Transforming a Truly Traditional Dairy Product Company's Logistics and Transportation Related Decision Making Processes

Bahadır Aktaş[1*], **Çağla Ediz**[1], **Büşra Alma Çallı**[1], **Erman Coşkun**[1,2]

1 Sakarya University, **2** MBS College of Business and Entrepreneurship, Kingdom of Saudi Arabia, * Corresponding author, bahadiraktas@sakarya.edu.tr

Abstract

Logistics Information System (LIS) and Transportation Management Systems (VTS) are critical in the food sector. Especially, since dairy products are more sensitive to the temperature change and physical damage, finding and solving problems by tracking carriers and monitoring environmental effects are the main topics that LIS and TMS aim to solve. This paper examines a company that produces and distributes dairy products and located in the Marmara Region by using case study research methods. Multiple data collection methods are used in conjunction to reveal the company's current LIS practices and to identify its problems. After revealing problematic business processes in the logistics operation, a roadmap considering data and system integration so as to support decision-making processes has been proposed. Particularly, transportation based data from LIS and TMS which has high potential to offers robust solution for problematic areas was considered for integration within the company.

Keywords: Logistics information system, Transportation management system, System integration, Case study.

Citation: Aktaş, B., Ediz, Ç., Çallı, B. A., Coşkun, E. (2018, October) *Transforming a Truly Traditional Dairy Product Company's Logistics and Transportation Related Decision Making Processes*. Paper presented at the Fifth International Management Information Systems Conference.

Editor: H. Kemal İlter, Ankara Yıldırım Beyazıt University, Turkey

Received: August 19, 2018, **Accepted:** October 18, 2018, **Published:** November 10, 2018

TRANSFORMING A TRULY TRADITIONAL DAIRY PRODUCT COMPANY'S LOGISTICS AND TRANSPORTATION RELATED DECISION MAKING PROCESSES

ABSTRACT

Logistics Information System (LIS) and Transportation Management Systems (VTS) are critical in the food sector. Especially, since dairy products are more sensitive to the temperature change and physical damage, finding and solving problems by tracking carriers and monitoring environmental effects are the main topics that LIS and TMS aim to solve.

This paper examines a company that produces and distributes dairy products and located in the Marmara Region by using case study research methods. Multiple data collection methods are used in conjunction to reveal the company's current LIS practices and to identify its problems. After revealing problematic business processes in the logistics operation, a roadmap considering data and system integration so as to support decision-making processes has been proposed. Particularly, transportation based data from LIS and TMS which has high potential to offers robust solution for problematic areas was considered for integration within the company.

KEYWORDS: Logistics Information System, Transportation Management System, System Integration, Case Study

1. INTRODUCTION

The integration of Information Technology (IT) / Information Systems (IS) in an enterprise is key for providing efficiency and getting fully benefit from these systems. In-depth investigations and investments should be made to shed a light on how these systems will be implemented and how they will be integrated with the existing systems when companies invest in their information systems.

Food supply chain has its own characteristics regarding the processes, transportation, storage and waste processing. Nature of the products necessitates considering various aspects of the food supply ecosystem. Accorsi, Bortolini, and Baruffaldi (2017) draw attention on the labor-intense and human-made characteristics of the food supply chains. Therefore, the complexities and uncertainties associated with production, storage, transportation and distribution channels arise which requires a great level of visibility and traceability. Environmental conditions, regulatory issues, access to urban areas within a time limit and interdependencies between the entities (storage facilities, market and production facilities) make the sustainability and control issues more difficult. Particularly, in the stage of transportation resources compromising energy labor, fuel, time and shelf lime are the main constraints that should be taken into account by managing and controlling the mode of transportation, capacity, vehicle speed and costs. In order to manage and control these parameters vehicle routing, loading and precautions regarding the product corruption and spoilage are essential tasks (Accorsi, Bortolini & Baruffaldi, 2017).

Since the production and distribution of dairy products are vulnerable to spoilage and physical damage during transport, LIS integration is critical. It is necessary to integrate LIS deeply with Decision Support System (DSS) and ERP in order to determine the causes of the distribution problems and the reasons for the returned products.

