

Influential Contextual Factors on Information Sharing through Supply Chain: A Case of Apparel, Food and Printing Industries in Sri Lanka

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Abstract

Information Sharing (IS) refers to the extent to which critical and proprietary information is communicated to one's supply chain partner. It is one of the most important Supply Chain Management (SCM) practices for achieving excellence in organizational management. For evaluating IS, the measurement instrument developed by Li et al., (2005) was used. This model defines seven dimensions of IS which covers information flow in both directions: from inside and to outside of the organization. The level of IS of each dimension was measured by five point Likert Scale. The main objectives of the study were to analyze the impact of important contextual factors on Supply Chain Management practices of manufacturing firms and to find out the areas to be improved for better levels of SCM practices. The data were collected from a random sample of 86 firms in three industries: Apparel, Food and Printing. The contextual factors considered were: Industry, Size of the Firm, Length of the SC, Channel Structure and the Level of Uncertainty in the Demand. Analysis of Variance (ANOVA), Pairwise Mean Comparison and Rank Correlation Analysis were the major tools used in the analysis. The study discovered that the Industry, Size of the firm and SC structure affect significantly on information sharing practice of manufacturing firms in Sri Lanka. The attributes of IS to be improved in the firms of different industries and sizes were also identified by the study.

Key Words: Supply Chain Management Practices, Information Sharing, Contextual Factors, Manufacturing Firms

Introduction

As identified by the most of research in the area of Supply Chain Management (SCM), there are a number of barriers disturbing effective

implementation of SCM. Poor managerial and employee support, unclear objectives, lack of strategy and corporate culture are the major ones (Charles et al., 2003) among these barriers. Therefore, understanding the impact of the factors affecting SCM practices would support to overcome the barriers and facilitates effective SCM implementation. Identifying the impact of a firm's main contextual factors on SCM practices will provide a start to comprehensive SCM feasibility assessment. This study focused on Information Sharing practice, which enables partners aware of changes among them and empowers them to face various business challenges.

Management of supply chain would not be a success without right sharing of information with trading partners throughout the supply chain. According to Li et al., (2005) 'Information Sharing (IS)' refers to the extent to which critical and proprietary information is communicated to one's supply chain partner. For evaluating IS the measurement instrument developed by Li et al., (2005) was used. This model consists of six SCM practices: strategic supplier partnership, postponement, information sharing, information quality, internal lean practices, and customer relationship. The data were collected through a questionnaire from 86 randomly selected manufacturing firms of three industries: Apparel, Food and Printing. These industries were selected because a lot of Sri Lankan firms are engaged in these. Findings of this study will offer initiatives to practice SCM in Sri Lankan manufacturing companies, which are far behind in the global competition. A few firms in Sri Lanka have formally implemented SCM and even they are not based on properly studied compatibility of the practices to the firm's context.

Organizations share various types of information with their trading partners in the supply chain. The levels of Information Sharing (IS) of different types of firms are neither equal nor sufficient. The firms that share information in right way obviously achieve excellence in their business. Lack of understanding about the impact of firm's contextual factors on the SCM practices and the difficulty to recognize the specific areas to be developed for improving these practices disturb the effective implementation of SCM. This study aimed to identify influential contextual factors on Information Sharing practice in the organizations of Apparel, Food and Printing industries. The contextual factors selected were: Industry, Size of the Firm, Length of the SC, Channel Structure and the Level of Uncertainty in the Demand.

