64

Int. J Sup. Chain. Mgt   Vol. 2, No. 4, December 2013

Supply Chain Coordination Competency and Firm Performance: An Empirical Study

Rajendra Kumar Shukla[1*], Dixit Garg[2], Ashish Agarwal[3]

[1] Department of Manufacturing Technology, J.S.S.Academy of Technical Education, Noida (U.P.), India,
rkshukla135@yahoo.com
[2]Department of Mechanical Engineering, National Institute of Technology, Kurukshetra Haryana, India
dixitgarg@yahoo.co.in
[3]Mechanical Engineering Department,Indira Gandhi National Open University, New Delhi, India
ashish_ka@yahoo.com

ABSTRACT

This paper presents a model to conduct an empirical study in Indian industries to improve the performance of their supply chain. The present research focuses on various variables that affect coordination and performance of supply chain of a manufacturing company. In a survey, variables helping in improving coordination and performance of the supply chain have been gauged. With the help of factor analysis, top priority variables have been identified. The findings show that contracts, standardization of rules, joint cost minimization, risk and reward sharing and uses of electronic data interchange (EDI) have a significant influence on the coordination. Learning and growth, better product quality, reduced customer complaints, profits margin and customer service level are emerged as top level performance indicators of manufacturing organizations. Further, a framework is suggested, that includes the relationship between top priority variables of supply chain coordination and firm performance.

Keywords:
Supply chain management, Supply chain coordination, coordination mechanisms, Firm performance, Factor analysis.

1. INTRODUCTION

A supply chain involves a group of facilities and all the activities associated with transformation of raw materials into intermediate goods, then final products, and deliver the products to end customers through a distribution system [19]. According to Handfield, supply chain involves materials and information flow both up and down the supply chain [6]. Effective management of these flows requires creating synergistic relationships between the supply and distribution partners with the objective of maximizing customer value and providing a profit for each supply chain member. To improve the overall performance of the supply chain, the members of the supply chain need to work in harmony towards a unified system and coordinate with each other. Thus, "coordination" comes into focus. The supply chain

activities can be effectively managed by introducing the concept of coordination.

Supply chain members can compete among supply chains when all the members of a supply chain act as a part of one system. Supply chain coordination is necessary to integrate all the supply chain activities, which may help in improving supply chain performance. Coordination performance is a key part of supply chain performance.

This paper investigates the relationship between supply chain coordination and performance of an organization. The following section discusses the literature review, methodology, data collection and data analysis. In the final section implication and conclusions on improving, the performance by coordination is presented.

2. LITERATURE REVIEW

Coordination can be defined as the process of managing dependencies among activities of a supply chain [14]. Supply chain coordination provides risk reduction, access to resources, and competitive advantage [15]. Supply chain coordination dictates the cost improvement and value that can be gained [3]. The concept of coordination may guide SC members to work coherently to identify interdependencies between each other to mutually, define goals and to fairly share, risks & rewards [1]. According to Hamon [5] and Ho [7] performance measurement (PM) is a critical factor for effective management. Without measuring something, it is difficult to improve it. Hence, enhancing the organizational performance needs identifying and measuring the influence of supply chain coordination on it.

Based on the survey and study of supply chain practices in Indian industries, it is recommended that Indian organizations should align supply chain strategy with business strategy in order to deliver highest customer satisfaction [18]. There is a need to streamline processes for supply chain integration to achieve operational excellence, and form partnerships to minimize inventory and maximize profits. However, the Indian firms are aware of supply chain practices, the application of these practices and coordination among all supply chain members may further help in achieving competitive advantage [20]. The practical issues of supply chain coordination can be explored by conducting interviews with the managers of various organizations. Following are some of the coordination related obstacles.

> The manufacturer wants to push maximum inventory to the downstream side whereas the distributors/retailers want to have minimum inventory.
> The production system wants to reduce its operating cost whereas the distribution channel wants to generate high revenue by providing good customer service.
> The distribution channel wants to maintain high inventories of variety of products, which may result interruption of production runs.

The lack of coordination may result in poor performance of supply chain. The consequences of lack of coordination are inaccurate forecasts, low capacity utilization, excessive inventory, inadequate customer service, inventory turns, inventory costs, time to market, order fulfillment response, quality, customer focus and customer satisfaction [17]. Benefits accruing from effective supply chain coordination are elimination of excess inventory, reduction of lead times, increased sales, improved customer service, efficient product development efforts, and lower manufacturing costs, greater flexibility to cope with high demand uncertainty, increased customer retention, and revenue enhancements [4], [8], [13].

