

LEVERAGING THE MULTIMODAL TRANSPORT OPERATION (MTO) TECHNOLOGY LINKED TO THE INTERNET OF THINGS (IOT) TO OPTIMIZE THE SUPPLY CHANGE MANAGEMENT (SCM) IN BUSINESS OPERATIONS

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ABSTRACT

In Current era, innovations assume a pivotal job in deciding an achievement of an industry, since the market is progressively unpredictable, understanding the client base and anticipating of interest itself is mind-boggling, over that satisfying the estimated interest by meeting all the inventory network container necks is considerably more intricate without better IT and coordination between the different colleagues. This has pushed the organizations to address the hole through different programming application and using the prominent information pockets are significant. So as to help this test, as a piece of the survey the effect of IoT in the region of Supply Chain Management, for example, as for Transportation is examined. An investigation has been done in different ventures and recognized components affecting the store network proficiency in a perplexing business condition. This is hypothetical investigation is accomplished for successful Business usefulness in relating the mechanical advancements that are the IoT. In light of the study directed, the parameters that could assume an urgent job in the business tasks are distinguished. In this IT-driven world, using the vital data from the date and picking up the upper hand help the business to meet the developing business sector to serve the client better. Gartner says a thirty-overlap increment in Internet-associated physical gadgets continuously 2020 will "altogether adjust how the inventory network works. Prior to arriving at the client, items should cross the various colleagues from makers, providers, the Distribution Centers, retailer, and afterward client. So it is fundamental for the business to give the permeability of item in each phase of the Supply chain to have the right data about the character, area, and other following data. This examination endeavors to bring the hub of IoT in Transportation. Likewise, the examination features the IoT trigger focuses on following the exact data of the merchandise that is associated with a typical stage. The elements impacting the inventory network the board is talked about in area 4. As IoT is in the newborn child arrange, regarding the worldwide business condition, an endeavor has been had to think about its effect on the Multi-modular basic leadership situation. This system would be a lot of value in the Business condition of how to improve the business to a superior scale.

1. INTRODUCTION

“Knowledge is power, and businesses that influence IoT have the prospective for an incredible advantage,” Redding says. At its heart, generally an IoT refers to a wide-spread ecosystem of physical objects interconnected with the Internet, having an ability to detect themselves and establishing data communication with the other objects in the spectrum¹. Such objects have embedded sensors with software and network connectivity. It helps in integration of physical

world with the existing computer based systems. These objects should possess basically 6 important characteristics: (i) ability to identify itself (ii) ability to communicate (iii) Inbuilt intelligence (iv) Energy efficiency (v) Safety (vi) Expressing. The resultant give rise to more economic benefits. It is expected that the IoT things could cross over 50 billion objects by 2020. In the IoT sense, “Things”, implies an extensive types of devices such as automobiles embedded with sensors, bio-chip transponders on farm animals, heart monitoring implants, field operation devices that collects useful data with the help of various existing technologies. Currently, the availability of Wi-Fi for remote monitoring with respect to the usage of washer or dryer is prevailing in the consumer markets. On the other hand, the consumer market is becoming highly competitive which interns put pressure on industry to meet the demand, it drove the companies to address the process in Supply chain industries especially in Transportation industries facing many challenges in entire network while using different modes like water, air, road and rail, It force the companies across the world to adopt the IoT to increase efficiency of an operation in freight Transports. An application of science in the balanced way is termed as an Intelligent Transportation^{3,4}. In this paper, the author highlights the importance of IoT with respect to the application of transportation. IoT deals with the integration of various aspects of information processing, communication and control across widespread range of transportation systems. It highlights the several aspects in transportation such as vehicles, the infrastructure and the user of the vehicle. IoT helps in building smart transport system such as electronic toll system, logistic and fleet management, inter and intra vehicular communication etc⁵. Basically, in real life scenario, the entire transportation system can be monitored for safety, intelligent and to obtain much more transportation information on vehicle, automatic driving implementation and so on. As of now, we could find the technological innovation in transportation such as anti-theft system in vehicles, highway electronic toll, transportation police mobile law enforcement, vehicle violation monitoring, vehicle anti-theft system etc. The aforesaid are considered to be emerging step and yet to create much more automations in the near future. Hence, in the technological revolution, Transportation IoT solves a lot of problems that cannot foreseen.

