



International Journal of Information Technology and Management

ISSN online: 1741-5179 - ISSN print: 1461-4111

<https://www.inderscience.com/ijitm>

Impact of e-commerce on supply chain management

P.G. Saleeshya, R. Rahul

DOI: [10.1504/IJITM.2023.10055150](https://doi.org/10.1504/IJITM.2023.10055150)

Article History:

Received:	22 June 2016
Last revised:	25 August 2017
Accepted:	23 December 2018
Published online:	05 April 2023

Impact of e-commerce on supply chain management

P.G. Saleeshya* and R. Rahul

Department of Mechanical Engineering,
Amrita School of Engineering,
Coimbatore, Amrita Vishwa Vidyapeetham, India
Email: pg_saleeshya@cb.amrita.edu
Email: rahulramananmfg@gmail.com
*Corresponding author

Abstract: E-commerce is web-enabled technology that brought significant changes in the supply chain activities of an industry. Supply chain management has become a major strategy in manufacturing and service industry. An attempt has made in this paper on identifying the significant factors that affect the e-commerce adoption in the supply chain of a company, identifying the effects of e-commerce on different aspects of supply chain. The study also identifies the major performance parameters of a supply chain and effect of e-commerce adoption on these supply chain variables. An attempt has been made to propose a conceptual model for the study based on the existing literature and field study; the model is validated by academic experts and also experts in industry. Correlation analysis is being carried out to find gap between the ideal and actual situation.

Keywords: supply chain; e-commerce; correlation; conceptual model.

Reference to this paper should be made as follows: Saleeshya, P.G. and Rahul, R. (2023) 'Impact of e-commerce on supply chain management', *Int. J. Information Technology and Management*, Vol. 22, Nos. 1/2, pp.13–31.

Biographical notes: P.G. Saleeshya is a Professor of Mechanical Engineering at the Amrita School of Engineering, Coimbatore, India. She received her MTech and PhD from Indian Institute of Technology, Bombay, India. Her areas of interest in teaching and research is mainly focused on operations strategy: agile manufacturing, lean manufacturing, sustainable lean, lean Six Sigma, green design and manufacturing, and responsive supply chain, agility in textile industries. She has several publications in various international journals, and two book chapters in the *Encyclopedia of Business Analytics*.

R. Rahul is an alumnus of Amrita School of Engineering, Coimbatore. His areas of interest include supply chain management and lean manufacturing

1 Introduction

Supply chain is a group of organisations, people, activities, information and resources involved in transformation of a product or service from supplier to customer. Supply chain activities include the conversion of raw materials to final product and deliver to final customer. Supply chain management includes management of activities included in sourcing, procurement, manufacturing, distribution. In short supply chain management

coordinates supply and demand within and across companies. E-commerce started gaining popularity after 2000 as it support supply chain activities. E-commerce is buying and selling of goods and services, or transmitting funds or information over an electronic network

The paper covers the study of barriers exist to integrate e-commerce to supply chain, effect of e-commerce on different supply chain aspects and supply chain performance variables. For the purpose of study we developed a conceptual model based on existing literature and discussion with experts in supply chain. The model is validated academically and industrially by conducting interviews by administering a questionnaire. Finally correlation analysis was done to check the level of correlation between the response of academic and industrial experts.

2 Background literature

The supply chain involves information flow, cash flow, material flow. Information flow involves the request for quotation, purchase order, monthly schedules, change requests, quality complaints, reports on supplier performance, confirmation of purchase order, reports on action taken on deviation, despatch details, report on Inventory, invoices etc. For an efficient and effective supply chain, it is important that all three flows are managed properly with least efforts. Ranganathan et al. (2011) states that the emergence of the Internet is cost-effective business medium that changed the way the companies communicate, acquire and utilise resources, as well as build and sustain competitive edge. Gunasekaran and Marri (2002) considers e-commerce as an emerging area that coordinates processes related to buying, selling and trading of goods and services and information through computer networks. Lancioni et al. (2003) provides an overview of some of the tools and trends, including website structure, e-purchasing, electronic marketplaces, building vendor relationships, and the use of the internet in managing supply chains. Raghuram and Saleeshya (2015) provide the responsiveness of supply chain. The adoption of e-commerce in supply chain can contribute to the agility. Saleeshya et al. (2012) give the agility assessment of a supply chain. Valverde and Saade (2013) examine the effect of e-supply chain management systems in the North American electronics manufacturing services industry. Based on a study conducted by Khan et al. (2014), it suggests that e-commerce adoption has positive influence on small and medium scale industries, such as higher average sales growth rate, on-time order management. This study is useful to understand how e-commerce adoption affects firm's performance.

Reddy and Divekar (2014) showed the challenges faced by e-commerce are very poor awareness about social media websites, television advertisements, lack of safe payment methods, money back guarantee. Chong et al. (2009) show the relationship between supply chain factors such as product complexity, product volume and transaction frequency and trust with the e-collaboration tools adoption level. Popsitar (2011) showed that several factors that can affect the e-commerce adoption are environmental factors, organisational factors and technological factors. Each group comprises a number of aspects that may affect the implementation of e-commerce system. We found in literature that competitive pressure (Kuan and Chan, 2001), supply chain member pressure (Min and Galle, 2003) and supplier's relationships (Dooley and Purchase, 2004) are the most important environmental factors. There are several organisational factors such as organisation size (Patterson et al., 2003), company culture (Rahim, 2008), volume of

e-transactions, user resistance to change, organisational skills set and resources that can affect the implementation of e-commerce. Reliability of e-commerce system and compatibility with the other IT systems (Rahim, 2008) are the technological factors. Kurnia et al. (2015) studied the level of e-commerce adoption in Malaysian grocery small- and medium-sized enterprises using a survey by checking the level of adoption of e-commerce tools such as e-mail, internet, EDI, extranet, EFT, barcode. Bakker et al. (2007) finds that product categories differ in terms of variety and volume and have different requirements for e-commerce solutions. The supply chain can be categorised to three main areas namely procurement, processing and distribution (Prasad and Sounderpandian, 2003). We found in literature that the major supply chain performance variables are cost, quality and innovation (Anaton, 2014).

