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A taxonomy of supply chain innovations

Ayfer Başar, Nihan Özşamlı, Alp Eren Akçay, Gökçe Kahvecioğlu, Gürdal Ertek

Faculty of Engineering and Natural Sciences, Sabanci University,

Orhanli, Tuzla, 34956, Istanbul, Turkey

ABSTRACT

In this paper, a taxonomy of supply chain and logistics innovations was developed and presented. The taxonomy was based on an extensive literature survey of both theoretical research and case studies. The primary goals are to provide guidelines for choosing the most appropriate innovations for a company and helping companies in positioning themselves in the supply chain innovations landscape. To this end, the three dimensions of supply chain innovations, namely the goals, supply chain attributes, and innovation attributes were identified and classified. The taxonomy allows for the efficient representation of critical supply chain innovations information, and serves the mentioned goals, which are fundamental to companies in a multitude of industries.

Keywords: **Supply chain innovations, logistics innovations, supply chain technology, service innovations, supply chain taxonomy, innovation taxonomy.**

INTRODUCTION

As global competition comes into prominence, companies have to find new and innovative ways to survive in the harsh conditions of the global market (Cefis and Marsili, 2005). Companies must adapt to the limitless changes in their local environments, as well as the global economy. Survival depends the robustness of the companies against the changes, the trends and diverse unpredictable situations, which requires flexible adoptaion through novel approaches.

A supply chain is the set of entities and processes involved in connecting the firm to its customers (Harrison, 2005). A well-designed and operated supply chain is one of the significant

determinants of survival among competition, if not the distinguishing factor (Chopra and Meindl, 2007). Increasing the supply chain performance is possible by means of adapting the supply chain organization to the changes of the market, through novel strategies and practices, namely through innovations. Innovation can be defined as the "generation of a new idea and its implementation into a new product, process, service" or organizational structure (Urabe, 1998). Schumpeter, referred to as the "father of innovation", identifies innovation as the critical dimension of economic change throughout history (Schumpeter, 1934). This brings about the concept of supply chain innovation, which covers all the innovative activities that increase the effectiveness of a company's supply chain and bring competitive advantage to the company (Chapman et al., 2003; Roy et al., 2004; Flint et al., 2005).

In this study, we concentrate on the supply chain and logistics innovations as a whole and construct a three-dimensional taxonomy of supply chain innovations. Taxonomies essentially provide classifications of body of knowledge in a certain field, structuring the existing facts within a unified framework (McCarthy and Keith, 2000). Even though independent taxonomies of supply chains and innovations exist literature, to the best of our knowledge, a comprehensive taxonomy of supply chain innovations does not currently exist.

The goal is that the presented taxonomy framework brings fresh perspectives to this field, guiding both researchers and practitioners in understanding, adopting, and initiating supply chain innovations. The presented taxonomy has been constructed after a thorough investigation of both research papers in literature and highlighted case studies. The objective is to help and guide firms in positioning and planning their supply chain innovations in accordance with their desired goals (first dimension), the attributes of their supply chains (second dimension), and their innovative capabilities, priorities and proficiencies (third dimension). The study provides this guidance in the paper through two unique contributions: 1) As a methodological contribution, it introduces the three dimensions of supply chain innovations, 2) As a practical contribution, it maps best practices in the investigated case studies onto these three dimensions, demonstrating how the taxonomy can be used.

Supply Chain Innovation

Supply chain strategy is vital for the firms to gain competitive advantages. Within the supply chain activities, numerous different processes are included, such as products, information, and cash flows, which are required to work collaboratively and share among different entities of the supply chain (Chopra and Meindl, 2007). The main objective of a company is to make its products or services available to its customers with minimum cost and highest market value. The organization of its supply chain plays the leading role in achieving this goal, since it is directly related with the time, quantity, specification, and price at which the final customer reaches the product or service (Levi and Kaminsky, 2003). In case of a change in the market conditions, the appropriate innovations depending on the supply chain structure can be useful in order to readjust to these new conditions. Innovations are implemented in supply chain activities such as distribution, marketing, storage, manufacturing, and other areas included within the scope of the supply chain (Ohba et al., 2000; Shin, 2000; Harland et al., 2001; Naim and Barlow, 2002; Trinekens et al., 2003; Roy et al, 2004; Treville, 2004; Evans et al, 2006; Wiskerke and Roep, 2007). Since the supply chain consists of all steps until the product reaches the end-user, innovations within the supply chain have become especially vital in order to acquire a competitive advantage (Bhatnagar and Sohal, 2003; Chapman and Corso, 2005; Panayides, 2006; Flint, 2008; Skipper et al., 2009).

