



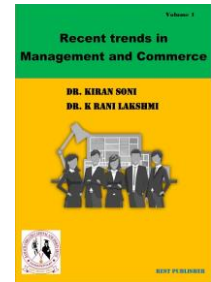
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### Role of Smart City Development in Supply Chain Performance

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#### Abstract

Smart city concept has become quite popular among the nations worldwide. Governments of various countries have launched smart city initiatives in the anticipation of transforming their existing cities into more technologically advanced cities equipped with the requisite intelligence to deal with the realistic problems. The definition of smart city is now seen as the future of urban development, and within years the cities of the entire world will transform into smart cities, possessing an integrated framework of infrastructure and technology which will not only enhance the living standards of people, but also will provide the citizens with a better connectivity and transparency to interact in the urban environment. No doubt this transformation will affect every segment constituting in the today's world, but this study is solely focused to analyze the impact of this smart city development on the prevailing practices of supply chain management and assessing the consequent advancements that will occur in the supply chains due to this modernization.

**Keywords:** Supply Chain Management (SCM), Internet of Things (IoT), Big Data Analytics (BDA), Information and Communication Technology (ICT)

#### 1. Introduction

The contemporary world is equipped with various technological tools and resources which ease the existence of human civilization (Fulk, 2017). Today's technology provides the world with immense opportunities of dealing with the realistic problems more efficiently and effectively, paving a way towards a healthy and modern environment (Mettler, 2016). With continuous technological advancements, the present world is way more aware of their surroundings, communication network has enhanced, industrialization is escalating with the help of modern automated tools, and the concept of sustainable practices has evolved (Anthony Jr, 2020). Thus, the various advancements in the technological world has transformed the entire world to an easier, faster and a better place to live (Goswami et al., 2020, Bahrini and Qaffas, 2019). Although there are a lot of advantages associated with today's technology (Hytha et al., 2019), there still exists a lot of challenges that need to be overcome (Edquist, 2010). There are various possibilities to enhance, evolve and develop the contemporary technology to such an extent so that the world could be converted into a better and improved form where people, governance, environment and the living could be transformed to a smarter version of themselves, which will be capable of tackling with the several issues associated with the society (Su et al., 2011). This incorporates the need for the concept of 'smart cities' and its implementation in the various parts of world (Nam and Pardo, 2011, Angelidou, 2014). Smart city comes up with an idea of the optimum usage of the available resources and efficient utilization of space so as to ensure effective functioning of all the prevailing systems (Hall et al., 2000). Better connectivity, better utilization of time, efficient money investment and their integrated framework including environment friendly practices are some of the characteristic factors for the smart city development (Neirotti et al., 2014, Öberg and Graham, 2016). Governments corresponding to different nations are working on the smart city projects to transform their city into a superior form of themselves. Smart city transforms all of the elements existing in the present-day world to a large extent (Hasija et al., 2020). Many research works are already present associated with smart city development (Caragliu and Del Bo, 2019, Sharifi, 2019, Komninos et al., 2019), but none of them is specifically concerned regarding the impact of smart city development on the supply chain mechanisms and its functioning. This study aims to fill the research gap by providing an assessment of the advancements which will occur in supply chain practices by analyzing the advancement in each element individually which constitute supply chain. The study attempts to answer the following questions

- What is meant by the term 'smart city' and what are the various elements associated with it?
- What are the various elements related with supply chain management?
- What is the impact of smart city development on supply chain management and what are the consequent advancements in SCM?

The study aims to answer these questions with the help of the following research objectives:

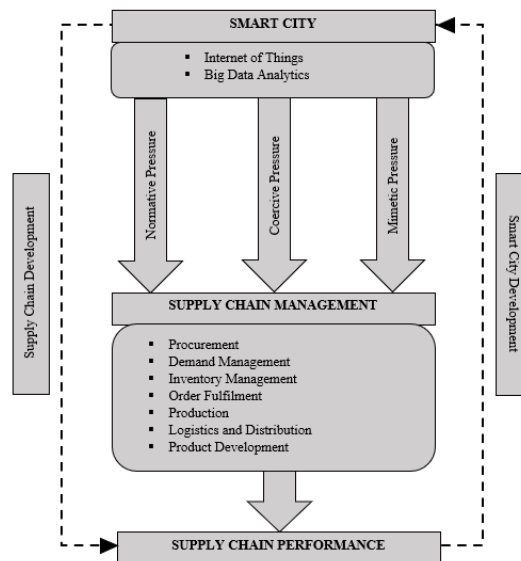
- Explain the term 'smart city' and recognizing various elements associated with it.
- Identifying the elements related with supply chain management.

