OPTIMIZATION OF SUPPLY CHAIN EFFICIENCY IN MULTI CRITERIA DECISION ENVIRONMENT USING AHP MODEL

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ABSTRACT

Inventory optimization is a key element in the global supply chain. Optimization can be achieved only through trail and error method from time to time in a dynamic environment. Inventory Optimization is can focus on the inventory positions based on customized requirements of the clients for independent products. It helps to gain a substantial market share by way of consistently satisfying the requirements of the clients." Powerful optimization algorithms determine service levels and inventory targets for each product location leveraging demand forecast data, sales history, manufacturing and distribution assets, and transportation networks to consider the total landed cost of inventory – including transportation expenses, handling charges and holding costs – which can change dramatically and swiftly in today's volatile environment. Time-phased execution accounts for demand trends and seasonality effects. Additionally, the solution also considers existing multi-environment network complexity, lead times, costs and constraints, as well as demand and supply variability.
This Paper presents the different models with the empirical data to make decisions about supply chain organization using AHP model and highlights key factors to optimize the supply chains. The centralized organization model identifies process control , decentralized organization model indicates the need for time saving, centre led organization model and organization model fits with corporate strategy suggests the need for cost benefits, and finally, governance structure elevates the supply chain function emphasizes the need for time saving as primary factors for the optimization of supply chains in the market. The factors are identified through administration of AHP model on the real time data observed in the supply chain firm. Supply chain optimization is a regular function in a dynamic market and the success depends on the suitability of the model selected and degree of optimization administered in the supply chain function.

Keywords*: Supply chains- Business model- Organizational model- AHP Model- Cost benefits- Corporate strategy.*

Introduction:

Optimization of supply chain costs is mandatory to attain the targets fixed by the management in terms of costs, profits, delivery time, stock holding period, carrying costs and finally overall cost of inventory. This is in turn a key function in any one of the manufacturing companies, which are in to manufacturing line. In addition the sensitivity of inventory costs is high among the SMEs in the auto sector due to cut edge competition prevailing in the market.

Achieving the market efficiencies through better portfolios of the products selected for manufacturing and distributing at the appropriate time to the market and collection of funds from the firms by having a stringent credit policies and procedures is a difficult job. No single strategy can work to optimize the inventory function. Each firm has its own inventory model, based on the nature of product and the type of firms to which they are supplying. In some cases the combination of big and small clients are existed. To deal with each of the class, a separate rules and regulations are framed and followed. Each client's information in relation to supply credit terms and conditions are kept confidential.

After practicing all the strategies, it is also mandatory to have an empirical method which can indicate a broad and key area of focus. It is possible only by way of understanding the distribution pattern and system and proximity to the markets. In point of view of all these, a separate strategy is suggested for avoiding each of the barriers. The present AHP model used in the paper is focused on identifying the type of criteria of distribution with the respective barriers. This in fact can help in optimizing the inventory function.

Factors Ensuring Supply Chain Success:

Every company designs its own supply chain practices and inventory management tools and techniques to optimize its inventory cost and the overall success of the organization. The degree of success is determined by various internal and external factors. The internal factors include capacity of storage and consumption, material handling practices, the plant layout etc. These factors can be optimized by mere implementation architectural changes in the layout and deploying the hi-tech infrastructure to handle its materials. The external factors include availability of inventory, purchase cost and time and distance factor between the vendor and the company. Based on this many companies designed their storage criteria as centralized, decentralized, center-led, corporate and governance structure. Every structure has its own barriers in optimizing the inventory function. However the common barriers has alternatives faced by all the companies are process control , purchase cost, time , material handling and transportation cost and customer satisfaction through timely delivery. Based on this the present paper is focused to identify which process can avoid common barriers under which criteria is identified using the AHP technique.

Methodology:

AHP Process (Analytic Hierarchy process). The weights assigned to the various factors namely Process Control, Cost benefits, Time saving, Material consumption, and customer satisfaction are normalized using the Met labs package and the ranks were obtained. The weights are assigned on the basis of supply chain observation and the factors influencing the optimization in supply chains. The same criteria are followed in all the methods. The assigned weights are changed in accordance with the changes in the observation and level of influence of variables in each of the models. To process the variables weights through Analytical hierarchy process (AHP), MAT LAB package is used. Based on the rankings obtained through AHP model, key element is identified to make the supply chain more effective and optimized. The variables are identified through review of literature and the manufacturing industries in the sample area, belongs to auto component manufacturing SMEs. The quality of the relationships established for the purpose of study is validated by random inspection with the oral interviews of the executives in the inventory function. The data is correlated with the observations and the reliability of the same is hold good with 82%. Based on the data relationships observed the data is converted into matrices and AHP model is administered to identify the critical variables to take the decisions in the various environments existed in the sample industry.