LITERATURE OVERVIEW

The study presents the literature related with supply chain innovations under three categories. First, it reviews the literature on innovation. Then we review the literature on supply chain

innovations, including the case studies. Finally, the study summarizes the literature on supply chain taxonomies and related taxonomies, relating these taxonomies to the study.

Innovation

Being a highly popular concept in today's business world, innovation is heavily investigated in terms of many aspects such as methods, reasons, and tools. In his classic *Mastering the Dynamics of Innovation* book, Utterback (1996) claims that adapting the initial product to demand deviations and market opportunities by a systematic methodology of innovation carries companies to the leadership position in being the most stable to changes. Utterback (1996) also emphasises the use of technology for competitive advantage and introduces the concept of *innovation management*. These claims, together with the reported successes of best practices, have greatly motivated our research, urging us to contribute to the innovation processes through a systematic understanding of the domain.

Feldman (2002) underlines the innovation's dependence on knowledge and claims that product innovations gather technologic and scientific knowledge in the process of gaining market knowledge. He also introduces the linear model of innovation in which scientific discovery, product development, and market introduction precede one another. Acs and Audretsch (1990) investigate innovation in the small firms versus the big firms: they compare the concentration of innovation with the characteristics of industries by the scale of the size of the firms. They analyze innovation output in both small and large firms operating within highly competitive industries, and they conclude that small and large scaled firms respond differently to the change of market conditions. There exists an extensive literature that investigates the various aspects of innovation and the management of innovation. The research papers can be found in journals such as Technovation, Research Policy, and Journal of Technology Management. In recent years

innovation has turned out to be the main focus of governments as well as firms. The classic reference in this subject is OECD's Oslo Manual (1995).

Supply Chain Innovations

In this study, we focus on new supply chain strategies and supply chains' relations with novel business models and innovations. Previously published papers about supply chains mainly focused on market orientation and customer focused structures. Harland et al. (2001) introduces a multitude of business situations and offered supply network structures that enable advantages to the firms. The paper presents several real world cases such as Benetton, Toyota, and Nissan and provides insight into their supply chain strategies. Trinekens et al. (2003) focus on two international food supply chains in Africa, investigating the spill-over effect for innovations in supply chains.

An industrial study by Ohba et al. (2000) focuses on logistics in the film manufacturing industry. This paper centers on the logistic operations in the manufacturing system and measures the performance of their newly constructed system. In a similar study of the supply chain in relation to the demand chain concept, Treville (2004) focuses on a Nordic pulp and paper manufacturer's supply chain management case. The aim is to provide lead-time reduction and sufficient information flow through the supply chain. The paper concludes with theoretical insights. Another view of the modelling of the supply chains came from Beamon (1998). The paper gives detailed information about the supply chain models in then exisiting literature and provided supply chain performance measures in different papers.

Richey (2005) focuses on the relationship between reverse logistics and innovation within the supply chain at the strategic and operational levels. Chapman and Soosay (2002) suggest and emphasize the construction of a supply chain model that continuously supports innovative operations. One other issue in Chapman and Soosay's paper concerns the use of technology. The

claim is that the implementation of new technologies brings not only efficiency and effectiveness, but also improvement in service quality. The paper presents data about the information flow in the supply chain and how suppliers learn from customers and customers from suppliers, claiming that every stage in the supply chain should have an innovative structure.

Taxonomies of Supply Chains and Innovations

A taxonomy has been offered for supply chains by Chandra and Tumanyan (2005), the generalization of planning problems in supply chain management. Capar et al. (2004) introduce a *supply chain management taxonomy* structure that includes definitions. We adopt and extend the structure in their taxonomy in our supply chain attributes dimension. Similar to this study, Hamber (2000) focuses on tactical distribution strategies in the combat area within military logistics. The paper presents a detailed analysis of the distribution operations and offers to a method of classification, which endeavores to predict the outcomes.

