A STUDY ON IMPACT OF IT-LEVERAGED SUPPLY CHAIN OPERATIONAL BENEFITS ON COMPETITIVE MARKETING PERFORMANCE

G. Kannabiran
National Institute of Technology, Tiruchirappalli
and
S. Sundar
Bharathidasan Institute of Management, Tiruchirappalli

Abstract. *Companies invest heavily in Information Technology (IT) particularly in the supply chain with the belief that this investment will help them to gain competitive advantage and improve organizational performance. This study examines the impact of Information technology usage in the downstream supply chain on operational benefits and the relationship between operational benefits and marketing performance, in manufacturing companies in India. Findings are drawn from the analysis of the primary data collected from 307 supply chain managers from companies across 58 different manufacturing industry segments. The factor analysis confirmed the appropriateness of the data set and three dimensions – order/delivery processing benefits, opportunity cost reduction benefits and supply chain cost reduction benefits emerged from the operational benefit variables. Order/delivery processing benefits and supply chain cost reduction benefits are highly correlated with competitive marketing performance.*

Key Words: Supply chain, Operational benefits, Competitive marketing performance.

A supply chain is a system of people, activities, information, and resources involved in producing a product and then moving it to reach the end-customer. Many organizations attempt to integrate and closely coordinate the various elements of their supply chains in order to enhance efficiency. Indeed, minimizing cycle time— the time it takes to fulfil a customer's needs — has been a central goal of executives in recent decades (Ketchen et al 2008). Organizations invest heavily in Information Technology (IT) in the supply chain with the principal belief that they will gain competitive advantage in today's highly dynamic and changing business market (Kim & Kim 2009). This study seeks to study the operational benefits from IT usage in the downstream supply chain, that is, in the out-bound processes—from the company through its distribution channels to its consumer, measure the competitive marketing performance effect of such IT investments and to examine the relationship between Operational benefits and Competitive Marketing Performance of the organization.

THEORETICAL BACKGROUND AND RESEARCH QUESTIONS

There has been a growing recognition of the ways that Information Technology (IT) changes the way firms operate and interact with their suppliers and channel partners thus enabling them to create more responsive supply chains. Past research indicates that manufacturers are able to improve supply chain agility, reduce cycle time, achieve higher efficiency and deliver products to customers in a timely manner (Rajdou, 2003). Indian companies have been quick to recognize that a rigid supply chain will be incapable of fully meeting customer expectations and have made substantial investments in IT in the supply chain to bring about process improvements that will have a definite impact on organizational performance. Since most organizations have made massive investments in IT, evaluating companies' performance against their IT investments has become an important theme not only among researchers but also in business practices (Kwon, 2003).

According to Neely (2005) a process cannot be managed if its performance cannot be measured. Many researchers have stressed the importance of using the right metrics to manage a supply chain efficiently and effectively (Gunasekaran et al., 2001; Lambert and Pohlen,

2001; Neely et al., 2005). In the last decade, much has been written about the need to have a balanced approach in developing supply chain metrics (Kaplan and Norton, 1992; Beamon, 1999; Gunasekaran et al., 2001; Lambert and Pohlen, 2001 and Bhagwat and Sharma, 2007). Yet, the empirical research on supply chain performance, in recent times, has focused mainly on the financial performance impact on the supply chain due to IT investments (Bharadwaj et al, 1999; D'Avanzo et al, 2003; Dehning et al, 2003; Chen et al, 2004; Jin, 2006 and Blankley 2008). Financial metrics seem to be inadequate to measure supply chain performance. Since they are historical measures they do not provide a forward-looking view and they can be very difficult to tie to operational effectiveness (Camerinelli and Cantu, 2006). Nor do they provide an insight into marketing performance and customer satisfaction levels.

