

Adoption of IT Infrastructure to Enhance the Environmental Sustainability: Case of Supply Chain Businesses

*Saeed Ahmed**, *Muhammad Zubair Ahmed***, *Muhammad Zulqarnain Siddiqui****,
*Tauseef Iqbal Khan*****, *Qazi Shahab Azam*****

Abstract

This paper investigates the effect of the adoption of IT Infrastructure on environmental sustainability. The purpose is to strike a balance between the adoption of IT as a Supply Chain enabling tool and environmental sustainability. Many large organizations are directly responsible for creating an imbalance in nature through industrial contamination. However, with the development of the Supply Chain, has brought about awareness of pollution hazards that have endangered the environment. IT Infrastructure and its proper adoption can offer a viable solution ensuring environmental sustainability. This study focuses on how businesses can improve supply chain with the adoption of IT Infrastructure that will reduce carbon emission other sources of pollution. Qualitative research is conducted to study the impact and results are represented at the end of the research. In the research findings, it is concluded that the Horizontal Collaborative network for Supply Chain is the key to sustainability and the role of IT infrastructure is the dominant factor for improving Supply Chain.

Keywords: *IT Infrastructure, Supply Chain*

JEL Classification: *M1, M15*

INTRODUCTION

The consistently changing environment and the global warming phenomenon have derived the companies and organizations around the globe to understand and identify environmental issues and produce environmentally sustainable solutions. According to (Seuring & Müller, 2008), approximately two-third of the world leaders in the supply chain agree that sustainability will play a pivotal role in the supply chain in the future. It is clear through the customer's demand and consumer behaviour that the supply chain's perception of sustainability has shifted from 'it is good to have' to 'it is the need of the system'.

Correspondence:

** Assistant Professor, Iqra University, Saeed.ahmed@iqra.edu.pk,*

*** Associated Professor, Iqra University, zubair@iqra.edu.pk,*

**** Lecturer, Iqra University, zulqarnain@iqra.edu.pk,*

***** Lecturer Iqra University*

There is no doubt that the warehousing of goods, transportation, and the product has an evident impact on the carbon footprint of the organization (Winter, & Knemeyer, 2013). As a result of this, the companies have realized that it has become more important than ever to re-assess the current supply chain system and induce practices with reduced environmental impact; hence reducing cost and overall impact on the environment simultaneously. The role of sustainability in the supply chain is not only important for long-term profitability but it is also important for the reduced environmental impact of the company and suiting the corporate social responsibility of the company. For this purpose, the role of information technology is evident in companies. IT has become important and mandatory to achieve a responsive and efficient supply chain. The members of the supply chain i.e. customers, suppliers, and the companies; are linked through the flow of capital, material, and information (Taticchi, 2010). Information is the glue that holds this whole system of the supply chain together and information unlocks the responsiveness of the supply chain towards the demand. The use of information technology can inevitably improve the overall system of the supply chain.

Information technology has helped the companies around the globe with several tasks; improving efficiency and effectiveness of the overall system have been the pivotal role of IT in companies around the globe. Now as the companies are shifting their focus towards sustainability, IT can play an important role in this aspect. This paper is focused on the role of IT in the enhancement of the environmental sustainability of the supply chain system in companies around the globe.

Aims and Objectives

This study aims to evaluate the role of IT and IT infrastructure in the development of a better and sustainable supply chain business with a focus on environmental sustainability. For this purpose, the objectives of this report are:

- Assess of current supply chain
- Evaluate the current technological innovations available for the supply chain.
- Develop a sustainable supply chain model for the firms which will be environmentally friendly.

Research Questions

The research questions for this study are:

- 1 What is the role of IT in supply chain businesses?
- 2 How the role of IT can be used to develop an environmentally sustainable supply chain management system?

LITERATURE REVIEW

Theoretical Framework

Several theories encompass the subject of sustainable supply chain management. This research encompasses the following theories:

Resource-Based View

This theory ensures that enough strategic resource is available at the company's disposal for supply chain management. For a sustainable competitive edge, these resources can be used by the company for a better and sustainable supply chain management.

Transactional Cost Analysis

This theory ensures the cost-effectiveness of a company's transactional portfolio. According to Lee (1997), transactional cost analysis ensures that the difference in pricing is maintained within the limits provided by the market and trends. For a sustainable supply chain, the company can work with the transactional cost analysis to ensure that the supply chain is becoming sustainable as well as cost-effective.

