations and suggestions in order to minimize the problem.

The flow of this paper is as follows; section 2 explains the reviewed literature, section 3 describes the methodology used,

section 4 describes the ways of data collection and analysis carried out, section 5 consists of the results and the discussion and finally, section 6 carries the conclusion.

2 LITERATURE REVIEW

According to Shanmugam (2007), rubber manufacturers are using different types of raw materials such as different rubber compounds, carbon black, etc. Further, it is stated that, in tire industry, as a major material, 41% of natural rubber is needed for manufacturing a tire and all other raw materials are used in lower percentages. The study by Sakarindr (1979) stated that natural rubber is an important source of foreign exchange earnings and government revenues for developing countries such as Sri Lanka. Further, the study of Ankush, et al., (2013) stated that tire industry is highly raw-material intensive and the cost of raw materials accounts for approximately 63% of tire industry turnover and 72% of production cost.

This research is mainly based on raw material inventory holding period. Holding cost is the cost associated with maintaining an inventory until it is used or sold. According to Gor (2004), "company could estimate that its annual inventory holding cost is approximately (13-15) % of the original purchase price of the commodity". Further holding cost is called the opportunity cost, an expense incurred by having the capital tied up in inventory.

MacroSys Research and Technology (2005) stated that inventory holding cost is held 33% of the total logistic cost in a manufacturing company. It creates additional costs components such as storage cost, insurance, inspection cost, depreciation, etc. and directly affects to company bottom line results. Therefore, minimizing the inventory holding period is very important to a company.

According to the study of Gor (2004), the major reasons for holding inventories are, to use a buffer stock to satisfy the expected demand, to use a safety stock to

protect against uncertainties, to take advantage of economic order cycles, to maintain independence of operations, to allow smooth and flexible production operations and to guard against seasonal price increases.

The study of the Ministry of Enterprise Development and Investment Promotion et al., (2009) stated some contemporary reasons for inventory holding in Sri Lankan rubber industry. Supplier side constraints, price increases and material shortages during the monsoon season allow companies to purchase more before the season and hold the inventory with them. Also, it further stated some reasons such as continuous purchasing unless there are low consumption rates, and purchases more than the required quantity where the imported duties are fair to them. These also result in excess inventories of raw materials which creates inventory holding as an unrealized cost for a company.

This reviewed literature provided evidence for raw material inventory holding and ways of its generation. But no sufficient empirical literature provided evidence within the accessible limits in the local context. Therefore, this study was conducted to fill in this existing empirical gap.

3 METHODOLOGY

According to the financial statement analysis of Piyasena and Ahamat (2006), it is stated that cash cycle (days) has an increasing trend of inventory holding period of the leading rubber manufacturers. Thus they try to minimize their overhead costs such as inventory holding cost. Due to the significance of this problem, "inventory holding period in days" (difference between total order issued date and order receipt date) was selected as the dependent variable.

This research tested twelve independent variables. The variables such as "economic order quantity (EOQ)", "quality status of raw material", "government charges" and "insurance cost" were stated in the literature. Selections of other

independent variables and derivations are as follows. In order to avoid price hikes and seasonal availability issues; companies hold inventories. Therefore, this research tested the “price of raw material” and the “excess order quantity” (the difference between the required and the ordered quantity) as the dependent variable. Due to supplier side constraints, companies hold inventories in advance to operate smooth production. Some suppliers deliver the order by several numbers of deliveries. Then, issues occur with lead times and there occurs delivery delays. This research further tested the “number of deliveries”, “lead time days” (the difference between the delivery promised date and the ordered date), and the “delivery delayed days” (the difference between order receipt date and the delivery promised date) as independent variables.

Inventory holding problem arose because actual production was below the level forecast for the period. Without considering the actual production, companies purchase continuously. Therefore, this research tested “consumption rate”, “number of issues per order” and “excess receipt quantity” (difference between receipt and ordered rubber quantity) as other independent variables.

4 DATA COLLECTION & ANALYSIS

The research sample was one hundred numbers of import order schedules of RSSIII natural rubber category which were randomly selected over four years. This research used secondary data collected mainly through a company network system by several user interfaces and manuals related to supplies, planning and import & shipping department of a selected company.

All the data were then further analyzed by using statistical software. Correlation analysis was performed to identify whether there was a relationship between the tested independent variables and raw material inventory holding. Since there was more than one independent variable in this research, multiple regression

analysis was used in modeling the relationship between the dependent variable and independent variables. Normality of the dependent variable was checked and justified in order to conduct multiple regression analysis.

Hypothesis testing was conducted to examine whether there is a correlation between the variables, to examine the significance of the model built and to test the significance of the coefficients of the model variables. Then, the regression model was justified by testing multicollinearity diagnostics and assumptions related to the error component. Conclusions and recommendations were then made to minimize the raw material inventory holding problem based on the results.

5 RESULTS AND DISCUSSION

The data were normally distributed and the relevant statistical tests were used for further analysis at 95% level of confidence. Results of the correlation analysis are given in Table 1. Significance of the relationships between the variables was determined, by using significant two tailed test. If the P values was lower than 0.05, it was concluded that the relationship was significant. Pearson correlation value was used to determine the strength of the relationship between variables and whether the relationship was positive or negative. If the correlation value was greater than 0.05, it was concluded the variables had strong association between them.