Coordination variables identified, from literature review are plans and schedules, standardization of rules, flexibility, contracts, information sharing, joint decision making, risk and reward sharing, resource sharing, quantity discount, flexible return policies, incentive mechanisms, credit scheme, effective communication, joint cost minimization, collective learning, knowledge sharing, uses of Electronic Data Interchange (EDI), order coordination, performance monitoring, scheduling of frequent meetings with stakeholder. Performance indicators identified, from literature, for coordinating supply chain, are profits margin, low inventory level, minimize costs, customer service level, reduction in lead time, Increase in market share, better product quality, return on investment, order fill rate, capacity utilization, level of product availability, good relationship, improved flexibility, product variety, unit cost reduction, on time delivery, goodwill, learning and growth, reduced customer complaints and reduced waste.

3. RESEARCH METHODOLOGY
Based on the review of literature and the feedback from the manufacturing organizations various coordination variables that need to be considered for improving supply chain performance have been identified. The content validity of these constructs have tentatively established by extensive review with top executives and other stakeholders. Some items were removed from the construct if their removal results in an increase in the reliability estimates, however care was taken to ensure the validity of the measures is not threatened by the removal of a key conceptual element.
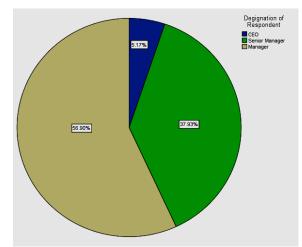
3.1 Survey Methodology
In this study, a survey-based questionnaire distributed in various manufacturing organizations to capture the perception and judgment of the concerned supply chain persons working in this domain. Invitations to participate

in the survey requested responses from those experts who have experienced in this field of managing supply chain and logistics. The researchers framed the questionnaire based on 5-point likert scale, where 1 meant "strongly disagree" and 5 meant "strongly agree". E-mail, plant visit and postal survey questionnaire were used as the research instrument. The questionnaire focused on the importance of critical coordination and performance related factors that clarified from literature review and from the survey. The objective of this research is to prioritize the coordination variables that improve firm performance and to put the results before the industries so that productivity can be increased.

3.2 Data Collection Procedures
The data collection phase of the literature review has involved exhaustive search of many of the prime Management journals including that the researchers could access. In addition to, the preceding journals, some conference papers, articles, were also accessed as well as, the following databases were searched like Emerald, Science Direct, Proquest, Springer, etc. Invitations to participate in the survey requested responses from the organizations that were manufactures of automobile parts and the target respondents in each organizations were Director of logistics, Chief operation manager, Controller of stores, and other officials and people who were directly or indirectly involved in managing proper supply chain and logistics operation in those organizations. Overall, 58 respondents were obtained for analysis.

4. DATA ANALYSIS AND RESULTS
In this research, the raw data captured by a questionnaire in word format sheet. This sheet was then converted into statistical software package (SPSS.17). Respondent

profile and other data related with surveyed firms are shown below. **Figure 1** present profile of respondent .
Figure 1: Profile of respondents

Figure 2 provide graph between Number of employee and Annual turnover, while **Figure 3** indicate information regarding Annual turnover and Average Profits .
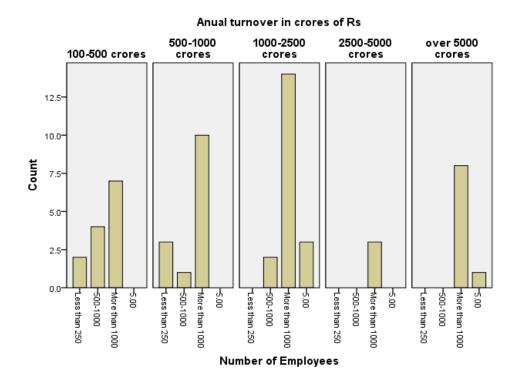
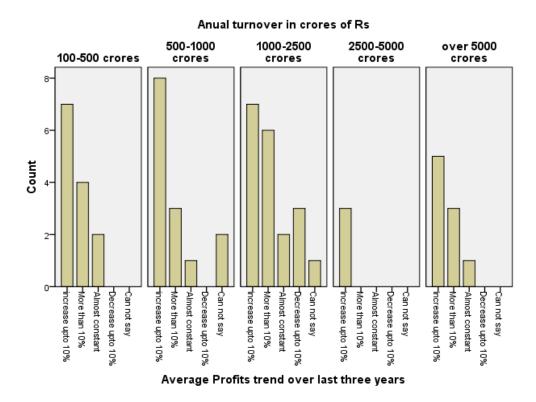**Figure 2: Graph between Number of employee and Annual turnover**

Figure 3 :Graph between Annual turnover and Average Profits

The Cronbach's alpha was calculated to assess the reliability of each scale. Alpha values over 0.7 indicate that all scales can be considered reliable [16].

