Aligning inventories with supply chain strategies

Vipul Chalotra
Assistant Professor, Department of Commerce, University of Jammu

Abstract

Inventory alignment means properly managing the inventories which is vital for successful operations of any firm. Managers can augment the profitability of business by adopting proper inventory management control devices and competitive strategies. The paper investigates different supply chain strategies for aligning inventories among 44 managers of small manufacturing firms, 74 wholesalers and 120 retailers 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 data after purification & validation through factor analysis was subjected to multivariate tools. The results of hierarchal regression model and ANOVA revealed service optimisation, inventory stablisation, cost reduction, economy & efficiency and competitive ability being the predictors of proper inventory management. Further, it was noticed that managers with different qualification and work experience donot significantly differ with regard to applying inventory control strategies.

Key Words: Inventory management, Small Scale Industries (SSIs), Supply chain.

Introduction

Increasing globalization has tended to lead to longer supply lead-times, which, by conventional inventory control theory, result in greater levels of inventory to provide the same service levels (Waters, 2002). The impact is normally recognised as occurring with regard to safety stock, with the amount of this stock increasing in a square root relationship to the lead-time. In addition with more distant supply lines, there is also the possibility of an increasing variation in the supply lead-time and this would further increase the amount of safety stock. A further factor is the transport economics of long distance movements whereby there may be significant cost economies achievable by dispatching in larger quantities and this would tend to increase cycle stocks. This relationship between the use of offshore sourcing strategies and the resultant increased inventory levels has been demonstrated by Lowson (2002). However, there has been some concern about the true costs of inventory and whether companies do in fact recognise these fully. For example, Christopher (2005) highlights costs such as storage, obsolescence, damage, deterioration, shrinkage, insurance and management costs, as well as the more traditional cost of capital. With an incorrect assessment of inventory costs, there is the danger that companies may make inaccurate supply chain trade-offs in this respect and, therefore, hold too much inventory (Lee & Billing ton, 1992). In lean supply chain thinking, inventory is regarded as one of the seven "wastes" and, therefore, it is considered as something to be reduced as much as possible (Womack and Jones, 1996). Similarly, in agile supply chains, inventory is held at few echelons, if at all (Van Hoek et al., 2001), with goods passing through supply chains quickly so that companies can respond rapidly to exploit changes in market demand (Christopher & Towill, 2001). There have been various supply chain taxonomies based on these concepts and most stress the need for inventory reduction within each of the classifications. For example, Vonderembse et al. (2006) state that a lean supply chain "generates high (inventory) turns and minimises inventory throughout the chain" in an agile supply chain companies "make in response to customer demand" and in a hybrid supply chain companies "postpone product differentiation and minimize functional components inventory". There is thus an emphasis on inventory reduction in each of these supply chain classifications. Nevertheless, there is a recognition that inventory can play a key part in lean and agile thinking. The holding of "strategic inventory" at decoupling points can act as a buffer, separating lean production activities from an agile response to volatile market places (Christopher & Towill, 2001). Customer orders can thus be satisfied from this inventory, enabling lean principles to be applied to the manufacturing process, based on a more level production schedule. The production and movement of goods is generally forecast-driven up to the decoupling point and then driven by actual demand orders downstream from the decoupling point (Christopher, 2000). This type of structure is necessary when the supply lead-time is greater than the demand lead-time (Harrison & van Hoek, 2005), as in such cases production cannot be based on actual customer orders. Whilst inventories provide some security against fluctuations in the level of customer demand, there is concern that they may reduce the ability of supply chains to respond to changes in the nature of that demand. Etienne (2005) lists factors such as speed to market for new products, responsiveness to new technology (leading to potential obsolescence of existing inventory), responsiveness to market niches, feedback time for quality issues, and "feed forward" time (e.g. speed of signal to the market, through actual use, that the product has been improved).

