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Freight Spend Visualization and Analytics with BI Tools

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Transportation cost or freight cost is considered to be a big part of supply chain cost to keep a manufacturing firm operated. Hence, how to optimize freight cost is a frequent question asked by many logistics specialists. In this thesis, freight data is the focus to be examined for improvement since it reflects what is happening in the operations.

This study is conducted by using qualitative research methods. Data is gathered through interviews and discussions with the key stakeholders from the case company. The selected research approach is action research because improvements were suggested based on shreds of evidence gathered from the deep involvement with the case company. After the problems were identified through the CSA process, existing knowledge about data visualization and related concepts were explored, which then, together with the suggestion from stakeholders, were used to form the proposal.

The outcome of this study is the improvement plan for freight data visualization to enhance the problem-solving process and reporting practices at the case company. Freight data is exploited by using and implementing a BI tool for reporting and analytics. The benefits for the company are significant because the key stakeholder can, later on, create and customized reports with freight data stored on the cloud. The proposal is approved by the case company and will start immediately to test its practicalities.

Keywords	Business Intelligence, data visualization, transportation data

Contents

Glossary

ORM	Object-relational mapping. The set of rules for mapping objects in a programming language to records in a relational database, and vice versa.
DBMS	Database management system. Software for maintaining, querying, and updating data and metadata in a database.
T&L	Transportation and Logistics
BI	Business Intelligence
EMEA	Europe, the Middle East, and Africa
AR	Action Research
CSA	Current State Analysis
LSP	Logistics Service Provider
TMS	Transportation Management System

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1 Introduction

A supply chain is a consortium of many different activities, out of which Logistics and transportation is a major contributor. It is the physical movement of goods, money, and information that strengthens the links among parties, between suppliers and consumers. With the expectation of 2,7% growth of international trade in 2020 (IHS Markit, 2020), transportation continues to solidify its critical role.

Undoubtedly, logistics bears a cost, and that cost needs to be well-managed so that it will not hurt the whole chain. Transportation cost genuinely concerns freight cost that incurs to have the goods shipped. Costs for freight should be actively managed to reduce, for example, the number of expedited shipments and the cost of all shipments (Kaczmarek,2017). Therefore, freight data management is essential for the company to understand, manage, and optimize transportation-related expenses.

Moreover, fuel and freight are believed to make up nearly two-thirds of logistics costs. Therefore, transparent and accurate data is needed to help companies to optimize those costs and develop a transformative strategy to improve all the bottom lines like operational efficiency, also to increase profits for shareholders. (Supply Chain Brain, 2020)

Furthermore, with the evolvement of technologies over the past 10 years, multiple tools are at hand to provide greater access and manage the big data related to transportation. In 2017, a survey was carried out by Analytiqa to gather opinions from senior decision-makers in the British logistics sector. The question was raised towards an issue as to which area of their business was most benefitting from technology. Figure 1 below shows the result of the survey, which suggested that “Greater operation visibility and reporting” was the most selected answer to that question.