Analysis of collected data for coordination and performance Variables were carried out by adopting the steps as explained in **Figure 4.**
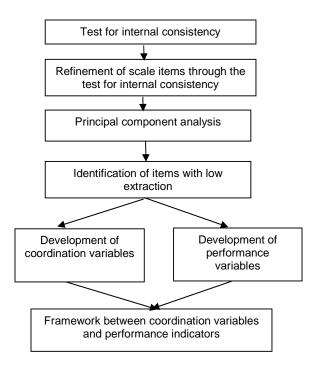

Figure 4: Analysis method for coordination and performance Variables

In present case Cronbach's alpha is 0.889 for coordination variables and 0.896 for performance indicators. The researchers performed factor analysis on the coordination and performance related variables with the primary objective of determining minimum number of factors that account for maximum variance in data. Here, principal component method with varimax rotation has been applied. It is used to reduce the number of variables [9]. It gives loading for each combination of variables and loading factors. Higher loadings mark a higher correlation between variable and factor. In this research, we follow the Kaiser criterion [10], which suggests selection of those factors with Eigen values having greater than one.

Principal component analysis is a procedure, which is widely accepted in various applications of information systems domain and proved to be feasible in research method [2], [11].

Extraction communalities are the estimates of the variance in each variable accounted for by the factors (or components) in the factor solution. Smaller values indicate those variables, which do not fit well with the factor solution, and we must eliminate them from the analysis. **Table 1** represents the communalities. Communalities indicate the amount of variance in each variable that is accounted for

Table 1: Communalities Factors

Communalities	Initial	Extraction
Plans and schedules	1.000	0.794
Standardization of rules	1.000	0.892
Flexibility	1.000	0.631
Contracts	1.000	0.823
Information sharing	1.000	0.689
Joint decision making	1.000	0.685
Risk and reward sharing	1.000	0.838
Resource sharing	1.000	0.854
Quantity discount	1.000	0.863
Flexible return policies	1.000	0.646
Incentive mechanisms	1.000	0.817
Credit scheme	1.000	0.803
Effective communication	1.000	0.677
Joint cost minimization	1.000	0.709
Collective learning	1.000	0.723
Knowledge sharing	1.000	0.490
Uses of Electronic Data Interchange	1.000	0.689
Order coordination	1.000	0.815
Performance monitoring	1.000	0.733
Scheduling of frequent meetings with stakeholders	1.000	0.759
Extraction Method: Principal Component Analysis		

Table 2 indicates total variance, as shown below. As it can be seen the researchers used principal component as the extraction technique and rotation method used is Varimax Rotation is a method that simplifies the interpretation of factor analysis. Varimax aims to maximize the variance of squared loadings on a factor to produce some high and low loadings for each factor [12]. Here the factors are being rotated among each other so that they are mutually orthogonal i.e. perpendicular in n dimensional plane. The rotation minimizes the number of variables having higher correlations on factor. As the rotation is orthogonal, the resulting factors will be uncorrelated. In the rotated factor variables with higher factor loading is considered as most important.

Table 2: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.92	34.619	34.619	6.92	34.62	34.619	3.91	19.95	19.95
2	3.17	15.872	50.491	3.17	15.87	50.491	3.41	17.05	37.01
3	1.91	9.592	60.082	1.92	9.59	60.082	3.24	16.20	53.21
4	1.67	8.382	68.465	1.68	8.38	68.465	2.35	11.79	65.01
5	1.23	6.177	74.641	1.24	6.18	74.641	1.92	9.63	74.64
6	0.91	4.543	79.185						
7	0.86	4.323	83.508						
8	0.82	4.077	87.585						
9	0.51	2.524	90.109						
10	0.45	2.230	92.339						
11	0.31	1.524	93.863						
12	0.26	1.282	95.144						
13	0.21	1.069	96.213						
14	0.18	0.904	97.118						
15	0.17	0.849	97.967						
16	0.11	0.551	98.518						
17	0.09	0.472	98.990						
18	0.09	0.449	99.439						
19	0.08	0.382	99.821						
20	0.04	0.179	100.00						

Table 3 summarizes the results of identified factors by Varimax orthogonal rotation method. Factor Loading is considered as simple correlation between the factors and variables. It is used to decide which variable belongs to which factor. The judgement can be best suited for rotated factor matrix. Each variables belongs to the factors with which it has the highest loading (neglect the negative sign).

