

IDENTIFICATION OF FACTORS AFFECTING WAREHOUSE EFFICIENCY IN APPAREL INDUSTRY

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Abstract- Warehouse activities are now becoming the midpoint of important to ensure the effective storing, handling, receiving the goods efficiently in the manufacturing firms. Therefore, this study has been conducted to identify the factors affecting to warehouse efficiency in apparel industry. The scope of this thesis is limited to the apparel firms in western province. A quantitative research approach based on questionnaire survey conducted for this thesis. Factor analysis was conducted to identify the factors affecting to the warehouse efficiency in apparel industry. Therefore, primary data was collected from 200 respondents using structured questionnaire. In this research there are 25 independent components have been identified through past literature review and by use of the SPSS version 17 data had been analyzed. Afterward it is found that there are six factors which affecting to the warehouse efficiency namely, quality, warehouse planning, productivity, and inventory control, cost and labor satisfaction.

Keywords- Apparel industry, Efficiency, Logistics and Supply chain, Warehousing

I. INTRODUCTION

Apparel industry has been begun to expand since 1970 and it has been has been contributed 51 percent of export to the Sri Lankan economy since 2001. (Kelegama, 2004). Mainly Sri Lanka export sportswear, lounge wear, lingerie, bridal wear, children's wear, work wear, swimwear and fabrics over the world. (Jayawardana s. , 2016) MAS Holdings, Brandix group, EAM Maliban Textile(Pvt) ltd, Crystal Martin Group and Hidramany Group can be

identify as some key players in apparel industry. (BOI, 2017)

Warehouses are comprised with loading, unloading, shelving, receiving, packaging, picking, transfer, storage, handling returns and handling claims and value adding operations. There are four main warehouse processes as receiving, storing, picking and shipping can be identified in warehouse. (Rouwenhorst, Reuter, & et al, 2000) Warehouse represents around 20-24 percent of overall logistics costs while being the ending point for Supply chain (Davis H. W., 2005) (Dadzie & Johnson, 1991) Warehouse efficiency denotes the performance level which can be described a process to create highest amount of outputs by using less inputs. (Potocan, 2006)

Apparel industry in Sri Lanka has been position in the world as manufacturer of "Garments without Guilt". (Jayawardana s. , 2016) Therefore, apparel companies needed to store their raw materials, work in progress goods, maintenance items and finished goods in a safe way. Subsequently, warehouse plays a major role in apparel industry to ensure quality and the safety of goods.

Major objective of this research is to identify the factors affecting to warehouse efficiency in apparel industry and to provide guidelines to improve warehouse efficiency.

Limitations of the study: There were some responses based issues. Because majority of the data were collected through distributing printed questionnaire. Therefore it took nearly two months to collect data

II. LITERATURE REVIEW

Quality, service and cost dimensions have given growth to improve more efficient strategies for warehousing. (Kaur & Batra) As per research of Francielly et al., they have been included replenishment accuracy, storage accuracy which is mentioned as product store in proper location, receiving accuracy, accuracy of physical inventory count, delivery and order shipping accuracy under quality indicators. Also, on time delivery, orders shipped on time, perfect order, order fill rate, stock out rate and customer satisfaction under indicators of quality. (Francielly e. a., 2015)

There was a research based on warehouse efficiency at SME of maintenance and repair item distributor. They have been more focused on order picking, inventory control and inventory accuracy. (Limere, Pradhan, Celik, & Solder, 2011) According to the Saleheen, et al. Product availability, productivity and cost effect to warehouse efficiency (Ferdoush e. a., 2014)

Productivity indicators (Mentzer & Konrad, 1991), (Francielly e. a., 2015), customer relation activities, quality level, costs, space utilization (Liviu, Emil, & Maria, 2009), warehouse automation (Jun, Li, & Jing, 2015), operational efficiency, FIFO, (Ewiene & Tayie, 2012), labor turnover (Tariq, Ramzan, & Riaz, 2013) , receiving time, replenishment time and put away time (Francielly, Mario, Alpan, & Rodriyuez, 2015), lead time (Chalotra, 2003), maintenance cost (Marco, Ruffa, & Mangano, 2009), inventory cost (Krittathip e. a., 2012), (Kaur & Batra) and safety (Jun, Li, & Jing, 2015) have been identified in previous researches as efficiency factors.

III. METHODOLOGY

The research scope has limited to the apparel industry in Sri Lanka and quantitative research method has been used in this research. Number of factors identified in analysis can be identified as the independent variable and the dependent variable is the warehouse efficiency. The population is consists of managerial, executive employees and workers in 3014 warehouses in apparel industry in western province while sample size represent the 200 respondents from 20 units. Structured questionnaire was distributed to collect primary data and exploratory factor analysis was used to conduct a data analysis.