From the existing literature, we have identified major effects that caused by the e-commerce implementation in procurement, processing and distribution areas. Prasad and Sounderpandian (2003) provide wide range effect of e-commerce on different supply chain areas. Rath and Sanghamitra (2013) state that e-commerce technologies can be used in functional areas such as product design, product sales and distribution in a better way than traditional system of promotion. Otieno et al. (2013) states that e-procurement is an online system by which companies can be linked directly to suppliers for the purpose of buying products and services at lowest cost. E-procurement replaces its offline version called tender. Subramanian and Shaw (2002) studied the value of e-procurement to an organisation. They proposed a formula to measure value of e-procurement: value of e-procurement = price benefits + transaction costs benefits – technology costs.

Web-centred technologies have added 'velocity' to the design, manufacturing, and aftermarket service of a product. E-manufacturing includes the ability to monitor the plant floor assets, predict the variation of product quality and performance loss of any equipment for dynamic rescheduling of production and maintenance operations, and synchronise with linked business services to attain an integration between manufacturing and higher level enterprise systems. Saha and Grover (2011) state the term e-manufacturing refers to the ability of a manufacturing system to integrate various inputs using internet. With the market being increasingly competitive and customer oriented desiring to get best of the quality at cheapest available price of a product in shortest possible time. Another important fact is that each customer may desire to have a certain different set of values added to the product being purchased. Customers want to voice their concerns directly to manufacturers thereby necessitating an interface to hear them in real-time and take suitable action thereupon, if needed, in real-time. As such identifying the enablers of e-manufacturing has become important for manufacturer in customer-oriented manufacturing to lure new customers along with retaining the old customers. It will also result in closing the gap between demand and supply of a product. Cheng and Bateman (2008) state that e-manufacturing provides a high level of automation in manufacturing business information rather than physical one as used to be, thereby improves the information flow and work flow in the organisation. Having real time information is crucial in managing supply chain efficiently; companies need to coordinate data about order quantity, location, delivery time to decrease the waste in production and delivery process. Rodriguez et al. (2007) present a new concept called e-sensors which can be considered as a part of e-commerce. Aydin and Savrul (2014) presented the relationship between globalisation and e-commerce. They explained that

telecommunication and transport links flourished by globalisation, created a new way of accessing to market through e-commerce.

From the existing literature we find out the barriers for e-commerce adoption in a supply chain and the effects of e-commerce adoption in different supply chain areas and the supply chain performance variables affecting with e-commerce adoption. We plan is to develop a conceptual model showing the e-commerce barriers, effect of e-commerce on supply chain and the supply chain performance variables. The model is finalised by the discussion with academic experts, including researchers in the domain areas, interviews are conducted to rate their responses. A detailed case study is conducted in a leading textile industry in south India. Study is conducted based on the model and by administering a questionnaire and personal interview. Statistical analysis is done with the data provided by the industrial experts and academic experts. Likert scale is the most widely used approach to obtain responses in survey research. The format of a typical five-level Likert scale could be: 1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4 – agree, 5 – strongly agree (Boone and Boone, 2012).

The Pearson product-moment correlation coefficient, better known as the correlation coefficient, or as 'R', is the widely used correlation coefficient. Pearson's 'R' signifies the connection between two variables that have a linear relationship with each other. If the two variables have a straight line relationship in the positive direction, then 'R' will be positive and considerably above 0. If the linear relationship is in the negative direction, so that increases in one variable, are associated with decreases in the other, then $R < 0$. The possible values of 'R' range from -1 to $+1$, with values close to 0 signifying little relationship between the two variables.

3 Industrial case study

We selected a leading textile industry in south India. The company is using a mixed form of traditional and e-commerce enabled supply chain. Their level of e-commerce adoption is comparatively low in procurement and production supply chain activities and high in sales and distribution activities. They are currently using the e-commerce website indiamart to sell their product to new customers. Even though they adopted e-commerce in their one part of supply chain, it was not a success as expected. The reason for this includes the low quality of the yarn produced, cost. They have regular customer for taking their product. About 80% of sales are through the traditional mode only. We conducted face to face interview with the industrial experts. The questionnaire consist of open ended questions to know the general operating status of the company and close ended questions like rating response on Likert scale based on the factors developed in our model.

4 A conceptual model to access the impact of e-commerce on supply chain

In this section we propose a conceptual model to assess the impact of e-commerce on supply chain. The conceptual model consists of three sections, top section shows the factors that affect the integration of e-commerce in a supply chain, middle section shows the effect of e-commerce integration in different aspects of supply chain activities namely

procurement, design and manufacturing, sales and distribution and bottom section shows supply chain parameters affected by e-commerce.