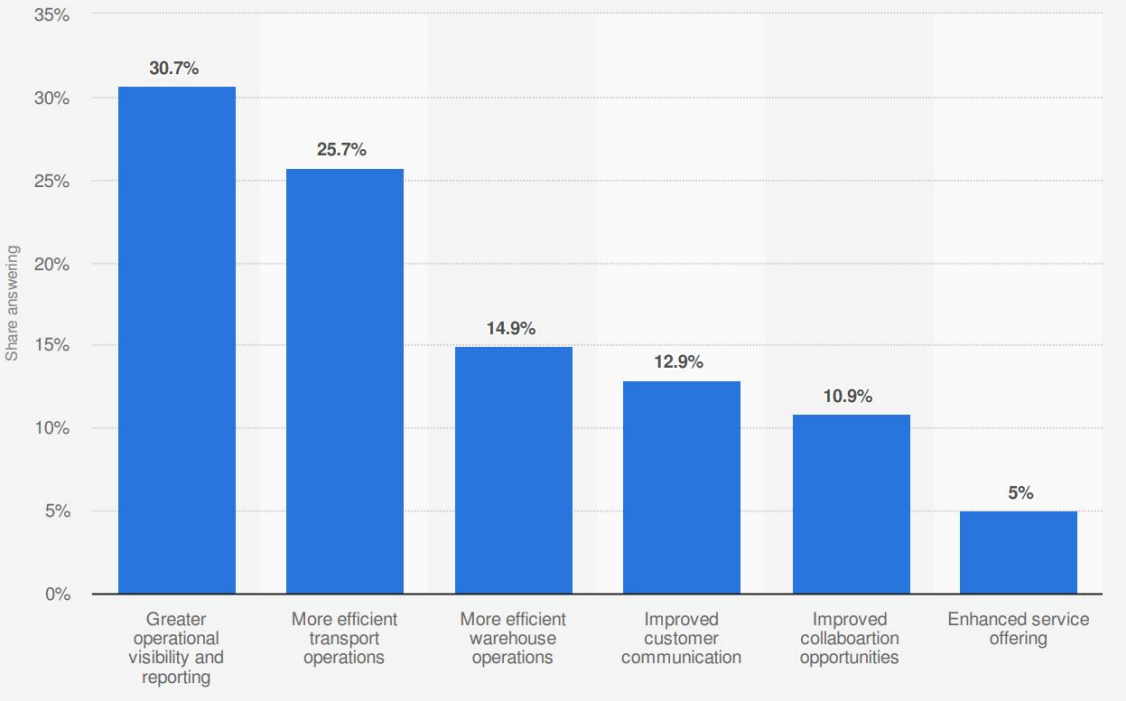


Figure 1. UK views on areas in the logistics sector most benefitting from technology (Statista, 2020)

It is the attitude and enthusiasm of the companies whether they are ready yet to align their organization towards the business intelligence pathway by creating processes, with the help of technologies, to convert raw data into meaningful information that drive profitable decisions.

1.1 Business Context

The case company of this Thesis is a Finnish manufacturer and an exporter of panoramic X-ray imaging machines and spare parts for dentists and health practitioners. The products are distributed globally but the biggest market shares are from North America and EMEA regions.

At a manufacturing firm, logistics and production go hand-in-hand, playing vital roles in bringing success to the business. The production combines raw materials and components to make consumable products, while logistics assures a smooth flow of

input, raw materials, and assembly parts, to the production plant and the output when finished products are shipped to final customers on time, at the optimal costs. By definition, logistics refers to the processes of acquiring, transporting, and storing resources along the supply chain and logistics. In this study, the freight spend is just covered the transportation part, not the warehousing activities of the case company.

Overall, the main task of the logistics department at the case company is to oversee and manage the cost of inbound logistics, the transportation of goods and raw materials from suppliers to the production plant, and outbound logistics, the delivery of goods and products to the end customers.

1.2 Business Challenge, Objective, and Outcome

The thesis writer has started at the case company located in Tuusula since May 2018, assisting the Logistics Manager with upstream and downstream logistics. Having participated in daily operations at Tuusula, the author realized that the spend and transportation data is fragmented and manually processed. Different spend for different traffic lanes is stored mostly in various Excel files. As a result, it takes a great amount of time for whoever within the organization would like to gather transportation data for reporting or analytical purposes. Moreover, the transport database is mainly saved in the internal cloud of the business sectors in Finland, which means managers who are not located in Finland can not get access to these files.

Most of the time, extra discussion through email is needed to ask for the submission of necessary data. For example, a specific monthly report will be sent to the Logistics director of EMEA, after reviewing, she then has the file sent to the Vice President (VP) in the States. If the VP has any questions about the past year's performance of any traffic lanes in Finland. He then needs to email and asks the EMEA director, she, at that point, needs to go through a hundred files stored in Finland to find the exact answer for the VP. Through this real-life example, it is easy to conclude that the freight data is not real-time visible and accessible at all, which makes the reporting process troublesome and time-consuming.

At the same time, transportation data plays a critical role in the whole logistics and supply chain management. Due to a big volume of data, it is a challenge for every company to get hold of the issue. However, due to the current advance of the technology world, tools

are available to give firms a hand. It has been recognized by the case company that there is an existing challenge in managing the logistics and transportation data of the operation. Not only it appears as a bottleneck of the current administration, but it is also an obstacle preventing further development comprising cost spend analysis or cost optimization.

