Effective Warehousing: A Boon for Supply Chain Laurels

Dr. Vipul Chalotra
Assistant Professor, Dept. of Commerce, University of Jammu, 180006
Udhampur campus

ABSTRACT-*Effective warehousing is regarded as competitive weapon as wider market demands incessant supply of goods and that too in authentic condition. This genuine nature of goods is protected by warehousing/storage methods and techniques used by firms. 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 highlights 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 Regression analysis and correlation revealed that effective warehousing management improves competitive strength, it has positive impact on enhanced preservation & control and proper warehouse management is directly related to overall cost reduction.*

Key Words*: Warehousing, Supply Chain, Small Scale Industries (SSIs)*

INTRODUCTION

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. "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). Therefore, its said that effective warehousing is a boon for supply chain success.

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. It includes equipments such as automated storage & retrieval systems (AS/RS), automated guided vehicles (AGVs) and conveyorised sortation systems, but excludes technology where warehouse operators are still necessary (Baker, 2004). Warehousing management in SC 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 present research identifies warehousing management and the various practices adopted by small manufacturing firms operating in District Udhampur of J&K State.

RESEARCH HYPOTHESES

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

Hyp 1: Effective warehouse management & control improves competitive strength

Hyp 2: Warehouse management has positive impact on enhanced preservation & control

Hyp 3: Proper warehouse management is directly related to overall cost reduction

Obj: To analyse the impact of effective warehousing on competitive strength, enhanced preservation & control and overall cost reduction.

RESEARCH METHODOLOGY

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.

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).

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 ≥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 competitive strength. The result of linear regression analysis enticed that the correlation between predictor and outcome is positive with values of R as .692, which signifies good correlation between predictor and the outcome. In the model 1, R is .692 which indicates 69% association between dependent and independent variable. R-Square for this model is .448 which means that 44% of variation in warehousing can be explained from the independent variable. Adjusted R square (.447) 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 warehouse management & control improves competitive strength"** is accepted as represented by its significance level $p < .05$.

Table 1.3 shows output from regression analysis to elicit the impact of warehousing on competitive strength. The result of linear regression analysis enticed that the correlation between predictor and outcome is positive with values of R as .829, which signifies good correlation between predictor and the outcome. In the model 1, R is .829 which indicates 69% association between dependent and independent variable. R-Square for this model is .719 which means that 71% of variation in warehousing can be explained from the independent variable. Adjusted R square (.705) 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 **"Warehouse management has positive impact on enhanced preservation & control"** is accepted as represented by its significance level $p < .05$.

In order to test the third and final hypothesis (Table 1.4), the single metric dependent variable "Cost reduction" is examined with "Proper warehouse management". The correlation is significant with value (.704**) which signifies high positive correlation between Cost reduction and warehouse management. Therefore, the last hypothesis **"Proper warehouse management is directly related to overall cost reduction"** is accepted.

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 provides unmarked insights to the effectiveness of warehousing and its relationship with the various aspects in small scale industries in District Udhampur of J&K state. The study reveals that effective warehousing management improves competitive strength. On the other hand, it has positive impact on enhanced preservation & control and proper warehouse management is directly related to overall cost reduction. 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 Ensures smooth inflow & outflow of goods	4.06 4.31	.399 .601	.815 .671				.784 .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	AdjustedR^2	Std. Error of Estimate	F value ANOVA	Sig. level	β	t	Sig. level
1.	.692	.448	.447	.50274	195.83	.000	2.08	11.94	.000

a. Predictors: (Constant), Competitive strength
b. Dependent Variable: Effective warehousing management & control

Table 1.3: Regression Model Summary

Model	R	R^2	AdjustedR^2	Std. Error of Estimate	F value ANOVA	Sig. level	β	t	Sig. level
1.	.829	.719	.705	.2184	28.981	.000	.198	2.303	.021

a. Predictors: (Constant), Enhanced preservation & control
b. Dependent Variable: Warehousing management

Table 1.4: Correlation Matrix

		Cost reduction	Warehouse management
Cost reduction	Pearson Correlation Sig (2-tailed) N	1 368	.704(**) .000 368
Warehouse management	Pearson Correlation Sig (2-tailed) N	.704(**) .000 368	1 368

(**) Correlation is significant at 0.01 Sig level (2-tailed)

REFERENCES

1. Adams, N.D., Brown, T.W., Firth, R.V.D. and Misenheimer, L.P. (1996), "Warehouse and Distribution Automation Handbook", McGraw-Hill, New York, NY.
2. Allen, N. (2003), "Upping the Stakes", Logistics Europe, March, pp. 23-26.