Operational Benefit Measures

The supply chain deals directly with the orders and delivery of goods to customers and hence it is called "driver of customer satisfaction" (Stewart, 1995). Beamon (1999) has suggested resources, output and flexibility as three types of performance measures for supply chains. Gunasekaran et al (2001) have proposed a framework for assessing the strategic, tactical and operational level performance of supply chains. Melnyk et al (2004) have defined a typology for supply chain metrics that include both financial and operational metrics. Bhagwat and Sharma (2008) have developed a balanced score card that measures and evaluates business operations from the perspective of finance, customer, internal business process and learning and growth. Chae (2009) has developed primary and secondary operational metrics based on the SCOR model's four meta-level processes. Sambasivan et al (2009) have identified the top five supply chain performance criteria as inventory turnover, cycle time, fulfilment rates, supply chain service and perfect order. The indicators for the construct on operational benefits described here have been integrated from the prior research detailed in this literature.

Competitive Marketing Performance

Srivastava et al (1999) while developing a framework to understand the integration of marketing with business processes identify supply chain management as one of the three core business processes that generate value for customers. Svennson (2003) argues that there should be a holistic and cross-disciplinary focus in supply chain management that should include marketing theory and the ultimate consumer perspective. In recent times a number of researchers, (Wisner, 2003: Byrd & Davidson, 2003; Wu et al, 2006;Li et al, 2006, Kim et al 2006 and Fawcett et al, 2008) have therefore, included measures of marketing performance benefits in assessing the impact of IT in the supply chain. The indicators for the construct of competitive marketing performance have been drawn from their prior research.

From the above discussion, the study tries to answer the following research questions:

1. What are the likely dimensions in operational benefits from the usage of Information technology in the downstream supply chain?
2. Is there any dominant variable that influences competitive marketing performance?
3. Is there any relationship between operational benefits from IT usage and competitive marketing performance of organizations?

METHODOLOGY

In keeping with the scope of the research framework, a comprehensive survey questionnaire was designed to capture the responses of respondents on the perceived operational benefits from the usage of IT in the downstream supply chain and the competitive marketing performance of their organizations. The survey questionnaire was mailed to 975 manufacturing organizations across various industry segments in India having an asset base of Rs.500 crores and above (Information obtained from CMIE Prowess Data Base) which is used as the sampling frame for this study. A total of 307 responses were obtained from the downstream supply chain managers. These 307 respondent managers belong to 58 different industry segments. The respondents were asked to fill out the questionnaire where quantitative responses were measured using a five-point scale. Twelve operational benefits were measured on a Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. The data have been analyzed with the help of SPSS 16.0 package.

ANALYSIS AND RESULTS

The analysis section deals with three parts. The first part deals with identifying the underlying dimensions of operational benefits (factors emerged) through factor analysis. The second part deals with the identification of significant variables that contribute to Competitive Marketing Performance through regression analysis. The last part deals with discovering if there is a relationship between competitive marketing performance and operational benefit dimensions by using bivariate correlation analysis.

Identification of Dimensions in Operational Benefits

An exploratory level factor analysis (Principal Component Analysis) with Varimax rotation was applied for identifying the underlying dimensions. The 12 individual statements of operation benefits in manufacturing industry were examined and the reliability of the subsequent factor structures was then tested for internal consistency of the grouping of the items. The KMO measure of sampling adequacy (0.839) provided in the following table suggested that there is sufficient amount of significant correlation between the variables existed in the correlation matrix of the variables to proceed with factor analysis. The Bartlett's Test of Sphericity was used to examine the hypothesis that the variables are uncorrelated. The Bartlett's test of Sphericity Chi-square statistic of 1850.558, would mean the 12 statements are uncorrelated and hence as concluded in KMO, factor analysis is appropriate for the given data set. The results are presented in Table-I.

Table I – Results of KMO and Bartlett's Tests.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.839
Bartlett's Test of Sphericity	Approx. Chi-Square	1850.558
	df	66
	Sig.	.000

Table II - Result of Factor analysis - Principal Component Analysis.
Total Variance Explained

Component		Initial Eigenvalues			Extraction Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Dimensions	1	5.231	43.595	43.595	5.231	43.595	43.595
	2	1.880	15.665	59.260	1.880	15.665	59.260
	3	1.010	8.418	67.678	1.010	8.418	67.678
	4	.811	6.760	74.438			
	5	.610	5.083	79.521			
	6	.505	4.212	83.734			
	7	.470	3.917	87.650			
	8	.405	3.375	91.025			
	9	.383	3.190	94.215			
	10	.276	2.300	96.515			
	11	.237	1.977	98.492			
	12	.181	1.508	100.000			

Eigen Value represents the total variance explained by each factor. In Principal Component Analysis, the total variance in the data is considered to determine the minimum number of factors that will account for maximum variance of data. Table II presents the results from exploratory principal components factor analysis with Varimax rotation on the 12 individual operation benefits items categorized into three groups.

