Cost Effectiveness and Service of Reverse Logistics for Parts and Subassemblies: An Empirical Investigation

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***Abstract* —The modern supply chain management is witnessing a radical transformation as an effect of competitive strategy. The domain or reverse logistics has been now an area of research for practitioners as well as academicians. The functional part of machines as well as subassemblies often faces the situation of return. We conducted a survey on return of parts and subassemblies to investigate the factors governing their reverse logistics in terms of cost effectiveness and service of reverse logistics. This study has revealed that organizational role, returns policies, forecasting and retrieval centres have a positive impact of handling of returns in the form of parts and subassemblies.**

The result of this study provides a template guideline for designing a cost effective reverse logistics program with an improved customer service.

***Keywords—Reverse Logistics, product design, forecasting, retrieval centres, return policies*.**

I. INTRODUCTION

The forward logistics in a supply chain have been studied and various models for an efficient handling of the same are worked out by different researcher, practitioners and academicians so far. In the recent past, the need of reverse logistics has been realized as a result of environmental safety and the regulations pertaining to it in different nations. The companies involved in manufacturing are incorporating reverse logistics in their supply chain management activities also many business enterprises look at reverse logistics as gaining business advantage on product returns [1]. Many authors have defined reverse logistics in their own words however, the definitions reflect similar concept. The concept is moving of the product back into the supply chain for the purpose of capturing value or otherwise disposal. Various studies have given different insights on this topic. While scanning the literature on reverse logistics the service improvement and cost effectiveness of reverse logistics seems to be very less. We set our objectives with respect to these research gaps as to identify the factors influencing the cost and the service of reverse logistics. For the present study, the product returns taken into consideration are the returns in the form of part and subassemblies.

II. RESEARCH OBJECTIVES

We set our objectives as

i. To identify the factors influencing the cost and service of reverse logistics.
ii. To test the hypotheses of causal relationship between the variables.

III. THEORY DEVELOPMENT

The variable of organizational role refers to decision making on the arrival of product return. Decision makers must be aware of the relative importance of the various drivers and the techniques for implementing them [7].

Return policies can be seen as major drivers for sales and customer satisfaction. Liberal or restrictive return policies make a significant effect on product return handling [9].

Forecasting refers estimates on product returns and can be treated as preplanning for handling of returns. Toktay et al., (2003) [10] finds that future returns are the function of past sales.

The variable of retrieval centre refers to the collection points for return or facilities created for the customer to submit their return or to lodge their request of product return. The collection and recovery of returned items is an extremely critical issue of reverse logistics there is no comprehensive & practicable approach to resolve this issue [1]. Retrieval centre facilitate ease in submitting returns and speeds up the process of reverse logistics.

Major contributors of cost in manufacturing are production cost, productivity, capacity utilization and inventory reduction. Dowlatsahi, (2005) [2] considered cost of reverse logistics as a strategic factor and the cost associated with it as strategic cost. Present study considers cost as the subjective assessment of the cost benefits as an outcome of firms remanufacturing, recycling or any of the cost associated with bringing the product in a usable form.

Service refers to customers services extended for a reverse logistics activity. The service of RL is equally important as the remanufacturing or recycling of the product

[2]. Trebilcock, (2001) [11] consider reverse logistics just not about logistic activity but it is a customer service

Thus, from the literature review it is evident that the cost and service of reverse logistics is significantly dependent on organizational role, returns policies, forecasting and retrieval centres.

IV. DEFINING THE HYPOTHESES

We noticed from the literature review that variables such as organizational role, returns policies, forecasting and retrieval centres are putting in remarkable impact on the performance measures of reverse logistics. The performance measures under consideration of this study are cost and service of reverse logistics. The hypothesis definitions were made under the basis of the literature support.

H1 The ease of locating retrieval centers in the supply chain network will have significant effect on cost of the reverse logistics.
H2 Liberal return policies will have a significant effect on the cost of reverse logistics.
H3 Forecasting the expected returns will have significant effect on the cost of reverse logistics.
H4 The ease of locating Retrieval centers in the supply chain network makes a significant effect on customer service for reverse logistics
H5 Organizational role in decision making on the returns will have significant effect on customer service for reverse logistics.
H6 Forecasting the expected returns will have a significant effect on service of reverse logistics.

V. DATA COLLECTION

We surveyed 383 small to large size firms through a survey questionnaire. Measurement scales used in this analysis were all matured scales from previous research. Respondents were asked to mark their response on a 0- 5 Point scale [0= not at all, 1 = to very little extent, 2 = to some extent, 3 = to reasonable extent, 4 = to reasonably high extent, 5 = to very high extent]. This data was entered carefully in software of SPSS 17 as an input file to take up the further analysis.

VI. VALIDITY AND RELIABILITY

We ensured validity of the data and the reliability through the subsequent tests as described in this section. The factors loading values were checked and found reasonably high on their respective factors i.e. always greater than 0.40, indicating desirable convergent validity in the measures [8]. No cross loadings of factors was ensured hence good discriminant validity.