Literature Review

Supply Chain Management (SCM) practices have been defined as a set of activities undertaken in an organization to promote effective management of its supply chain (Li et al., 2005; Li et al., 2006). This research found six constructs for SCM practices, defining a number of dimensions (attributes)

for each construct. Information Sharing was one of these practices and according to the model it has seven dimensions. These dimensions are described under the Methodology section. Lockamy and McCormack (2004) and McCormack and Kasper (2002) provide research evidence to prove the positive relationship between SCM practices and different aspects of organizational performance. Studying the impact of the factors affecting SCM practices would support to overcome the barriers against effective implementation SCM. Berman and Sami (2005) analyzed the effect of supplier and customer contribution on manufacturing problems and developed a flexibility assessment framework to discuss its impact on the total chain of manufacturing. Ho et al., (2002) highlighted some major weaknesses of the extant literature with respect to the conceptualization, operationalization, and modelling of SCM, identified potential causes underlying these shortcomings. The research found that a greater advance in theory development is possible if researchers adopt a process-based view of SCM, develop conceptual SCM models based on a context-practices-performance framework, and synthesize theories and research of SCM and those of related fields such as organization studies.

The realities of today's digital economy are requiring and enabling dramatically improved levels of SC efficiency and effectiveness. The business-to-business (B2B) or extended digital SC, enabled by Internet technologies, is specifically being offered as the next competitive weapon. McCormack and Kasper, (2002) provided definitions and measures of the extended SC construct and reviewed the results of an ongoing benchmarking research project completed in cooperation with the US and European Supply Chain Councils. This study found that internet usage is just beginning in both the USA and Europe but has significant relationships to cross-company (B2B) integrating practices that are key components of the extended SC and SCM performance.

MIT Center for Transportation and Logistics classifies Supply Chain practices into five broad types:

1. *Supply Chain Integration (SCI)* includes integration with customers, with suppliers, and across the internal organization. From the functional perspective, integrated collaborative product development is also included.
2. *Complexity Management* refers to coping with supply chain complexity in a cost-effective way.
3. *Aligning Strategy and Supply Chain* implies that SCM is well integrated into the strategic planning of a company and its CEO-level agenda.

4. *Information Technology (IT) with Process Improvement* means adoption of advanced SCM software combined with process improvement.
5. *Operational Innovation* means creating and implementing leading-edge practices and technologies in SCM.

The purpose of the research done by Damien (2005) is to review a sample of the literature relating to the integration and implementation of SCM practices from a strategic viewpoint. The literature were examined from three perspectives. First, SC integration covers issues relating to integration of core processes across organizational boundaries through improved communication, partnerships, alliances and cooperation. Second, strategy and planning examines SCM as a strategic matter for trading partners, along with factors relating to the amount of planning required. Third, implementation issues concern factors critical for successful implementation, as well as issues specific to inter and intra-organizational aspects of supply chain initiatives are contained in this sub-group. An important emergent theme from the literature is the importance of taking a holistic view, and the systemic nature of interactions between the participants. At the same time, it is also apparent that this requirement to take such a holistic and systemic view of the SC acts as an impediment to more extensive implementation. The strategic nature of adopting a SC-wide perspective, on the one hand provides significant potential benefit, and on the other requires trading partners to think and act strategically. This review of the literature serves to highlight the inter-dependence between integration (technologies, logistics, and partnerships), a strategic view of SC systems, and implementation approach. All three need to inform and underpin each other in order for management of supply chains to be able to deliver on the promise of benefits for all trading partners. Simatupang and Sridharan (2005) proposed an instrument to measure the extent of collaboration in a SC consisting of two members, suppliers and retailers. The proposed model for collaboration incorporates collaborative practices in information sharing, decision synchronization and incentive alignment. The findings showed that the collaboration index positively associates with operational performance.

Methodology

The data were collected from a randomly selected sample of manufacturing firms from apparel, food and printing industries. Computer generated random numbers were used to select firms from the sampling frame srilankabusiness portal. The above three industries were selected because they represent a larger proportion of Sri Lankan Manufacturing companies and they are different in perceived SC characteristics. The Industry, Size of the Firm,

Length of the SC, Channel Structure and Level of Uncertainty in the Demand were assumed to be most important contextual factors when it is prepared to implement SCM at a firm. Annual turnover of the company was used as the basis for classifying the companies into Small, Medium and Large (Table 1). The answers provided by the responding companies for the question, 'Size of the Company' were also used as the prior data (Small/Medium/Large). The Dot-Plots of annual turnover were obtained to see the clustering of companies according to the Size of the Company as mentioned.

