A STUDY OF IMPACT OF IOT ON SUPPLY CHAIN AND PROCUREMENT IN A PHARMACEUTICAL COMPANY

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Abstract - Internet of things (IoT) is being used along with other technologies like Big Data, Artificial Intelligence to achieve objectives like speed, agility, security and traceability in Supply chain. This strengthens the supply chain management and credibility of services provided by the organizations. In this paper, we explore how Internet of things applications are being used in Supply chain and its impact on Procurement, and Materials management of a pharmaceutical company. We identify the facilitators and barriers for implementation of IoT which the firm faced. The insights generated by this study can be utilized by practicing managers to plan the implementation of IoT and prepare risk response actions for potential risks.

Keywords - Internet of Things; Supply Chain; Procurement; Pharmaceutical

I. INTRODUCTION

Emerging technologies like Artificial Intelligence (AI), Machine Learning (ML), and Internet of things (IoT) are transforming the future of businesses. There has been a huge emphasis on how these technologies are impacting the strategic functions and enterprise business functions. Beyond just looking for cost savings, Internet of things (IoT) is being used along with other technologies like Big Data, Artificial Intelligence to achieve objectives like speed, agility, security and traceability in Supply chain. This strengthens the supply chain management and credibility of services provided by the organizations. IoT facilitates machine-enabled decision making by constantly monitoring the parameters of production process and through the use of technologies like wireless sensors, RFID tags, mobile apps etc. (Zhou et al, 2015). It can accelerate the flow of information throughout the supply chain, and the material flow can be tracked and traced over the IoT.

Pharmaceutical companies operate in complex supply chains comprising of vast numbers of causative ingredients' suppliers and components to drug production. The new serialization regulation necessitates inventory of pharmaceutical companies to be auditable throughout each stage of supply chain. The Pharmaceutical companies require continuous monitoring of live temperature, humidity, physical position of their raw materials and final product to ensure traceability of drugs produced. The traditional ERP system though provided some functionalities it does not have big data analytics and IoT features built into it. Therefore, the pharmaceutical companies are exploring application of IoT to increase visibility of their supply chain and their procurement and materials management (Pachayappan, 2016). In this paper, we explore how Internet of things applications are being used in Supply chain and its impact on Procurement, and Materials management of a pharmaceutical company. We identify the facilitators and barriers for implementation of IoT which the firm faced. The insights generated by this study can be utilized by practicing managers to plan the implementation of IoT and prepare risk response actions for potential risks.

II. LITERATURE REVIEW

Abdel-Basset et al. (2018) applied the internet of things (IOT) in supply chain management (SCM) through building a smart and secure system of SCM. The authors proposed an efficient framework which integrated (N-DEMATEL) technique with AHP is and helped researchers to design secure system of supply chains. Qiu et al. (2015) identified that the emergence of Internet of Things (IoT) offers a possible solution to achieve real-time visibility and information sharing, as well as appropriate level of intelligence. The authors proposed an IoT-enabled SHIP for enhancing the effectiveness and efficiency of sharing physical assets and services. Papert and Pflaum (2017) developed a theoretical IoT ecosystem model using grounded theory methodology. The model comprised of 19 different roles, their relationships and value contributions that can help companies understand the implementation of IoT services, to find the right partners with which to cooperate, and to establish their own ecosystem.Li (2011) suggested that internet of things can manifest advantage in the green supply chain management of agricultural products, and can provide the future direction of agricultural information.Sun et al. (2011) proposed an IOT-based supply chain information-sharing platform SOA architecture that utilized dynamic, real-time of IOT technology. It resulted in increase of information acquisition speed of all nodes in supply chain and promoted information transparency.

Yuvaraj and Sangeetha (2016) proposed a supply Chain simulation platform system for application of IoT technology in supply chain management. This

system provided full range of search service and visualization for the customers of mobile commerce.Hiromoto et al. (2017) proposed the development of a cyber-secure, Internet of Things (IoT), supply chain risk management architecture. The proposed architecture was designed to reduce vulnerabilities of malicious supply chain risks by applying machine learning (ML), cryptographic hardware monitoring (CHM), and distributed system coordination (DSC) techniques to mitigate the consequences of unforeseen (including general component failure) threats. Ben-Daya et al. (2019) explored the role of Internet of Things (IoT) and its impact on supply chain management (SCM) through an extensive literature review. Important aspects of IoT in SCM were covered including IoT definition, main IoT technology enablers and various SCM processes and applications.