The detailed description of conceptual model is given below. The top section, the factors affecting e-commerce integration in a supply chain were broadly classified in to three separate groups of factors, they are environmental factors, organisational factors, technological factors. The environmental factors include competitive pressure, consumer pressure and supplier-consumer relationship. To survive in the market, the company should be competitive enough. There are so many companies in the market providing the same product at lower price and better quality, so in order to survive in the competitive environment; the company has to innovate their technology and practices. Adoption of e-commerce in the company's supply chain helps them to innovate the supply chain practices and to thrive them in the competitive environment. If a company product is available to them through e-commerce websites, they may prefer to buy that product, thus the factor pressure from consumer makes the company think to shift to e-commerce business. A manufacturing company may consist of many numbers of suppliers. The company needs to keep a close relationship with all the suppliers to share the real time information. Adoption of e-commerce enables the sharing of real time information related to all aspects of supply chain such as demand, production planning and scheduling activities.

The organisational factors include size of organisation, culture of organisation, frequency of usage, infrastructure, financial resources, top management support. Success of adoption of e-commerce in a supply chain depends on the size of organisation and frequency of usage. Larger the size of organisation and higher the level of usage for e-commerce, it is economical to adopt the e-commerce in the supply chain. The employees in an organisation resist the implementation of any new technology or change, so make the employees aware of the ease of usage of e-commerce and benefits the company may achieve after e-commerce adoption in the supply chain.

The technological factors include simplicity, reliability, and compatibility with IT infrastructure. The ease of use of e-commerce in business is simple and it forms a common platform among the different supply chain activities to share reliable information.

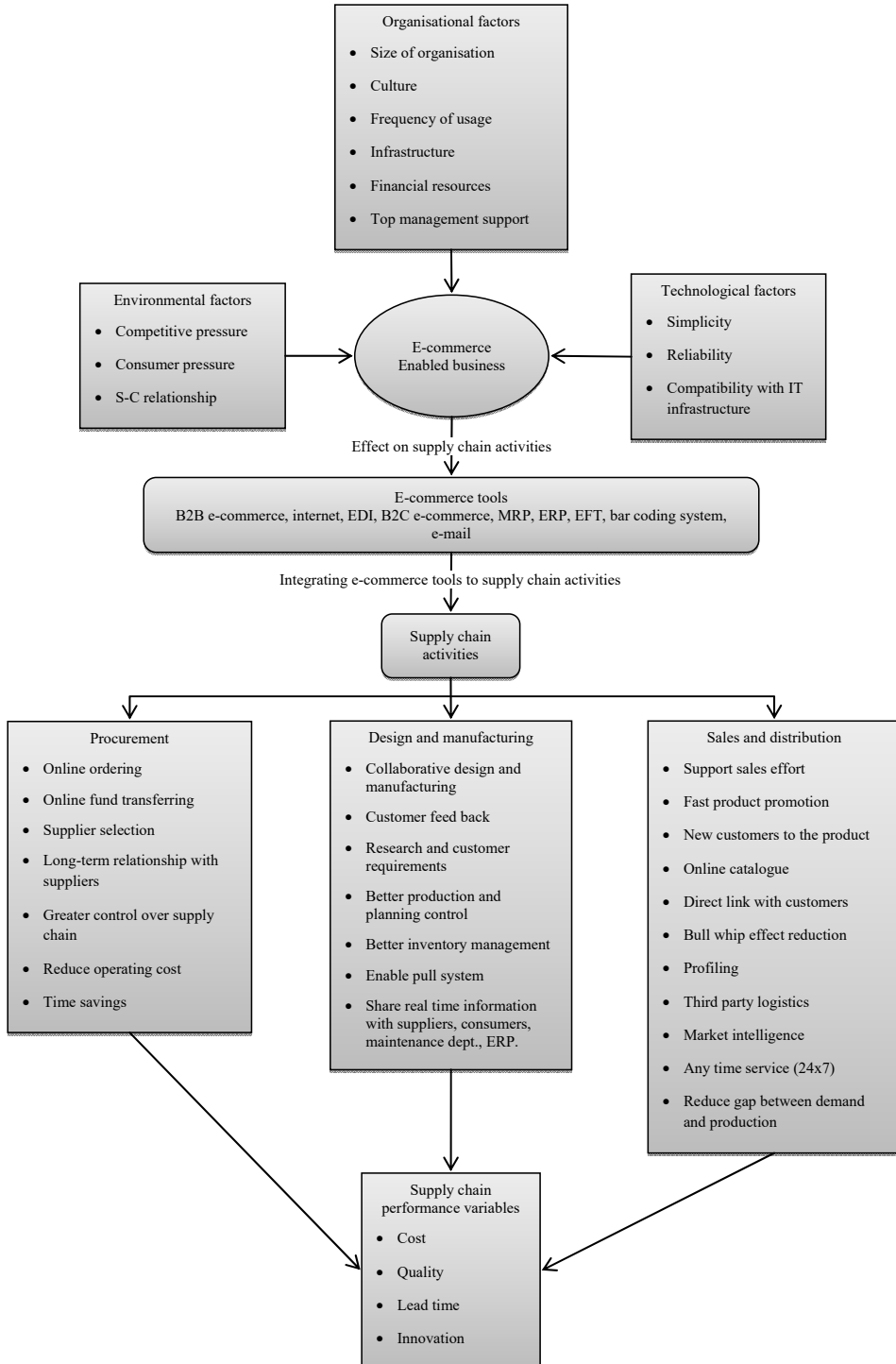
Next part of conceptual model shows typical e-commerce tools, they are listed as business to business e-commerce, business to consumer e-commerce, electronic data interchange, electronic fund transferring, bar coding, e-mail. The conceptual model shows these e-commerce tools are integrating to various supply chain activities. The middle section of model shows the detailed effect of e-commerce on supply chain activities like procurement, design and manufacturing, sales and distribution. In procurement supply chain major e-commerce effects are listed as, online ordering, online fund transferring, supplier selection, long term relationship with suppliers, and greater control over supply chain, reduce operating cost, time savings. In traditional procurement system, ordering, fund transfer, supplier selection were more time taking as these involves paper works. With e-commerce implementation everything become more fast, results in considerable time savings and reduces operational cost. E-commerce provides a means to maintain a long term and close relationship with suppliers.