For this reason, within the context of this study, LIS and TMS and especially Vehicle Tracking System (VTS) applications of a company that specifically produces and distributes dairy products have been analyzed. The problems regarding integration, reporting, tracking, visibility and transparency which are experienced in practice are scrutinized. In the study, case analysis method was adopted, interviews were conducted, document and application analysis were carried out. Thus, problematic areas are identified and strategies that can be applied to improve these areas are presented.

2. LITERATURE REVIEW

Success and failure of Information Systems have been the topic of a remarkable number of research so far. In spite of various multidisciplinary studies and new perspectives, problems regarding the adoption and utilization of IT/IS are still considerable. IS failure should be approached from perspectives of system development, project management, top management and users. Organizations that adopt IS/IT successfully acquire the benefits of enhanced productivity, profitability, performance and effectiveness of processes. Getting those positive outcomes and successful consequences again depend on a wide range of factors including task characteristics, structure, people and technology (Petter et al. as cited in Dwivedi et al., 2015).

In the case of food supply chains, because of the characteristics of products and nature of the processes, LIS constitutes the major building block of the Information Systems within the organizations. A wide range of systems including Enterprise Resources Planning (ERP), Warehouse Management Systems, Transportation Management Systems and Global Positioning Systems (GPS) support the processes and operations of logistics management (Barbosa & Musetti, 2010). In addition to these, technologies compromising electronic data interchange (EDI), radio frequency identification (RFID) and barcode offer the benefits of visibility, traceability, improved communication and coordination throughout the supply chain. Although, LIS mainly focuses on logistics operations, LIS adoption in organizations in multi-faceted. Ngai mentioned organizational profiles, perceived barriers and advantages as influencing factors of LIS adoption as cited in Barbosa and Musetti (2010). Moreover, relevant literature emphasised the effects of size, characteristics of operations and the sector in which the organizations conduct business (Barbosa & Musetti, 2010).

Specifically, TMS assist inbound and outbound logistics by being a part of an ERP System or operating as an independent system. TMS mainly deals with operations and management of transportation and distribution. Major functions of a TMS compromise of route planning and management, performance tracking, controlling vehicle load and speed and optimization (Barbosa & Musetti, 2010). Transportation systems utilize a wide range of modern technologies and can be integrated with these technologies. As a consequence, for the purpose of enhancing transportation operations, technologies and systems enabling information share and dissemination are required. Telematics, detectors, sensors for remote measurements, satellite communications for providing information of distant objects, databases for storing information are among technologies that serve to meet these requirements. These technologies enhance transportation, lower financial costs, increase the quality of transportation and eliminate delivery time so as to meet customer requirements (Grabara, Kolcun & Kot, 2014). One major technologies utilized by Transportation Management Systems is GPS.

Global Positioning System (GPS) consists of a network of satellites which "…periodically emit radio signal of short pulses to GPS receivers. A GPS receiver receives the signal from at least three satellites to calculate a distance and uses a triangulation technique to compute its two dimensional or three-dimensional position" (Chadil, Russameesawang & Keeratiwintakorn, 2008, p. 393). When the location of an object is estimated than the route and average speed of an object can be identified. Thus, for tracking vehicles GPS is accepted as a major technology. GPS is one of the technologies supporting Transportation Management which facilitate control over vehicles by enabling fleet tracking (Barbosa & Musetti, 2010). Mondragon et al. (2009) emphasized the importance of GPS in enhancing visibility, communicating the real-time data regarding the details of transportation and providing information to enterprise systems. Vehicle tracking systems using GPS technologies share information regarding the vehicle and provides real-time tracking. El-Medany and Al-Omary claimed that real-time tracking systems identify accurate positions of vehicles by eliminating relevant costs (as cited in Verma & Bhatia, 2013). Range of capabilities and offered advantages of TMS and associated technologies can be summarised as follows;

However, nowadays solely implementation of LIS or TMS is not enough for the survival of organizations. Depending on the arguments above, successful adoption is must so as to get full benefit from these technologies. A range of issues related with integration problems, organizational resistance, necessary skills and resources as well as top management related factors should be addressed appropriately. Innovation and searching for new opportunities which contribute to gain competitive advantage should be among top strategies of organizations (Witkowski, 2017). RFID technology which is accepted as one of the revolutions in supply chain processes has significantly impacted the visibility in supply chains. Accordingly, Witkowski (2017) draws attention on smart technologies as innovative solutions in supply chains. IoT solutions have a lot to offer for effective transportation as a result of deep interaction with the environment and other objects, production of location based information and reacting to physical conditions. A number of optimization solutions to transportation decisions will be provided as a result of the implementation of these technologies (Witkowski, 2017).