2. IOT IN TRANSPORTATION

Dealing with the progression of Material, data, and cash over the pipeline of a business procedure is named as Supply Chain Management⁶. It is exceptionally esteemed to lessen the mistakes among the organic market and to make lower-cost items through the proficient assembling process by precise of the item in the store network. Also, it is important for a business to consider the different elements of the chain and to gain accuracy rights from the sources of supply of raw materials, manufacturers and the distribution channels. Henceforth, it is necessary to have close communication with the transportation management process from the source to the destination⁷. The basic needs of a human, emerging from the daily newspapers, magazines to the comfort zone of using air conditioners, laptops are accomplished via the service offered by transportation. Since these commodities are manufactured at one place, the delivery has to done to the concern person at the right time. Hence, it can be even stated that the backbone of a human life itself is the transportation industry. It is also stated that, the absence of transportation industry would

disintegrate the functioning of domestic as well as global economies. Realizing the fact, the importance of freight transportation in the industry sector is discussed⁸. As transportation represents collective involvement of various business partners such as Shipper, Consignee and Freight Forwarder (FF). The importance of IoT in these aspects are stated. Generally, a shipper or consignor is a sender of the goods and a consignee is the receiver of the goods and FF acts as mediator taking care of all the activities for the movement of the products from one place to another^{9,10}. Though, there exists various modes to ship goods from source to destination, the driving factors and challenges behind the shipment must be considered. These challenges can be addressed partly through the sophisticated modern TMS systems in the larger scale supply chains. On the other hand due to lack of visibility of In-transit and supply chain dwell point, the customers have higher inventory than manufacturing company, its suppliers, and the intermediaries. Hence, a streamlined supply chain logistics process¹¹ is required. Therefore, in this IT driven world, latest technology has given an insight towards, the positive edge in integration of physical product movement and visibility through interconnected devices to connect pallets, trailers and containers systems which is otherwise called as Internet of Things.

3. BACKGROUND OF IOT

In the beginning of 1982, there was a discussion on the smart devices and the first internet connected machine was released for reporting stock level and temperature. Later in 1991, The Mark weiser's pioneer publication has published a report on, "The Computer of the 21st Century", and this has thrown a light towards the academic venues on, the vision of Internet of thing. Based on this, the IEEE spectrum has stated a concept of automating home appliances for the entire factories through integration, by using the collection of data. Hence, only in 1999, the concept has gained its momentum through Device to Device (D2D) communication based on the Bill Joy's "Six Webs Framework". Meanwhile, in 1999, Kavin Ashton has applied the word "Internet of Things", in Procter & Gamble and had a detailed discussion in 2009 with RFIDJournal.com., because of the increased digital interconnection with the people and things. Recently, it has been predicted that, in 2020 there will be more than 50 billion networked devices. Hence, it is a new age for the computer to capture data automatically with IoT and to alert the humans based on their needs¹². In today's modern business, the visibility of goods in transit is one of the key challenges for the supply planning to meet the customer demands. The application of the Internet of Things helps the business to mitigate this problem. In various places, IoT plays a key role in transportation involving various technologies such as electronics, embedded software, wireless technologies, logistics etc. Behind the IoT, is the used of wireless sensor signals that is read by the reader device from the identity tags present in the goods, then they are transferred to the central or main computer. The systems, upon receiving the encoded signals from these devices does data analytics. The analysis is given in the form of useful documents for the strategic decision making purpose done by managers. Also, the reliability issues in using electronic tags are discussed¹³. However, our study, is limited to wireless application used in IoT especially in Transportation. The IoT contains intelligence of various things like vehicles, sites, roads / lanes in the logistics infrastructure. In the logistics infrastructure, the role of a vehicle is termed as an epicentre or

nucleus. The range of vehicles includes trucks, locomotives, planes and ships with embedded wireless sensor networks and processors. As the vehicles dwell or traverse the sites, enormous amount of intelligence is embedded in the structures such as mobile equipment's, stationary or semi-stationary equipment and site structures etc., present in the sites. As the transportation media such as roads/lanes is important, IoT is being applied to these areas also. To get an innovative online paradigm for leading business dynamics IoT supports a lot was also discussed by researchers. Hence, the foresaid discussion gives an insight on the importance of IoT with respect to the transportation which is leading to a tremendous improvement for businesses.

3.1 IoT Enablers

In traditional communication methods if the customer wants to track down a particular consignment, they must contact the relevant business partners for an update. Due to the lack of visibility, this often leads to fire-fighting approach in complex multimodal environment. While transportation deals with movement of goods (via) various modes including deep-sea shipping, it is the MTO - Multimodal transport operator, who takes care of the whole contract right from shipping to the stated destination (UN,1980). Currently, MTO is the core method in the transportation of international process as it enables the co-ordination and optimisation of all modes of transport into an integrated system for achieving cost effective delivery of product in the supply chain. In this context, there are different enablers existing to capture the crucial information of a product to gain visibility throughout the supply chain link namely Barcode, QR Code, NFC, Passive RFID and active RFID.