In design and manufacturing supply chain the major effects of e-commerce identified are collaborative design and manufacturing, customer feedback, research on customer requirements, better production and planning, better inventory management, enable pull system and share real time information with suppliers, consumers, maintenance department. Collaborative design and manufacturing means, with the adoption of e-commerce design and manufacturing sections are more connected each other even if the design and manufacturing sections are in different locations or in two different countries. Electronic commerce enable the manufacturing section can check whether the design is feasible with the available technology, supplier capacity, manpower, etc. with the minimum time. The status of production, scheduling, inventory etc. is shared across the supply chain, so that every member of the supply chain is aware of the actual status and can act accordingly. For example if a machine in the shop floor breakdown, that information is shared among all supply chain members, so that the supplier can plan accordingly to regulate the flow of material, maintenance and can rectify the machine as soon as possible. E-commerce enable pull system to an extent, as real time demand is extracted directly from the customer.

The effects of e-commerce on sales and distribution supply chain were listed as support sales effort, fast product promotion, increased market share, online catalogues, direct link with customers, bull whip effect reduction, profiling, third party logistics, market intelligence, any time service (24x7), reduce gap between demand and production. In sales and distribution supply chain, e-commerce enable the organisation to have direct link with customers, customers are placing demand directly to the company through e-commerce website. Now most of the companies are using a mixed form of supply chain, both traditional and e-commerce enabled. The interaction of company to its customers via social networking sites like Facebook enables the fast product promotion; there by support the sales effort by extending the product to new customers. The e-commerce adoption can cause elimination of wholesalers and retailers, the company itself can sell the product directly to the customer. This results in 'direct link with the customers. Bull whip effect means the amplification of demand of product from downstream to upstream of a supply chain. The main reason behind the bull whip effect is lack of updated information along the supply chain members, with e-commerce implementation bull whip effect can be reduced. Profiling involves the process of identification of most demanded product and sorting in best warehouse location, so that the product can be shifted as soon as the demand comes. Other significant effects of e-commerce on sales and distribution supply chain are third party logistics, market intelligence, any time service, reduce gap between production and demand.

The performance variables of a supply chain were identified are cost, quality, lead time, innovation. The overall effect of e-commerce on procurement, manufacturing and distribution supply chain activities reduces cost and leads time, improves the quality of product and help to innovate the supply chain practices. The next step is the validation of the model developed through academic experts and industrial case study by administering a detailed questionnaire. The questionnaire is the research tool developed to extract data for statistical analysis. The method of data collection and research instrument were explained in the next section.

Figure 1 Conceptual model for accessing the impact of e-commerce on supply chain management



5 Research methodology

The research methodology is using the data collection instruments the data required for the study is collected and subjected to processing and analysis. The data collection instrument is the questionnaire. Correlation analysis of data is done using the software Minitab.

5.1 Data collection instruments

The research tool, questionnaire consist of open ended and closed ended questions, open ended questions gives the descriptive information about the company practices. Closed ended questions give the data for statistical analysis. The Likert scale is used for rating the response of each attribute in the conceptual model. We used a five level Likert scale consists of – strongly agree, agree, neutral, disagree, and strongly disagree. The respondent may rate their response to any one of the level of Likert scale.

5.2 Data processing and analysis

The model is validated with discussion with academic experts, researchers and their response is rated in the Likert scale. The data collected from the academic experts were considered as the ideal conditions. In the company selected for case study, 28 high level and medium level officials responded to the survey. Detailed interviews are conducted by administering the questionnaire and rated their response for each attribute in the model in the Likert scale. The data collected through industrial case study represent the actual condition in the company. In the analysis step we have done Pearson correlation analysis to determine the level of correlation between the ideal data collected from academic experts and actual data from industrial case study.

6 Findings of study

The response from industry and academic experts is collected and tabulated, the mean and standard deviation of each factor is determined. Finally correlation analysis is done to determine the gap between the ideal and the actual situation.

6.1 Factors affecting e-commerce adoption

From the conceptual model it is clear that the factors affecting the e-commerce adoption were environmental factors, organisational factors and technological factors. This section shows the detailed response of each attribute environmental factors, organisational factors and technological factors. The response were rated on a Likert scale, consisting of five levels – strongly agree (SA), agree (A), neutral (N), disagree (D), strongly disagree (SD). This abbreviation is used in all the response rating columns.