3. METHODOLOGY

Case Study Research (CSR) is structured upon real-time and detailed relational analysis based on limited amounts of examples, data, events, and relations between them. It is a unique method to observe a situation through a data set (Yin as cited in Zainal et al., 2007). Also, It provides a detailed analysis from the participant's point of view using a variety of data sources and it focuses on explaining, understanding, controlling and forecasting the subject that is handled (Djurić et. al., 2010). While quantitative studies focus on repetition and patterns on the data set on a macro level, case studies focus on a specific event on a micro level. (Lechman, 2014). CSR could go one step beyond quantitative analysis and can use both quantitative and qualitative data to analyze data thoroughly (Tellis as cited in Zainal et al., 2007). Because of these reasons, CSR is one of the important research methods for Management Information Systems (Benbasat et al, 1987).

Case studies have the triangulation at its core. The proper combination and the synthesis of diversified techniques, views, methods, strategies, or theories are at the focal point of CSR (Tellis, 1997, Johansson, 2003, Djurić, 2010, Zainal, 2007) (Table 2).

Within the scope of this study, logistics and distribution network operation solutions of a dairy product company are examined. Afterwards, the integration and implementation of these solutions throughout the company and the problems experienced are presented. In this process, information was gathered through (1) interviews (Table-3) with the authorized persons in the operation, (2) investigations by the researcher (direct observation) and (3) system review and analysis (physical artifacts) by the researchers directly. Thus, triangulation of data collection was performed.

4. CASE DESCRIPTION

4.1. Company Presentation

The company is based in Sakarya, Turkey and produces dairy products. The company has about 350 employees and has approximately 300 tons of milk processing capacity in a day. The company distributes its products predominantly to the Marmara and Eastern Black Sea Region. In addition, the company also distributes its products to major cities such as Istanbul, Ankara, and İzmir (Figure 1). The company has established at least one storage location for each city. This distribution from the factory is carried out to the company's own stores or the central stores of the two of the biggest supermarkets in the area with whom the company made an agreement. In total, 17 warehouses' distribution operations are handled by the company.

4.2. Problem Description

4.2.1. Company's Transportation and Logistics Situation

The vehicles transporting the products from the company to the warehouses can either be the company's own vehicles, rented vehicles or the vehicles that belong to the drivers who drive them. The workers who carry out the transportation from the factory to the warehouses are called "chauffeurs" and the workers who distribute the products from the warehouses to the customers are called "distributors". The number of the vehicles belonging to the drivers, which are all articulated lorries, is 5. On the other hand, chauffeurs (5 to 6 people) who are company employees have 4 lorries in use. Articulated lorries are preferred when product pallets exceed a certain size. Articulated lorry's chauffeurs generally deliver certain areas and they get paid according to the longest distance fare they have been sent. On the other hand, drivers that are employed by the company are sent to the routes that have been selected by the route planning officer according to the demand and the current situation. In other words, there is no certain working area for these chauffeurs.

4.3. Current Solutions

4.3.1. Transportation and Logistics Solutions

Order lists of the products are created for each transportation by the planning officer but this orders list and driver relation isn't integrated into ERP solutions. Chauffeurs text the license plate of the vehicle that they are assigned and vehicle's destination to the planning staff. This process is used as a way to track which product pallet the driver is transporting and also to reveal the person who is responsible from a particular vehicle in case of possible traffic tickets.

The distribution of products from the company's warehouses to the customers is carried out by the distributors. The distributors are able to see the products demanded from customers via web-based handheld terminals integrated with ERP system and then deliver the products according to this information. When the product is delivered to the customer, the distributor records this information using hand terminals so that the employees of the company can see it online.

