An Exploratory Framework Of Warehousing In Supply Chain Of Small Manufacturing Firms

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Abstract

Warehouses act as preservatives and demand meeting barrel that induces firms to produce incessantly so as to cater the needs of wider market. Effective warehousing is regarded as competitive weapon and managers can augment the profitability of business by adopting proper warehousing management control devices and competitive strategies thereby enhancing supply chain efficiency. The present study places interest in the warehousing management systems adopted in 44 small scale units operating in district Udhampur of J&K State. The research framework was examined by empirical analysis of primary data collected. Validity and reliability of the scales in the construct were assessed through BTS and Cronbach-alpha. The results of linear regression model revealed that proper warehousing planning and control has positive impact on inventory control, leads to improved customer service and results in profitability.

***Keywords**: Warehousing, Supply Chain, Small-Scale Industries (SSIs)*

1. Introduction

Proper warehousing management in Supply Chain attributes for general sales growth by potential improvements in productivity, order accuracy, reduced space requirements, increased volume capacity, control of inventory and increased customer service (Adams et al., 1996; Matthews, 2001; Allen, 2003; Fernie *et al*., 2000; Rushton *et al*., 2000; Harrison & Van Hoek, 2002; Mason - Jones *et al*., 2000; Tarn *et al.*, 2003; Kamarainen & Punakivi 2002; Marvick & White, 1998; Naish & Baker, 2004 and Christopher & Towill, 2000). "The efficiency and effectiveness in any distribution network in turn is largely determined by the operation of the nodes in such a network i.e. the warehouses". Reduction in material handling, increase accuracy levels, improvement in service consistency & availability, increase speed of service are the main decision criteria in warehousing management (Hackman *et al.*, 2001; Naish & Baker, 2004; Emmett, 2005 and Drury & Falconer, 2003). Customer service failings at the warehouse level can have significant impacts on companies in terms of sales & profits, market share (Sanders & Ritzman, 2004), brand switching (Koste & Malhotra, 1999) competitive capabilities (Stalk *et al*., 1992) and picking efficiency (Gibson & Sharp, 1992 and Gray *et al*., 1992). Warehousing management is defined as "the direct control of handling equipment producing movement and storage of loads without the need for operators or drivers" (Rowley, 2000).

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Effective Role of Warehousing

The effective role of warehouses is being seen as increasingly important as they change from "holding yards" to "switching yards" (Drucker, 1992). In this context, Higginson and Bookbinder (2005) list the roles of distribution centres as:

- Make- /break-bulk consolidation centres, in order to consolidate customer orders together into one delivery and gain transport economies.
- Cross-dock centres, whereby customer orders are satisfied from another source (e.g. a manufacturing plant) and just pass through the distribution centre within a few hours (or a couple of days at the most).
- Transshipment facilities, which are used to change transport mode (e.g. from large line-haul vehicles to smaller delivery vehicles).
- Assembly facilities, where the final configuration of the product to individual customer requirements can take place.
- Product-fulfilment centres, responding directly to product orders from the final consumer (e.g. as internet fulfilment operations).
- Returned goods depots, handling unwanted and damaged goods, as well as goods returning under environmental legislation such as for product recovery and packaging waste.
- Miscellaneous roles, such as customer support, installation and repair services.

A number of these roles may be associated with some of the concepts mentioned earlier, such as agility, production postponement, and time compression. These are generally recognised as increasing trends in warehousing (Maltz and DeHoratius, 2004). However, a survey of large warehouses in the United Kingdom indicated that over 50 per cent of the floor area is generally taken up by storage, with most of the remaining area being used for the associated goods-in, order picking, packing and despatch activities (Baker, 2004). In that survey, although value-added activities took place in over 70 per cent of the warehouses, they only accounted for about 5 per cent of the floor area. These activities were thus relatively minor in nature and normally occurred as part of the pick and pack process. Similarly, cross-docking was rather limited in nature with 74 per cent of the warehouses cross-docking 5 per cent or less of their throughput. Inventory holding is recognised as a key role of warehouses in modern supply chains. The continuing importance warehousing, appears to warrant further research, particularly as the literature is somewhat equivocal in this subject. The literature provides some very useful insights into these components