The objective of the study is to improve visualization for freight spend with BI tools. On this account, the outcome of this study is the improvement plans with actions point as how to implement the chosen BI tool.

1.3 Thesis Outline

The scope of this thesis is limited to the logistics department of the company. Only transportation data available for the two years (2019-2020) are analyzed and examined because transportation information details of the company before 2019 are fragmented and not fully archived.

This thesis is written in seven sections. Section 1 is the introduction, describing the business context and triggers for the thesis. The research direction, or which approach to use and how it is designed, is discussed in Section 2. To continue, section 3 reports on the results of the current state analysis. Key findings from the current state analysis help to build the conceptual framework in Section 4. Section 5 presents the initial proposal. Finally, feedback and improvement for thesis research are discussed and suggestions for future implementations are highlighted in the last section.

2 Method and Material

This section overviews the research approach, research design, how the data collection was made and analyzed.

2.1 Research Approach

Research is “a careful study of a subject, especially to discover new facts or information about it” (Research, 2021). It is a search of knowledge consistently comprising of different tools, skills, and a clear structure of how to perform and achieve the proposing purposes in any profession. On this account, the research approach is believed to be that bone structure.

Research methodology or research approach is acknowledged as the consortium, of which its branches are namely data collection and data analysis methods. Those branches act as the root, the anchorage that holds firm and feed; in other words, prove the chosen methodology above. Some of the common research types were introduced by (Chandra and Hareendran, 2017) in the figure below.

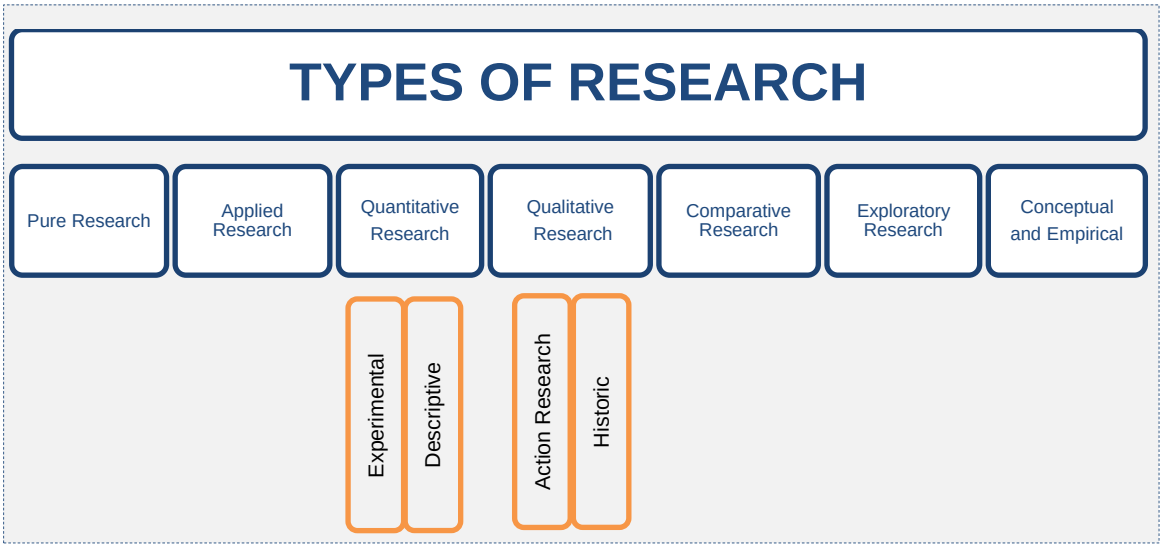


Figure 2. Types of research (Chandra and Hareendran, 2017)

The two most commonly discussed methods are qualitative and quantitative. They are the basic, based on which other mix approaches are formulated.

Quantitative research deals with statistical numbers and is described with a deductive reasoning process, shown in the figure below. The progress starts with a theory and the expected outcome is the confirmation or rejection of a hypothesis deductive approach (Dudovskiy, 2017). Common data collection methods used in the testing or observation could be surveys, experiments, or observation checklists of variables that cannot be controlled (Streefkerk, 2019). Experimental and descriptive researches are the major classification of quantitative research.