Clemons and Aron (2002) a study online distribution, constructing a taxonomy of channel structures and determining the attributes for ideal channel structure. A taxonomy of information technologies services is presented by Stern and Davis (2003). The paper views information technology models as service models and compared the features of these service models, in order to develop a taxonomy.

None of the aforementioned taxonomies encompass supply chain innovations. Our taxonomy combines the three important dimensions in supply chain innovations, namely goals, supply chain attributes, and innovation attributes.

Taxonomy for Supply Chain Innovations

The taxonomy of supply chain innovations consists of three dimensions. These dimensions help to determine the classification of supply chain innovations in relation to the supply chain characteristics and the goals of the companies. The fundamental goal is to answer the question *"What kind of supply chains can have what kind of innovations in order to accomplish what kind of goals?"* and the study needs the mentioned three dimensions in order to answer this three-dimensional problem. Firstly, it lists the goals the firms try to reach when they pursue supply chain innovations. Secondly, it creates a taxonomy of supply chain attributes that show how supply chains differ from each other. The study analyzes case studies reported in literature and in the Supply Chain Innovation Award (SCIA), and taxonomy papers (especially Capar et al., 2004) to construct an extensive classification of attributes of supply chains. Then, as the final dimension, the study classifies the innovations based on their attributes. These three dimensions in the taxonomy are shown in Tables 1, 2, and 3, together with data from case studies that report companies that were finalists for the Supply Chain Innovations Award (SCIA) by the Council of Supply Chain Management Professionals (CSCMP).
When the attributes take continous values, we discretize the value set into two or three possible values, labeled with fuzzy pronouns such as low and high. One reason for this discretization is to preserve compactness, wheras the other is to introduce the fuzzy terms that can be used to describe the values for these attributes. Still, the original continous values for the attributes, where available, should always be collected, stored, and presented, in addition to the fuzzy pronouns. In selecting the fuzzy values for the attributes, we introduced subjective boundaries based on the distribution of the attribute values in the complete set of case studies.

Dimension One: Supply Chain Innovation Goals

Companies implement supply chain innovations with varying goals and priorities in mind. These *innovation goals* can depend on the firm itself, but the supply chain and innovation

attributes being used can also have a significant impact. While a company may focus on service augmentation by the help of supply chain innovations, another company may emphasize the cost reduction (operational efficiency), standardization, better flexibility or adaptation to the market changes. Other goals can be listed as expanding revenue, improving customer satisfaction (service quality), increasing product quality, and achieving better strategic planning. Table 1 lists the supply chain innovation goals as proposed in the taxonomy.

<< TABLE 1 COMES ABOUT HERE>>

Dimension Two: Supply Chain Attributes

The study classifies the supply chain attributes into three main categories: Market attributes, supply chain attributes, and product attributes. The classification of supply chain attributes in our taxonomy is given in Table 2.

The first category, *market attributes*, includes the *competitive structure* which has three subcategories: the market structure of the supply chain can be monopolistic, including only one firm serving in the corresponding market; oligopolistic, which means that there are a few firms serving the majority of the customers; and highly competitive, meaning that many firms are serving many customers. The number of companies competing in the market and the share of these companies in the total market capitalization determines the competitiveness structure of the market. The second subcategory of the market attributes is the *size of the service market*. This can be measured through market capitalization and grouped as large markets (that is, total market capitalization is larger than $ 200 Billion), medium markets (that is, total market capitalization is larger than $ 20 B but less than $ 200 B) and small markets (that is, total market capitalization less than $20 B).