Table 1 Response rating on environmental factors

<i>Environmental factors</i>	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Competitive pressure	19	68	7	36	2	7	0	0	0	0	4.607143
Consumer pressure	10	36	7	25	0	0	7	25	4	14	3.428571
Supplier consumer relationship	14	50	8	29	6	21	0	0	0	0	4.285714
Group mean											4.107143
Group standard deviation											0.60924

Table 2 Response rating on organisational factors

<i>Organisational factors</i>	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Size of organisation	20	71	8	29	0	0	0	0	0	0	4.614286
Culture	21	75	7	25	0	0	0	0	0	0	4.75
Frequency of usage	15	54	10	36	1	4	2	7	0	0	4.357143
infrastructure	18	64	8	29	2	7	0	0	0	0	4.57143
Financial resources	19	68	9	32	0	0	0	0	0	0	4.571429
Top management support	23	82	5	18	0	0	0	0	0	0	4.778571
Group mean											4.64881
Group standard deviation											0.1650536

Table 3 Response rating on technological factors

<i>Technological factors</i>	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Simplicity	8	29	15	54	5	18	0	0	0	0	4.10
Reliability	16	57	6	21	3	11	3	11	0	0	4.25
Comp actability with it infrastructure	6	21	5	18	4	14	13	46	0	0	3.1428
Group mean											3.833
Group standard deviation											0.602221

Table 4 Response rating on effect of e-commerce on procurement supply chain

<i>Effect on procurement</i>	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Online ordering	16	57	9	32	3	11	0	0	0	0	4.64
Online fund transferring	24	86	3	11	1	4	0	0	0	0	4.82
Supplier selection	14	50	4	14	5	18	3	11	2	7	3.8
Long-term relationship with suppliers	21	75	5	18	0	0	2	7	0	0	4.60
Greater control over supply chain	7	25	6	21	0	0	10	36	5	18	3
Reduce operating cost	14	52	6	22	1	4	5	19	1	4	4.175
Time savings	15	54	8	29	5	18	0	0	0	0	4.57
Group mean											4.24
Group standard deviation											0.633

Table 5 Response rating of effect of e-commerce on production supply chain

<i>Effect on production supply chain</i>	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Collaborative design and manufacturing	9	32	11	39	6	21	2	7	0	0	4.25
Customer feedback	22	79	2	7	4	14	0	0	0	0	4.64
Research on customer requirements	13	46	6	21	2	7	4	14	3	11	3.78
Better production planning and control	24	86	4	14	0	0	0	0	0	0	4.85
Better inventory management	25	89	2	7	1	4	0	0	0	0	4.85
Enable pull system	19	68	8	29	1	4	0	0	0	0	4.64
Share real time information with suppliers, consumers, maintenance dept.	26	92	1	4	1	4	0	0	0	0	4.89
Group mean											4.56
Group standard deviation											0.377

In Table 1, column 1 shows the environmental factors, column 2 to 6 shows the different levels of Likert scale (SA, A, N, D, SD), column 7 represent the mean of response rating. Number 19 in column 1 represent that, out of 28 respondent 19 strongly agree the competitive pressure as an important factor in the adoption of e-commerce and number 68 represent the relative percentage of respondent strongly agree competitive pressure. In

similar way other numerical values can be interpreted. In Table 1, competitive pressure has highest mean of 4.6 so it can be considered as a main factor among the environmental factors. Tables 2–7 can be interpreted in same way of Table 1.

Table 6 Response rating on effect of e-commerce on sales and distribution supply chain

	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Support sales effort	26	93	1	4	1	4	0	0	0	0	4.9
Increased market share	23	82	2	7	0	0	2	7	1	4	4.5
Online catalogue	15	54	6	21	2	7	2	7	3	11	4.25
Direct link with customers	22	79	3	11	1	4	2	7	0	0	4.6
Bullwhip effect reduction	26	92	1	4	1	4	0	0	0	0	4.7
Profiling	19	68	4	14	3	11	1	4	1	4	4.57
Third party logistics	11	39	12	43	5	18	0	0	0	0	4.35
Market intelligence	23	82	5	18	0	0	0	0	0	0	4.82
Any time service	27	96	1	4	0	0	0	0	0	0	4.96
Fast product promotion	27	96	1	4	0	0	0	0	0	0	4.96
Reduce gap between demand and production	26	93	2	7	0	0	0	0	0	0	4.9
Group mean											4.7
Group standard deviation											0.259

Table 7 Response rating of supply chain performance variables

	<i>SA</i>		<i>A</i>		<i>N</i>		<i>D</i>		<i>SD</i>		<i>Mean</i>
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	
Cost	20	71	7	25	1	4	0	0	0	0	4.6
Quality	19	68	6	21	2	7	1	4	0	0	4.5
Lead-time	25	89	3	11	0	0	0	0	0	0	4.8
Innovation	18	65	6	21	4	14	0	0	0	0	4.5
Group mean											4.6
Group standard deviation											0.1414

6.2 Effects of e-commerce adoption on supply chain

The detailed response of effects of e-commerce on different supply chain activities like procurement, design and manufacturing, sales and distribution are shown in this section.

6.3 Effect of e-commerce adoption on supply chain performance variables.

The detailed response of effects of e-commerce on different supply chain performance variables like cost, quality, lead-time and innovation are shown below.

6.4 Response rating from academic experts

The response from industrial experts were collected and evaluated. To find the gap between the ideal and actual condition, the response from academic experts and researchers in the domain area were collected and tabulated. The detailed response from the academic experts and researchers were shown in Table 8.