Determine the normalized criteria weights W = W1, W2 ….Wn) using the (nxn) pair wise comparison matrix. Check for consistency of the pair wise comparison matrix using eigen value /eigenvector theory. Normalized scores for all alternatives with respect to each criterion. Here an (mxn) matrix is obtained where S_{ij} = normalized score for alternative `t' with respect to criterion `j'.

i) $\Sigma S_{ij} = 1$ for j= 1, 2 …n

ii) This is where scaling of criteria values takes place

iii) The actual criteria values are never used in AHP.

MCDM:

1. Consists of constructing a global preference relation for a set of alternatives evaluated using several criteria.
2. Selection of the best actions from a set of alternatives, each of which is evaluated against multiple, and often conflicting criteria.
3. Identify the alternatives.
4. Identify the criteria (attributes) that are relevant to the decision problem.

Criteria Weights Matrix:

Table1.1: Showing the Model Weights

	Centralized	Decentralized	Center Led	Corporate	Governance
Centralized	1	½	2	3	1/4
Decentralized	2	1	1/5	4	1/6
Center led	1/2	5	1	5	1/3
Corporate	1/3	¼	1/5	1	6
Governance	4	6	3	1/6	1

Normalized – scores of Criteria weights matrix:

Among all the models Governance structure elevates the supply chain function seems to be the best method for using in the multi criteria decision making in supply chains. However, based on the business model the model applicability needs to be changed for optimum results. The detailed summary of the various models applicability and the key factor identification method is explained in the following pages.

Centralized Organization Model:

Under this method all purchases are centralized and the purchase process is taken care by the corporate level management by having a separate SBU to perform the purchase function. Simultaneously they do have warehousing and logistics SBU to store and deliver the inventory to the required points from time to time. The major advantage under this method is scale of economies in purchasing and storing and to have a proper outflow control on both inventory and funds. In general organized retail businesses, organized banks can centralize their purchase function of their utilities.

Table1.2: Showing the Normalized Values for the Model Weights along with Factor Ranks

	Centralized	De-centralized	Center led	Corporate	Governance	Total score	Rank
Centralized	4.9999	13.250	5.450	18.041	19.249	60.991	0.140
Decentralized	6.1000	5.000	5.700	15.027	24.900	56.728	0.130
Center led	13.999	13.499	4.999	31.555	31.625	95.680	0.220
Corporate	25.266	37.666	19.116	5.000	12.191	99.241	0.228
Governance	21.555	29.041	15.233	51.333	5.000	122.164	0.281

Table 1.3: Showing the Factors Loadings And The Ranks For The Multi Criteria Variables Using Centralized Organization Model

	Process Control	Cost benefits	Time saving	Material cost	Customer satisfaction	Overall score	Normalized Score	Rank
Process Control	1	3	7	2	4	149.2	0.437	I
Cost benefits	1/3	1	5	2	6	94.08	0.275	II
Time saving	1/7	1/5	1	3	5	48.55	0.142	III
Material cost	½	½	1/3	1	6	37.81	0.110	IV
Customer Satisfaction	1/4	1/6	1/5	1/6	1	11.68	0.034	V
Total						**341.33**		

It is identified that the factors influencing the supply chain optimization is identified using the centralized organization model. On the basis of the weights assigned, the rankings were given. The factor having highest score loading is the key variable and vice versa. Process control is the key factor in the centralized organization method and the customer satisfaction is recorded as least variable. The order of the ranks is indicated in the above table. Hence, the centralized organization model firms needs to be focused on process control to optimize the supply chain efficiency.

Table 1.4: Showing the Factors Loadings and the Ranks for the Multi Criteria Variables Using Decentralized Organization Model

	Process Control	Cost benefits	Time saving	Material cost	Customer satisfaction	Overall score	Normalized Score	Rank
Process Control	1	2	1/3	2	½	46.874	0.190	III
Cost benefits	1/2	1	2	2	4	65.083	0.265	II
Time saving	3	1/2	1	3	3	68.999	0.280	I
Material cost	1/2	½	1/3	1	6	41.999	0.171	IV
Customer satisfaction	2	1/4	1/3	1/6	1	22.680	0.092	V

It is found from the above table that the time sharing is the key factor in the supply chain optimization according to the decentralized environment. It is due to the decentralized supply chain activities needs to be co-ordinate well. It requires time. Optimization of time consumption for moving supply from point to point can help in optimizing the supply chain. The order of the factor identified with the score loadings are: Time saving as primary factor, cost benefits as secondary and Process control, material cost and customer satisfaction in the ranks of three, four and five respectively. Hence, decentralization model focused on time saving.