Review of Literature

Inventory has also been a subject in the debate on supply chain resilience, which has been of increasing interest in recent years, particularly as the "leaning-down" of companies and global sourcing have increased supply chain risks (Christopher & Peck, 2004). It is recognised that international supply chains may be particularly vulnerable owing to such factors as the geographic area covered, the transport modes used, political/border factors and environmental issues (Prater et al., 2001). Whilst risk mitigation strategies may contain many elements, the use of inventory is generally recognised as one possible tool. For example, Chopra and Sodhi (2004) list "increase inventory" as a risk mitigation approach, whilst Christopher and Peck (2004) state that "the strategic disposition of additional capacity and/or inventory at potential 'pinch points' can be extremely beneficial in the creation of resilience within the supply chain". Lee (2002) particularly emphasizes the role of inventory in situations of supply uncertainty. There are thus widely varying views about the role of inventory in the literature and some of these views appear to have conflicting goals. For example, the goal of traditional inventory control theory has been the optimisation of inventory levels, whereas the goal discussed in more recent thinking, such as that on lean and agile supply chains, has concentrated more on the minimisation of inventory levels. However, the latter has been counteracted to some extent by the understanding of the role of decoupling points and the part that inventory may play in some risk mitigation strategies. Whilst the minimisation of inventory is widely discussed, this needs to be defined and there is a recognition that resources can be reduced too much, leading to terms such as "corporate anorexia" (Radnor & Boaden, 2004). This suggests that there is in fact an optimum level of inventory. However, the identification of this level needs to involve wider concepts than those just associated with traditional inventory control theory. Inventory holding plays an important role in modern supply chains. A survey of logistics costs in Europe identified the cost of inventory as being 13 per cent of total logistics costs (Establish Inc/AT Kearney, 2004). A similar study in the USA, found inventory costs significantly higher at 24 per cent (European Logistics Association/Herbert W. Davis & Co., 2005). The present research explores the inventory management techniques used in small scale industries of District Udhampur of J&K State.

Testable Hypotheses

On the basis of in-depth analysis of existing review of literature and its meaningful conclusions, the following hypotheses had been emerged in order to make the study more reliable and responsive. The main hypotheses are:-

Hyp1: Proper Inventory control strategy affects costs, economy & efficiency and competitive ability.

Hyp2: Managers with different qualification doesn't significantly differ with regard to applying inventory control strategies.

Hyp3: Managers differing with regard to previous work experience donot significantly differ in applying inventory control strategies

Research Methodology

The primary data for the study were collected from 44 functional manufacturing SSIs out of 49 units registered under District Industries Centre (DIC), Udhampur of J&K State. Five units were found to be non functional. The nature and number of downward members in Supply Chain included in the study were 74 (wholesalers) and 120 (retailers). The manufacturing units were 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 and snowball/referral sampling for obtaining data from wholesalers and retailers. The number of wholesalers identified under cement (12), pesticide (2), steel (2), battery/lead/alloy (12), menthol (1), guns (3), and conduit pipes (2), gates/grills/varnish (5), maize/atta/dal mills (14) and miscellaneous (20). The number of retailers identified was cement (22), pesticide (4), steel (4), battery/lead/alloy (20), menthol (2), conduit pipes (8), gates/grills/varnish (5), maize/atta/dal mills (33) and miscellaneous (27). Information was collected by administering self developed questionnaire prepared after consulting experts and review of literature which comprised of general information and 37 statements of inventory management. Statements in the questionnaire were in descriptive form, ranking, dichotomous, open ended and five -point Likert scale, where 1 stands for strongly disagree and 5 for strongly agree. The data collected was further analysed with the help of SPSS (Version 16.00) for data purification, checking validity and reliability. Multivariate tools such as Mean, Standard deviation, hierarchal linear regression model and ANOVA were used to test hypotheses and drawing meaningful inferences.