Figure 3. Deductive reasoning process (Dudovskiy, 2017).

Instead of numbers, qualitative research deals with words and arguments, and inductive reasoning would rationally define its process, illustrated in the figure below. Unlike quantitative research, theories and hypotheses are not applied at the beginning of the research. It is the search for action patterns through observation, and theories are drawn as the result of the whole process. However, theories are still used or referred by the researchers if they are helpful and necessary to formulate the other research elements, for example, research objectives or problem statements (Dudovskiy, 2017). Some data collection methods that are helpful to answer the qualitative research questions include interviews, discussion among focus groups, or consistent observation of the culture and behavior of a community or organization (Streefkerk, 2019). Action research and historic research are the major examples of qualitative research.

Figure 4. Inductive approach (Dudovskiy, 2017).

There are different elements involved in the research that could be examined to develop the final research design. The choice of research approach depends firstly on the purpose for carrying out the study, what the researcher aims to achieve. Also, the

suitable approach should fulfill the research objective and can answer the problem statement. Additionally, data collection methods are deciding elements for picking an appropriate research approach. When discussing the research methodologies and approaches, Kananen (2013) classified different elements, which help to form the choice of methods used to conduct research, into the table below.

Table 1. Classification of different research approaches and methods including their characteristics (Kananen 2013, 29).

	Research families / methodologies		Research approaches with multiple methods and strategies		
Type	**Qualitative**	**Quantitative**	**Case study**	**Design research**	**Action research**
1. Relationship between theory and practice	Induction (from practice to theory; theory building)	Deduction (from theory to practice; theory testing)	Abduction	Abduction	Abduction
2. Purpose of research	Understanding	Generalization Prediction	Understanding	Change	Change, Intervention
3. Researcher's role	External	External	External	External / internal	Active, internal
4. Responses (data)	Texts, descriptions (e.g. open questions, theme interviews, etc)	Numbers (e.g. from structured responses, etc)	Many, open questions	Many, open questions	Many, open questions

Action research is selected for this study because the research has a deep involvement with the case company problem. The desired outcome acts as feedback for the improvement of the organization. According to Coughlan and Coghlan (2002), action research aims at encouraging researchers to learn from operational management, initiate corrective action, and build up a body of scientific knowledge and theory in action.

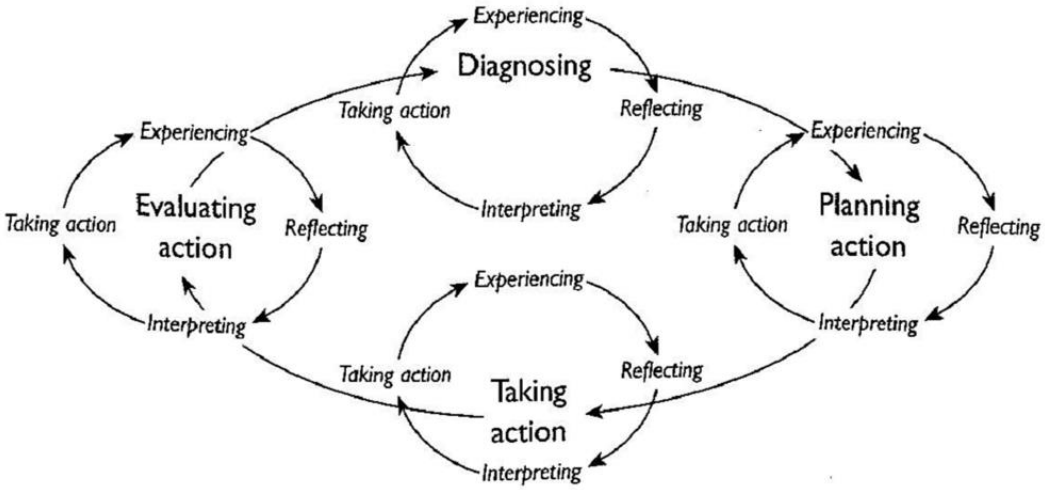


Figure 5. The experiential learning cycle in action research projects (Coghlan and Brannick 2005: 21).