Table 8 Response rating from academic experts

<i>Response rating from academic experts</i>	
<i>Response rating on factors affecting e-commerce adoption</i>	
Environmental factors	
Competitive pressure	5
Consumer pressure	4
Supply chain relationship	5
Organisational factors	
Size of organisation	3
Culture of organisation	4
Frequency of usage	4
Infrastructure	5
Financial resources	5
Top management support	5
Technological factors	
Simplicity	5
Reliability	5
Compatibility with it infrastructure	5
<i>Response rating on effect on procurement activities</i>	
Online ordering	5
Online fund transferring	5
Supplier selection	5
Long-term relationship	5
Greater control over supply chain	4
Reduce operating cost	4
Time savings	5

Table 8 Response rating from academic experts (continued)

	<i>Response rating from academic experts</i>
<i>Response rating on effect on production activities</i>	
Collaborative design and manufacturing	3
Customer feed back	4
Research on customer requirements	5
Better production operation planning control	5
Better inventory management	5
Enable pull system	4
Share real time information with suppliers, consumers, maintenance dept., ERP	4
<i>Response rating on effect on sales and distribution activities</i>	
Support sales effort	5
Increased market share	5
Online catalogue	4
Direct link with customers	4
Bullwhip effect reduction	4
Profiling	4
Third party logistics	3
Market intelligence	4
Any time service (24x7)	5
Fast product promotion	5
Reduce gap between demand and production	3
<i>Response rating supply chain performance variables</i>	
Cost	5
Quality	4
Lead time	5
Innovation	5

6.5 Correlation analysis

In the previous section the response rating of each of the attributes in ideal and actual situation were shown. To find the relationship between the data collected by academic experts and industrial case study, correlation analysis is done using the software Minitab. Data required for correlation analysis is extracted from the Likert scale.

6.5.1 Pearson coefficient for factors affecting e-commerce adoption

Among the environmental factors 'competitive pressure' in Table 9 has higher Pearson coefficient value which signifies that company experience high competition from the other competitors in the market which make them to think of adopting e-commerce. 'Consumer pressure' has negative correlation which means that the company experience

no pressure from the consumers for their product. Due to a large number of competitors in the textile field consumers has wide number of choices. The small and medium scale textile industries are called 'sunset' or 'dying industry'. Due to the competition from big textile industries this company's product has less market value and the company have to push it to the market. And the 'supply chain relationship' is very poorly correlated as the company does not maintain a long relationship with suppliers. They keeps supplier maximum 6 month, after that when the requirements come which ever supplier is willing to give, they will take from them.

Table 9 Pearson coefficient for environmental factors

<i>Environmental factors</i>	<i>Pearson correlation coefficient</i>
Competitive pressure	0.1539
Consumer pressure	-0.104
Supply chain relationship	0.069

Among 'organisational factor' infrastructure in Table 10 is most correlated as the company needed to invest on IT infrastructure to implement e-commerce in the company. After infrastructure the 'culture of organisation' and the 'frequency of usage' is moderately correlated as the company also faced the resistance from employees when they implemented e-commerce systems.

Table 10 Pearson coefficient for organisational factors

<i>Organisational factors</i>	<i>Pearson correlation coefficient</i>
Size of organisation	-0.219
Culture of organisation	0.333
Frequency of usage	0.286
Infrastructure	0.369
Financial resources	0.28
Top management support	-0.901

Two negatively correlated factors are identified; they are 'top management support' and 'size of organisation'. The factor top management support is highly negatively correlated because the company experts says that as it is a govt. undertaking company so accepting the proposal suggested by the company executives to the board member of the company involving many govt. officials is very difficult. If it is a private firm, we can easily get the top management support if they are convinced with the benefits after implementing the technology or change. Size of organisation is negatively correlated, as per the response from the company experts e-commerce can be implemented in small, medium or large industries; the factor that depends is the level of usage in the company.

Table 11 Pearson coefficient for technological factors

<i>Technological factors</i>	<i>Pearson correlation coefficient</i>
Simplicity	0.218
Reliability	0.325
Compatibility with it infrastructure	0.069

In Table 11, all the ‘technological factors’ are positively correlated. The most correlated factor is reliability as e-commerce adoption in the company can avail reliable information platform along the supply chain areas.

6.5.2 Effect of e-commerce on supply chain activities

Table 12 shows all effects in the procurement activities are positively correlated, with maximum correlation for ‘online fund transferring’ as the company has a high level of electronic mode of transactions in all areas of supply chain. All other effects such as online ordering, long term relationship, supplier selection, control over supply chain, time savings are moderately correlated. The effect reduce operating cost is poorly correlated because as operating cost cannot be reduced much more by e-commerce adoption because the company has several other operational problems all these affect the cost.

Table 12 Pearson coefficient for effect of e-commerce on effect procurement activities

<i>Effect of e-commerce on procurement activities</i>	<i>Pearson correlation coefficient</i>
Online ordering	0.318
Online fund transferring	0.443
Supplier selection	0.288
Long-term relationship	0.304
Greater control over supply chain	0.275
Reduce operating cost	0.176
Time savings	0.341

The effect ‘better inventory management’ in Table 13 is highly correlated with the data collected from academic experts with a correlation coefficient of 0.855. As the e-commerce adoption results in efficient information sharing along the different areas of supply chain so there is no need to stock much and wait for the demand to come. The effect ‘better production and operation planning control has a correlation coefficient of 0.753. Production and planning activities like forecasting, scheduling, sequencing, maintenance all this become better with the efficient information sharing along the supply chain. All other factors have moderate level of correlation.