Table III - Rotation Sums of Squared Loadings

Total	% of Variance	Cumulative %
3.693	30.776	30.776
2.481	20.673	51.449
1.947	16.229	67.678

In rotation of factors, factors are transferred through rotation into a simpler one that is easier to interpret. It does not affect the percentage of total variance explained. However, the variance explained by the individual factors is redistributed by rotation. The most commonly used method is Varimax rotation procedure. This procedure maximizes the variance of the loadings on each factor, thus minimizing the complexity of the factors.

It is evident from the above table that 67% of the variance is caused by three dimensions which have been identified in Table III. Factor loading for each item has exceeded the minimum threshold level of 0.40 (Kim and Mueller, 1978; Noursis 1985). As a result, three factors were extracted with Eigen values greater than 1.

The individual statements in the first factor comprise: Reduction in order fulfilment cycle time, increase in delivery performance to committed date, and increase in perfect order fulfilment. These are measures that indicate superior order processing and delivery performance which will lead to customer satisfaction. Accuracy of forecasting procedures based on orders received leads to reduction in stock-outs at the company end, and to a reduction

in excess stock maintenance at company end. We have therefore labelled the first factor as Order and delivery processing benefits, which explains 30.77 percent of variance in original variance.

The individual statements in the second factor comprise (1) Reduction in Primary Loss of Sales (2) Reduction in Distributor Stock Out, (3) Reduction in Secondary loss of Sale .The second factor, we label as Opportunity cost reduction benefits, which explains 20.67 percent of variance in original variance.

The individual statements in the third factor comprise (1) Increased Finished goods turns (2) Reduction in supply chain management costs and (3) Reduction in Back Order execution, which measure the efficiency of the supply chain. The third factor has been labeled as supply chain cost reduction benefits, which explains 16.22 percent of variance in original variance.

Table – IV - Rotated Component Matrix

	Component		
	Order/ Delivery processing benefits	Reduction in Opportunity costs benefits	Reduction in supply chain costs benefits
Increased Forecast Accuracy	.826		
Increased Delivery Performance to committed date	.785		
Reduction in company Stock out	.780		
Reduction in excess Stock	.748		
Reduction in order processing cycle Time	.723		
Increase in Perfect Order fulfillment	.709		
Reduction in Secondary Loss of sale		.872	
Reduction in Distributor Stock Out		.848	
Reduction in Primary loss of sale		.638	
Increased Finished goods turns			.860
Reduction in SCM Cost			.649
Reduction in Back Orders			.609

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations

Identification of significant variables in Competitive Marketing Performance

Multiple Regression analysis has been carried out on the five items in the Competitive Marketing Performance construct where respondents were asked to rate their company's performance as compared to their competitors on a five-point scale with regard to the variables of Sales growth, Market share, Entry into new markets, New Product introductions and Customer satisfaction. The results of the regression model summary are presented in Table V.

Table V - Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Dimension	.938	.879	.877	.294

Predictors: (Constant), Customer Satisfaction, New Product Introduction, Market share, Entry in new Markets, Sales growth.

The model summary table shows R-Square for this model is .879. This means that 87.9 percent of the variation in Competitive Marketing Performance (dependent variable) can be explained from the 5 independent variables.

Table VI - Results of ANOVA from Regression Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	188.876	5	37.775	437.257	.000
	Residual	26.004	301	.086		
	Total	214.879	306			

Predictors: (Constant), Customer Satisfaction, New Product Introduction, Market share, Entry in new Markets, Sales growth

Dependent Variable: Competitive Marketing Performance

The ANOVA Table VI shows that the chosen five variables significantly contribute to the dependant variable Competitive Marketing Performance.