Table 1: Results of Correlation Analysis

Inventory Holding Period	Pearson Correlation	Sig.
EOQ	-0.975	0.000
Excess Receipt Quantity	-0.975	0.000
Price of Raw Material	0.530	0.000

The correlation analysis showed significant, strong and negative linear relationship between the raw material inventory holding period and economic order quantity as well as the excess receipt

quantity. Also, it was concluded the inventory holding period had significant, positive and strong linear relationship with the price of raw material. Accordingly, other factors were insignificant with raw material inventory holding period.

Table 2 shows the summary taken from the multiple regression analysis. According to the result taken from the ANOVA table, the significance test P value was 0.000 and lower than 0.05. Therefore, it was concluded the overall model was significant. R² value taken model summary table was 0.967, and it was concluded this regression model was the best model for predictions. Therefore, 96.7% of variability in raw material inventory holding period in rubber industry can be explained by this model.

The p values taken from the coefficient table; for the constant, economic order quantity, excess order quantity, consumption quantity and raw material price were less than 0.05. There was enough evidence to conclude that constant and the four variables were significant.

Table 2: Summary of Multiple Regression Analysis

Model Summary (R ² Value)		0.967		
Significance of the Model (P Value)		0.000		
Model	Coefficient	Sig.	Collinearity	
			Tolerance	VIF
Constant	4775.815	.000		
EOQ	-414.790	.000	.706	1.416
Excess Order Quantity	0.722	.000	.673	1.485
Consumption Quantity	-0.894	.000	.459	2.181
Material Price	7.196	.023	.436	2.291

The regression analysis identified the following linear model shown in (1), at 95% confidence level as follows;

$$\text{Raw Material Inventory Holding Period} = 4775.815 - 414.790 \text{ Economic Order Quantity} - 0.894 \text{ Consumption Quantity} + 0.722 \text{ Excess Order Quantity} + 7.196 \text{ Price of Raw Material} \quad (1)$$

When other factors held constant, one unit increase in economic order quantity will decrease inventory holding period by 414.79 and one unit increase in consumption quantity will decrease inventory holding period by 0.894. Similarly, one unit increase in excess order quantity will increase inventory holding period by 0.722 and one unit increase in price of raw material will increase inventory holding period by 7.196.

According to Table 2; the Variance Inflation Factor (VIF) for significant variables were lower than 5 and the tolerances were greater than 0.2. Therefore, it was concluded that there was no problem of multicollinearity. The assumptions regarding the error component such as residuals are independent, normally distributed and have constant variance were satisfied.

The mean values of four independent variables which contributed to raw material inventory holding were used to create a pie chart, in different percentages as depicted in the following Fig: 1. According to this, the major contributor is EOQ (31.4%). The excess order quantity and the consumption quantity contribute 26.6% and 25.9% respectively and the minor contribution is from the price of raw materials (16.1%).

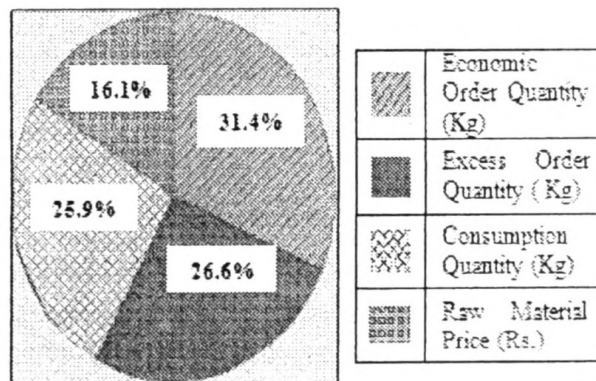


Figure 1: Reasons for Raw Material Inventory Holding Period

6 CONCLUSION

According to the findings of this research, the following economic order quantity, the excess ordering of materials, the rate of consumption and the price considerations of raw material are the contributors to the raw materials inventory holding problem. Also, the economic order quantity and the consumption rate have a negative significant relationship whereas the excess ordering and the price of raw material have a positive significant relationship with respect to raw material inventory holding period.

To take advantages in economic order cycles, companies tend to follow economic order quantity. Companies order excess quantities because of the forecast errors and to avoid the risk of insufficiency. Even though the production rate is low due to several reasons, companies' purchase inventory continuously. Also the main raw material in rubber industry affect with price and availability considerations during the monsoon season. Before the prices reach peak, companies buy more and store them each year. Therefore, during the season they are filled with the inventory. These are the ways of holding raw material inventory in manufacturing companies while creating an additional cost.

This research suggests JIT purchasing with forward contracting with the suppliers and JIT production as the best feasible solution to reduce the raw material inventory holding problem. JIT purchasing with forward contracting allows companies to purchase frequent small quantities on time. Seasonal price fluctuations and material availability drawbacks can be overcome through forward contracting with the reliable suppliers. JIT production follows "pull" based manufacturing system and allows manufacturers to have accurate forecast, which result in excess ordering and the problems associated with changing the rate of consumption can easily be avoided.

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