Multi stage sampling technique has been used as sample technique. Therefore, stratified random sampling technique has been used in first stage. Hence, sample has been divided in to stratum as small scale, medium scale and large scale. Convenience sampling technique has been used to distribute the questionnaire and data collected from 200 respondents using structured questionnaire.

Primary data were collected through questionnaire survey & web based questionnaire to identify the relationship between independent variable and the dependent variable and SPSS version 17 has been used to analyze data while Microsoft Excel was used for the management purposes of data.

IV. RESEARCH METHODS

Factor analysis has been used in this study to reduce the data to recognize a small amount of factors which explain most of the variance which is observed in considerably larger amount of manifest variables. Reliability analysis has been used to determine the internal consistency of data. Cronbach's alpha is the most common and popular measure of internal consistency or reliability. (Reynaldo & Santos, 1999) Following formula can be applied, (α = Cron bach's alpha, r = inter item correlation, pair wise, no. of items in the scale)

$$\alpha = \frac{rk}{(1+(k-1))} \dots\dots\dots \text{Equation 01}$$

Keiser- Meyer-Oklin Test (KMO test) has been used to identify the suitability of data for factor analysis and Acceptability for a set of variables is greater than 0.7.

Total variance has been used to determine the total percentage of variance of components which is described by variables and then factor rotation has been conducted according to the verimax rotation method to gain the meaningful factors. Then component score co- efficient vmatrix used to formulate the equation for model.

Crosstabs has been used to determine to whether there is a relationship between two variables and shows a significant value less than 0.05 in the chi square table if there is effect of one variable on the other.

One way ANOVA used to test whether there is a significance difference between at least two samples or

not. There for it can be used following (02) equation. (SST=Sum of square of total variance, SB= Sum of square between groups, SSW= Sum of square of within groups)

$$SST=SB+SSW \dots\dots\dots \text{Equation 02}$$

Hypothesis are written as follows,

$$H_0=\mu_1= \mu_2= \mu_3= \mu_4 = \dots\dots\dots = \mu_n \text{ (All means are equal)}$$

$$H_A= H_0 \text{ is not true (At least two samples are difference)}$$

V. RESEARCH FINDINGS AND DATA ANALYSIS

Reliability Statistics

Table 1. Reliability Statistics	
Cronbach's Alpha	N of Items
.939	25

Keiser- Meyer-Oklin (KMO) Measure of Sampling Adequacy is denotes the sample size of the data. According to the above table KMO is 0.889. This value is surpassing the recommended value of 0.6.

According to the Bartlett's test of Sphericity,

- H_0 : Correlation matrix is an identity matrix
- H_1 : Correlation matrix is not an identity matrix

The value of the Bartlett's test significance of above table is 0.0000. That value is less than 0.05. It indicates the correlation matrix confirming correlation is significantly different from zero. This means that the correlation matrix is not an identity matrix.

According to the Rotated Component Matrix, factor loading for component one, replenishment accuracy in our warehouse has an positive impact on warehouse efficiency (Q2), Orders are picking correctly per order picked (Q4), usually our warehouse personnel maintain an effective put away time (Q6), errors free orders are shipping efficiently on time (Q7), most of the time we

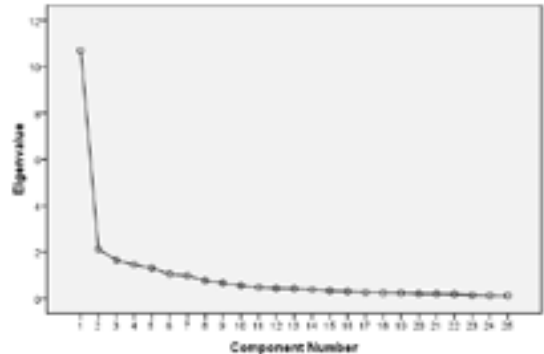


Figure 1. Scree Plot

have orders distributed without accidents (Q8), usually we deliver our goods on time to increase efficiency (Q9) and there are guidelines or standard operating procedures in your warehouse (Q13) are having higher loadings within component one. Therefore those variables can be identified as greatly influential and significant than other variables. By considering those seven variables, factor one can be formed.

$$\text{Factor 1} = f(Q2, Q4, Q6, Q7, Q8, Q9, Q13)$$

This factor one can be named as quality.