In action research, there are soft data and hard data. On one hand, hard data covers physical reports such as financial statements, operational statistics, or marketing action plans. On the other hand, soft data are the interpretation or understanding gained through observation, discussion, or interviewing. Although, arguably, soft data is largely perceptual and not entirely valid (Coughlan and Coghlan 2002, 231), it is a crucial source of data for the action researcher. Consistent observation forms the business context subconsciously until a point that leads to the question about rationale for action.

2.2 Research Design

Research design is the overall structure of any research, which describes the logic, the framework, and the instruments acquired to construct the whole study. (Chandra and Hareendran, 2017)

The research design of this thesis consists of five parts. In the first part, the business challenge of the thesis is clarified. From the business challenge, the objective and the actual expected outcome from the conducted research are defined. This stage is important for creating substance to the researched problem and determining the later phases of the thesis.

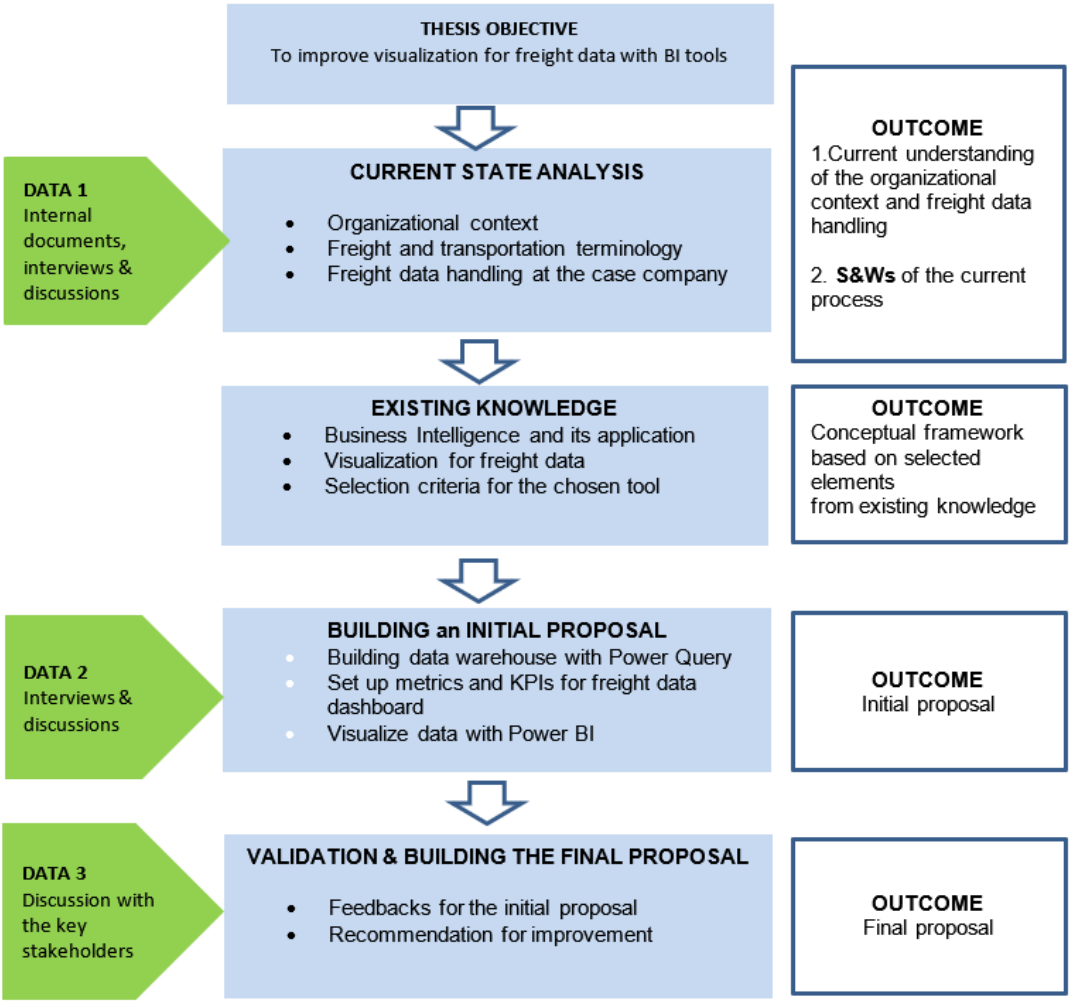


Figure 6. The research design of this study.