4.3.2. Vehicle Tracking Solutions

The company has been using a VTS for over a year. VTS enables the firm to track the vehicles location with GPS tracking and various sensors are implemented in vehicles to provide more information (Figure 2).

Sensors included in VTS are; (1) temperature sensor, (2) Fuel Level Sensor, (3) Weight Sensor and (3) Speed Sensor as well as a GPS tracking system. While some of the sensors mentioned above is still in use, some of them are not used or abandoned.

4.4.Problem Analysis

4.4.1. Transportation and Logistics System Problems

The common problem with product transportation system is that the vehicle's driver's license plate and driver's information are not registered to the company's ERP system. Because of this, the product transportation information cannot be integrated with the GPS tracking system which track excessive acceleration or braking that can damage products during transportation. Such information is received from the Canbus system, however it isn't integrated with the ERP system. Thus, no causal relationship can be established between driver behavior and product return reasons and customer complaints.

4.4.2. Vehicle Tracking System Problems

While vehicle tracking system used by the company has a lot of potential, it has some shortcomings due to failed sensors and lack of solid integration to the ERP system (Table 4). For example, fuel level sensors are currently unable to provide data to the system and this results in unusable reports. In addition, temperature sensors collect data but the data only can be seen live, which means there is no back logging of the temperature sensor value. This creates a problem when advanced reports that sheds a light on the reasons for spoiled products and returned parcels.

Most of the reports and alarms are valuable when associated with location data however, VTS uses estimated address, not coordinates, in most of the reports. This may be useful for end user but it makes further analysis impossible or harder. Luckily one of the reports shares coordinates as well as addresses. So, this report can be integrated with other to know the coordinates of the vehicles at a given time.

5. ROAD MAP

5.1. System Integration

The dairy products company covered in the study can track vehicle location, the temperature of the transported products and driver error and aggressiveness. However, these data have been imprisoned in the LIS system and has not been able to feed the ERP system due to poor system implementation and the lack of integration. Likewise, the driver information, order information and product information located in the ERP system aren't integrated with the LIS. It is also not possible to receive or create location-based reports from LIS due to incomplete data integration and incorrect data structure. The purposed data integration structure should be implemented in order to increase the traceability of the company's logistics operations.

The analysis of information gathered by the system should reveal (1) whether or not the drivers use the most efficient route, (2) whether or not the driver in aggressive driving style cause more product returns, and (3) which drives perform more efficiently on which route. As a result of integrating these results into the DSS of the company, the decisions to be made should be used during the planning phase and for the improvement of the logistic network.

5.2.Advanced Reports

Advanced reporting is possible if the location data in the LIS system is implemented correctly into the system. These advance reports should be implemented into maps to identify areas where the distribution is intensive, to locate areas that cause intense braking or sudden acceleration more frequently, and to locate areas where vehicles have to travel below a certain speed. If these reports are integrated with the DSS and the business process, the company can save time and money with proper planning.

As an example, the heap map below, which is created specifically for the sake of this research shows the route of a specific car, which transports products from Sakarya to Istanbul, and the speed level (0 to 120, 5 level coloring) of the car with the data from 09.07.2017 to 16.07.2018. Analysis like this can show diversions from the route, speed analysis can be made and it shows the regular route the vehicle uses and the speed of the vehicle in certain points.

This example can be extended to the drivers instead of vehicles and also, alerts, notifications and sensor data can be integrated into the map report to feed DSS.

System integration will enable the company's planning staff to obtain meaningful the data they will use every step of the way from route preparation to order preparation. The drivers will work on the more efficient routes and losses caused by driver faults will be more transparent. Upper-level managers will be able to see the order intensity, problematic areas and productive areas the entire fleet at glance with visual reports and be informed about the logistics function of the company.

6. CONCLUSION

System integration is a cornerstone for any company. It allows operational personnel to work more efficiently. It also enables planning director and mid-level manager to have an easy and timely access to timely data and it paves the way for senior executives to be able to make better long-term decisions by having a clear idea about the company at a glance. This study by conducting case based approach investigated logistics operations of a diary product company which discovered problematic areas in terms of system integration. As a result of the research, it has been seen that without the proper system integration and implementation, information systems such as LIS, TMS and VTS can't unveil their full potential. In order to take advantage of the information systems' full potential and prevent unnecessary investment, data integration and deep system analysis is needed.