<< TABLE 2 COMES ABOUT HERE>>

The second category includes the *supply chain attributes* themselves. There are three subcategories under supply chain attributes. The first one is the *scale of the supply chain*, taking values of global or local. The second subcategory is the *inventory turnover*, which measures the speed at which inventory is converted to financial inflow. Inventory turnover is used very extensively in practice. Inventory turnover ratios of the companies are classified as high and low, representing the ratios with more than or equal to 7 and less than 7, respectively. The third subcategory is the *focus of the supply chain*, which can be either efficiency or agility. It is possible to claim that if a company manufactures products that are sold in high amounts to a large public, efficiency is the priority of the supply chain. On the other hand, if the price is not the primary concern for the consumers but swift delivery and availability are much more appreciated, supply chain planners focus on the agility. *Number of days Cost of Goods Sold (CGS) in inventory* is the fourth subcategory. It is the average inventory from the last two balance sheets divided by the per day cost of goods (i.e. the annual cost of goods divided by 365). Companies are classified under two groups according to their number of days CGS in inventory: high and low. Greater or equal to 50 is considered high, and less than 50 is considered low.

The third category covers the *product attributes* of the supply chain. This category has eight attributes. First is the *stage in life cycle* of the product, whereby the product of the supply chain can be at any of the four stages: introductory, growth, maturity, and decline. Therefore, supply chain attributes and the strategy and innovations may differ in accordance with the phase the product or service is in. The second attribute is the *marketing life length*, which can be long or short. For instance, marketing life length of a newly introduced cell phone is shorter than a soft drink. The third attribute is the *shelf life* of the product. It is also classified as long and short depending on the timeframe at the end of which a product spoils, or becomes unusable in another way. The fourth attribute is the *demand structure*. This attribute has a significant effect on the supply chain structure because the supply chain is constructed according to the deliveries. This attribute takes one of three possible values: certain demand with few fluctuations, uncertain demand, and project type ordering. The fifth attribute within the product

attributes category is the *customer structure*. Customer attributes play significant role in the selection of a company's supply chain strategies. Here there are three possible values: companies, individual consumers, or both of them. The sixth attribute involves the *manufacturing/service attributes*, and branches into several sub attributes. The first sub attribute under here is the *order cost*: it can be high or low, and this is a relative score which varies according to the sophistication of the product and the sales channels. The second sub attribute is the *inventory holding cost*, which can be classified as high or low. The third sub attribute is the *transportation cost*: the higher the transportation cost, the more critical the supply chain becomes in shaping the success or failure of the company in its industry. While categorizing the companies according to the transportation cost, the study takes into account the transportation cost as a fraction of the total value of the product. For instance, transportation cost for packaged food is higher than a complex industrial machine due to the high price of the latter. The seventh subattribute under product attributes is the *profit margin*, which takes the values of high or low. In mapping the case studies onto the taxonomy, the study takes the profit margin of 10% as the threshold level. The eighth attribute is the *specifications* of the product. This attribute can take one of the following four values: durable goods (cars, electronic equipment, and furniture), perishable goods (food), shopping goods, and raw materials (products of the suppliers).

Dimension Three: Innovation Attributes

The attributes of innovations can be categorized depending on various attributes, such as in which business function (where) the innovations are made, which tools are used for the innovations, the extent of change owing to these innovations, at which decision level the innovations are incorporated, at which supply chain stage these innovations are implemented. A of innovation attributes is given in Table 3.

First, companies should determine the supply chain stage where the innovation will be developed. This can be in process, organization, or product/ service design. If the firm decides to focus on the processes while implementing innovations, it has to define clearly which processes must be improved such as warehousing and transportation, manufacturing, purchasing, packaging, and customer service. The innovations related to each of these processes require different know-how and have different results for the company and its supply chain partners. If the company wants its innovations to highlight the structure of the organization, the alterations in the structural models, and the management and leadership methods, the tasks and roles of workers become highly important for this firm. Alternatively, the innovations can be done in the design of the products or processes to receive higher quality and better performance.

<< TABLE 2 COMES ABOUT HERE>>

After deciding where the innovations will be executed, companies should also determine the tools used for innovations. If the innovations are knowledge-based, then different *knowledge-based* tools and methods such as knowledge retrieval, knowledge sharing, knowledge transfer, or knowledge storage will be evaluated by the company, and the most appropriate one(s) will be selected for use in the innovations. If the firm gives high importance to the *relationship networks*, it can use Customer Relationship Management (CRM), Supplier Relationship Management (SRM), Business Buyer Relationship Management (BBRM), or Vendor Relationship Management (VRM) in accordance with its supply chain and business strategies. In many innovations, *technology*, including the usage of Internet, Electronic Data Interchange (EDI), Radio Frequency Identification (RFID), and other Information Technology (IT) is a necessity.