- **Barcodes:** Barcodes exists in the 1D, 2D and QR Code, out of which QR code is the most widely used in stores, as it stores more characters than the other barcodes. Recently, due to the dynamics in business requirements, new Digi marc enabled packages have evolved. In Point-of-sale and Parcel tracking applications barcodes are used widely¹⁴. However, despite its ubiquity, barcode adds little values in IoT areas when compared to other wireless techniques.
- **RFID and NFC**
- **Radio frequency identification and Near field communication** are mainly used to transmit signals through tags and it varies in range, the range of NFC is 4inches/10cm when compared to RFID which is of 100 meters, both has its own advantages and disadvantages. Due to its range of coverage RFID dominates the transportation industry and it is considered to be one of the best system application^{15–17}.

When every time RFID reads, it adds a data to a card and eventually supplies the data to the ERP system to perform the seamless transaction for optimizing the shipping schedules, to have the inventory required for the retailers and manufacturers at the end of the supply chain and it intern increases the sales by reducing the time to market was also addressed. The RFID is useful in these aspects to overcome the challenges^{18–21}. In 2008, a new container tracking solution using integrated approach of RFID and GPS for a long distance cargo visibility and along with that NFC based on RFID technology enables easy data transfer within close proximity using smart device technology has evolved. In 2005 IBM and Maersk developed a system called Trecs to track the shipping container with the help of back-end software and a wireless network. Using a sensor system shipper, can access to get the status of the cargo in transit, such system gives complex transportation business model like dynamic decisions about the destination point for cargo arrival. Since the multimodal transportation involves various business parties across the geographies, it

creates more challenges in instant sharing of information, so these technologies helps the business to make a decision at the right time.

4. RESULTS AND DISCUSSION

Based on the study done by the authors with respect to industries such as Manufacturing, Wholesales, Retailers sectors, the business environment is found to be complex. In order to gain the benefit of a IT systems there is a need of collaborative approach to overcome these challenges. The Figure 1 shows model covering the major business process that is being used widely, such as Sales Order (SO) , Stock Transport Order (STO) from Customer to Distribution Centre (DC), Purchase Order (PO), Sales Information, PO acknowledgement, Invoice from the Distribution Centre (DC) to Vendor and Integration of Transaction data from DC to legacy Warehouse management system and Transportation systems. In all these communications there are different middleware's used to transform the data via Electronic Data Interchange (EDI) according to the target system requirement using Process Integration (PI) and Electronic Data Interchange For Administration, Commerce and Transportation (EDIFACT) for external parties and other technologies like IBM MQ, Web methods and PI for Internal parties like inter and intra companies. Figure 1 shows the multiple system connectivity and the use of complex business process which creates complexities in attaining the business goals. Hence, the factors influencing the Supply chain efficiency has been categorized into three types.

Therefore, these three factors are used to build the tool for supply chain to find the alternative solution in a collaborative approach for the next generation supply chain management which is also called Supply Chain Control Tower Concept.