Strategic Choice Theory

This theory is connected with the organizational structure and the working of the company regarding supply chain management. According to Caniato (2017), this theory signifies the role of leadership and management in sustainable supply chain management.

Just-in-Time Theory

This is an inventory strategy adopted by businesses in the supply chain. According to Fernie and Sparks (2018), the just-in-time paradigm ensures that the goods are delivered only when required increasing the efficiency of the overall system and decreasing the wastage, hence reducing inventory cost. The essence of this method is forecasting the demand appropriately. Sustainable supply chain management requires this theory to be adopted to ensure that resources are conserved and appropriate forecasting is done for efficiency and effectiveness.

Sustainability

Sustainability is the act of balancing what is called the iron triangle and that is time, cost, and quality. In all industrial practices across the globe, sustainability is becoming the top priority of the management agenda. Sustainability can be defined as the development which meets the present demand without compromising the future generation's ability to meet its own needs (Amer, 2014). The benefits which a company gain through sustainability are employee loyalty, brand loyalty, innovation, increased technological skills, better relations with the government, improved corporate reputation, and financial gains. Moreover, the act of sustainability ensures future supplies intact. The triple bottom line model best represents the sustainability model which encompasses around three fundamentals i.e. environment, society, and economy.



Figure 1: Triple bottom line model According to this model, sustainability can only be reached via encompassing the social, economic, and environmental aspects related to the organization. For the best sustainable practicing organizations, the same should follow all three fundamentals to become fully sustainable and reap the benefits of sustainability.

Supply Chain Sustainability

Supply chain management is the management of information, material, and finances through and from the company to the supplier and the end-user/customer. The supply chain can best be defined as the seamless integration of the overall business process from supply to end-user through the suppliers adding value to the customer support (Seuring & Müller, 2008). Each member in this value chain from source to consumption is a value-adder. The addition of value at each step calls for resource management and source handling. Nowadays, the supply chain is often mixed with sustainability for better outcomes suited as per organizational requirements and sustainability needs. According to Dania and Xing (2016), the management of capital flow, information, and material, as well as organizational corporation among companies on the line of the supply chain while addressing the three sustainable development dimension from triple bottom line model i.e. social, environmental, and economic; which are originally derived from stakeholder and customer's requirement, is known as sustainable supply chain management.

It is evident through the current global practices of the companies that they are striving towards sustainability in their workflows. According to Goyal and Rahman (2014) being environmentally friendly and going green is the future way. To meet the futuristic requirements, companies are making the production and delivery system more efficient and environmentally friendly with the minimum carbon footprint. Complex processes are being tasked down into small environmental free processes. Saving natural and non-renewable resources is the major goal of all such activities. Malik and Abdallah (2016) state that this is the 'right choice' adhering to the future and making this world a better place to live. The important aspects while considering the sustainability of the supply chain is to know where the raw material is coming

from, who the suppliers are, what is the delivery mechanism, and how the system reduced carbon footprints and how it can be optimized (Pagell, 2014).

The ideal starting point for sustainability in the supply chain can be considered as the process which is considered as the domain. The literature related to sustainable supply chain management is gradually growing since this new phenomenon is ever-changing with the technological and innovative changes across the globe.

Environmental Friendly Practices

The supply chain is the planning, sourcing, and making, delivering, and returning as defined in Supply chain operation references. From the cradle to the grave, the entire chain needs a revisit of business practices. For industries, that begin with procurement, the fundamental principle involves all stakeholders are taken on board. The concern is obvious to raise the focus on environmental sustainability from purchasing practices that encourage only those suppliers as potential who are ready to work on the sustainability model. This includes revamping the eco-friendly environment, selection criteria of suppliers, less paperwork, emphasizing e-procurement, pollution-free transportation, lean warehouse practices, and induction of biodegradable products. Not only will this ensure environmental nurturing, but this is also concerned with production size and inventory management. According to our sustainability understanding, the industry will closely monitor the market and produce under demand just to avoid wastages, overproduction and hence that will contribute to saving resources for future generations.