Data analysis and major findings

The suitability of raw data for factor analysis obtained from SSI managers is examined through Anti-image, KMO value, Bartlett's Test of Sphercity and (p-value = 0.000), indicating sufficient common variance and correlation matrix (Dess et al., 1997 and Field, 2000). The process of R-Mode Principal Component Analysis (PSA) with Varimax Rotation brought the construct to the level of 21 statements out of 37 statements originally kept in the domain of inventory management. The KMO value (0.688) and Bartlett Test of Sphercity (451.755) indicates acceptable and significant values. Therefore, factor loadings in the final factorial design, are consistent with conservative criteria, thereby resulting into five-factor solution using Kaiser Criteria (i.e. eigen value ≥ 1) with 68.58% of the total variance explained. The communality for 21 items ranges from 0.56 to 0.89, indicating moderate to high degree of linear association among the variables. The factor loading ranges from 0.517 to 0.888 and the cumulative variance extracted ranges from 17.30 to 68.58 percent. The communalities and % of variance explained by each factor is displayed in the Table 1.1. A brief description of factors emerged is as under:

Factor 1 (Economy & efficiency): This factor consists of five items namely, "Effective inventory control brings potential savings", "Inventory control avoids costly interruptions in operations", "Inventory control strategy facilitates purchase economies", "Inventory holding results in effective utilization of human & equipment" and "You keep inventory in accordance to your firm size". The mean values varied between 4.13 – 4.22, factor loadings between .598 - .828 and communalities from .566 - .852. The factor acknowledges the significance of inventory management which assists SSI managers in potential savings, purchase economies and smooth operations.

Factor 2 (Service optimisation): Items underlying this factor includes "Regular supply at reasonable prices builds customer confidence", "Inventory control is consistent with safety & economic advantage", "Inventory control facilitates cost accounting activities" and "Inventory planning improves service level" which connotes good mean values fluctuating between 4.13 – 4.27. The factor loadings for this factor confined within .386 to .790 and communalities from .735 to .844. This factor depicts managers' attention regarding proper inventory management & control as it improves service level and acts as catalyst for building customer confidence.

Factor 3 (Inventory stablisation): This factor concentrated on three items namely, "Sufficient inventory is build to minimise price fluctuation", "Adequate warehousing facilities are there for stocking inventory" and "Inventory catalogue is maintained to influence inventory control" whish bespeaks average mean values ranging between 3.90 – 3.86 but significant factor loadings (0.744 – 0.888) and communalities (0.761 - .897). Inventory control can be properly exercised with the help of inventory catalogue and by adequate warehousing facilities.

Factor 4 (Cost reduction): This factor envisages three items focusing upon "Inventory planning & management reduces storage costs", "High inventory turnover affects revenue costs" and "SCM assists you to maintain adequate inventories". The mean values for the aforesaid items are significant and ranges between 4.04 – 4.15. The factor loadings and communalities exhibited significant values (Table 1.1). The factor entices to reduce storage costs and improve revenue by proper inventory management & control.

Factor 5 (Competitive ability): The items "Effective inventory control enhances market share" and "Inventory control paves for competitive ability" are taken into consideration by this factor which supports the items with significant mean values 4.20 & 4.18, high factor loadings values (.873 & .718) and communalities with values .791 & .654 respectively. This factor clearly demonstrates that effective control enhances market share and improves competitive ability.

Reliability: The alpha reliability coefficients for F_1 (0.802), F_2 (0.823), F_3 (0.829) is higher than the criteria of 0.77 obtained by Gordon and Narayanan (1984) indicating high consistency. F_4 (0.627) and F_5 (0.605) are 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 (Table 1.1).

Validity: The five factors obtained alpha reliability higher & equal to 0.50 and satisfactory KMO value at 0.688, indicating significant construct validity of the construct (Hair et al., 1995).

Manager's profile

It has been found that 40.9% (18) of the entrepreneurs (Managers) are graduates and 20.5% (9) entrepreneurs are post-graduates. Three entrepreneurs were just metric pass constituting 6.8% of the total respondents. Another group of entrepreneurs who were qualifies upto higher secondary were 29.5% (13). Those who had done technical courses were just one out of total 44 respondents. Thus, it becomes clear that large proportion of entrepreneurs are enlightened and well educated. Thus, qualification of entrepreneurs highlights the awakened nature of owners/managers operating SSIs.