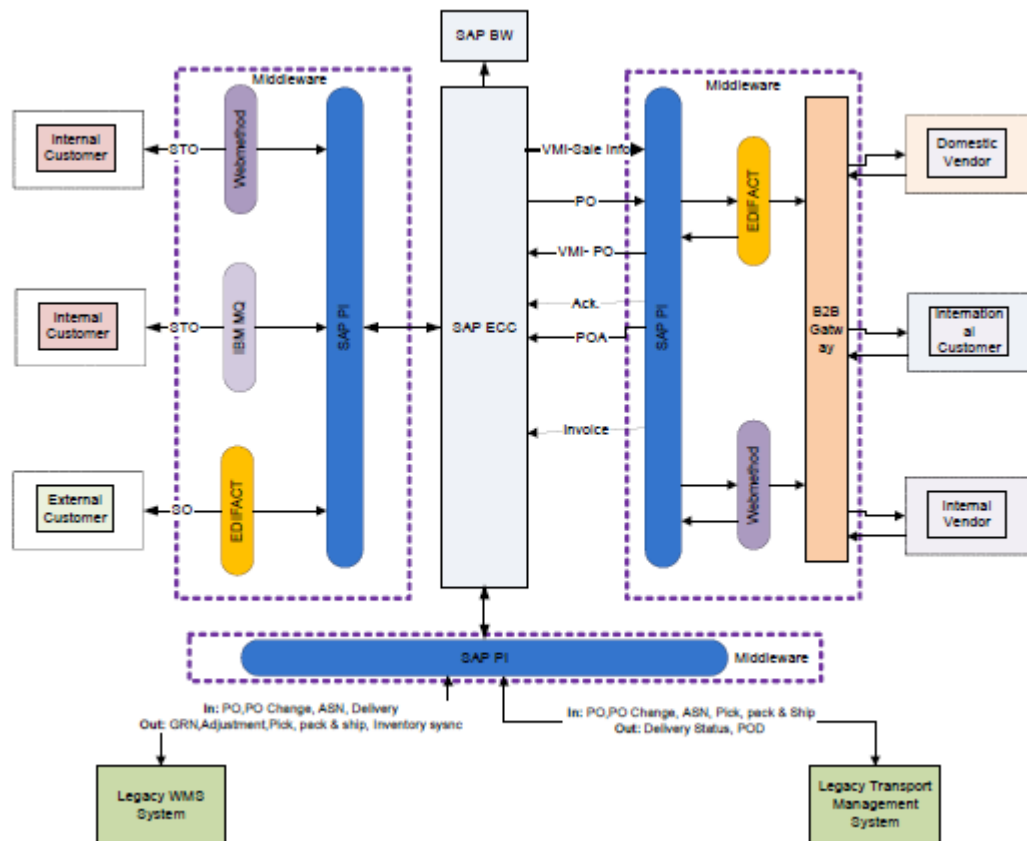


Figure 1. Business landscape.

As the volume of data generating from IoT is large, managing these data and categorizing the data into business critical and non-business critical data becomes difficult. Hence, the further study has been conducted in relation to the Multimodal Transportation system to identify the IoT nodes and common business critical parameters are listed in Figure 2. The researchers Gattuso and pellicano in 2014 have proposed a four levels of SCM model to Intelligent Transportation. System (ITS), for efficient transportation of goods to fulfil the business demand. Intelligent Transportation System is a combination of Information and communication technologies and further classified into seven macro-categories. e-business oriented systems; freight transport operation; intermodal transportation systems; site-specific ICT systems; transport and other Public Administrations related systems; city logistics and e-freight^{22–24}. Industry 4.0, discusses the intelligent decision by using a virtual copy of physical world²⁵. Based on the understanding from various studies, the authors have depicted the flow of information from various nodes of Multimodal transportation business scenario, indicating the smarter way of information flow to take a prompt decision. It is otherwise called as Smart Goods Logistics. It also highlights the vital nodes that are used in tracking the accurate information of the goods with IoT trigger points connected to a common platform for sharing of the business critical information through Internet.

So the authentication of data received from nodes are very critical for secured storage and retrieval, in complex business scenario²⁶.

The real time information hub enables the accessibility of information across the different segments of supply chain. As, there exists various nodes in networks requiring manual intervention in conventional supply chain, the tags can be embedded to the products, for enabling the information flow. This information is used by various parties in the value chain and the movement of goods become autonomous based on which, concrete decisions can be taken on the fly. The following represents parameters within the nodes in the Figure 2.