Furthermore, companies should determine the *extent of the change* caused by the innovations. The study will list these from bottom up: Renewal innovations are implemented when the products or services reach their decline stage in their life cycles. Incremental innovations, which

are the most common type of innovations, consist of small changes made for the enlargement of the companies, and they generally prevent big changes in the product, process, or service. Architectural innovations improve the ongoing processes and products to expand the productivity. Radical innovations focus thoroughly on the new product and process types rather than improving the current ones. At the extreme, transformational innovations create entirely new types of products and processes.

The planning horizon at which the implementation of the innovations occurs can be determined by looking at the relationship of the supply chain and business strategies. The planning horizon can be strategic, tactical, or operational.
The final consideration is the supply chain stage involved in the innovation: The innovation can mainly focus on one or more of the supply chain partners consisting of customer, retailer, distributor, manufacturer, and supplier. Although, these partners work together in the supply chain, the innovation emphasized on a specific one will typically have its impacts on the others.

DEMONSTRATION

The taxonomy developed in the paper is now demonstrated through the mapping of recent innovation success stories onto the three dimensions of goals, supply chain attributes, and innovation attributes.

Data Source

The case studies that we investigated thoroughly came from the finalists of the Supply Chain Innovation Award (SCIA), organized by the Council of Supply Chain Management Professionals (CSCMP). Even though there are other case studies that we have examined, we will map only the case studies from SCIA finalists onto the taxonomy structures of supply chain attributes and innovation attributes. We examined these companies and organizations according to their supply chain attributes and supply chain innovation attributes, as classified in the previous section. We subsequently constructed a dataset, which is presented in the tables. The financial data and other company data have been obtained from the Forbes.com website. The data extracted from the case studies will hereafter be referred to as the *SCIA dataset*.

Nearly all the companies that are listed as finalists of SCIA have increased their efficiency and potential market, reached higher customer satisfaction levels, achieved higher profit rates with on-time deliveries, or have reduced their operational costs by using the innovations. The finalist companies and organizations for 2005-2010 have been used in constructing the taxonomy, and the data for 2010 finalists are displayed in Tables 1, 2, and 3, demonstrating the taxonomy.

Mapping the Case Studies onto the Taxonomy Dimensions

In the methodology section, we provided the three dimensions and taxonomies within each dimension, for investigating the companies in terms of supply chain attributes, supply chain innovation attributes, and innovation goals. Next, relevant data of the companies of the case studies have been carefully collected, and the values for each of the attributes in each of the dimensions have been assigned. If an case study exhibits a particular attribute value, the

corresponding cell of that firm is marked with an "X" similar to the analysis in the supply chain landscape.

It would be favorable to have the values for every attribute of every company for all the three dimensions. However, it proved to be very time consuming and difficult to achieve this during the data collection process, and it proved impossible to collect some of the data, especially for supply chain attributes. The validation of completeness with earlier data was facilitated through a scatter plot visualization, with the companies on the x axis, and the attributes on the y axis. On the other hand, each company may or may not have a value for all of the attributes in dimension three, innovation attributes, since each company may focus on different areas to improve its performance and industry position. The data for the first dimension, the innovation goal attribute, has to be complete: Each company must have at least one innovation goal.

It is critical to remain consistent about the assumptions and decision criteria in evaluating different companies in terms of the supply chain and innovations attributes. Achieving this consistency was the most time consuming part of the data collection process, and required many cross checks and revisions. Table 2 gives a sample supply chain innovations analysis for the SCIA dataset.