Table 1: Classification of the Firm Size

Industry	Turnover Range (in Rs. Millions)	Size
Printing	Not more than 10	Small
	10-100	Medium
	Over 100	Large
Food	Not more than 100	Small
	100-750	Medium
	Over 750	Large
Apparel	Not more than 50	Small
	50-500	Medium
	Over 500	Large

Length of the SC was approximated by classifying the number of upstream and downstream entities as Small, Medium and large according to the manufacturer's awareness. The level of uncertainty in the demand for the manufacturer's main product was classified into two: Low and High. The structure of the intermediaries was identified as the channel structure the upstream and downstream structures were considered as given in Table 2.

Table 2: Coding for Upstream & Downstream Supply Chain Structures

Raw Material Flow (Upstream)	Upstream Structure
Raw material manufacturer ? Manufacturing company	Up-Str1
... ? Retailer ? Manufacturing company	Up-Str2
... ? Distributor/Wholesaler ? Manufacturing company	Up-Str3
Finished Product Flow (Downstream)	Downstream Structure
Manufacturing company ? End customer	Down-Str1
Manufacturing company ? Retailer ? End customer	Down-Str2
Manufacturing company ? Distributor/Wholesaler ? Retailer ? End customer	Down-Str3

The supply chain evaluation model of Li et al., (2005) used to collect data and it contained six constructs as mentioned above, including information sharing. The Information Sharing (IS) construct consists of seven dimensions mentioned below.

1. Sharing the business unit proprietary information with trading partners (IS1)
2. Making informed trading partners in advance of changing needs (IS2)
3. Trading partners share proprietary information with the company (IS3)
4. Trading partners keeping the company fully informed about issues that affect the business (IS4)
5. Trading partners share business knowledge of core business process with the company (IS5)
6. The company and the trading partners exchange information that helps establishment of business planning (IS6)
7. The company and the trading partners keep each other informed about events or changes that may affect the other partners (IS7)

The level of IS of each dimension was measured using five point Likert Scale (5 = the dimension strongly exists and 1 = the dimension does not exist at all): The arithmetic mean was selected as the most appropriate measure of location (average) of IS construct according to the descriptive analysis results. The histogram of IS values indicated approximately symmetric pattern in the distribution. This analysis was basically three types. They are: General Linear Model (GLM), Pairwise Mean Comparison and Rank Correlation analysis. The dependencies of the SCM practices on contextual factors were tested using a specific Analysis of Variance called 'General Linear Model (GLM)'. GLM is used to perform univariate analysis of variance with balanced and unbalanced designs, analysis of covariance. In a hierarchical model specified for a GLM, if an interaction term is included, all lower order interactions and main effects that comprise the interaction term must appear in the model. After identifying significant factors, Tukey's Pairwise Comparison was performed to find out which levels of the factors are significantly different. In comparing larger numbers of means, there is no proof that the Tukey method is conservative for the general linear model. The results of the GLM analysis were validated by a residual analysis: Spearman's Rank Correlation analysis was carried out in order to find out the areas to be improved, for achieving better levels of IS. The rank correlation was used because the Pearson's coefficient of correlation has no possibility to apply because it measures only the degree of linear relationship between two continuous variables. The following were the

alternative hypothesis formulated for testing the effect of the contextual factors on information sharing.

- H_{IA}: The industry influences on information sharing
- H_{IB}: Size of the firm influences on information sharing
- H_{IC}: Length of the firm's SC influences on information sharing
- H_{ID}: Level of uncertainty in the demand influences on information sharing
- H_{IE}: Upstream SC structure influences on information sharing
- H_{IF}: Downstream SC structure influences on information sharing
- H_{IG}: Industry and size of the firm have a combined effect on information sharing
- H_{IH}: Industry and length of the firm's SC have a combined effect on information sharing
- H_{II}: Industry and level of uncertainty in the demand have a combined effect on information sharing
- H_{IJ}: Upstream and downstream SC structure has a combined effect on information sharing

Results and Discussion

The composition of the sample, according to the industry and the size of the firm is given in Table 3.