- Analyzing the advancements in supply chain management due to smart city development. The paper is arranged as follows: Section 2 surveys the literature on smart city and its components followed by normative, coercive and mimetic pressure. Then the study shifts towards supply chain management and its element, and finally ends its literature part on supply chain performance. Section 3 presents the concluding remarks.

## 2. Literature Review

This section consists of literature on smart city, supply chain management and their associated elements.

**Smart City:** Smart cities are defined as the cities which use an integrated framework of technology and infrastructure to enhance the quality of living and improve the interactions of citizens with modern surroundings. The 'smart city' concept is based on the sole aim of the optimum usage of available space with efficient utilization of accessible resources in order to frame an effective system with sustainable practices for the co-existing society (Lombardi et al., 2012). Smart city is an integrated framework consisting of six components; Smart economy, Smart environment, Smart mobility, Smart governance, Smart people and Smart living (Hall et al., 2000). Thus, smart cities make the use of latest information and communication technology in transforming the conventional functioning of government, living of citizens and environment-friendly practices.



*Figure 1: An integrated framework of Smart city and Supply Chain Performance*

**Internet of Things (IoT):** The term IoT stands for Internet of Things. IoT primarily refers to all the devices which are connected to internet worldwide (Ashton, 2009). These devices are interconnected with each other via internet and thus can communicate by share information with each other (Tan and Wang, 2010). The specialty of IoT is that these devices can be monitored and regulated remotely. IoT is the primary factor which possess the power of revolutionizing the world into smart city framework (Zanella et al., 2014). In a smart city framework, the data is collected with the help of various IoT sensors and then subsequently utilized in reforming the resources, services and assets effectively.

**Big Data Analytics (BDA):** Big Data Analytics refers to the analysis of massive sets of data in order to reveal the hidden patterns and correlations, so that the enterprise may obtain meaningful information from it (Russom, 2011). Big data analysis along with the information and communication technology (ICT), facilitates smart city development to a large extent (Gandomi and Haider, 2015). Smart city sensors utilize this technology to collect data from different smart city gateways pre-installed in the cities, and then assess them for furthermore analysis (LaValle et al., 2011). Big data analysis can be utilized in various sectors such as security, sustainability and city planning.

**Normative, Coercive and Mimetic Pressure:** The primary influences which drive the change in supply chain management in the era of smart city development are institutional pressures (Khor et al., 2016, Glover et al., 2014). These institutional pressures are defined as the pressure which institutions exert on different organizations/individuals via imposing some restrictions, setting norms etc. (Liu et al., 2010). The institutional pressures can be categorized furthermore as normative, coercive and mimetic pressure. Normative pressures include the social pressure on the organization to follow certain norms. Coercive pressure is an organization's response to the formal and informal influences by other organizations. Mimetic pressure depicts the imitation of other organizations to deal with uncertainty.

## 3. Supply Chain Management

Supply chain management is defined as the management of goods and services, starting from the point of origin to the point of consumption. It involves the proper management of flow of inventory, flow of capital, and flow of information across the entire supply chain (Mentzer et al., 2001). It encompasses all the activities that involves the transformation of raw material into finished products, maximizing the customer satisfaction and competitive gain.

**Elements of supply chain management:** The various elements associated with supply chain management are discussed in detail in Table 1. The subsequent developments and advancements in each of the elements are also shown.