Using the Taxonomy

The taxonomy can be used by companies for benchmarking with their competitors, for mapping their existing supply chain innovations, and for positioning and planning their future innovations. For example, a company interested in Intel can read the following from Table 1: The goal of the innovation reported for Intel in the 2010 SCIA dataset aimed at achieving efficiency through reducing costs, improving customer satisfaction, and allowing for better strategic planning. Other critical information is encoded in Table 3: The innovation involved

inventory management in manufacturing. The innovation aimed at developing a new structure for the task and roles of the workers. The tools used in the innovation were mainly knowledge-oriented, covering all aspects of knowledge management. The relationship network that was covered was the vendor network (VRM, vendor relations management) and a radical change was brought to the way the vendor relations were managed. The vendors of Intel involved in the scope of this innovation were the retailers, and the innovation was at the manufacturer stage of the supply chain.

CONCLUSION AND FUTURE RESEARCH

In this study, we presented a structured approach for the analysis and interpretation of supply chain innovations. The taxonomy in the paper allows companies to position themselves in relation to the best practicing companies and competitors in their industries, by mapping their goals, supply chain structures, supply chain innovation attributes, and goals to the three dimensions it contains.

It is possible to summarize the contributions and future research of this study in terms of four main topics: the study presented a taxonomy for mapping supply chain innovations and the implementation of this structured framework by using real world data and answered the questions with respect to the data collection, data consistency check, and decision making in subjective matters by the demonstration of making assumptions and subjective judgements.

In this study, what was focused on was the framework to understand supply chains and related innovations. Moreover, the study illustrated the application of this structured framework by using sample company and supply chain innovation case studies obtained from CSCMP (CSCMP). In order to get further insights about various industries and supply chain innovation characteristics belonging to them, richer and more detailed company data (that is, large numbers of companies from diverse industries emphasizing supply chain innovations) can be used to maximize the benefits achieved by the use of our taxonomy. Finally, once extensive

representative data has been collected, the collected data in the three dimensions can be analyzed to discover actionable knowledge, such as patterns, gaps, and trends.
As another future research, the supply chain attributes and innovations presented in the article can be further analyzed in the context of supply chain integration (Chopra and Meindl, 2007). One possible research question would be identifying the supply chain structures that empede or enhance supply chain integration.

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Table 1 . SCIA dataset mapped onto the (Supply Chain) Innovation Goals dimension

						Pepsi Bottling Group	
1.1.	Service Augmentation		X		X		
1.2.	Efficiency in cost reduction	X	X	**X**	X	X	X
1.3.	Standardization						X
1.4.	Better flexibility and adaptation to market changes		X				
1.5.	Expanding revenue	X				X	
1.6.	Improving customer satisfaction		X	**X**	X		
1.7.	Reducing defect rate		X				
1.8.	Better strategic planning	X		**X**		X	X

Table 2. SCIA dataset mapped onto the Supply Chain Attributes dimension

2.1. Market attributes	2.1.1.	competitiveness structure	2.1.1.1.	highly competitive							
			2.1.1.2.	oligopolistic	X		**X**	X	X	X	
			2.1.1.3	monopolistic		X					
	2.1.2.	size of the service market	2.1.2.1.	large number of customers		X	**X**	X	X		
			2.1.2.2.	a few number of customers	X					X	
	2.1.3.	market growth rate	2.1.3.1.	high growth rate		X	**X**				

			2.1.3.2.	stable				X	X	X
			2.1.3.3.	negative growth	X					
1.2. Supply Chain Attributes	2.2.1.	scale of the supply chain	2.2.1.1.	global		X	**X**	X	X	X
			2.2.1.2.	local	X					
	2.2.2.	inventory turnover	2.2.2.1.	high		X			X	
			2.2.2.2.	low	X		**X**			X
	2.2.3.	focus of the supply chain	2.2.3.1.	efficiency	X			X	X	X
			2.2.3.2.	agility		X	**X**			
	2.2.4	number of days cost of goods sold (CGS)	2.2.3.3.	high	X	X	**X**			
			2.2.3.4	low					X	X
2.3. Product Attributes	2.3.1.	stage in life cycle	2.3.1.1.	introductory						
			2.3.1.2.	growth	X	X	**X**	X		X
			2.3.1.3.	maturity					X	
			2.3.1.4.	decline						