Table 3: Composition of the Sample

		Size of the Firm			
		Large	Medium	Small	Total
Industry	Apparel	14 (16.3%)	10 (11.6%)	04 (4.7%)	28 (32.6%)
	Food	13 (15.1%)	09 (10.5%)	11 (12.8%)	33 (38.4%)
	Printing	07 (8.1%)	12 (14%)	06 (6.9%)	25 (29%)
	Total	34 (39.5%)	31 (36.1%)	21 (24.4%)	86 (100%)

Table 4 gives the p-values correspond to the GLM analysis performed to identify contextual factors which have significant influence on Information Sharing practice of firms. These results were validated by a residual analysis and its results are given in the Appendix.

Table 4: P-Values of the General Linear Models ($\alpha = 0.05$)

Model	Factor	p-Value
<i>GLM 1:</i> Industry + Size + Industry * Size	Industry	0.006
	Size	0.022
	Industry*Size	0.526
<i>GLM 2:</i> Industry + SC Length + Industry * SC Length	Industry	0.007
	SC Length	0.361
	Industry*SC Length	0.892
<i>GLM 3:</i> Industry + Demand Uncertainty + Industry * Demand Uncertainty	Industry	0.004
	Demand Uncertainty	0.287
	Industry*Demand Uncertainty	0.575
<i>GLM 4:</i> Upstream SC Structure + Downstream SC Structure + Upstream * Downstream SC Structure	Upstream SC Structure	0.000
	Downstream SC Structure	0.251
	Upstream SC Structure* Downstream SC Structure	0.018
<i>One-Way ANOVA</i> SC Structure	All combinations of Upstream and Downstream structures	0.000

As the p-values indicate, Industry and Size of the Firm have individual effects on IS and do not have an interaction effect. The combined factor of Upstream and Downstream structure is also significant and it implies that SC structure is also one of the influential contextual factors on level of IS. The one-way ANOVA also implies that the SC structures have significant impact.

The mean profiles and Tukey's Pair-wise mean comparison (Table 5) was applied to industry and the results revealed following: Apparel manufacturers have relatively higher level of Information Sharing practice than printers and food manufacturers. The level of IS of Apparel manufacturers is higher than the overall average IS while for the other two industries it is lower than the average. Small-scale firms practice lesser IS relative to large-scale firms. Organizations who buy their main raw material directly from its manufacturer and sell their main product directly to the end customer have relatively high IS practice.

According to the GLM 2 and GLM 3 SC Length and Uncertainty of demand do not have any significant effect. Upstream and downstream SC structures have a significant combined effect on IS. The one-way ANOVA performed using all combinations of SC structures, indicates that SC structure as a whole significantly influences IS of manufacturing organizations. Figure 1 gives the mean profile of IS for all SC structures.