When consider the factor loading of component two, we are storing our products in proper locations in warehouse (Q1), we applied FIFO for our inventory management (Q5), we are successful in our transport utilization (Q16), most of the time our warehouse personnel utilizes a reasonable warehouse spaces for product handling (Q18) and we are successful in reducing transport cost (Q19) can be used for form factor two.

$$\text{Factor 2} = f(Q1, Q5, Q16, Q18, Q19)$$

This factor can be named as warehouse planning

Furthermore factor loading of component three shown that factor loading of, Successfully maintain physical Inventory count accuracy in our warehouse (Q3), Rarely our products are not available in stock when the customer makes an order (Q10), Effective receiving, replenishment storage and delivery productivity results a higher efficiency in your warehouse (Q11), Do you think labor productivity and efficiency can be impact on your

warehouse performance efficiency (Q24) and Do you think that warehouse automation can be changed your warehouse efficiency? (Q25) can be formed as using these variables.

Factor 3= f (Q3, Q10, Q11, Q24, Q25)

Factor three can be named as productivity

According to the factor loading of component four, Most of the time our warehouse personnel serve our supplier and makes product ready for shipment on the reasonable time (Q14), we are successful in minimizing total carrying/holding cost (Q15) and we are successful in minimizing total product damage in the warehouse (Q17) have higher factor loadings greater than 0.5 while others are less than 0.4 except Q8 and Q13 that are already considered under component one and Q25 already considered under component three. There for factor four can be formed using Q14, Q15 and Q17.

Factor 4= f (Q14, Q15, Q17)

Factor four can be named as, inventory control

As results of factor loadings of component five, holding higher inventory cost has a negative effect on warehouse efficiency (Q12), Lead time for replenishments, dock to stock, order picking, shipping and delivery have negative impact on warehouse performance efficiency (Q20) and Maintenance cost can be retraining factors for increase warehouse efficiency (Q21) have loading value more than 0.65 while others are less than 0.3. Thus, factor five can be formed using those variables.

Factor 5= f (Q12, Q20, Q21)

Factor five can be named as cost

Furthermore factor loading of component six, do you have faced to problem of labour turnover in your warehouse which causes to reduce warehouse efficiency? (Q22) and Are you satisfied with your income level? (Q23) have been consisting of factor loading values greater than 0.7 while others have been consists of factor loading values less than 0.5.

Factor 6= f(Q22, Q23)

Factor six can be named as labor satisfaction

Reliability Statistics

Table 2. Reliability Statistics for Six Factors

Cronbach's Alpha	N of Items
.802	6

Table 3. Cronbach's Alpha

Factor	Name	Cronbach's Alpha	N of items
F1	Quality	.922	7
F2	Warehouse planning	.821	5
F3	Productivity	.854	5
F4	Inventory Control	.828	3
F5	Cost	.768	3
F6	Labor Satisfaction	.602	2

As a result of the reliability analysis all Cronbach's Alpha values are more than 0.6. As those values are greater than 0.5 those items can be combined to create variables. That is because items are having unidirectional.

According to the Component Score Co-efficient matrix result,

$$\text{Factor 1 (Quality)} = 0.306Q2 + 0.342Q4 + 0.211Q6 + .292Q7 + 0.175Q8 + 0.041Q9 + 0.138Q13$$

$$\text{Factor 2 (Warehouse planning)} = 0.125Q1 + 0.291Q5 + 0.325 Q16+ 0.337 Q18 + 0.352 Q19$$

$$\text{Factor 3 (Productivity)} = 0.197Q3 + 0.311Q10 + 0.287 Q11+ 0.263Q24 + 0.283 Q25$$

$$\text{Factor 4 (Inventory control)} = 0.444Q14 + 0.418Q15 + 0.219Q17$$

Factor 5 (Cost) = 0.296Q12 + 0.465Q20 + 0.384Q21

Factor 6 (Labor satisfaction) = 0.556Q22 + 0.445 Q23

To Identify Whether Factors Depend on Scale of the Company

Hypothesis to identify whether factors depend on company scale can be shown as below,

H_0 = Efficiency factor is not different between company scale

H_1 = Efficiency factors at least one is not equal

According to the descriptive statistics, small scale industry have doubt whether the quality factor is affect to the warehouse efficiency. So small scale industries have not clear idea about the quality factor. However, medium and large scales companies are strongly considered factor one as influence to the efficiency of the warehouse.

Also factor five varies between small and large scale companies as it show significant values. Mean value for the smaller scale is less while larger scale represents high There for smaller scale industries have not clear answer whether the cost factor is affect to the warehouse efficiency. But then again larger scale companies were agreed on the factor cost as warehouse efficiency factor.