Moreover, literature review reveals the obstacles in food supply chains and shifting patterns in terms of solutions. Supporting system integration with smart technologies and innovative solutions, and establishing an integration platform within the IoT context should be the focus of supply chains in order to be agile, competitive and productive.

7. REFERENCES

Benbasat, I., Goldstein, D. K., Mead, M. (1987). The case research strategy in studies of information systems. MIS quarterly, 11(3), 369-386.

Djurić, I., Nikolić, D., Vuković, M. (2010). The role of case study method in management research. Serbian Journal of Management, 5(1), 175-185.

Dwivedi, Y. K., Wastell, D., Laumer, S., Henriksen, H. Z., Myers, M. D., Bunker, D., ... & Srivastava, S. C. (2015). Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers*, *17*(1), 143-157.

Hisano Barbosa, D., & Andreotti Musetti, M. (2010). Logistics information systems adoption: an empirical investigation in Brazil. Industrial Management & Data Systems, 110(6), 787-804.

Accorsi, R., Bortolini, M., Baruffaldi, G., Pilati, F., & Ferrari, E. (2017). Internet-of-things paradigm in food supply chains control and management. Procedia Manufacturing, 11, 889-895.

Grabara, J., Kolcun, M., & Kot, S. (2014). The role of information systems in transport logistics. International Journal of Education and Research, 2(2), 1-8.

Chadil, N., Russameesawang, A., & Keeratiwintakorn, P. (2008, May). Real-time tracking management system using GPS, GPRS and Google earth. In Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, 2008. ECTI-Con 2008. 5th International Conference on (Vol. 1, pp. 393-396). IEEE.

Helo, P., & Szekely, B. (2005). Logistics information systems: an analysis of software solutions for supply chain co-ordination. Industrial Management & Data Systems, 105(1), 5-18.

Johansson, R. (2003). Case study methodology. International Conference of Methodologies in Housing Research.

Lechman, E. (2014). Case Study Methodology. Few Conceptual Considerations. Research on Enterprise in Modern Economy - theory and practice, 4,21-31.

Mondragon, A. E. C., Lalwani, C. S., Mondragon, E. S. C., & Mondragon, C. E. C. (2009). Facilitating multimodal logistics and enabling information systems connectivity through wireless vehicular networks. International Journal of Production Economics, 122(1), 229-240.

Tellis, M. W. (1997). Application of a case study methodology. The Qualitive Report 3(3), 1-19.

Verma, P., & Bhatia, J. S. (2013). Design and development of GPS-GSM based tracking system with Google map based monitoring. International Journal of Computer Science, Engineering and Applications, 3(3), 33.

Witkowski, K. (2017). Internet of things, big data, industry 4.0–Innovative solutions in logistics and supply chains management. Procedia Engineering, 182, 763-769.

Yin, R. K., (1984). Case study research: Design and methods. Beverly Hills, CA: Sage Publishing, ABD.

Yin, R. K., (1994). Case study research: Design and methods (2nd ed.). Thousand Oaks, CA: Sage Publishing.

Zainal, Z. (2007). Case study as a research method. Jurnal Kemanusiaan, 9, 1-6.