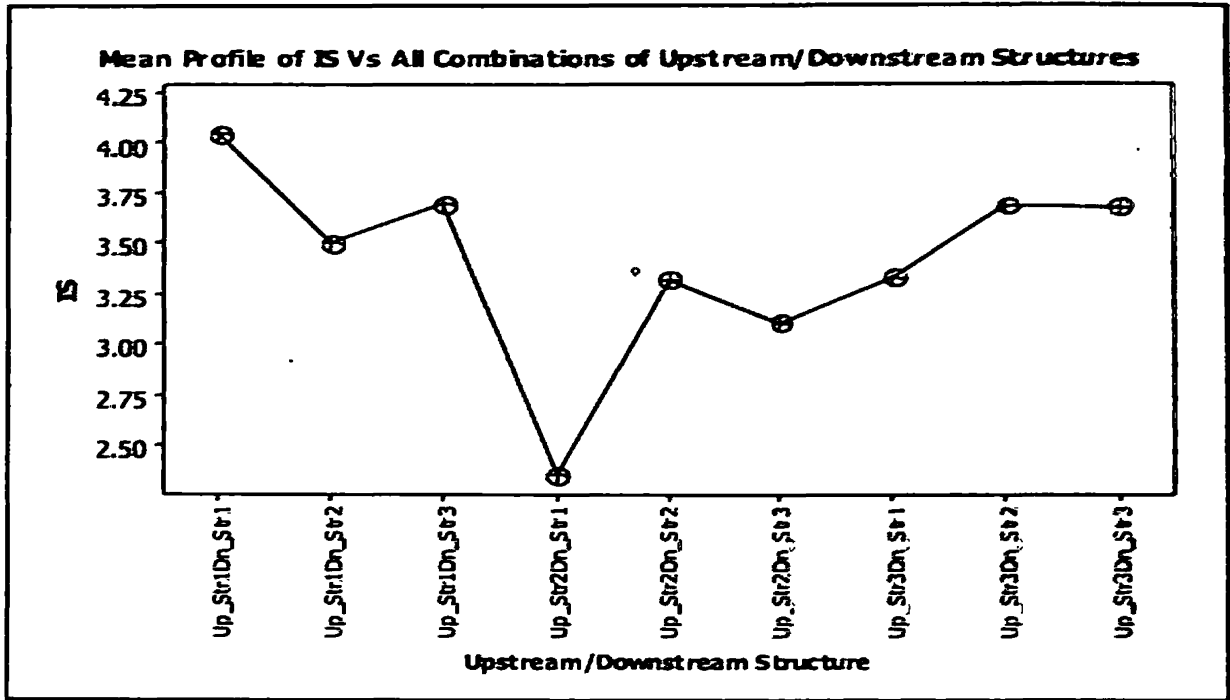


Figure 1: Mean Profile of IS for SC Structures

Tukey’s pairwise comparison provided that SC structures given in Table 5 have significant influence on firm’s IS practice.

Table 5: Significant Combinations of SC Structures on IS (Tukey’s Pairwise Comparison)

- i. Up-Str1/Down-Str1 & Up-Str2/Down-Str1
- ii. Up-Str1/Down-Str1 & Up-Str2/Down-Str2
- iii. Up-Str1/Down-Str1 & Up-Str2/Down-Str3
- iv. Up-Str1/Down-Str2 & Up-Str2/Down-Str1
- v. Up-Str1/Down-Str3 & Up-Str2/Down-Str1
- vi. Up-Str2/Down-Str1 & Up-Str3/Down-Str2
- vii. Up-Str2/Down-Str1 & Up-Str3/Down-Str3

Spearman’s Rank Correlation Analysis was used to identify the attributes of IS to be improved. The recommendations were expected to make according to the Industry and Size of the firm. This is only to identify areas of the IS practice to be improved. in the companies which are lagging behind the others. The Rank Correlation Coefficients were calculated between score of a particular SCM construct and all of its attributes. Then required attributes were selected by carefully analyzing the correlation values.

Tukey's Pairwise Comparison results say that this difference mainly exists between Apparel and the other two industries. Table 6 and 7 provide the obtained rank correlation values with industry and size of the firm respectively.

Table 6: Rank Correlation Coefficients with IS for Industry

Attribute of IS ¹	Apparel	Food	Printing
IS1	0.58634	0.48070	0.40627
IS2	0.35327	0.63248	0.37795
IS3	0.51692	0.58966	0.58423
IS4	0.70808	0.76103	0.81138
IS5	0.54697	0.67912	0.61831
IS6	0.37562	0.60482	0.78140
IS7	0.40003	0.66309	0.56544

For attribute IS1, correlation coefficients of Food and Printing industries are less than that of Apparel industry. Therefore, IS1 (Sharing business unit proprietary information with trading partners) has been identified as the main attribute which caused for relatively less IS level in these two industries.