As seen from Figure 6 above, the second part of the research design is the current state analysis of the data visualization and analytics currently done in the case company. To perform the analysis, Data 1 comprising of interviews with managers from the case company and internal documents are collected. Also, own observations are utilized in the current process maps. Data 1 is done with the aim to reveal the strengths and weaknesses, implying the need for a new process. Also, this stage helps to define the targets for the literature focus in the next step.

Based on the current state analysis, a conceptual framework is created from existing knowledge gathered in the third step. Literature sources are explored to give an

understanding of data visualization are be examined to suggest a suitable proposal for the next stage.

In the fourth stage of research design, an initial proposal for improvement of freight spend visualization and analytics process is formed based on Data 2 consisting of the company internal data and suggestion from the managers.

The final stage is the validation of the initial proposal with the company representatives. During this stage, feedbacks are collected through discussion and further improvements are planned for the final proposal of the process.

2.3 Data Collection and Analysis

This thesis started with observations of the current practices at the case company to form a pre-understanding and find the business problem. The observations also related to the business processes, the company culture, and operational systems, which called for a change.

For the data collection process, both primary and secondary data are used as data sources. Primary data is gathered through observations, questionnaires, and interviews with the company managers and specialists. While secondary data is collected through internal sources such as annual reports, databases. The two types of data are not entirely separated; they are interlinked to support the analysis of current practices.

As seen from Table 2 below, data is gathered in three rounds, marking each round as Data 1, Data 2, and Data 3 correspondingly. All the methods supplement each other and aim at clarifying current state analysis, building the conceptual framework, and developing the final proposal of the study.

Table 2. Details of Data collections 1-3 used in this study.

	Participants / role	Data type	Topic, description	Date, length	Documented as
	Data 1, Current state analysis				
1	Respondent 1: L&T Manager	Interview via Teams	The current process for data reporting and visualization? Satisfied or not? Any improvement needed?	30 minutes	Teams Recordings
4	Case company Intranet and SharePoint	Freight spend report, spreadsheets	Data collection to analyze the current process	90 minutes	Written text & graphics
5	Thesis writer	Observation	Sketching out the current process	consistently during work	Written text & graphics
	Data 2, Proposal building				
6	Participants: ✔ L&T Manager ✔ IT specialist	Face- to- face discussion or via MS Teams	🕐 Qualitative feedbacks 🕐 Creative brainstorming 🕐 Co-creation for proposal building	90 minutes	Fieldnotes
	Data 3, Validation				
7	Participants: ✔ L&T Manager	Group interview/ Final presentation	Validation, evaluation of the Proposal	90 minutes	Field notes

Data 1 was collected and analyzed for the current state analysis. L&T Manager from the case company, who is responsible for all the main logistics procedures and development, was interviewed via Teams to get the status quo of how freight data is being processed. During the interview, questions, designed beforehand, were asked.

Data 2 was collected to build the initial proposal, while Data 3 suggested the checklists for the improved proposal. Those two rounds of data collection were executed through internal discussion with key stakeholders of the case company.

From the discussion, the writer expected to receive qualitative feedbacks, underlying opinions, and insights into the business problems, which was of importance to build and evaluate the proposal. The responses were documented as field notes in electronic form.

All textual data from all three rounds of data collection were analyzed using Thematic Analysis. Since the research follows an inductive approach, the data are supposed to determine the themes of the research. (Caulfield, 2019)

While collecting Data 1 for the current state analysis, internal documents were examined and analyzed. The documents mentioned in Table 3 together with observation help the thesis writer sketch out the current process map of how data archived for reporting and visualization process.

Table 3. Internal documents used in the current state analysis, Data 1.