Information Technology and Sustainability

Information Technology (IT) is a critical enabler of sustainability. This is because IT increases the efficiency and effectiveness of any process by reducing the repetitive actions, and optimizing the overall process. Seuring and Müller (2008) considers information as the biggest driver is performance is the supply chain since it provides foundations on which the whole system of supply chain manages decisions and executes transactions. The integration of IT with supply chain processes improves visibility across the chain. This information provides the management with the opportunity to make the system of the supply chain more efficient and responsive, hence can be concluded that good information is a prerequisite for the sustainable supply chain management. According to Amer and Eltawil (2014), the investment in IT to improve the supply chain and make it more sustainable would not work until the required information is provided. The role of Information Technology in the supply chain lies in better and reliable delivery of information and sharing of the information for coordination purposes of competitive initiatives, improving collaboration and communication. Accessible and accurate information that is suitable for all levels should be shared across the organization. However, the result in the current scenario is investing in IT infrastructure a lost cause. Effective management of IT in such a case could result in significant contributions both as a tool as well as a driver to overcome the implementation barrier. According to Kayikci and Zsifkovits (2013), there is an increased need for cooperation and collaboration among partnering companies as well as rival companies. 'Horizontal collaboration network' in the supply chain is a phenomenon based upon this increased communication, cooperation, and collaboration among companies (Diabat, 2014). This horizontal collaboration requires more than one company to bind with each other enabling the sharing of supply chain networks with each other. Although this solution is

applicable but requires better communication and information sharing among the companies as the size of the supply chain would increase exponentially in case of sharing. Deployment of IT infrastructure and the development of fast technological methods of communication is important and essential for such sustainable targeted growth in supply chain settings.

METHODOLOGY

There are two basic types of research methods that are used in business research i.e. qualitative and quantitative research (Matthews, 2014). This study has used qualitative research methodology to answer the research questions and resolve the research aims and objectives. The qualitative research has a primary concern of exploration of the problem. This is used to gain an in-depth understanding of the factors like motivation, opinions, and reasons. It provides an insight into the problem and is used to uncover trends, and dive deeper into the problem. This research will use a qualitative approach to uncover the trends of supply chain and specialize in a deductive approach to evaluate the impact of IT on the sustainability of the supply chain business.

Research Strategy

Further on, this research has adopted a strategy of literature review to answer the questions relevant to existing techniques and technologies used in the supply chain (Matthews, 2016). There is an extensive amount of research that has already been conducted in the sustainability of supply chain business and the influence of IT in the supply chain business. This research has successfully used the existing researches and literature to evaluate the impact of IT infrastructure adoption on environmental sustainability in the case of supply chain businesses.

Ethical Consideration and Limitations

There are a few ethical considerations in the research. Special care is taken while using existing literature, yet to ensure that each researcher and paper used is properly cited and provided with proper acknowledgment through citation and referencing (Lather, 2013). Lastly, the research has a limitation which is the lack of data on IT in the supply chain. As this is a new phenomenon which has been adopted a decade ago, less literature is available on the subject of this study.

RESULTS AND DISCUSSION

There are four steps to increase the sustainability of supply chain management. These steps require IT infrastructure as their core competency and essential deriving tool to develop better sustainability results.

Mapping Supply Chains

Events throughout the world can result in disruption of the supply chain and can also damage brand reputation. Despite these types of risks, organizations possess optimum visibility of their supply chain beyond the first supplier tiers. Having optimum visibility of the extended supply chain provides an opportunity for organizations to develop an in-depth understanding with the potential risks and to map suitable contingency plans to minimize the impact of a

supply chain disruption in the organization along with integrating suppliers on their bottom line

Several companies are unaware of the impact of sustainability on the supply chain. An early step in this regard could be to identify the most significant social and environmental challenges, inventory suppliers, and prioritize efforts with the suppliers. According to Yan and Dooley (2014), companies can even reduce their suppliers as a part of sustainability against performance criteria. For this purpose, the most essential tool which could be used is a computerized system with proper data of inventory, sale, and supplier. Comparatively, it is difficult to calibrate and assess manual data as compare to computerized data which could be assessed and evaluated through computer programs enabling the company to make a proper decision and appropriate changes to the existing system strategically (Brandenburg, 2014).

Communication of Expectation

Focusing on sustainability protocol within the supply chain is the best way to communicate the culture and values of the corporation to the customers as well as suppliers. Communicating and establishing expectations by the use of code of conduct for the supplier could be a critical step in incorporating suppliers into the sustainability efforts by the company/ organization (Beske & Seuring, 2014). For this purpose, the companies can use the best communication technology for appropriate and efficient delivery of information and messages. In the current competitive world scenario, timely delivery of information and communication is the key to the success of all organizations. This can be reached through an appropriate communication channel that can be developed through the appropriate deployment of IT infrastructure.