3. Baker, P. (2004b), "Aligning Distribution Center Operations to Supply Chain Strategy", International Journal of Logistics Management, Vol. 15, No. 1, pp. 111-123.
4. Christopher, M. and Towill, D.R. (2000), "Supply Chain Migration from Lean and Functional to Agile and Customised", Supply Chain Management: An International Journal, Vol. 5, No. 4, pp. 206-213.
5. Dadzie, K.Q. and Johnston, W.J. (1991), "Innovative Automation Technology in Corporate Warehousing Logistics", Journal of Business Logistics, Vol. 12, No. 1, pp. 63-82.
6. Dawe, R.L. (1995), "Reengineer Warehousing", Transportation and Distribution, Vol. 36, No. 1, p. 98-102.
7. De Koster, R., Le-Duc, T. and Roodbergen, K.J. (2007), "Design and Control of Warehouse Order Picking: A Literature Review", European Journal of Operational Research, Vol. 182, p. 481-501.
8. Drury, J. and Falconer, P. (2003), "Building and Planning for Industrial Storage and Distribution", 2nd ed., Architectural Press, Oxford.
9. Emmett, S. (2005), "Excellence in Warehouse Management", Wiley, Chichester.
10. European Logistics Association and A.T. Kearney Management Consultants (2004), "Differentiation for Performance Excellence in Logistics", Deutscher Verkehrs-Verlag GmbH, Hamburg.
11. Fernie, J., Pfab, F. and Marchant, C. (2000), "Retail Grocery Logistics in the UK", International Journal of Logistics Management, Vol. 11, No. 2, pp. 83-90.
12. Frazelle, E. (2001), "Supply Chain Strategy: The Logistics of Supply Chain Management", McGraw-Hill, New York, NY.
13. Gibson, D.R. and Sharp, G.P. (1992), "Order Batching Procedures", European Journal of Operational Research, Vol. 58, pp. 57-67.
14. Gray, A.E., Karmarkar, U.S. and Seidmann, A. (1992), "Design and Operation of an Order Consolidation Warehouse: Models and Application", European Journal of Operational Research, Vol. 58, pp. 3-13.
15. Hackman, S.T., Frazelle, E.H., Griffin, P.M., Griffin, S. and Vlasta, D.A. (2001), "Benchmarking Warehousing and Distribution Operations: An Input-output Approach", Journal of Productivity Analysis, Vol. 16, No. 1, pp. 79-100.
16. Harrison, A. and Van Hoek, R. (2002), "Logistics Management and Strategy", Pearson Education, Harlow.
17. Hatton, G. (1990), "Designing a Warehouse or Distribution Centre", The Gower Handbook of Logistics and Distribution, 4th ed., Aldershot, pp. 175-193.
18. Herbert W. Davis & Co. (2005), "Logistic Cost and Service", paper presented at the Council of Supply Chain Managers Conference.
19. Higginson, J.K. and Bookbinder, J.H. (2005), "Distribution Centres in Supply Chain Operations", Logistics Systems: Design and Optimization, Springer, New York, NY.
20. Jarvis, J.M. and McDowell, E.D. (1991), "Optimal Product Layout in an Order Picking Warehouse", IIE Transactions, Vol. 23, No. 1, pp. 93-102.
21. Koste, L.L. and Malhotra, M.K. (1999), "A Theoretical Framework for Analysing The Dimensions of Manufacturing Flexibility", Journal of Operations Management, Vol. 18, pp. 75-93.
22. Maltz, A. and DeHoratius, N. (2004), "Warehousing: The Evolution Continues", Warehousing Education and Research Council, Oak Brook, IL.
23. Marvick, D. and White, J. (1998), "Distribution Operations: Managing Distribution Facilities for Strategic Advantage", Strategic Supply Chain Alignment, Gower, Aldershot.
24. Mason-Jones, R., Naylor, B. and Towill, D.R. (2000), "Engineering the Agile Supply Chain", International Journal of Agile Management, Vol. 2, No. 1, pp. 54-61.

25. Matthews, R. (2001), "Automated flexibility", Industrial Handling & Storage, June/July, pp. 12-19.
26. Naish, S. and Baker, P. (2004), "Material Handling: Fulfilling the Promises", Logistics and Transport Focus, Vol. 6, No. 1, pp. 18-26.
27. Pfohl, H.C., Zollner, W.A. and Weber, N. (1992), "Economies of Scale in Customer Warehouses: Theoretical and Empirical Analysis", Journal of Business Logistics, Vol. 13, No. 1, pp. 95-124.
28. Rouwenhorst, B., Reuter, B., Stockrahm, V., Houtum, G., Mantel, R. and Zijm, W. (2000), "Warehouse Design and Control: Framework and Literature Review", European Journal of Operational Research, Vol. 122, No. 3, pp. 515-533.
29. Rowley, J. (2000), "The Principles of Warehouse Design", 2nd ed., Guideline No. 4, The Institute of Logistics and Transport, Corby.
30. Rushton, A., Oxley, J. and Croucher, P. (2000), "The Handbook of Logistics and Distribution Management", 2nd ed., Kogan Page, London.
31. Sanders, N.R. and Ritzman, L.P. (2004), "Using Warehouse Workforce Flexibility to Offset Forecast Errors", Journal of Business Logistics, Vol. 25, No. 2, pp. 251-269.
32. Stalk, G., Evans, P. and Shulman, L.E. (1992), "Competing on Capabilities: The New Rules of Corporate Strategy", Harvard Business Review, March-April, pp. 57-69.
33. Tarn, J.M., Razi, M.A., Wen, H.J. and Perez, A.A. (2003), "E-fulfilment: The Strategy and Operational Requirements", Logistics Information Management, Vol. 16, No. 5, pp. 350-362.