As far as owners (Managers) past experience is concerned, it was found that 58.8% (25) were having past working experience of 5 – 10 years as SIDCO is a newly formed Industrial complex in District Udhampur. Eight respondents were found to have work experience of 1 – 5 years which contributed to 18.2% of the total respondents. Those having previous work experience between 10 – 15 years were 5 in number with 11.4% constitution. 4.5% (2) of the respondents were with rich experience of 15 – 20 years and 9.1% (4) of the respondents were with exorbitant experience and exposure of beyond 20 years.

The first hypothesis was tested with regression analysis. The result of step-wise linear regression analysis (Table 1.3) enticed five independent factors as significant in predicting the dependent variable. These are: "Service optimisation", "Inventory stablisation", "Cost reduction", "Economy & efficiency" and "Competitive ability". The correlation between predictor and outcome is positive with values of R as .610, .638, .730, .763, and .798, which signifies high correlation between predictor and the outcome. In model 1, R is .610 which indicates 61% association between dependent and independent variables. R-Square for this model is .372 which means that 37% of variation in inventory management can be explained from the five independent variables. Adjusted R square (.368) indicates that if anytime another independent variable is added to model, the R-square will increase. Further beta values reveal significant relationship of independent variables with dependent variable. "Service optimisation" has emerged as the strongest predictor whereas "Competitive ability" is found to be the weakest as represented by relative t-values. Change in R square is also found to be significant with F-values significant at 5% confidence level. Errors in regression are independent as indicated by Durbin-Watson value (2.213). The aforesaid findings support the hypothesis *"Proper Inventory control strategy affects costs, economy & efficiency and competitive ability"*.

To test the second hypothesis, the qualification of the respondents was classified into five categories viz., Metric, Higher secondary, Graduate, Post graduate and others (Technical courses etc). The results of ANOVA (Table 1.4) revealed that managers with different qualification level doesn't differs significantly with regard to applying inventory control strategies (Sig. 0.247) as the *p* value is more than .05. Therefore, the second hypothesis is also accepted.

The third and final hypothesis was analysed by taking into consideration the previous work experience of the respondents (managers/manufacturers/owners/suppliers). The previous work experience was classified into five categories i.e. 1-5 yrs, 5-10 yrs, 10-15 yrs, 15-20 yrs, and above 20 yrs. The ANOVA results portrayed that suppliers with different work experience donot differ significantly in adopting and applying inventory control strategies as $p > .05$ i.e. 0.664. Therefore, the third hypothesis is also accepted (Table 1.5).

Conclusion

Aligning inventory management strategies involve incessant decision making by managers. Proper inventory management is vital for reducing costs, enhancing product quality and improving competitive ability and operational flexibility. The study provides substantive prop up for previous findings in the existing literature and fresh insights about the inventory management control techniques and strategies adopted in small scale industries. Proper inventory management assists in improving asset productivity & inventory turns, targeting customers & positioning products in diverse markets. The study highlights that proper inventory management results in service optimisation, inventory stablisation, cost reduction, increasing economy & efficiency and fostering competitive ability. Further, it was noticed that managers with different qualification and work experience donot significantly differ with regard to applying inventory control strategies. The managers must be sensitized through periodic training & education programmes in order to better implement the existing and latest inventory control 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 for Inventory Management