2. Review of Literature

The literature related to warehousing management in the context of supply chain is scarce,

though few things quoted by eminent authors had been taken care of. Warehouses are the final point in the supply chain for order assembly, value added services and despatch to the customer, represents approximately 20-24 per cent of total logistics costs (European Logistics Association and A.T. Kearney Management Consultants, 2004; Herbert W. Davis & Co., 2005 and Dadzie & Johnston, 1991). Warehouses are critical to the achievement of customer service levels (Frazelle, 2002). They act as the nodes in the supply chain where customer orders are assembled and dispatched. Warehouses are primarily for receiving, storing, picking and shipping goods (Hatton, 1990 & Dawe, 1995) and are synonymous distribution centre, transshipment, cross dock, or platform centre and all types of nodes in a distribution network (Rouwenhorst *et al.*, 2000). De Koster *et al.* (2007) broaden the ambit of warehouses for storing or buffering products (raw materials, goods-in-process, finished products) at and between points of origin and points of consumption. It includes equipments such as automated storage & retrieval systems (AS/RS), automated guided vehicles (AGVs) and conveyorised sortation systems (Ackerman and Brewer, 2001; Frazelle, 2002b; and Rushton *et al.*, 2006), but excludes technology where warehouse operators are still necessary (Baker, 2004). The present research deals in exploration of warehousing management practices of supply chains in small manufacturing firms operating in District Udhampur of J&K State.

3. Objective of the Study

To analyse the impact of warehousing on inventory, customer service and profitability.

4. Research Hypotheses

Based on extensive review of literature the following hypotheses had been framed for the present study:

H 1: Proper warehousing has positive impact on inventory control

H 2: Effectual warehousing leads to improved customer service

H 3: Effective warehousing planning & control influences profitability

5. Research Design and Methodology

Sampling and data collection

The primary data for the study were collected from 44 functional manufacturing SSIs registered under District Industries Centre (DIC), Udhampur of J&K State sub-divided into ten lines of operation comprising cement (8), pesticide (3), steel (3), battery/lead/alloy (5), menthol (2), guns (2), conduit pipes (2), gates/grills/varnish (5), maize/atta/dal mills (3) and miscellaneous (11). Census method was used to elicit response from owners/managers of the SSIs. Information was collected by administering self developed questionnaire prepared after consulting experts and review of literature

which comprised of general information and various statements (19) of warehousing management. Items in the questionnaire were in descriptive form, ranking, dichotomous, open ended and five-point Likert scale. The data collected was further analysed with the help of SPSS (Version 16.00) for purification, checking validity and reliability. Ranking tables were used to elicit meaningful responses from the data.

The Survey Instrument

The survey instrument for managers was sub-divided into general information and information about dimensions of warehousing management based on ranking and ordinal scale (5<——>1) ranging from 'strongly disagree' (1) to 'strongly agree' (5). The primary data were collected by making four to seven visits for getting response from managers. The secondary information was collected from various sources namely books, magazines, empirical papers from online journals & hard copies of journals, annual action plan and other documents published and unpublished.

Reliability and validity of the instrument

Reliability: As evident from the Table 1.1, the Cronbach's reliability coefficients for all 18 scale items underlying four factors within the domain of warehousing management ranges from 0.631 to 0.853. The alpha reliability coefficients for F_1 (0.833), F_2 (0.853) and F_3 (0.846) is higher than the criteria of 0.77 obtained by Gordon and Narayanan (1984) indicating high internal consistency. F_4 (0.631) is also at a minimum acceptable level of 0.50 as recommended by Brown et al. (2001) and Kakati and Dhar (2002) thereby obtaining satisfactory internal consistency. However, the overall alpha reliability score for all factors is also satisfactory at 0.790. Adequacy and reliability of sample size to yield distinct and reliable factors is further demonstrated through Kaiser-Meyer-Olkin Measure of Sampling Adequacy that is 0.671 and all factor loadings between items and their respective constructs being greater than equal to 0.55.

Validity: The four factors obtained alpha reliability higher & equal to 0.50 and KMO value at 0.671which indicate significant construct validity of the construct (Hair *et al.*, 1995).

6. Data Analysis and Interpretation

Factor analysis was applied to the collected data and the suitability of data obtained from SSI managers was examined through Anti-image, KMO value, Bartlett's Test of Sphercity (p-value = 0.000), Principal Component Analysis and Varimax Rotation (Stewart, 1981; Dess et al., 1997 & Field, 2000). The first round didn't obtained KMO value. In the second round the KMO value was: 536, connoting low values of factor loadings (below 0.5) and communalities (below 0.60) for few items. After that in the next round, the KMO value (0.671) and Bartlett Test of Sphercity (456.51) indicated acceptable and significant values. The process of R-Mode Principal Component Analysis

(PSA) with Varimax Rotation brought the construct to the level of 18 statements out of 19 statements originally kept in the domain of warehousing management. Therefore, factor loadings in the final factorial design, are consistent with conservative criteria, thereby resulting into four-factor solution using Kaiser Criteria (i.e. eigen value e"1) with 67.01% of the total variance explained, i.e. 18 items got grouped in four factors. The communality for 18 items ranged from 0.58 to 0.90, indicating moderate to high degree of linear association among the variables. The factor loadings range from 0.621 to 0.892 and the cumulative variance extracted ranges from 20.37 to 67.01 percent. The percentage of variance explained by each factor came out to be F_1 (20.37%), F_2 (18.94%), F_3 (17.93%), and F_4 (9.97%) and is displayed in the Table 1.1. A brief description of factors emerged is as under:

Factor 1 (Competitive strength): Five items included in this factor are: "Warehouse control can handle multi-stockroom inventories", "It leads to efficient space utilization & flexibility of arrangement", "Warehousing control provides ready availability of stocks", "Effective warehousing control outperforms competitors on customer service" and "Warehousing control leads to minimisation of material deterioration and pilferage". "Warehouse control can handle multi-stockroom inventories" scored good mean value (4.06) with highest factor loading (.823) and communality (.791) which indicates that this variable is significantly contributing towards the factor. The other variables also significantly contributed towards the factor with mean values ranging from 4.04 – 4.13 and factor loadings .638 - .823. The communalities of the variables are beyond .60 which again proves significance of all the variables contributing towards the factor. The overall mean value scored by the factor is 4.07 which highlight the importance of this factor towards the dimension of warehousing management. So, managers perceive that effective warehousing control can positively meet customers' requirements by providing ready availability of stocks.

Factor 2 (Enhanced preservation & control): Four variables underlying this factor are: "Warehousing planning provides complete storage to various items", "Warehousing planning helps in distribution of goods economically", "Effective warehousing control meets the demands of consuming departments" and "Effective warehousing builds goodwill & invites business". The mean values of all the variables lies between 4.00 to 4.04. Factor loadings varied from .624 - .892 which implies that all the factors are significantly contributing towards the factor. The communalities for all the variables fluctuates within .582 to .867 which connotes that except one variable i.e. effective warehousing builds goodwill & invites business (.582) all the other variables are having positive linear association among them. In all, this factor contributes above average (Mean value = 4.02) towards the domain of warehousing management. So managers regards the services of warehousing to be the root cause of distributing the goods economically and in meeting the demands of different consuming departments.

Factor 3 (Effective purchase planning): The five variables that emerged in this factor includes, "Your warehousing techniques supply timely goods to markets", "Warehousing control avoids unnecessary waiting time", "Warehousing planning results in shorter path philosophy", "Warehousing control leads to codification & preservation" and "Warehousing planning assists in effective purchase actions". The mean values of all the variables hovered within 4.06 – 4.22, factor loadings from .621 - .788 and communalities between .683 to .907 which acknowledges that all the variables are significantly contributing towards this factor. The overall mean score of the factor is 4.12 which again proves that the factor is significantly contributing towards the dimension of warehousing management. The managers perceive that they enjoy lot of benefits from adopting warehousing management techniques which assists them in effective purchasing, ensures shorter path philosophy and supplying timely goods to markets.

Factor 4 (Overall cost reduction): This factor divulged two variables namely, **"**Warehousing planning & control structure reduces overall costs" and "Warehousing control ensures smooth inflow & outflow of goods". The variable "Warehousing planning & control structure reduces overall costs" scored mean value of 4.06 and factor loading .815 with communality .784 which indicates that the variable is contributing significantly towards the factor. The second variable scores mean value of 4.31, factor loading .671 and communality .625 which implies that though mean value is good but factor loading specifies that this variable is contributing less significantly towards the factor. The communality further promulgate that less linear association exists within the variables. The overall mean value of this factor is strongest among all factors with mean value 4.19 which intimates its importance to the dimension of warehousing management. In the nutshell, managers perceive that proper warehousing planning & control reduces the overall costs.

Table 1.2 shows output from regression analysis to elicit the impact of warehousing on inventory control. The result of linear regression analysis (Table 1.2) enticed that the correlation between predictor and outcome is positive with values of R as .455, which signifies good correlation between predictor and the outcome. In the model 1, R is .455 which indicates 45% association between dependent and independent variable. R-Square for this model is .207 which means that 20% of variation in warehousing can be explained from the independent variable. Adjusted R square (.118) indicates that if anytime another independent variable is added to model, the R-square will increase. Further beta value reveals significant relationship of independent variable with dependent variable. Change in R square is also found to be significant with F-values significant at 5% confidence level. Thus the hypothesis "Proper warehousing has positive impact on inventory control" is accepted as represented by its significance level $p < .05$.

Table 1.3 avows output from regression analysis to elicit the impact of warehousing on customer service. The result of linear regression analysis (Table 1.3) enticed that the correlation between predictor and outcome is positive with values of R as .890, which signifies high correlation between predictor and the outcome. In the model 1, R is .890 which indicates 89% association between dependent and independent variable. R-Square for this model is .792 which means that 79% of variation in warehousing can be explained from the independent variable. Adjusted R square (.765) indicates that if anytime another independent variable is added to model, the R-square will increase. Further beta value reveals significant relationship of independent variable with dependent variable. Change in R square is also found to be significant with F-values significant at 5% confidence level. Thus the hypothesis "Effectual warehousing leads to improved customer service" is accepted as represented by its significance level $p < .05$ (.027).

