

Using GIS/GPS to Optimize Supply Chain Management and Logistics at Walmart

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Abstract— Supply chain management and logistics are becoming more sophisticated due to the escalating demand for effectiveness and efficiency within companies and their suppliers. Considering retailers, such as Walmart, delays in the chain is causing an increase in inventory costs while also experiencing a shortage in stock. In consequence, profitability is diminished, and losses crop in. As such, there is a need for an automated system that allows asset tracking, and therefore, adoption of GPS and GIS technologies is essential to curb these shortcomings.

Index Terms— GIS, GPS, Tracking, Transport, Monitoring, Optimizing, Solution, Supply chain management

1. INTRODUCTION

In logistics and supply chain management, many organizations are currently facing many challenges, primarily because these two areas is increasingly becoming sophisticated. Despite the adoption of Global Positioning Systems (GPS) in existing transport management systems, there are still logistics delays attributed to lack of effective planning before accomplishing tasks within the supply chain. However, the transportation and distribution of small, individual items, for example parcels, has had no challenges, especially because the market leaders in the industry such as UPS and DHL have successfully implemented real-time tracking systems, which are fueled by excellent Global Positioning Systems (GPS) and Geographical Information Systems (GIS) [5]. Ideally, shortcomings become apparent when it comes to tracking bulky consignments of both goods and raw materials that are transported in large containers. In such instances, visibility and clarity between the hauler and shipping customers becomes elusive. Essentially, global logistics industry is increasingly becoming competitive as a lot of pressures is being exerted on haulers to increase efficiencies, improving cost control while also enhancing customer service.

Considering the shipping lines involved in supply chain management, there are problems with the first and last mile parts, terms used to reference stages in the delivery process, where products are collected from the primary shipper and delivered to customers in the containers.

Goods within the packages include clothing and accessories, plastics, iron and steel products, footwear, and toys among other consignments. Even so, most companies persistently face

problems in the last mile; where containers are collected from the port and finally delivered to the destination. Therefore, it results to lack of supply chain synchronization, resulting to increased lead-times from ordering to fulfillment while also increasing operational costs. Also, transportation costs are very high when delays are experienced in the chain, therefore increasing a firm's operational costs, when they should be avoided by adequate planning.

In addition, the delays are caused by factors such as transport congestion along the road network. However, according to McKinnon (2006), most logistics delays occur at the distribution centers, shops, and reception bays of the factories, and as such, this indicates that "back-door congestion" escalates the average variability and length of off-loading and loading times. Even so, considering the presence and adoption of GPS and GIS technologies, these problems can be effectively addressed, in order to ensure effectiveness and efficiency of supply chains.

Furthermore, GPS technology has been adequately established in mobile communications but is yet to be proved as a working technique in global supply chains. As such, the challenge is not only to introduce a working technical solution, but also to add a more user-centric business model that ensures the participation of all stakeholders, including the track drivers, who should act as primary information initiators.

2. GPS/GIS OPERATION

Made up of 24 satellites that were placed by the U.S. Department of Defense (DOD), the GPS is a navigation system that is currently being managed by the U.S. Air Force 50th Space Wing. Primarily, it was designed for military purposes, such as assisting soldiers and their military vehicles, ships, and planes to accurately determine their locations globally. However, in the 1880s, the U.S. government made the system available for civilians, even though it was not as precise as the signals used for military applications. The three segments within the GPS system are: the user, space, and control. Even so, the satellites must have earth-based receivers that can capture the signals from at least four signals. The receivers have the capability to triangulate and pinpoint location. The operation is based on simple mathematics, a technique known as trilateration [3].

Ideally, four equations are formed, and the receiver can deduce the x , y , z , and t parameters. From these, the location of an object on the earth's surface is accurately and precisely located to within 15 meters. The tracking system can be used commercially to position transiting vehicles, where some systems store the data (passive tracking) or some can send the information to a centralized database, such as the GIS (active tracking). As such, the latter is purely real-time and is best utilized in commercial applications, such as corporate vehicle or fleet tracking. In essence, it is a useful tool to monitor employees in the entire supply chain system, thus optimizing and streamlining logistics procedures and processes.

On the other hand, a GIS is a computerized information management system that is used for capturing, storing, managing, retrieving, analyzing, and displaying spatially-rendered information. It is attached to many applications, including transport and logistics, and thereby, is the basis for location-based services involving analysis and visualization of data, and thus, facilitating a decision-making process.