Factor-wise Dimensions	Mean	S.D	F.L	Eigen Value	Variance Explained %	Cumulative Variance %	Comm-unality	α
F1 (Economy & efficiency)	**4.17**	**.482**		**8.204**	**17.300**	**17.300**		**.8022**
Brings potential savings	4.13	.408	.828				.852	
Avoids costly interruptions in operations	4.18	.390	.807				.797	
Facilitates purchase economies	4.22	.522	.711				.742	
Results in effective utilization of human & equipment	4.18	.390	.608				.679	
Inventory is in accordance to the firm size	4.13	.701	.598				.566	
F2 (Service optimisation)	**4.18**	**.391**		**3.643**	**15.700**	**33.000**		**.8231**
Ensures customer confidence	4.27	.450	.386				.844	
Consistent with safety & economic advantage	4.20	.408	.790				.795	
Facilitates cost accounting activities	4.13	.347	.726				.820	
Improves service level	4.13	.347	.563				.735	
F3 (Inventory stablisation)	**3.89**	**.531**		**2.923**	**15.504**	**48.504**		**.8293**
Price fluctuation	3.90	.520	.888				.897	
Warehousing facilities	3.86	.553	.870				.793	
Inventory catalogue & control	3.90	.520	.744				.761	
F4 (Cost reduction)	**4.11**	**.473**		**1.646**	**10.863**	**59.367**		**.6273**
Reduces storage costs	4.04	.680	.790				.837	
Affects revenue costs	4.15	.370	.734				.831	
Adequate inventories are always there	4.15	.370	.517				.641	
F5 (Competitive ability)	**4.19**	**.425**		**1.298**	**9.217**	**68.584**		**.6057**
Enhances market share	4.20	.461	.873				.791	
Paves for competitive ability	4.18	.390	.718				.654	

Footnotes: KMO Value =.688; Bartlett's Test of Sphercity = 451.76, df = 153, Sig. =.000; Extraction Method Principal Component Analysis; Varimax with Kaiser Normalisation; Rotation converged in 11 iterations; 'FL' stands for Factor Loadings, 'S.D' for Standard Deviation and 'α' for Alpha.

Table 1.2: A Brief Profile of SSI Owners/Managers

S.No.	Variables	Classification	Frequency	Percentage
1.	Qualification	Metric Higher secondary Graduation Post graduation Others	3 13 18 9 1	6.8 29.5 40.9 20.5 2.3
2.	Previous work experience	1 – 5 years 5– 10 years 10 – 15 years 15 – 20 years Above 20 years	8 25 5 2 4	18.2 58.8 11.4 4.5 9.1
	Total		**44**	**100**

Table 1.3: Regression Model Summary (With Coefficient) of Inventory Control as Dependent Variable (Step-wise Multiple Regression Method)

Model	R	R^2	Adjusted R^2	Std. Error of Estimate	F value ANOVA	Sig. level	β	t	Sig. level	Durbin-Watson
1.	.610	.372	.368	.3976	84.231	.000	.765	9.083	.000	2.213
2.	.638	.410	.403	.3412	68.128	.000	.653	8.431	.000	
3.	.730	.534	.521	.3023	55.423	.000	.384	5.073	.000	
4.	.763	.596	.574	.2764	45.109	.000	.267	3.876	.003	
5.	.798	.634	.618	.2608	41.234	.000	.196	2.230	.009	

a) Predictors: (Constant), Service optimisation

b) Predictors: (Constant), Service optimisation, Inventory stablisation

c) Predictors: (Constant), Service optimisation, Inventory stablisation, Cost reduction

d) Predictors: (Constant), Service optimisation, Inventory stablisation, Cost reduction, Economy & efficiency

e) Predictors: (Constant), Service optimisation, Inventory stablisation, Cost reduction, Economy & efficiency, Competitive ability

f) Dependent variable: effective inventory control strategies reduce total costs

Table 1.4: ANOVA for Qualification

Description of Qualification	**Nature of Variable**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Metric	Between Groups	1.577	4	.394	1.417	.247
Higher Sec.	Within Groups	10.855	39	.278		
Graduate	Total	12.432	43			
Post Graduate						
Others						

Table 1.5: ANOVA for Work Experience

Description of Work Experience	**Nature of Variable**	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1 – 5 yrs	Between Groups	.722	4	.180	.601	.664
5 – 10 yrs	Within Groups	11.710	39	.300		
10 – 15 yrs	Total	12.432	43			
15 – 20 yrs						
Above 20 yrs						

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