	2.3.2.	marketing life length	2.3.2.1.	long	X		**X**	X	X	
			2.3.2.2.	short		X				X
	2.3.3.	shelf life	2.3.3.1.	long	X		**X**	X	X	
			2.3.3.2.	short		X				X
	2.3.4.	demand structure	2.3.4.1.	certain demand with little fluctuation	X	X	**X**	X	X	
			2.3.4.2.	uncertain demand						X
			2.3.4.3.	project type ordering						
	2.3.5.	customer structure	2.3.5.1.	firms	X	X	**X**	X		
			2.3.5.2.	individual customers					X	X

					2.3.5.3.		both individuals and firms							
	2.3.6.	manufacturing and service attributes	2.3.6.1.	order cost	2.3.6.1.1.		high			**X**				
					2.3.6.1.2.		low				X	X		
			2.3.6.2.	inventory holding cost	2.3.6.2.1.		high	X						
					2.3.6.2.2.		low				X	X	X	
			2.3.6.3.	transportation cost	2.3.6.3.1.		high (with risks)	X	X					
					2.3.6.3.2.		low				X	X		
			2.3.6.4.	manufacturing cost 2.3.6.4.1.	material cost	2.3.6.4.1.1.	high	X		**X**				
						2.3.6.4.1.2.	low		X		X	X		
				2.3.6.4.2.	costs of asset	2.3.6.4.2.1.	high	X						
						2.3.6.4.2.2.	low							
				2.3.6.4.3.	energy	2.3.6.4.3.1.	high							

					cost	2.3.6.4.3.2.	low		X		X		
				2.3.6.4.4.	labor cost	2.3.6.4.4.1.	high						
						2.3.6.4.4.2	low		X		X		
	2.3.7.	profit structure			2.3.7.1.		high profit rate	X	X	**X**	X	X	
					2.3.7.2.		low profit rate						X
	2.3.8.	specifications			2.3.8.1.		durable goods	X		**X**	X	X	X
					2.3.8.2.		perishable goods		X				X
					2.3.8.3.		shopping goods						
					2.3.8.4.		raw materials						

Table 3. SCIA dataset mapped onto the (Supply Chain) Innovations dimension

					1 Navistar	2 IPC Subway	**3 Intel**	4 SGI Footwear	5 Pepsi Bottling Group	6 AMWAY
3.1. Where the innovation is done	3.1.1.	Process	3.1.1.1.	warehousing & transportation	X	X		X	X	
			3.1.1.2.	manufacturing		X	**X**			
			3.1.1.3	purchasing						
			3.1.1.4	packaging		X		X		
			3.1.1.5	customer service						
			3.1.1.6.	inventory management			**X**		X	X
	3.1.2.	Organization	3.1.2.1.	structural models			**X**		X	
			3.1.2.2.	management and leadership	X	X				X

				methods						
			3.1.2.3.	task and roles of workers	X		**X**	X		
	3.1.3.	Product Design or Service Design								
3.2 Tools used for innovation	3.2.1.	Knowledge	3.2.1.1.	knowledge retrieval		X	**X**			
			3.2.1.2.	knowledge sharing	X	X	**X**	X		X
			3.2.1.3.	knowledge transfer	X		**X**	X	X	X
			3.2.1.4.	knowledge storage						X
	3.2.2.	Relationship Networks	3.2.2.1.	CRM						
			3.2.2.2.	SRM					X	X
			3.2.2.3.	BBRM						
			3.2.2.4.	VRM	X	X	**X**	X	X	X
	3.2.3.	Technology	3.2.3.1.	Internet						X
			3.2.3.2.	EDI				X		
			3.2.3.3.	RFID	X					
			3.2.3.4.	other usage of IT	X	X	**X**	X	X	

3.3. Extent of Change	3.3.1.	Transformational						
	3.3.2.	Radical			**X**			
	3.3.3.	Architectural						
	3.3.4.	Incremental	X	X		X	X	X
	3.3.5.	Renewal						
3.4. Decision Level	3.4.1.	Strategic	X	X				
	3.4.2.	Tactical			**X**	X	X	X
	3.4.3.	Operational						
3.5 Supply chain stage	3.5.1.	Customer						
	3.5.2.	Retailer		X	**X**	X	X	X
	3.5.3.	Distributor	X	X		X	X	X
	3.5.4.	Manufacturer		X	**X**			
	3.5.5.	Supplier						