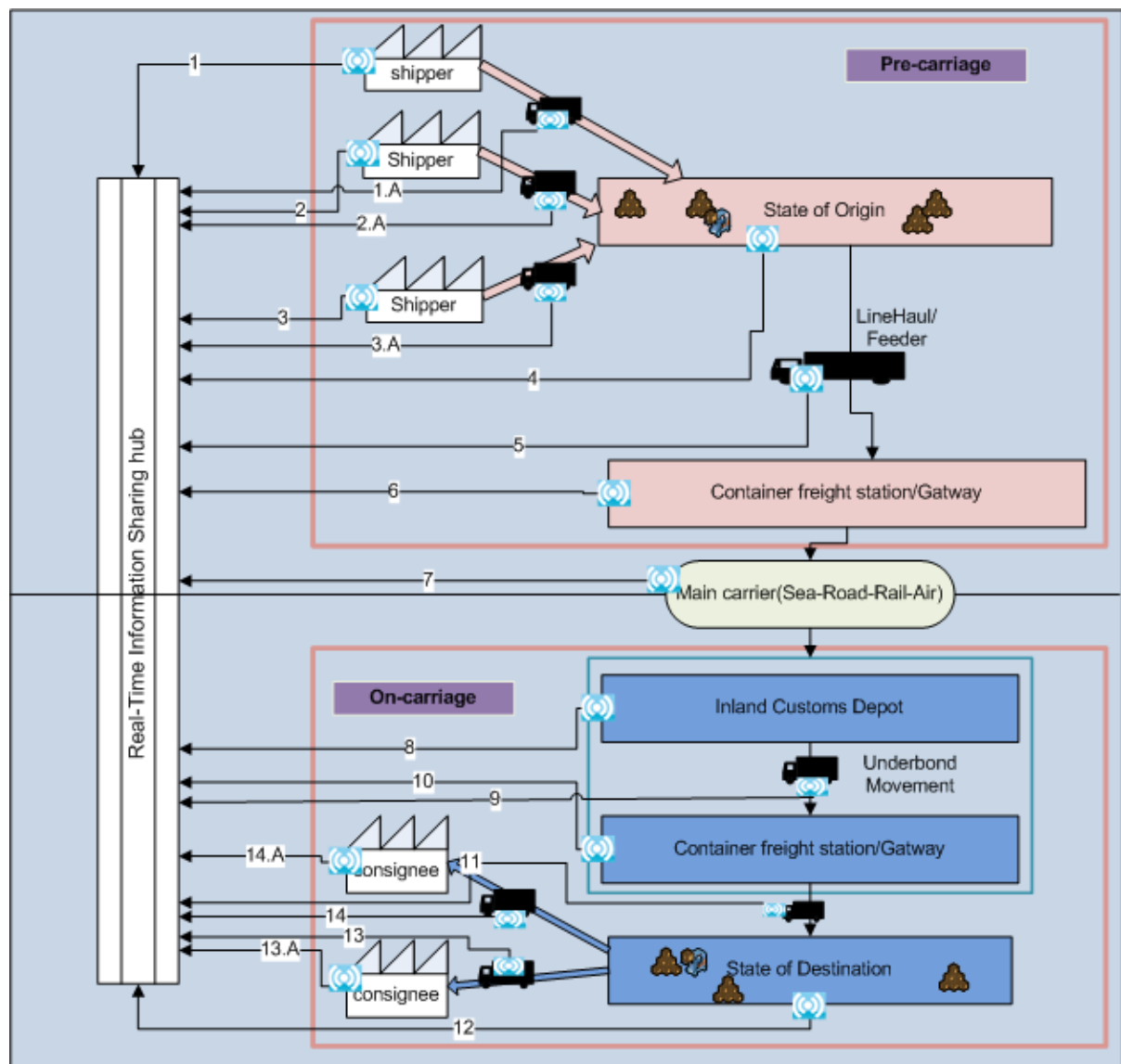


Figure 2. Goods flow in a typical international multi-modal transport chain with IoT.

1, 2, 3 - Stock level, Expiration date, Un-supply, Time delay in dispatching the goods from the source 1.A,

2.A,

3.A - Stock in Transits, Failures, Delays, Shipping Time

4 - Consolidation, shipment start, Time to Container

Freight Station (CFS)

5 - Goods in-transit, lead time to the destination,
product characteristics such as Safe temperature, current
temperature of the product

6 - Status of Stuffing

7 - Shipment start, time to designation, Actual location
of the shipment

8 - Arrival of goods

9 - Movement of goods from In-land Customs Depot
(ICD) to CFS

10- De-stuffing

11- In-transit to Forward house station (State of
Destination)

12 - De-consolidation, shipment start, time to destination

13, 14 - Truck details, Stock-in Transit detail, Arrival time to receiving Gate

13.A, 14.A - Check at Gatehouse, put-away time, if there is any need of further communication required then it is also sent the notification to the subsequent legs, for instance in case of buy to order (make to order) scenarios or cross-docking, flow through process. Supply chain industries requires a product or information on time to take a right decision, since IoT connected industry has the visibility of product delays globally, so key performance Indicator (KPI) are measured to take an alternative decision if there is any abnormality in the process chain. There are various business process that helps the business to meet the customer demand on time such as Discrete process, flow-through, Cross docking and Direct delivery to the stores, For instance if there is any delay during the transit, it will have an impact on the lead time to customer, so alternative arrangement such as instead of discrete pick, flow through process or direct delivery from the port of entry to customer or instead of put-away in the DC, floor ready merchandise process using flow through process can be adopted to compensate the delay in transit to meet the promised delivery date to the customer.

5. CONCLUSION

Owing to the diverse requirements in Transportation business, various software and business processes are used in the market to get the seamless business communication. Therefore, it is quite challenging to arrive at a common framework. Hence, the authors have identified generic parameters with respect to each IOT nodes of the Multimodel business process. This, helps to measure the process efficiency across the chain to quickly determine the alternative process to mitigate the delayed delivery to the customer. However, these parameters give an idea but industry, product and process specific requirement has to be analyzed to finalize right parameters for an effective supply chain business process.