GPS technology compliments the GIS, and therefore, both technologies are used simultaneously to enable location of corporate assets including vehicles used for transportation. Essentially, GPS systems are used to collect, store, and in turn transfer field data to a GIS for processing, and in turn help make firm decisions, especially when it comes to real-time tracking of vehicles used along the supply chain. The

relationship between GPS and GIS has been summarized below:

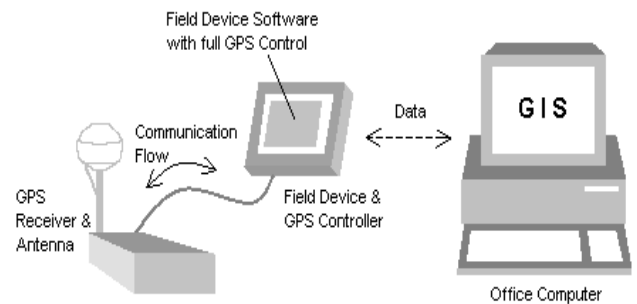


Figure 1: Relationship between GIS and GPS [1]

3. BACKGROUND ON THE CASE

Walmart is a viable sample for investigation. It is the world's largest retailer, and it uses supply chain management in transporting its goods. It has a lot of branches and departments in the entire U.S., but also has expanded globally to Europe, South America, and Asia. As such, it is easily accessible for data collection and review. The employees are readily available, and as such, using interviews to gather problems encountered by the organization was relatively easy.

4. WALMART'S SUPPLY CHAIN AND LOGISTICS PROBLEMS

Walmart has previously experienced logistics and supply chain management shortcomings before. For instance, according to the employees, Walmart senior management acknowledged that the enterprise lost \$3 billion primary because they ran out of stock merchandise and the stock grew at a higher rate compared to the sales. Essentially, these are problems associated with poor logistics. Even so, the firm cited various reasons for the loss, such as higher-than-expected tax rates, economic challenges, and poor weather, but from a logistics and supply chain perspective, inventory problem was the main reason that the business experienced lower earnings for the quarter that ended in April 30. Additionally, the employees revealed that the store back rooms are sometimes out of control.

The employees also reported that both poor procedures and too few payroll hours that were allocated to manage the store space makes it almost impossible to find specific products when

needed. As the workers assert, Walmart intends to solve the problems by adding more payroll hours into the stores, however, there was an early adoption of technique that had previously enabled the company to manage what it had in the stores much better, and this was the (Radio Frequency Identification) RFID technology. Walmart was a very early adopter of the GPS technology, which provided a competitive edge over the other competitors, such as Best Buy and Target, which are all chains of supermarkets. Surprisingly, Walmart has not revisited the technology to make it better and optimize its performance.

The RFID chips Walmart uses come in different designs but are all used for toll automation. Walmart adopted the technology back in 2003. Linda Dillman, the then Chief Information Officer (CIO), issues a mandate to its top 100 suppliers demanding that all pallets and cases should be RFID-tagged in a period spanning 18 months. The rest of the suppliers were to adopt the technology by 2006. However, by early 2009, the project was stopped as it provided no viable solutions to the already problematic logistics and supply chain management. Ideally, other simpler techniques including bar codes solved the same problem at a cheaper cost. The argument for the adoption of the RFIDs was that they required no line-of-sight to be read. However, they use radio frequencies that cannot pass through liquids or metals, and therefore, they could not facilitate a reliable read rate as originally anticipated. As such, their efficiency and effectiveness was compromised, and thereby, making the company go back to the drawing board.

Furthermore, according to the workers, the company is contemplating on cutting back the entire inventory, primarily because of the aforesaid reason, Walmart's stock is growing at a quicker rate compared to sales. However, the firm is not alone, other are experiencing similar challenges. Respondents have attributed unproductive inventory as the major business challenge compared to out-of-stocks. As such, it means that investor pressures have impacted a lot compared to customer pressures in driving purchase decision making. To surmise, considering Walmart's case, the RFID technology adopted is not enough to solve supply chain management and logistics problems within the company. The stock problems are as a result of poor logistical and supply chain shortcomings. Therefore, considering other technologies such as the GIS and GPS is essential to optimize their operability, and therefore,

facilitating cost-saving and a faster supply chain that will boost sales to surpass or stagnate with the sales.