Supplier Performance

There should be a compliance standard set for the target suppliers. For this purpose, proper research and survey is required to assess the suppliers and suggest those changes for the organizational requirements of sustainability (Ahi, 2013). This assessment becomes the starting point for the improvement of future programs and supply chain management systems. To retain a supplier, the company must communicate back to the supplier with suggestions and recommendations enabling improvement in the working of the supplier towards a sustainable business environment.

Join Industry Collaboration

Once the supplier performance is made clear to the organization, an audit program can ensure the authenticity and reliability of the data provided by the supplier. The companies would also require an inevitable collaboration in the future. Many companies currently recognize the need for a complex supply chain management system through collective efforts in an industry-wide spectrum. This collaboration will be in the field of the supply chain to ensure the sustainable delivery of products, raw material, and information. As a practical example of this collaboration, consider companies selling products in a target market (Pagell, 2014). A respective company would have to deliver goods irrespective of the carrier being filled fully or not. In such a case, the transportation of products happens with the transportation network not being used efficiently. On several occasions, the transportation network has to deliver at half of its capacity due to the customer's requirement of timely delivery of products.

Forms of Supply Chain Collaboration

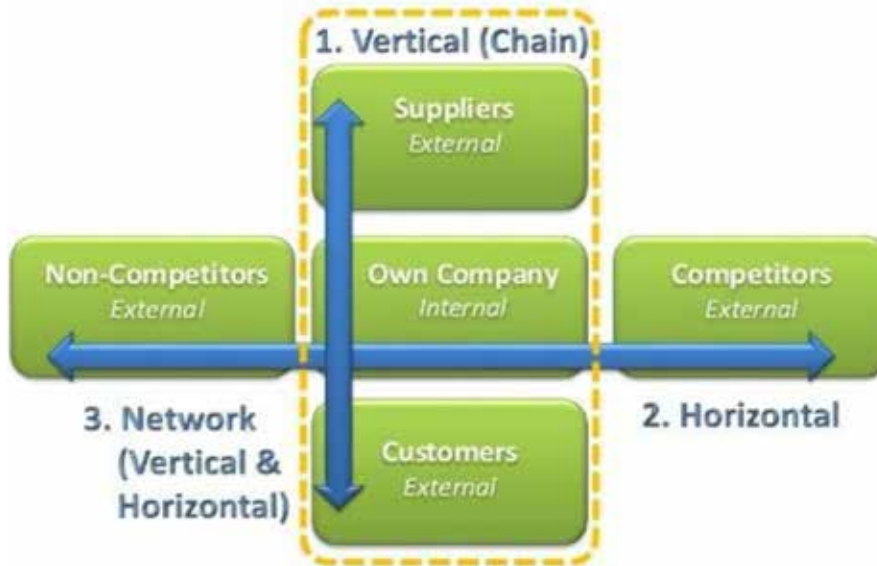


Figure 2: Horizontal Collaboration Network Horizontal collaboration network can be created among companies and organizations in a similar industry as well as different industries to ensure efficient and effective use of the supply chain system. This collaboration will help in the prevention of audit problems, redundancy in training, and the problem with the suppliers. Working with industry peers is a viable solution for sharing knowledge and resolving sustainability problems for the company and the industry (Beske & Seuring, 2014).

Through a sustainable and mature supplier program, a company can:

- a) Deploy and develop robust tracking tools, including software solutions and supplier tracking programs.
- b) Invest in the supply chain for better and fruitful results. As several companies will be equally investing in the supply chain, hence it would require lower investment by each for up-gradation and development.
- c) Assess logistics to determine the sustainability context.
- d) Incorporate a sustainable supply chain into procurement for better results.
- e) Encourage and evolve innovation. All these aspects are possible only through the development and deployment of appropriate IT infrastructure. This is because this horizontal collaboration of supply chain among companies will result in a complex supply chain system that can only be controlled through automation and proper IT infrastructure and tools. Manual supervision and control of such a system are not possible with horizontal collaboration.

Collaborative product Commerce

The implementation of sustainability through the deployment will remain a question unless the prime stakeholder customer is involved as the partner of horizontal integration. The integration of the supply chain with IT as an enabling tool is the cost incurring program. The acceptability of the overall supply chain cost by the end-user can encourage the firm to go

for sustainable solutions. Industries can be encouraged to implement environmentally friendly practices at the mutual benefit of future indemnity and the buyer's choice to go for the green.

CONCLUSION

International trade and capital flows contribute to sustainable economic growth and development. Moreover, these businesses also provide a base for attaining environmental and social objectives. When supply chain practices of international trade and environmental sustainability are mutually supportive, the contribution of each aspect to sustainable development is improved. It is crucial for supply chain businesses to reinforce coherent practices, to have growth in a sustainable environment with the integration of advanced technology.