**Table 1: Elements of Supply Chain Management and their Advancements**

<b>ELEMENT</b>	<b>DESCRIPTION</b>	<b>DEVELOPMENT IN THE ERA OF SMART CITY</b>	<b>REFERENCES</b>
<b>Procurement</b>	Procurement refers to the acquisition of goods, products or services from external sources by an enterprise depending upon its requirement to fulfill its business model.	Modern technologies may facilitate procurement process by increasing the collaborative power, analytics and engagement utilising digital tools such as AI (Artificial Intelligence) and IoT (Internet of Things). This integrated framework of digitalisation along with procurement is often termed as ‘digital procurement’, which is responsible for integrating data across supply chains.	(Nicoletti, 2018, Klünder et al., 2019)
<b>Demand Management</b>	Demand Management primarily focuses on analyzing the levels of consumption, and then looking for options to alter the consumption pattern in order to minimize the total cost. It involves the proper balancing of customer’s needs with the capabilities of supply chain. The sole aim of demand management is to provide the best value at the least cost to the demand chain.	The use of digital technology such as IoT (Internet of Things) and ICT (information and communication technology) will lead to an accurate prediction of demand, and thus eventually help in forecasting and demand analysis, reducing the costs significantly.	(Rexhausen et al., 2012, Bolton, 1998)
<b>Inventory Management</b>	Inventory management refers to the regulation of an enterprise’s inventory and the maintenance of proper inventory levels. Inventory encompasses all the goods: in raw form, in processing or finished products that an enterprise holds in its supply chain.	With the availability of real-time data and automated systems, the inventory management will be eased as the inventory systems will be capable of triggering the orders at right time and in proper quantity. Accurate demand forecasting and low and high inventory alerts and automatic replenishment systems will facilitate the inventory system and multi-location tracking including real-time tracking systems will transform the way inventory management functions in the conventional world.	(Liu et al., 2020, Cachon and Fisher, 2000)
<b>Order Fulfilment</b>	Order Fulfilment refers to the way of responding the customers’ orders by an enterprise. It comprises of many processes, such as payment clearance, in-stock availability, packaging, shipment and then reverse logistics.	Digital order fulfilment has already arrived in the market. Online shopping platforms with enhanced features such as face and body scan in order to check the correct fit for garments, cloths and relevant accessories are some examples of digitalization. Customized accessories and clothes are available in market which have completely transformed the conventional purchasing and buying strategy. With IoT and introduction to AI, there are immense possibilities of recreating order fulfillment with less time elapsed and fast shipments, along with well-managed reverse logistics.	(Saberi et al., 2012)
<b>Production</b>	Production is defined as the process of converting raw materials into finished products. The core manufacturing department is the most prominent sector of any supply chain. The inputs required for production are facilities, processing machines and equipment and the inventory.	Digital manufacturing technology consists of advanced robotics, 3D printing and cloud computing. These advancements in technology enhances the accuracy and precision of work as well as mitigates the risk of failure and damage. Big data analytics facilitates production by converting massive data into actionable information with the help of machine learning and data visualization techniques.	(Mayr et al., 2018, Wagner et al., 2017)
<b>Logistics and distribution</b>	Logistics and distribution refer to the flow of things between the supplier (origin) and the end customer. Thus, logistics encompasses all components in a supply chain such as information flow, planning, inventory, transportation and facilities.	Logistics collaborate with digital technology in order to give optimal performance. With the use of smart transport system, smart containers, and smart vehicles, all interconnected with a network, logistics services become fully automated and controlled. This not only enhances the efficiency, accuracy and saves time, but also increases supply chain transparency and in turn the overall performance.	(Barreto et al., 2017, Strandhagen et al., 2017, Timm and Lorig, 2015, Winkelhaus and Grosse, 2020)

<b>Product Development</b>	Product development consists of all the associated activities required to launch a product in market right from the scratch. It involves recognizing the requirement of market, thinking on the problem, coming up with a solution and reshaping it into a product. Subsequently, the marketing and competitive strategy decides the success of the product in the market.	The arrival of intelligent technology such as big data analytics, IoT, cloud computing and mechatronics, the shape of industry is transforming and its functioning is upgrading. Product development could be done on another level with the help of Artificial Intelligence and robotics. Automation of industries are leading to the formation of an extensively smart environment, where product development will be carried out intelligently.	(Nunes et al., 2017, Santos et al., 2017)
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**Supply Chain Performance:** Supply chain performance can be improved consequently, when advancements in digital technology collaborate with supply chain management (Beamon, 1999). Cost-efficiency increases and responsiveness enhances due to smart city development. Thus, efficiency and agility both are maintained in a proper strategic fit, in turn enhancing the supply chain performance.

#### 4. Conclusion

Smart cities are recognised as the future of urban development. The upcoming era is going to encounter the transformation of all cities into smart cities, equipped with all the intelligent systems and digital technology to regulate its functioning. In this transformation, supply chains are the prominent part which will get affected. Supply chain management will undergo vital changes which will lead to its advanced form in the new smart city era. In this regard this research work assumes its significance in providing an insight to the future of supply chain management in the upcoming era of smart city. This study can be used for further analysis of these advancements in the supply chain elements and their dependency and driving power by using MICMAC analysis. A systematic model of these advancements in the supply chain elements can be obtained using Interpretive structural modelling (ISM) technique.

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