Table VII -Significant variables in Competitive Marketing Performance

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.002	.094		.025	.980
	Sales growth	.171	.026	.194	6.669	.000
	Market share	.247	.024	.303	10.400	.000
	Entry in new markets	.180	.023	.222	7.785	.000
	New Product Introduction	.213	.019	.294	11.242	.000
	Customer satisfaction	.190	.025	.184	7.472	.000

Dependent Variable: Competitive Marketing Performance

To determine if one or more of the independent variables are significant predictors of competitive marketing performance, the information provided in the coefficient table was examined. All the five independent variables were found to be statistically significant. It was found that Market share and New Product introductions contribute more to Competitive Marketing Performance than the other three variables.

Predicted Competitive
Marketing performance =.002 + (.171) Sales Growth + (.247) Market Share
+ (.180) Entry in new markets + (.213) New Product Introduction
+ (.190) Customer satisfaction + (.294) Ave. Error

Correlations between dimensions of Operational Benefits and Competitive Marketing Performance

The emerged three operational benefit dimensions from factor analysis were then tested for correlation with the competitive marketing performance construct by using bivariate correlation analysis and all the relationships are significant. Order/delivery processing benefits and supply chain cost reduction benefits are found to be highly correlated.

		Order/ & delivery processing benefits	Opportunity cost reduction benefits	Supply chain cost reduction benefits	Competitive Marketing Performance
Order & delivery processing benefits	Pearson Correlation	1	.509**	.522**	.528**
	Sig. (2-tailed)		.000	.000	.000
	N	307	307	307	307
Opportunity cost reduction benefits	Pearson Correlation	.509**	1	.609**	.359**
	Sig. (2-tailed)	.000		.000	.000
	N	307	307	307	307
Supply chain cost reduction benefits	Pearson Correlation	.522**	.609**	1	.413**
	Sig. (2-tailed)	.000	.000		.000
	N	307	307	307	307
Competitive Marketing Performance	Pearson Correlation	.528**	.359**	.413**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	307	307	307	307

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

DISCUSSIONS AND CONCLUSION

The study has identified three underlying dimensions of operational benefits from IT usage in the downstream supply chain – order and delivery processing benefits, opportunity cost reduction benefits and supply chain management cost reduction benefits. The correlations between all three operational benefit dimensions and competitive marketing performance have been found to be significant. This indicates the existence of a relationship between order and delivery processing benefits, opportunity cost reduction benefits and supply chain cost reduction benefits and competitive marketing performance. Market share and new product introduction have been identified as dominant variables contributing to Competitive Marketing Performance. Based on the above analysis and findings it is suggested that supply chain managers may concentrate their efforts on increasing the operational benefits through the usage of Information technology, increase market share and constantly introduce new products in the market to increase the competitive marketing performance of their organizations. Efforts in this direction would thus enhance the impact of usage of IT in the downstream supply chain and further lead to an overall superior firm performance.

REFERENCES

Beamon, B.M. (1999). Measuring supply chain performance. *International Journal of Operations & Production Management,* 19 (3), 275-292.

Bhagwat, R., & Sharma, M.K. (2007). Performance measurement of supply chain management: a balanced scorecard approach. *Computers & Industrial Engineering,* 53(1), 43-62.

Bharadwaj, A.S., Bharadwaj, S.G., & Konsynski B.R. (1999). Information technology effects on firm performance as measured by Tobin's q. *Management Science,* 45 (7), 1008-1024.

Blankley A. (2008). A conceptual model for evaluating the financial impact of supply chain management technology investments. *The International Journal of Logistics Management,* 19(2), 155-182.

Byrd, T.A. & Davidson, N.W. (2003). Examining possible antecedents of IT impact on the supply chain and its effect on firm performance. *Information & Management,* 41 (2) 243–255.

Camerinelli, E., & Cantu, A. (2006). Measuring the Value of the Supply Chain: A Framework. *Supply Chain Practice,* 8(2), 40-59.