According to the GLM analysis, the level of IS in three scales of manufacturing firms, are significantly different regardless of the industry. Tukey's Pairwise Comparison indicates that this difference mainly exists between Large and Small scale manufacturers. Therefore, Medium scale was not included in the correlation analysis

Table 7: Rank Correlation Coefficients with IS for Size of the Firm

Attribute of IS ¹	Large	Small
IS1	0.53448	0.53604
IS2	0.45543	0.39887
IS3	0.54070	0.58868
IS4	0.48759	0.88487
IS5	0.63912	0.79022
IS6	0.48759	0.70019
IS7	0.61791	0.73556

According to the values in Table 7, IS2 (Making informed trading partners in advance of changing needs) is the attribute which has caused lesser level of IS practice in Small firms compared to Large firms.

Conclusions and Discussion

The Industry has a significant impact on Information Sharing practice of manufacturers. Apparel manufacturers have relatively higher level of Information Sharing practice than printers and food manufacturers. Printers have the lowest level of IS while food industry is in between apparel and food. The level of IS of Apparel manufacturers is higher than the overall average IS while for the other two industries it is lower than the average. In Sri Lanka, apparel manufacturers are far ahead the other types of manufacturers, especially in global business. Since SCM is a gateway to the success in international business and sharing of information with trading partners is vital for good SCM, higher IS might be the dominating factor behind apparel manufacturers' business success. In the interviews with respondents while collecting data, it was found that printing companies pay the least attention on collaborative business success which could be achieved through SCM practices.

Size of the manufacturing firm has a significant impact on level of Information Sharing. Small scale firms practice lesser IS relative to large firms. The reason might be the relatively little use of information technology in small scale firms. The supply chain structure of manufacturers has an impact on their IS practice. In fact, this effect is the combined effect of upstream and downstream structures of the SC. Organizations who buy their main raw material directly from its manufacturer and sell their main product directly to the end customer have relatively high IS practice. The companies who buy their main raw material from retailers and sell to the end customer have lesser IS practice. According to these results, getting close to the suppliers has affected firms' IS than the closeness to the downstream SC partners. Therefore, it is more important for manufacturing companies to improve the knowledge on their supplier base and to minimize the number of intermediaries in between and raw material suppliers. However, since the effect of SC structure is a combined effect of upstream and downstream structures rather than upstream structure only, reducing the number of intermediaries to the end customers is also important.

Implications to the Practitioners

As implied by the results of the rank correlation analysis, the key area of IS that the manufacturers in food and printing industries should focus is 'Sharing business unit proprietary information with trading partners'. This does not imply that apparel firms are perfect in this type of information sharing but simply means that this is the key IS dimension which has caused to keep these two industries behind the apparel industry. According to the correlation analysis, all three industries should improve this attribute of IS in order to improve their overall IS practice.

Making informed trading partners in advance of changing needs' is the key IS attribute which small scale firms should improve in their IS. Small scale firms might not have much influential power on their trading partner and they should change this attitude and try to improve two-way communication emphasizing their importance to the trading partners. As the rank correlation analysis reveals, this attribute of IS is not good in any scale of manufacturing firms of three industries. Many of large Sri Lankan firms might have their trading partners overseas and might not have larger influential power. Therefore, they also should improve the means of communicating required changes in advance, which will cause to improve their sales performance.

Appendix: Results of Normality Test for Residuals

ANOVA Model	P-Value (Anderson Darling Normality Test)
GLM (IS Vs Industry, Size)	0.111
GLM (IS Vs Industry, SC Length)	0.075
GLM (IS Vs Industry, Uncertainty in the Demand)	0.139
GLM (IS Vs Upstream & Downstream SC Structure)	0.368
One-Way ANOVA (All combinations of Upstream & Downstream SC Structures)	0.368

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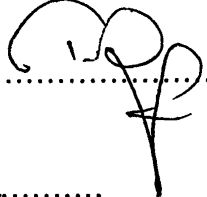
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