Table 1.5: Showing the Factors Loadings and the Ranks for the Multi Criteria Variables Using Center Led Organization Model

	Process Control	Cost benefits	Time saving	Material cost	Customer satisfaction	Overall score	Normalized Score	Rank
Process Control	1	1/2	3	2	1/3	52.51	0.191	II
Cost benefits	2	1	4	3	4	98.63	0.359	I
Time saving	1/3	1/4	1	3	3	49.21	0.179	III
Material cost	1/2	1/3	1/3	1	15	41.63	0.151	IV
Customer satisfaction	3	¼	1/3	1/5	1	32.74	0.119	V
						274.73		

It is observed from the matrix that in the central led organization supply chain organizations, cost benefits needs to be focused at all point of time. The secondary factor needs to be focused is process control, and time saving, material cost reduction, customer satisfaction are in the order of three, four and five ranks respectively. In case of centre led supply chain organizations, cost benefits are to be measures for all the events irrespective of the value and volume of the transaction. This can make the supply chain efficient.

Table 1.6: Showing the Factors Loadings and the Ranks for the Multi Criteria Variables Using the Organization Model Fits the Corporate Strategy Model

	Process Control	Cost benefits	Time saving	Material cost	Customer satisfaction	Overall score	Normalized Score	Rank
Process Control	1	5	2	2	4	55.13	0.235	II
Cost benefits	1/5	1	4	2	5	87.25	0.373	I
Time saving	1/2	1/4	1	3	2	44.23	0.189	III
Material cost	1/2	½	1/3	1	6	35.03	0.149	IV
Customer satisfaction	1/4	1/5	1/2	1/6	1	12.05	0.051	V
Total						233.70		

The supply chain which follows, the organization model fits with the corporate strategy, is set to be keen in cost benefits, process control, time saving, material cost and customer satisfaction in the order of priority of one to five respectively. Here once more the more focused thing is that the values of resources needs to be utilized in an optimistic way to ripe the benefits of optimized supply chains. The matrix explains the ranks on the experimental observed data.

Table 1.7: Showing the Factors Loadings and the Ranks for the Multi Criteria Variables Using Governance Structure Elevates the Supply Chain Function

	Process Control	Cost benefits	Time saving	Material cost	Customer satisfaction	Overall score	Normalized Score	Rank
Process Control	1	2	3	¼	¼	47.54	0.205	II
Cost benefits	1/2	1	3	2	1/2	26.69	0.115	V
Time saving	1/3	1/3	1	3	5	68.77	0.297	I
Material cost	4	½	1/3	1	4	42.89	0.185	IV
Customer satisfaction	4	2	1/5	1/4	1	45.57	0.196	III
						231.49		

It is found that in case of the supply chains following the governance structure elevating the supply chains, the success depends on the following factors in the order of priority. The primary factor which determines the success is time saving and the secondary factor is process control. The other factors in the order of priority are customer satisfaction with rank III, material cost with rank IV and finally cost benefits with rank five respectively.

Decentralized Organization Model:

Under decentralized model each SBU is given autonomy on purchase and usage of required inventories from time to

time by following the broad guideless given by the corporate level. It helps them in function at faster rate and also to optimize the inventory cost by way of local procurement and reduce the transportation cost. This system is generally followed by construction companies having different sided with different nature of projects.

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Center-led Organization Model:

In center-led organization the inventory function operates at two levels based on the amount of investment involved and the degree of sensitivity of the inventory purchased. The core and high cost inventories are taken care by the corporate level management and all other operational inventories are given to the respected SBU`s to perform independently by following the guidelines given by the management. This gives lot of flexibility and control simultaneously to perform the inventory control.

The Organization Model Fits the Corporate Strategy:

In general inventory function needs to be in accordance with the type of corporate and the management strategy. Under these circumstances some of corporate design and develop their own inventory function on trial and error method. A full fledged strategy with regard to inventory function may come into existence in long run. This can be suitable for a specific period. When the organization size and the inventory consumption level increases, additional

strategies will be design and linked with the existing function.

The Governance Structure Elevates the Supply Chain Function:

It is a hybrid structure of inventory function designed on democratic basis considering the basic elements required for inventory function. The success of inventory function depends on systematic process in the inventory procurement to delivery and on the other hand payment mechanism for the suppliers. By considering the two factors governance structure is framed and all the decisions taken by the company is in consultation with the committee members represented by inventory department, warehousing and finance etc. This gives lot of co-ordination between the departments to work in a smooth way.

Conclusion:

Based on the above discussion and appropriateness related to the Auto component manufacturing companies in the SME`s sector, it is identified that in centralized organizations process control needs to be improved, In decentralized organization model the primary barrier of time saving in decisions to be taken care of from time to time. Center-led organization model and corporate strategy model is successful in achieving the cost benefit. Finally the Governance structure is providing lot of co-ordination among the departments and the process speed of inventory function is increased and saved lot of time in procurement. This is to conclude that every company needs to identify the barriers in inventory function and design appropriate model to control inventory. This can help in optimizing the inventory function among the SMEs working in the Auto component manufacturing Industry.

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