Chae, B. (2009). Developing key performance indicators for supply chain: an industry perspective. *Supply Chain Management: An International Journal,* 14(6), 422–428.

Chen, I.J., Paulraj, A., & Lado, A.A. (2004). Strategic purchasing, supply management and firm performance. *Journal of Operations Management,* 22(5), 505–523.

D'Avanzo, R., von Lewinski, H., & Wassenhove, L.N.V. (2003). The link between supply chain and financial performance. *Supply Chain Management Review,* 7(6), 40-47.

Dehning, B., Richardson, V.J., & Zmud, R.W. (2007). The financial performance effects of IT-based supply chain management systems in manufacturing firms. *Journal of Operations Management,* 25 (25), 806–824.

Fawcett, S.E., Magnan, G.M., & Mc.Carter, M.W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal,* 13(1), 35–48.

Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management*, 21(½), 71-87.

Jin, B. (2006). Performance implications of information technology implementation in an apparel supply chain. *Supply Chain Management: An International Journal*, 11(4), 309-316.

Kaplan, R.S., & Norton, D.P. (1992). The Balanced Scorecard - Measures That Drive Performance. *Harvard Business Review*, 70(1), 71-79.

Ketchen, D.J, Jr., Rebarick, W., Hult, G.T.M., & Meyer, D. (2008). Best value supply chains: A key competitive weapon for the 21st century. *Business Horizons*, 51(3), 235–243.

Kim, D., Cavusgil, S.T., & Calantone, R.J. (2006). Information System Innovations and Supply Chain Management: Channel Relationships and Firm Performance. *Journal of the Academy of Marketing Science*, 34(1), 40-54.

Kim, J.W., & Kim, E.J. (2009). The impacts of IT investment directions and strategies of supply chain management (SCM) implementing enterprises on business performance. *International Journal of Business Research*, 9(4), 126-137.

Kwon, D.W. (2003). *The Effect of Valuation Logics of Information Technology on the Company Performance: Pluralistic Assessment of Paradox*. Ph. D., Dissertation, Case Western Reserve University.

Lambert, D.M., & Pohlen, T.L. (2001). Supply chain metrics. *The International Journal of Logistics Management*, 12(1), 1-19.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. & Rao, S.S. (2006). The impact of supply chain management practices on competitive advantage and organizational performance. *Omega*, 34(2), 107-124.

Melnyk, S.A., Stewart, D.M. & Swink, M. (2004). Metrics and performance measurement in operations management: dealing with the metrics maze. *Journal of Operations Management*, 22(3), 209–217.

Neely, A. (2005). The evolution of performance management research – development in the last decade and a research agenda for the next. *International Journal of Operations & Production Management*, 25(12), 1264-1277.

Rajdou, N. (2003). U.S. manufacturers' supply chain mandate: increase IT funding and unleash innovation (Technology). *World Trade*, December.

Sambasivan, M., Nandan, T., & Mohamed, Z.A. (2009). Consolidation of performance measures in a supply chain environment. *Journal of Enterprise Information Management*, 22(6), 660-689.

Srivastava, K.R., Shervani, T.A. & Fahey, L. (1999). Marketing, Business Processes, and Shareholder Value: An Organizationally Embedded View of Marketing Activities and the Discipline of Marketing. *Journal of Marketing*, 63, 168-179.

Stewart, G. (1995). Supply chain performance benchmarking study reveals keys to supply chain excellence. *Logistics Information Management*, 8(2), 38-44.

Svennson G. (2003). Holistic and cross-disciplinary deficiencies in the theory generation of supply chain management. *Supply Chain Management: An International Journal*, 8(4), 303-316.

Wisner, J.D. (2003). A Structural Equation Model of supply chain management strategies and firm performance. *Journal of Business Logistics*, 24(1), 1-26.

Wu, F., Yeniyurt, S., Kim, D., & Cavusgil, S.T. (2006). The impact of information technology on supply chain capabilities and firm performance: A resource-based view. *Industrial Marketing Management*, 35(4), 493 – 504.