Table 1.4 shows output from regression analysis to elicit the impact of warehousing on inventory control. The result of linear regression analysis (Table 1.4) enticed that the correlation between predictor and outcome is positive with values of R as .411, which signifies good correlation between predictor and the outcome. In the model 1, R is .411 which indicates 41% association between dependent and independent variable. R-Square for this model is .169 which means that 16% of variation in warehousing can be explained from the independent var iable. Adjusted R square (.149) indicates that if anytime another independent variable is added to model, the R-square will increase. Further beta value reveals significant relationship of independent variable with dependent variable. Change in R square is also found to be significant with F-values significant at 5% confidence level. Thus the hypothesis "Effective warehousing planning & control influences profitability" is accepted as represented by its significance level $p < .05$.

7. Conclusion

Effectual warehousing management in supply chain management paves way for increased profitability, proper storage and protection of goods, meeting timely demand of the market, ensuring unremitting supply of goods, creating goodwill of the manufacturer, handling multi stock room inventories, augments transportation and inventory balance etc. The study reveals that proper warehousing and planning leads to proper inventory control, secondly it improves customer service as it fulfills the timely needs and desires of customers and finally it enhances profitability of the small firms operating in District Udhampur. Further, the managers must be sensitized through periodic training & education programmes in order to better implement the existing and latest warehousing management techniques. The findings of the study is limited to small scale industries of district Udhampur of J&K State, so results drawn cannot be generalized for medium or large scale industries functioning in other parts of country having dissimilar business environment.

Table 1.1: Results Showing Factor Loadings and Variance Explained after Scale Purification (Rotated Component Method) Regarding Warehousing Management

Factor-wise Dimensions	Mean	S.D	F.L	Eigen Value	Variance Explained %	Cumulative Variance %	Comm-unality	α
F1Competitive strength	**4.07**	**.379**		**6.021**	**20.373**	**20.373**		**.8333**
Handle multi-stockroom inventories	4.06	.397	.823				.791	
Space utilization & flexibility of arrangement	4.06	.333	.793				.710	
Ready availability of stocks	4.06	.333	.786				.750	
Outperforms competitors on customer service	4.13	.462	.664				.625	
Material deterioration and pilferage	4.04	.370	.638				.650	
F2 Enhanced preservation and control	**4.02**	**.391**		**2.438**	**18.940**	**39.313**		**.8533**
Complete storage to various items	4.00	.373	.892				.867	
Distribution of goods economically	4.02	.340	.862				.803	
Meets demands of consuming departments	4.04	.370	.857				.874	
Goodwill & invites business	4.04	.480	.624				.582	
F3 Effective purchase planning	**4.12**	**.391**		**1.769**	**17.732**	**57.045**		**.8464**
Supply timely goods to markets	4.15	.428	.788				.782	
Avoids unnecessary waiting time	4.06	.333	.783				.907	
Results in shorter path philosophy	4.06	.333	.780				.774	
Codification & preservation	4.11	.386	.681				.867	
Assists in effective purchase actions	4.22	.475	.621				.683	
F4 Overall cost reduction	**4.19**	**.499**		**1.388**	**9.970**	**67.015**		**.6317**
Reduces overall costs	4.06	.399	.815				.784	
Ensures smooth inflow & outflow of goods	4.31	.601	.671				.625	

Footnotes: KMO Value = .671; Bartlett's Test of Sphercity = 456.511, df = 136, Sig. = 000; Extraction Method Principal.

Component Analysis; Varimax with Kaiser Normalisation; Rotation converged in 9 iterations; 'FL' stands for Factor Loadings, 'S.D' for Standard Deviation and 'α' for Alpha

Table 1.2: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	F-value ANOVA	Sig. level	β	t	Sig. level
1.	.455	.207	.188	.3582	10.941	.002	.455	3.308	.002

a. Predictors: (Constant), Inventory control.

b. Dependent Variable: Effective warehousing planning & control structure.

Table 1.3: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	F-value ANOVA	Sig. level	β	t	Sig. level
1.	.890	.792	.765	.2184	28.981	.000	.198	2.303	.027

a. Predictors: (Constant), Improved Customer Service.

b. Dependent Variable: Effective warehousing planning & control structure.

Table 1.4: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	F-value ANOVA	Sig. level	β	t	Sig. level
1.	.411	.169	.149	.3666	8.555	.006	.411	2.925	.006

a. Predictors: (Constant), Profitability.

b. Dependent Variable: Effective warehousing planning & control structure.

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