We performed KMO & Bartlett's Test of Sphericity for sampling adequacy. KMO values resulted higher than 0.5 indicating the sampling adequacy [5]. Bartlett's test of sphericity was favorable indicating the existence of correlation among these variables.

We used existing scales and hence the nomological validity (Hair et al, 2012). Reliability was assessed using reliability coefficient Cronbach alpha. In the present study observed Cronbach alpha was 0.60 and above indicating significant reliability of measures [3], [4]. Table 1 shows heuristics of data validity and reliability.

Table 1. Heuristics of data validity and reliability

Component	Technique	Basis of test	Source
Content Validity	Experts opinion, Literature support	Consent	(Hair et al., 2012) (Malhotra and Dash, 2012)
Convergent Validity	Factor Analysis	• Total Variance Explained greater than 60 percent • Eigen values greater than 1 • Scree plot • Factor Loadings above 0.4	(Hair et al., 2012) (Malhotra and Dash, 2012) (Narkhede et al., 2012)
Discriminant Validity	Factor Analysis	Rotated Component Matrix (No cross loadings)	(Hair et al., 2012)
Nomological validity	Literature support	Theoretically supported relationships from prior research	(Hair et al., 2012)
Reliability	Reliability test for scale	Cronbach alpha is a minimum of 0.60	(Hair et al., 2012) (Hulland, 1999)

Table 2. Summary of Results

	Hypothesis	SCN1 [R^2, β, P, Remark]
H1	The ease of locating retrieval centers in the supply chain network will have significant effect on cost of the reverse logistics	0.358 , 0.225, 0.000 Supported
H2	Liberal returns policies will have a significant effect on the cost of reverse logistics.	0.358, 0.219, 0.000 Supported
H3	Forecasting the expected returns will have significant effect on the cost of reverse logistics	0.358, 0.346, 0.000 Supported
H4	The ease of locating Retrieval centers in the supply chain network makes a significant effect on customer service for reverse logistics	0.453, 0.246, 0.000 Supported
H5	Organizational role in decision making on the returns will have significant effect on customer service for reverse logistics.	0.453, 0.485, 0.000 Supported
H6	Forecasting the expected returns will have a significant effect on service of reverse logistics.	0.453, 0.207, 0.000 Supported

VII. RESULTS AND DISCUSSIONS

We used multiple regression analysis to find the correlations between the variables. The regression equations under the basis of the hypothesis definitions were as under.

$$\text{Cost} = \alpha + \beta1 * RC + \beta2 * RP + \beta3 * F$$
$$\text{Service} = \alpha + \beta1 * RC + \beta2 * OR + \beta3 * F$$

Regression analysis was carried using SPSS 17. Linearity was checked and ensured through the partial regression plot of residuals versus variables. Normality of the error terms were tested and ensured by examining Histogram and Normal Probability plot. The tolerance values and Variance inflation factors were checked and the no issue of multicollinearity was observed. Table 2 shows summarized results of regression.

The resulting values of beta coefficient are used to now make the resulting regression equations. The resulting equations of cost and service

Cost =0.225RC+0.219RP+0.346F
Service =0.246RC+0.485OR+0.207F

The ease of locating a retrieval centre to a customer is supported significantly to cost of reverse logistics.

The significance of ease in locating retrieval centre might be to some extent capturing promotions to returns particularly for EOL equipments. The liberal policies on product return will turn out to an increase in customer satisfaction and will gain a cost advantage over remanufacturing. Automobile industry is seen much in buy back offers with liberal return policies.

Forecasting can be considered as a preplanning stage for reverse logistics activities. Forecasts on product returns demands for documentation on previous returns. The product recovery system through ease in locating retrieval centers has a significant positive impact on the service of reverse logistics. Thus for a good reverse logistics program the enterprises should look at this facility creation for the customers.

While investigating the service of reverse logistics, organizational role in decision-making is the most prominent variable having positive impact. Forecasting the expected returns significantly affects the service of reverse logistics in a positive sense. Moreover forecasting is the major part of planning for reverse logistics (Toktay et al., 2003).

VIII. CONCLUSIONS

This study, has empirically investigated the role of retrieval centre, return policies, importance of organizational in decision making and forecasting. The analysis of data was from small to large-scale industries. This study had recognized and presented the importance of ease of locating retrieval centre for a customer to get the benefits of customer satisfaction. Further, this study justified positive impact of role of retrieval centre on the cost and service of reverse logistics.

Our study has also described the accountability on the part of organization in decision making so that reverse logistics of an enterprise remains flexible and offers improved services.

An interesting fact on the trend of return policies was discovered during this research. Where a more than a decade back the trend was much with restrictive return policies, a major shift in this trend is witnessed in today's scenario.

The present study justifies the positive relation of liberal return policies to cost of reverse logistics Last but not the least it is discovered forecasting is an important tool the effectiveness, service of reverses logistics.

The present research offers a scope of study on a very similar ground where the returns could be categorized in terms of the degree to which the cause of return may be estimated.

IX. REFERENCES

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