Technological development and scientific progress are some of the major forces that possess a potential for improvement in living standards and productivity. Advanced technologies provide considerable promise for decoupling economic development from prolonged environmental sustainability. The primary contribution of this research study is to assess the different patterns of IT adoption through integrated supply chain and sustainable environment theories. This research study is attributed as one of the studies that investigate the organizations' inner and exterior aspects that motivate for IT adoption. This is the first integrative approach towards examining IT infrastructure from the perspective of supply chain management. It concludes that IT infrastructure is the most important component of sustainable supply chain management. However, this is still a requirement for comprehensive development of all i.e. supply chain management, IT infrastructure, and sustainability.

Despite the limitations, this study is a contribution to the quest of defining sustainable supply chain management concerning the IT requirements of the same. Hence it presents a relevant frame of reference for future research. The study has also taken into consideration the potential impacts on business as with the adoption; the customers are willing to put their preferences in environmental safety business practices.

REFERENCES

- Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of cleaner production*, 52, 329-341.
- Amer, L. E., & Eltawil, A. B. (2014, October). Collaborative sustainable supply chain network design: state of the art and solution framework. In *Proceedings of the 44th International Conference on Computers & Industrial Engineering, CIE 2014* (pp. 479-493).
- Beske, P. & Seuring, S. (2014), "Putting sustainability into supply chain management", *Supply Chain Management*, 19(3), 322-331.
- Brandenburg, M., Govindan, K., Sarkis, J., & Seuring, S. (2014). Quantitative models for sustainable supply chain management: Developments and directions. *European journal of operational research*, 233(2), 299-312.

- Dania WAP, Xing K, Amer Y (2016) Collaboration and sustainable agri-food supply chain: a literature review. In: *MATEC web of conferences. EDP Sciences, 58*, p 02004
- Diabat, A., Kannan, D., & Mathiyazhagan, K. (2014). Analysis of enablers for implementation of sustainable supply chain management—A textile case. *Journal of cleaner production, 83*, 391-403.
- Fernie, J., & Sparks, L. (Eds.). (2018). *Logistics and retail management: emerging issues and new challenges in the retail supply chain*. Kogan page publishers.
- Goyal, P., & Rahman, Z. (2014). Corporate sustainability performance and firm performance association: A literature review. *International Journal of Sustainable Strategic Management, 4(4)*, 287-308.
- Kayikci, Y. and Zsifkovits, H. (2013) Successful ICT integration in transport collaboration, in T. Blecker et al. (eds), *Pioneering solutions in supply chain performance management*, vol. 17 – Supply chain, logistics and operations management, Cologne: Josef EUL Verlag.
- Lather, P., & St. Pierre, E. A. (2013). Post-qualitative research. *International journal of qualitative studies in education, 26(6)*, 629-633.
- Lee, H. L., Padmanabhan, V., & Whang, S. (1997). Information distortion in a supply chain: The bullwhip effect. *Management science, 43(4)*, 546-558.
- León-Bravo, V., Caniato, F., Caridi, M., & Johnsen, T. (2017). Collaboration for sustainability in the food supply chain: A multi-stage study in Italy. *Sustainability, 9(7)*, 1253.
- Malik, M. M., Abdallah, S., & Hussain, M. (2016). Assessing supplier environmental performance: applying analytical hierarchical process in the United Arab Emirates healthcare chain. *Renewable and Sustainable Energy Reviews, 55*, 1313-1321.
- Matthews, B., & Ross, L. (2014). *Research methods*. Pearson Higher Ed.
- Pagell, M., & Shevchenko, A. (2014). Why research in sustainable supply chain management should have no future. *Journal of supply chain management, 50(1)*, 44-55.
- Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of cleaner production, 16(15)*, 1699-1710.
- Taticchi, P., Tonelli, F. and Cagnazzo, L. (2010), "Performance measurement and management: a literature review and a research agenda", *Measuring Business Excellence*, Vol. 14 No. 1, pp. 4-18.
- Winter, M., & Knemeyer, A. M. (2013). Exploring the integration of sustainability and supply chain management. *International Journal of Physical Distribution & Logistics Management*.
- Yan, T., & Dooley, K. (2014). Buyer–supplier collaboration quality in new product development projects. *Journal of Supply Chain Management, 50(2)*, 59-83.