5. SOLUTIONS

5.1. GPS and GIS in Supply Chain Management and Logistics

In order to solve these problems, Walmart needs to adopt a GIS and GPS technology. A GIS facilitates the storage, analysis, and display of geographically referenced data and information, provided by the GPS. Today, GIS can be used in making and implementing effective strategies that can help monitor vehicle location, and thus, making it possible for organizations to keep transit vehicles on schedule while also informing the stakeholders about accurate expected time of arrival of the transit goods [2]. Considering Walmart's case, it could be helpful because it can aid the adoption of a strategy that can help keep viable quantity of goods in the stores, which will not make fill the store thus making it impossible to access to the various goods.

Additionally, compared to the RFID technology, the GPS technique can be used to effectively track the tracks shipping the goods. In essence the satellites can operate virtually all-the-time as the platforms are located in space, and a clear line-of-sight is quickly established. GPS facilitates in-vehicle navigation systems and automatic vehicle location used globally today. Focusing on Walmart, if the technique is combined with GIS, a new dimension in road transportation will be realized that will enable competitive advantage, which comes from the fact that it will promote an easier supply chain managements along with streamlining the logistics. As such, Walmart can always have enough products in the store, which cannot waste the space but also meets customer expectations and requirements.

Nevertheless, the Walmart's RFID technology can "track and trace" the corporate's assets as they flow via strategic points that are equipped with fixed positional readers. The positive part of the RFID technique is that it can be mated with GPS/GIS techniques, and in turn, provide an increased geographic coverage and visibility for the company's products. As such, combining these technologies can be used to enhance logistics and supply chain functionalities. Currently, this would be costly, but as the techniques grow and decrease in cost, it would provide a viable solution that

Walmart can adopt to improve the aspects, and thus, aid in increasing sales while keeping inventory costs down. Implementing this would ensure that the company does not have to cut down the entire stock.

5.2. Real-Time Tracking Solution

Another aspect that can be considered in streamlining the supply chain is the adoption of a mobile GPS tracking that uses telematics and a web portal to streamline the chain. It can be built around mobile phone Personal Digital Assistants (PDAs) that can be programmed to accept driver instructions from the central portal, and allows the transmission of status updates and also positional data back to the portal (Figure 2). The tracking is addressed by using GPS handsets that can transmit vehicle coordinates back to the portal, usually at fixed intervals. The information received from the signals can be shown on a map, and hence the expected time of arrival (ETA) can be deduced [4].

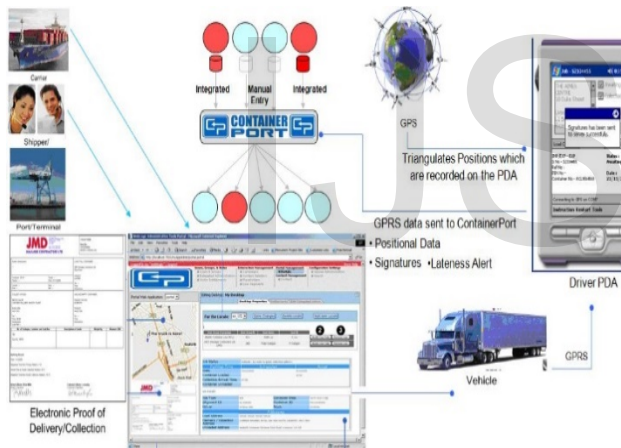


Figure 2: Real-time tracking system [4]

If Walmart can adopt this system, the benefits can include cost saving and thus more profitability, realization of improved communication, and also automating scheduled vehicle checks.

6. CONCLUSION

Both solutions are very promising to solve the logistics and supply chain problems in Walmart. If one of these solutions is adopted, the company is set to realize more profits, as the problems will effectively be mitigated. For instance, the losses associated with running out of stock will be checked, leading to more viability, visibility,

efficiency, and effectiveness in the supply chain management. In consequence, via the use of GPS/GIS will enable the realization of competitive advantage for Walmart. Furthermore, it would be easier to track company assets, and ensure that they are on schedule, thus promoting better planning and productivity. Even though the costs are great, especially the use of combined RFID and GPS/GIS technology, over time, the benefits will subsequently outweigh the costs, and thus efficiency and effectiveness will be achieved.

7. REFERENCES

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