To Identify Whether Factors Depend on No. of Employees in the Warehouse

Hypothesis to identify whether factors depend on number of employees can be shown as below,

H_0 = Efficiency factor is not different between groups

H_1 = Efficiency factors at least one is not equal

According to the descriptive statistics, companies that have more than 50 employees they are more concern about quality factors for the warehouse efficiency relative to companies which have less than ten employees. The

companies which have 11- 20 employees are more concern on the warehouse planning factors to the efficiency.

According to the descriptive statistics, companies which have 11-20 employees are more concern on the warehouse productivity factors relative to the companies which have less than ten employees and more than 50 employees. The companies that consist with more than 50 employees are more concern on the Labor satisfaction factors for the warehouse efficiency.

To Identify Whether Factors Depend on Security level

Hypothesis to identify whether factors depend on number of employees can be shown as below,

H_0 = Efficiency factor is not different between security levels

H_1 = Efficiency factors at least one is not equal.

According to the descriptive statistics, companies which have low security level do not have clear idea about the quality factors to the efficiency while companies which have high and moderate security levels are more concern on efficiency factors. Furthermore companies which have moderate level of security have more concern on labor satisfaction compared with the companies which have low security level.

Identify the Relationship between No of Customer Complaints and Efficiency Factors

According to the research done by Loughborough university customer complaints should handle efficiently. (Gruber & Szmigin, 2009)

Hypothesis can be shown as below.

H_0 . = Customer complaints are not depend on efficiency factors

H_1 = Customer complaints are depend on efficiency factors

According to the Chi-square test, Numbers of customer complaints are depend on the quality factor. Because, the chi-square value is 0.001 and it is significant. Because of P value is less than 0.005. Also number of customer complaints is depending on the, productivity, inventory control, and the Labor satisfaction. Because they are having P values which are less than 0.005

Table 4. Chi-Square Test

Factor	Factor name	Pearson chi-square
F1	Quality	0.001
F2	Warehouse planning	0.007
F3	Productivity	0.000
F4	Inventory Control	0.000
F5	Cost	0.005
F6	Labor Satisfaction	0.000

Table 5. Crosstab

		F1 Agree %	F2 Agree %	F3 Agree %	F4 Agree %	F5 Agree %	F6 Agree %
Number of customer complaints per week	0-1	86.7%	83%	87.8%	77.4%	66.1%	49%
	1-3	76.7%	58.3%	78.4%	70%	68.4%	81.6%
	4-10	73.3%	73.3%	33.3%	40%	63.2%	53.3%
	More than 10	100%	84.2%	5.3%	78.9%	64.5%	47.3%

According to the table 5, Companies which gain more than ten customer complaints per week are 100 percent agree on the quality factor and companies which gain customer complaints more than four but less than ten are agree on factor one and two while less agree on factor three.

V. CONCLUSION AND RECOMMENDATIONS

To identify the major factors affecting to the warehouse efficiency, factor analysis had been conducted. There

are six factors have been identified that are affect to the warehouse efficiency named, quality, warehouse planning, productivity, inventory control, cost and labour satisfaction. Furthermore reliability test carried out to create variables and conducting further analyses researcher identify how the efficiency factors depend on the scale of company, number of employees, security level of the company and identified the relationship between number of customer complaints and the efficiency factors.

Smaller scale companies should have to more concern on the quality and cost factors. Companies that have less than ten employees have to be more concern on the quality and the warehouse productivity factors. Also, companies which consist of 21-50 employees should more concern on the warehouse planning factors while companies which have more than 50 employees should more concern on the inventory control factors. If a company has less than 50 employees should more concern on Labor satisfaction factors.

Table 6. Number of Customer Complaints per week* Company Scale Cross Tabulation

		Company scale			Total
		small	medi-um	large	
Number of customer complaints per week	0-1 Count % within Number of customer complaints per week	2 1.9%	33 31.1%	71 67.0%	106 100.0%
	1-3 Count % within Number of customer complaints per week	17 28.3%	15 25.0%	28 46.7%	60 100.0%
	4-10 Count % within Number of customer complaints per week	0 .0%	6 40.0%	9 60.0%	15 100.0%
	More than 10 Count % within Number of customer complaints per week	0 .0%	0 .0%	19 100.0%	19 100.0%
	Total Count % within Number of customer complaints per week	19 9.5%	54 27.0%	127 63.5%	200 100.0%

According to the above table, larger scale companies are agreed on quality factors while they have more percentage of customer complaints. Therefore larger scale companies should have to be more concern on the quality factors.

Furthermore, this research can be used for future research studies and can be used to develop model for this.

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