Thus from **Table 4**, the most influencing variables for coordination are Contracts, Standardization of rules, Joint cost minimization, Risk and reward sharing and Uses of electronic data interchange (EDI). **Table 5** shows the Communalities table for performance indicators.

Table 3: Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
Plans and schedules	0.101	0.853	0.176	0.057	-0.149
Standardization of rules	0.025	0.906	0.152	0.205	0.072
Flexibility	0.522	0.552	0.156	0.160	-0.062
Contracts	0.861	0.199	0.159	0.104	-0.077
Information sharing	0.403	0.423	0.516	-0.227	0.174
Joint decision making	-0.011	0.327	0.410	0.410	0.492
Risk and reward sharing	0.030	0.214	0.105	0.841	0.271
Resource sharing	0.325	0.223	0.127	0.826	0.014
Quantity discount	0.713	-0.248	0.233	0.486	0.045
Flexible return policies	0.762	-0.018	0.130	0.186	0.112
Incentive mechanisms	0.594	0.426	-0.247	0.130	0.452
Credit scheme	0.680	-0.066	-0.470	-0.128	0.316
Effective communication	0.307	-0.060	0.572	0.061	0.498
Joint cost minimization	0.110	0.083	0.797	0.226	0.052
Collective learning	-0.025	0.220	0.644	0.450	0.238
Knowledge sharing	0.392	0.231	0.532	0.010	0.007
Uses of Electronic Data Interchange	0.143	-0.013	0.066	0.201	0.790
Order coordination	0.710	0.036	0.277	-0.132	0.464
Performance monitoring	-0.013	0.460	0.722	0.019	-0.008
Scheduling of frequent meetings with Stakeholders	-0.083	0.751	0.246	0.221	0.280
Extraction Method: Principal Component Analysis **Rotation Method: Varimax with Kaiser Normalization**					
a. Rotation converged in 10 iterations					

Table 4: Priorities of five most influencing factors

Factors (Components)	Factor Loading	Priority / Rank
Contracts	0.861	2
Standardization of rules	0.906	1
Joint cost minimization	0.797	4
Risk and reward sharing	0.841	3
Uses of electronic data interchange	0.790	5

Table 5: Communalities

Factors	Initial	Extraction
Profits Margin	1.000	0.786
Low inventory level	1.000	0.817
Minimise costs	1.000	0.838
Customer service level	1.000	0.734
Reduction in Lead time	1.000	0.778
Increase in market share	1.000	0.720
Better product quality	1.000	0.791
Return on investment	1.000	0.737
Order fill rate	1.000	0.562
Capacity utilization	1.000	0.616
Level of product availability	1.000	0.658
Good relationship	1.000	0.687
Improved flexibility	1.000	0.643
Product variety	1.000	0.646
Unit cost reduction	1.000	0.661
On time delivery	1.000	0.618
Goodwill	1.000	0.691
Learning and growth	1.000	0.612
Reduced customer complaints	1.000	0.629
Reduced Waste	1.000	0.626
Extraction Method: Principal Component Analysis		

Similarly important performance indicators are prioritize by factor analysis and listed below in **Table 6.**

Table 6: Priorities of five most influencing factors

Factors (Components)	Factor Loading	Priority / Rank
Learning and growth	0.773	4
Better product quality	0.816	2
Reduced customer complaints	0.780	3
Profits Margin	0.869	1
Customer service level	0.737	5

The findings show that standardization of rules, contracts, risk and reward sharing, joint cost minimization, and uses of electronic data interchange (EDI) have a significant influence on the coordination.

Profits margin, better product quality, reduced customer complaints, learning and growth, and customer service level are emerged as top-level performance indicators of the manufacturing organizations.