8. FIGURES and TABLES

8.1.Figures

Figure 1. Company's Logistics Distribution Coverage

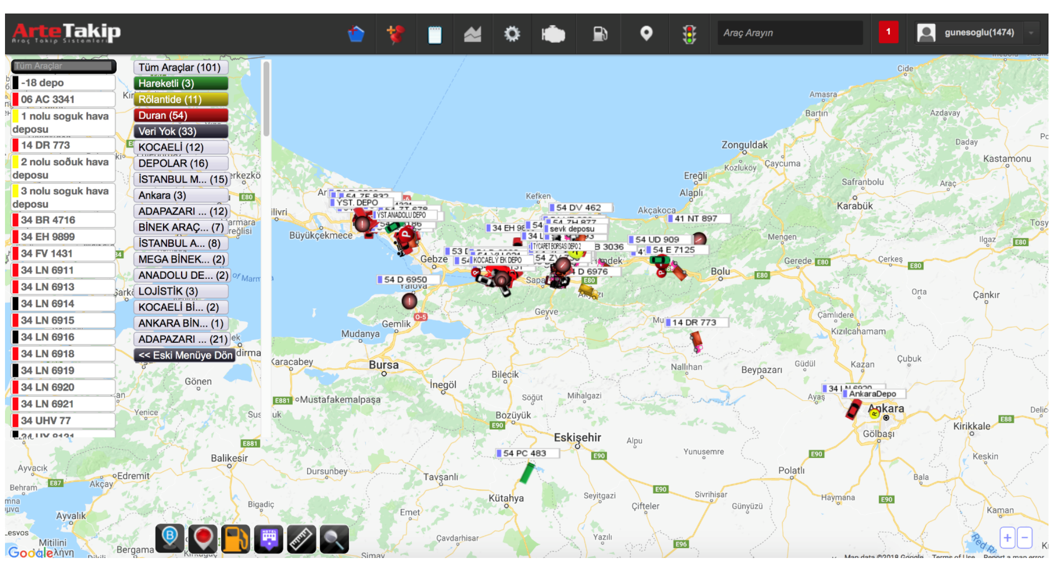

Figure 2. VTS used by the company (ArteTakip)