Pachayappan (2016) proposed a two layered network architecture of IoT platform comprising of radio frequency identifications and wireless sensor network layer that can track and monitor the goods during transportation, avoid the physical damages due to moisture, humidity and counterfeit drugs.Jara et al. (2010) proposed a solution to examine drug related problems based on IoT technologies, i.e. smart phones and Web to support ubiquitous Access, 6LoWPAN technology to support ubiquitous data collection of patients, sensors and hospitals, and RFID/NFC to support global identification.Hernández and Yamaura (2017) presented how IoT enabled solutions such as 5G wireless network, device miniaturization, AI and Machine to Machine (M2M) can be used to minimize the wastage risk of pharmaceuticals due to temperature excursions. Table 1 below highlights the key aspects of pharmaceutical context and how different elements of IoT can be leverage.

Key aspects in pharmaceutical context	Useful elements of IoT
Regulatory requirements and certifications from government agencies	Online uploading of data
Temperature monitoring	Sensors for temperature monitoring
Composition of drugs during their life	Composition monitoring
Impact of drug patients	Patient monitoring through body sensors
Online prescriptions	Online data availability

Table 1: IoT element in pharmaceutical context

III. METHODOLOGY

Telephonic interview was used as for data collection. Owing to the circumstances and feasibility, telephonic interview was the effective mechanism possible to collect data. Our aim was to check if the company uses Internet of things in their supply chain operations and how it has changed the way things were processed in the past and in the present. We also discussed things about how the future of procurement and materials management is going to be in the future and the challenges that companies will face when they try to adopt to these technologies. Also the penetrations rate and if these technologies will really disrupt the supply chain or not was also discussed. The research findings are given in the consequent data.

IV. DATA ANALYSIS

A. Impact of IoT on Supply chain:

The internet of things, as the name itself suggests provides the ability to collect more information. With increasing operations and expanding businesses, the amount of data is increasing enormously and handling such a data is difficult by procurement can lead to human errors. It is especially very valid when monitoring supply chains. This is the foundation for keeping Big Data engine running and improving.

At the pharmaceutical company, procurement functions are also on the brink of change with the implementation of IoT and future looks really positive. The company's focus has been completely shifted to drive value to the business and to automate most of the transactional activities freeing up resources to focus on other strategic business functions.

The internet of things has many unprecedented opportunities to digitally enable the supply chain and to create solutions that combine physical products and services. This will revolutionize the Supply chain in both operational and revenue opportunities.

B. Ways to implement IoT in companies that never used before:

Companies can start with digitizing the regular functions in the company and slowly move to further digitize the supply chain. The goal of using IoT in Supply chain is to ensure end-to-end visibility not just to the stakeholders but also to the customers. In an industry like Pharmaceuticals, its not just important to meet customer demands but also to save lives of customers.

So, a well-orchestrated network, where information flows with utmost transparency, the monitoring of seamless supply of medicines will improve. This is only possible by thinking through the customers' perspective.

C. IoT support to move Pharma to e-commerce:

Traditionally, pharma sector is subjected to many regulations compared to others, so there will be quite a few challenges to privacy of point of sale information will be restricted. The rise of IoT is on one side leading to growing interest by the whole industry, and on the other side, the rapid rise of many specialized third-party players, who could help us deal with useful aggregated data, while at the same time ensuring confidentiality of the patient.

However attempts to overcome the limits set by the physical prescription have become more and more common now and patients are shifting to online prescription, ordering and processing delivery is slowly becoming common.

D. Effect of IoT on Procurement:

Since most of the functions in the supply chain will be digitized and automated with the help of IoT, there will not be any physical intervention that has to be done from procurement team. This automated function can put the procurement function well advanced in time. This way IoT helps in increasing spend visibility and better understanding of supply chain activities. This will help your procurement team improve catalogue content and spend management by knowing exactly what is being used and exactly what is needed. Improvement in budget and contract management can be affected by the ability to predict these needs more accurately. As devices become smarter, more mobile and connected, the devices used to manage them need to do the same. Mobile procurement will become an even more important part of your procurement strategy. On the purchasing side, your users and employees will need their procurement workflows to be mobile and connected just like everything else in their lives.