	Name of the document	**Number of pages/other content**	**Description**
A	Case company Annual Report	253 pages	Business and Operational Processes
B	Case company Transportation Data 2019	Spreadsheet	Archived transportation data between case company and other logistics suppliers in 2017 (DHL Express, FedEx, TNT...)
C	Case company Transportation Data 2020	Spreadsheet	Archived transportation data between case company and other logistics suppliers in 2017 (DHL Express, FedEx, TNT...)

Next, the findings of the first round of data collection are discussed in Section 3 below.

3 Current State Analysis of Reporting Practices for Freight Data and Analytics at the Case Organization

This section of this thesis describes the process background of freight data visualization and analytics at the case organization. This part is of importance to define the strengths and weaknesses of the current practices.

3.1 Overview of the Current State Analysis

The objective of this phase is to find out what is not working in the current practices. The chosen person for interviews is the key member, who understands crucial aspects of the studied problems. Information collected at this stage is Data 1, comprising of the observation, and interviews.

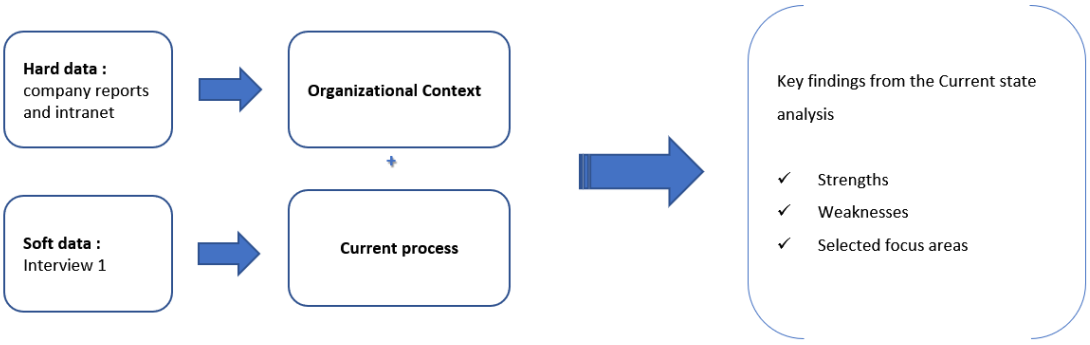


Figure 7. Overview of CSA

The observation about company culture and the business system, together with hard data comprising of company reports are used to familiarize the organizational context in section 3.2. The reason why organizational context is explained here is to emphasize the importance of freight data in routine work and it is of great benefit for reporting practices and analysis if they are handled well.

Next, in section 3.3, Freight and Transportation Terminologies are presented to explored what kind of data is studied.

To conduct section 3.4 as how freight data is being handled at the case organization, an interview is done with the L&T Manager. All the questions were prepared beforehand and listed in Appendix 1. The questionnaires are designed in a manner to encourage

interviewees to think about the studied subject in a broad view and share more critical opinions about it.

Based on the interview results, the analysis of the current practices was conducted, which results in key findings and identified challenges. Out of those, the focus areas were chosen to address in this study.

3.2 Organizational Context

Before describing the current way of collecting and visualizing the transportation data, a brief description of the organizational context where these practices take place is presented first.

The case company of this thesis is one of Finland's largest healthcare technology export companies and a center of excellence in dental imaging product development and manufacturing. The core competencies include the manufacture of X-ray tubes and the reconstruction of image quality.

Figure 8. Example of products manufactured by the case company

The company designs and manufactures X-ray machines that help dental professionals to correct, prevent and diagnose misaligned teeth and jaws of patients. This kind of dental practice is called Orthodontics. According to Fortune Business Insights (2019), the global orthodontics market size was valued at 4.06 billion USD in 2018 and is forecasted to reach 9.72 billion USD by 2026. Figure 9 below illustrates the growth in North America, which is the main export market of the case company.