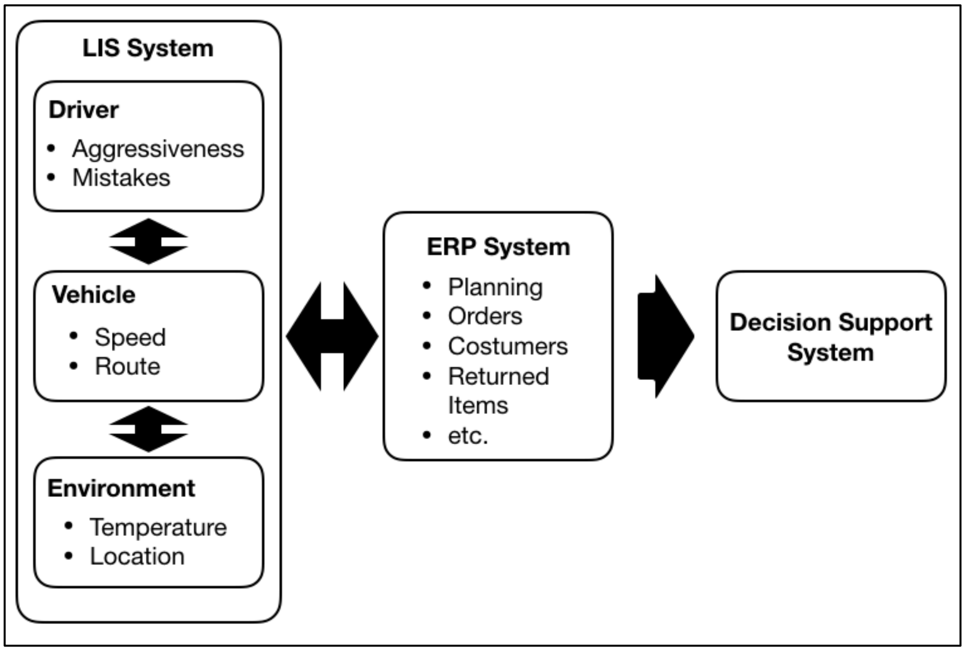

Figure 3. Proposed Data Integration

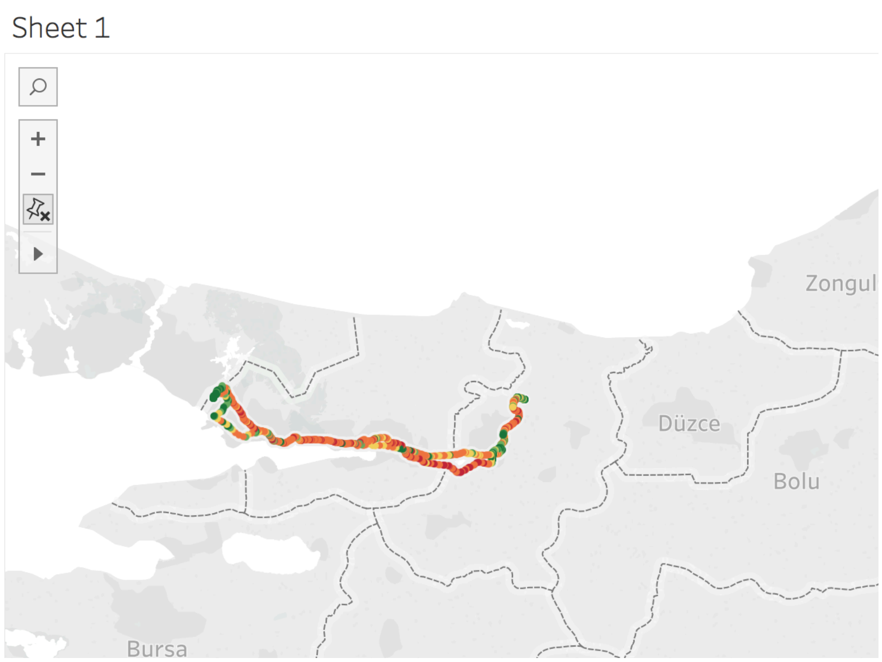

Figure 4. Map Based Report from Existing data

8.2.Tables

Capabilities	**Acquired Benefits**
• Optimization of transportation routes	Effectiveness and efficiency in processes with limited resources
• Operational issues regarding the transportation; monitoring and documentation	Operational efficiency in delivery and minimization of costs
• Controlling; load levelling	Elimination of costs, productivity
• Planning; route planning	Accurate scheduling
• Real time information	Improved communication and collaboration and inventory management

Table 1. Range of capabilities and offered benefits of TMS (Adopted from Helo and Szekely (2005))

Source of Evidence	Strengths	Weakness
Documentation	• stable - repeated review • unobtrusive - exist prior to case study • exact - names etc. • broad coverage – extended time span	• retrievability - difficult • biased selectivity • reporting bias - reflects author bias • access - may be blocked
Archival Records	• Same as above • precise and quantitative	• Same as above • privacy might inhibit access
Interviews	• targeted - focuses on case study topic • insightful – provides perceived causal inferences	• bias due to poor questions • response bias • incomplete recollection • reflexivity - interviewee expresses what interviewer wants to hear
Direct Observation	• reality - covers events in real time • contextual - covers event context	• time-consuming • selectivity - might miss facts • reflexivity - observer's presence might cause change • cost - observers need time
Participant Observation	• Same as above • insightful into interpersonal behaviour	• Same as above • bias due to investigator's actions
Physical Artefacts	• insightful into cultural features • insightful into technical operations	• selectivity • availability

Table 2. Types of evidence (Adopted from Yin (1994))

Capabilities	Acquired Benefits
• Optimization of transportation routes	Effectiveness and efficiency in processes with limited resources
• Operational issues regarding the transportation; monitoring and documentation	Operational efficiency in delivery and minimization of costs
• Controlling; load levelling	Elimination of costs, productivity
• Planning; route planning	Accurate scheduling
• Real time information	Improved communication and collaboration and inventory management

Table 3. Interview Questions

Sensor and Alert System	Report Capability / Incapability
• Fuel Level Sensor	• Fuel Consumption between fuel ups • Fuel Consumption while idle • Daily Fuel Consumption • Total Fuel Consumption • Current Fuel Level --- • Lack of required integration • Mostly offline
• Temperature Sensor	• Upper Temperature Limit • Lower Temperature Limit • Limit Exceeding Notifications • Live Monitoring Capability --- • Lack of required integration • Inoperative data logging (no retrospective data)
• Weight Sensor	• Current payload --- • Lack of required integration
• Speed Sensor	• Current Speed of the vehicle • Backlog of the speed data • Sudden brake and acceleration detection
• Alerts and Notification (SMS or e-mail)	• Exceeded speed limit • Exceeded idling duration • Sudden brake or acceleration • In case the temperature goes below or above the limit --- • Lack of necessary sensor integration • Offline sensors

Table 4. Capability/Incapability of Sensor and Alert System