The other effects IoT has on procurement are given below.

i) Asset tracking:The past lies in tracking numbers and barcodes. Now it's the time of RFIDs and GPS sensors that can track products from store to floor. This data can help in enhancing quality control

ii) Vendor Relations:This data that is being obtained by asset tracking can be used by companies to alter their own production schedules. This helps in handling the vendor relationship better.

iii) Connected fleets and scheduled maintenance:The data that is generated using IoT can be a big winner. If we spend money on the data analytics, it can help boost the deliveries, rectify bottlenecks, do predictive maintenance enabling us to deliver faster. Table 2 below summarizes the IoT actions in procurement and their benefits.

IoT actions	Benefits
Automate purchasing transactional activities	Mobile procurement
	Faster deliveries
	Better spend visibility
Digitizing the regular functions in the company	Improved catalogue content
Online prescription	
Aggregated data	Improvement in budget and contract management
	Better asset tracking
	Improved vendor relations

Table 2: IoT actions in procurement and their benefits

V. CHALLENGES FACED IN THE IMPLEMENTATION OF IOT

Data Protection – The determination of requirement of connecting the IoT ecosystem to disparate networks and figuring out a way of integrating the connectivity management are major issues faced.

Implementation – There is a lack of support in maintaining and ensuring product quality. Also dilemma faced is to identify the department that should be given responsibility for handling implementation.

Scaling – Scaling IoT device networks is a major challenge faced. Leaders should also be aware of issues of software, legal and recognize the need for specialized solutions.

Security – Even though majority of the executives have already incorporated security in IoT devices the risk of security concerns is still high. Another issue is lack of training on the new updates of IoT to the IT staff.

Figure 1 below presents the IoT enabled procurement functions.

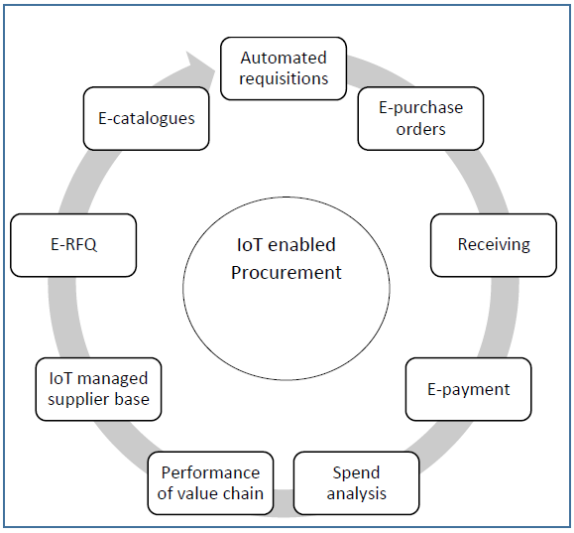


Figure 1: IoT enabled procurement

VI. CONCLUSION

IoT technologies helps to manage the operations better right from manufacturing to delivery. Connected devices, machines help to get data in real time and data analytics help to identify trends and opportunities which can be used to resolve problems before they even appear and optimize the supply chain.While deciding which technologies of IoT to use, always business goals should be taken into consideration. Critical issues such as security and compliance should be managed. IoT can thus help supply chains to benefit for increased flexibility, faster reaction times to market changes, and new, more competitive supply chain models.

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APPENDIX

Interview Questionnaire

1) What do you think is the impact of emerging technologies like IoT on pharmaceutical supply chain process?
2) Can you tell us a bit about how your company proceeded with implemention of IoT?
3) Can IoT help in moving Pharma market to e-commerce
4) What are the challenges your company faced in the supply chain process that effected during implantation.
5) What other technologies have made a significant impact on improving supply chain efficiency and visibility?
6) What is impact of this change in supply chain in Procurement and materials management?
7) Which technology is the next big thing in Procurement?
8) What is the reason for less adoption of these technologies in this country?

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