Table 13 Pearson coefficients for effect of e-commerce on design and production activities

<i>Effect on distribution activities</i>	<i>Pearson correlation coefficient</i>
Collaborative design and manufacturing	0.211
Customer feed back	0.455
Research on customer requirements	0.153
Better production operation planning control	0.753
Better inventory management	0.855
Enable pull system	0.325
Share real time information with suppliers, consumers, maintenance dept., ERP	0.24

In Table 14, ‘support sales effort’, ‘increased market share’, ‘profiling’, ‘any time market’, ‘fast product promotion’ are highly correlated with the ideal condition data gathered from academic experts. The effect, direct link with the customer is not fully possible in the practical situation, because the company supplies the product to many small scale textile industries, they are still not familiar with these new technologies, they will place their order to wholesaler and distributors only.

Table 14 Pearson coefficient for effect of e-commerce on distribution activities

<i>Effect on sales and distribution activities</i>	<i>Pearson correlation coefficient</i>
Support sales effort	0.941
Increased market share	0.823
Online catalogue	0.341
Direct link with customers	0.029
Bullwhip effect reduction	0.445
Profiling	0.941
Third party logistics	0.016
Market intelligence	0.595
Any time service (24x7)	0.88
Fast product promotion	0.651
Reduce gap between demand and production	0.273

6.5.3 *Pearson coefficient for effect of e-commerce on supply chain performance variables*

In Table 15, highly correlated variable is ‘lead time’ with correlation coefficient 0.835 as with the adoption of e-commerce cut off many time consuming work such as paper work, purchasing process, manual entry of all the data, traditional logistics, thereby reducing the overall lead time of the product ordered by a customer. The second highly correlated variable is ‘cost’ when we cut off unwanted time consuming work in the supply chain, total cost incurred will reduce. The quality is moderately correlated because with the e-commerce adoption only we cannot improve our quality of products it need better technology, skilled workers, and modern equipment. Another performance measure is the ‘innovation’, it means using innovative methods in procurement, production and distribution supply chain, and to an extent it is possible with e-commerce adoption.

Table 15 Effect of e-commerce on supply chain performance variables

<i>Supply chain performance variables</i>	<i>Pearson correlation coefficient</i>
Cost	0.56
Quality	0.381
Lead-time	0.835
Innovation	0.225

7 Conclusions

The study was conducted to identify the factors affecting e-commerce adoption in a supply chain, identify the major effects of e-commerce on supply chain and to identify the supply chain performance variables. A supply chain remains competitive as long as all the members of the supply chain are working together to fulfil customer demand as quickly as possible. The SCM is the backbone of e-commerce, a very critical component of e-commerce. Responsiveness of supply chain will help us achieve target service levels or fill rates and minimises stock out possibility and hence maximises buyer-supplier benefits. Supply Chain Efficiency means having the right product at the right place at the right time, can save money/reduce costs, and can enhance cash utilisation. The study concluded that among the factors effecting e-commerce adoption competitive pressure, top management support, culture of organisation, reliability are having major significance. The second part of the study involves identifying the effect of e-commerce adoption on different aspects of supply chain. The study concludes in the procurement part, the highly correlated factors are online ordering, online fund transferring, and time savings. In the design and distribution part, better inventory management, better production planning and customer feedback are the highly correlated variables. The study shows e-commerce seems to have major effect on sales and distribution area. Results of study indicates that implementation of e-commerce can cause a greater increase in sales, market share, fast product promotion and any time service. These effects are highly correlated. Last part of our study indicates the supply chain performance variables affected by e-commerce implementation. Four supply chain variables are identified; they are cost, quality, lead time and innovation. The correlation analysis shows that the supply chain performance parameter 'lead time' is most importantly can be considered. The e-commerce adoption can results in considerable reduction in lead time. The second most affected parameter is 'cost'. Considerable reduction in cost occurred by cutting down unnecessary activities involved in supply chain.

Most of the larger companies have built-in capabilities in all these processes either by themselves or they are running different processes as different units but catering to a single demand. In effect, they are having a dedicated supply chain. Smaller companies need to interact and establish relationships with each other in their quest for market share. But these companies are impeded by the fact that they can contact the other companies only through immediate agents. This adds the cost of supply network considerably. Thus the e-commerce business network makes the communication between every business men more effective. E-commerce has become the backbone of supply chain management. Popsitar (2011) provides some effect of e-commerce on supply chain as cost savings, time savings, improved efficiency of purchasing process, greater control over supply chain, increased profit margin, improved relationship with suppliers, improved customer satisfaction, increased quality through increased visibility of supply chain, gaining competitive advantage.

7.1 Gain and limitations of the work

Results of the study include reference to companies to understand the factors need to consider before implementing e-commerce in the company. This study helps them to identify what are the benefits they will attain after the implementation of e-commerce in

each level of supply chain, how significant they are, and how it affects the performance variable.

The limitations of the study consist of the validation of the conceptual model is done in only one industry, extending the study to more industries can ensure more reliable and accurate results. The data is analysed by Pearson correlation coefficient only, extending the mathematical analysis to hypothetical testing can enable more reliable results. The study addresses only the benefits of e-commerce on supply chain, it do not cover the risk in adopting the e-commerce.

7.2 *Future scope*

The current study can be extended to more number of industries and hypothetical testing can be done. The study currently focuses on supply chain of manufacturing sector; it can be extended to the supply chain of service sector, successful e-commerce companies like Flipkart, Amazon.in, etc. The study can be diverted to find the negative effects and the risk in e-commerce-based companies.