The above results shows the prioritized factors with the objective that if these factors are given proper attention then it would lead to proper functioning of supply chain management. Framework shown in **Figure 5** indicates the relationship between top priority variables of supply chain coordination and firm performance.
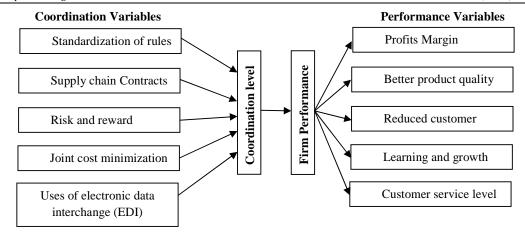
Coordination Variables   **Performance Variables**

Figure 5: Framework showing relationship between coordination and firm performance

5. CONCLUSION

In this paper, a study conducted on the existing supply chain coordination practices and their relationship with performance of supply chain of the Indian company has been presented. An attempt has been made to analyze the relationship between Supply chain performance and its coordination. The results from this research study provide learning insights and guidelines to the organizations desiring to leverage the benefits of supply chain coordination. The present research study has few limitations. This study focused on manufacturing organizations. Apart from manufacturing in particular, the other organizations like Retail, Pharma, aviation, construction, etc can be considered. There is scope to enhance this study by taking different industries and increasing the number of respondents into consideration.

REFERENCES

[1] Arshinder, Kanda, A. and Deshmukh, S. G., A Coordination based Perspective on the Procurement process in Supply Chain, *International Journal of Value Chain Management*, 2006 (a), 1, 117-138.

[2] Chang, J. C. J. and King, W. (2005). Measuring the Performance of Information Systems: A Functional Scorecard. Journal of Management Information Systems, 22(1): 85–115.

[3] Christiaanse, Ellen and Kuldeep Kumar (2000), "ICT-Enabled Coordination of Dynamic Supply Webs," International Journal of Distribution and Logistics Management, Vol. 30, No. 3/4, pp. 268-286.

[4] Fisher, Robert J., Elliot Maltz, and Bernard J. Jaworski (1997), "Enhancing Communication between
Marketing and Engineering: The Moderating Role of Relative Functional Identification," Journal of Marketing, Vol. 61, No. 3, pp. 54-70.

[5] Hamon, T.T. (2003) 'Organizational effectiveness as explained by social structure in a faith-based business network organization', Unpublished doctoral dissertation, Regent University, Virginia Beach, VA.

[6] Handfield, R. B. and Nichols, E. L. Jr. (1999). Introduction to supply chain management, Upper Saddle River, NJ: Prentice-Hall.

[7] Ho, L.A. (2008) 'What affects organizational performance?: the linking of learning and knowledge management', Industrial Management & Data Systems, Vol.108, No.9, pp.1234–1254.

[8] Horvath, L., 2001. Collaboration: The key to value creation in supply chain, Supply Chain Management: An International Journal 6 (5), 205–207.

[9] Jolliffe, I. T. (2002). Principle Component Analysis, 2nd Edition, Springer, New York, USA.

[10] Kaiser, H. F. (1960). The Application of Electronic Computers to Factor Analysis. Educational and Psychological Measurement, 10(1): 141-151.

[11] Karimi, J., Gupta, Y., and Somers, T. (1996). Impact of Competitive Strategy and Information Technology Maturity on Firms' Strategic Response to Globalization. Journal of Management Information Systems, 12(4): 55-88.

[12] Kim, J. and Mueller, W. C. (1978a). Introduction to Factor Analysis. Sage University Paper.
[13] Lee, Hau, L., V. Padmanabhan, and Seungjin Whang (1997), "Information Distortion in Supply Chain: The Bullwhip Effect," Management Science, Vol. 43, No. 4, pp. 546-558.

[14] Malone, T. and Crowston, K. (1994), ''the interdisciplinary study of coordination'', ACM Computing Surveys, Vol. 26 No. 1, pp. 87-119.

[15] Min, S. (2001). Supply Chain Management. In J. T. Mentzer (Ed.). Sage Publication

[16] Nunally, J. C. (1978). Psychometric methods. New York: McGraw-Hill Inc.

[17] Ra mdas, K. and Spekman, R.E. (2000), Chain or shackles: Understanding what derives Supply chain performance, Interfaces, 30, 4, 3-21

[18] Sahay, B.S. and Mohan, R. (2003) 'Supply chain management practices in Indian industry', International Journal of Physical Distribution & Logistics Management, Vol. 33, No. 7, pp.582–606.

[19] Schniederjans, M. J., Schniederjans, D. G. and Schniederjans, A. M. (2010), Topics in lean supply chain management, Singapore: World Scientific Publishing.

[20] Srivastava, S.K. (2006), Logistics and supply chain practices in India, VISION- The Journal of Business perspective, 10, 3, 69-79.