References

- Anaton, L. (2014) 'Factors influencing supply chain competitive advantage and performance', *International Journal of Business and Information*, Vol. 9, No. 3, pp.311–344.
- Aydin, E. and Savrul, B.K. (2014) 'The relationship between globalization and e-commerce', *Procedia – Social and Behavioral Sciences*, Vol. 150, pp.1267–1270.
- Bakker, E., Zheng, J., Knight, L. and Harland, C. (2007) 'Putting e-commerce adoption in a supply chain context', *International Journal of Operations & Production Management*, Vol. 28, No. 4, pp.313–330
- Boone, H.N. and Boone, D.A. (2012) 'Analyzing Likert data', *Journal of Extension*, Vol. 50, pp.1–5.
- Cheng, K. and Bateman, R.J. (2008) 'E-manufacturing characteristics, applications and potentials', *Progress in Natural Science*, Vol. 18, pp.1323–1328.
- Chong, A.Y-L., Ooi, K-B. and Sohal, A. (2009) 'The relationship between supply chain factors and adoption of e-collaboration tools: an empirical examination', *Int. J. Production Economics*, Vol. 75, pp.185–197.
- Dooley, K. and Purchase, S. (2004) 'Factors influencing e-procurement usage', *13th Annual IPSERA Conference*, University of Catania.
- Gunasekaran, A. and Marri, H.B. (2002) 'E-commerce and its impact on operations management', *Int. J. Production Economics*.
- Khan, S.A., Liang, Y. and Shahzad, S. (2014) 'Adoption of electronic commerce by small and medium enterprises and their performance: a survey in SMEs in Pakistan', *American Journal of Industrial and Business Management*, Vol. 4, pp.433–441.
- Kurnia, S., Choudrie, J., Mahbudur, R.M. and Alzougool, B. (2015) 'E-commerce technology adoption: a Malaysian grocery SME retail sector study', *International Journal of Business Research*, Vol. 68, No. 9, pp.1906–1918.
- Lancioni, R., Schau, H.J. and Smith, M.F. (2003) 'Internet impacts on supply chain management', *Industrial Marketing Management*, Vol. 32, No. 3, pp.173–175.
- Patterson, K.A., Grimm, C.M. and Corsi, T.M. (2003) 'Adopting new technologies for supply chain management', *Transportation Research Part E*, Vol. 39, pp.95–121
- Min, H. and Galle, W. (2003) 'E-purchasing: profiles of adopters and non-adopters', *Industrial Marketing Management*, Vol. 32, pp.227–233.

- Otieno, O.F., Muthoni, N.N. and Simon, M. (2013) 'Factors affecting use of e-procurement: a survey in selected firms in KISSI Town, Kenya', *Interdisciplinary Journal of Contemporary Research in Business*, Vol. 5, No. 4, pp.589–621.
- Popsitar, C. (2011) 'Factors affecting e-procurement adoption', *International Conference – Marketing from Information to Decision*.
- Prasad, S. and Sounderpandian, J. (2003) 'Factors influencing global supply chain efficiency: implications for information systems', *International Journal of Supply Chain Management*, Vol. 8, No. 3, pp.241–250.
- Raghuram, P. and Saleeshya, P.G. (2015) 'Assessing the responsiveness of supply chain – structural equation modelling based approach', *International Journal of Logistics Systems and Management*, Vol. 25, No. 4, pp.558–579.
- Rahim, M. (2008) 'Identifying factors affecting acceptance of e-procurement systems: an initial qualitative study at an Australian city council', *Communication of the IBIMA*, Vol. 3, pp.7–17.
- Ranganathan, C., Teo, T.S.H. and Dhaliwal, J. (2011) 'Web-enabled supply chain management: key antecedents and performance impacts', *International Journal of Information Management*, Vol. 31, No. 6, pp. 533–545.
- Rath, R.C. and Sanghamitra, S. (2013) 'An overview of e-commerce practices of marketing on supply chain management: emerging business opportunities and challenges', *International Journal of Supply Chain Management*.
- Reddy, N.A. and Divekar, B.R. (2014) 'A study of challenges faced by e-commerce companies in India and methods employed to overcome them', *Procedia Economics and Finance*, Vol. 11, pp.553–560.
- Rodriguez, W., Zalewski, J. and Kirche, E. (2007) 'Beyond intelligent agents: e-sensors for supporting supply chain collaboration and preventing the bull-whip effect', *International Journal of E-Collaboration*, Vol. 3, No. 2, pp.1–15.
- Saha, R. and Grover, S. (2011) 'Identifying enablers of e-manufacturing', *International Scholarly Research Network*, 6pp, ISRN Mechanical Engineering, Article ID 193124.
- Saleeshya, P.G., Thampi, K.S. and Raghuram, P. (2012) 'A combined AHP and ISM based model to assess the agility of supply chain- a case stud', *International Journal of Integrated Supply Management*, Vol. 7, Nos. 1–3, pp.167–191.
- Subramanian, C. and Shaw, M.J. (2002) 'A study of the value and impact of B2B e-commerce: the case of web-based procurement', *International Journal of Electronic Commerce*, Vol. 6, No. 4, pp.19–40.
- Valverde, R. and Saade, R.G. (2013) 'The effect of e-supply chain management systems in the north american electronic manufacturing services industry', *Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 10, No. 1, pp.79–98.