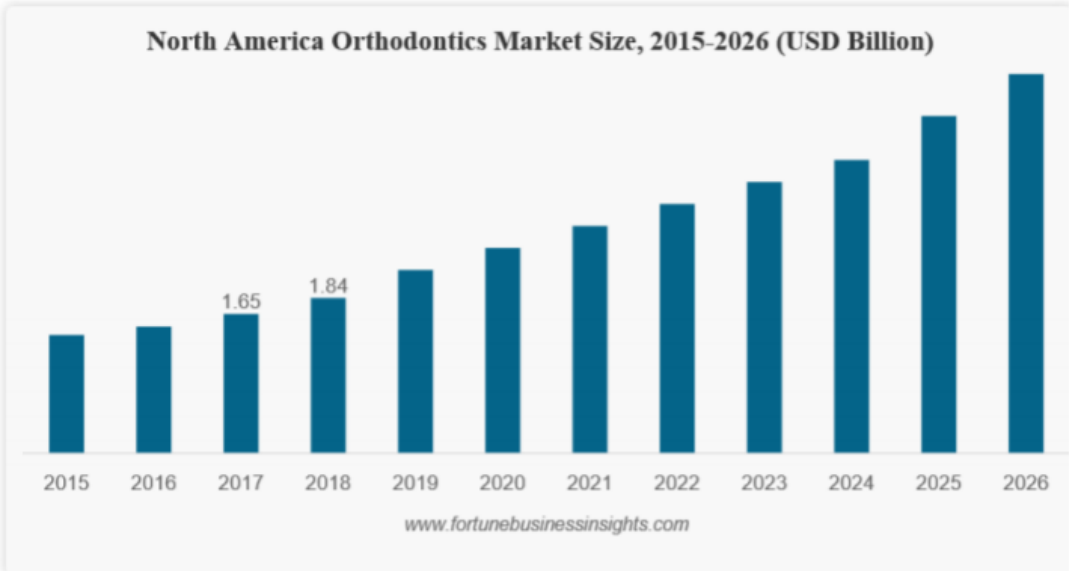


Figure 9. Orthodontics market in North America, 2015-2026.

As the demand is projected to increase, enormous stress is placed on the whole supply chain comprising of production, procurement, and transportation. Similar to other manufacturing firms, there are two transportation streams of material and products that need to be administrated here, namely inbound and outbound flow.

Inbound transportation is the movement of raw, semi-products, and spares from various sources of suppliers to the production site in Finland. The flow is carried out by various means of transportation including sea freight, road freight, or airfreight for cargo and parcels with contracted LSPs.

Figure 10. Inbound logistics flow.

To control the flow, FCA Incoterm is policed to be used since FCA allows a buyer to have ultimate control over the transportation of their products after the cargo has been formally exported from the country of origin. FCA term is advantageous to the case company because they have full control of all costs associated with logistics carried out by the 3rd party logistics provider. Therefore, to optimize the cost, the logistics team needs to understand the cost details and realize which LSPs should be contracted.

The second flow concerns outbound transportation enabling the moving of finished products from the factory to the retailers or end customers. As for the whole big X-ray machines, cargo shipments are the majority in the case company. Small spare parts could be shipped with couriers like DHL Express, TNT Express, or FedEx. To minimize the risk for customers and take control of the transportation process, CPT incoterm is in use for all of the export shipments, which means the case company organizes all the related transport and pays the freight.

Figure 11. Downstream logistics at the case organization.

Besides, the company acquires a make-to-order and agile production philosophy; outbound stocks are regulated to keep at the minimum level. Additionally, it must comply with the customer's required deadlines and volume; as well as to ensures the delivery with the best possible price... Therefore, transportation needs to be planned and managed meticulously. In more concrete terms, the goal is to sort out the best 3rd party transportation providers, who bring the best possible value for money, making sure that this downstream service is beneficial both for the company and end customers.

All in all, the transportation process at the case company bears a great amount of cost. But the answers to questions such as "How much do you spend on transportation?" or "Is the cost optimized?" cannot be assumed or guessed. Moreover, actions cannot be

taken without the support of hard data. Simply put, freight and transportation data are needed when the company wants to drive down logistics and transportation spend.

3.3 Freight and Transportation Terminology

Before diving into how the freight data is processed and managed at the case company, some key terms about freight and transportation are introduced in this part of the study. Subjectively speaking, by understanding these terms, the upcoming part is more comprehensible.

Freight refers to the commercial transportation of goods by any means, either by land, air, or sea. Unlike sending mail at the neighborhood post office, freight is generally the bulk transportation of goods. Freight shipping happens when:

- Numerous products to a distant customer need to be sent
- Delicate furniture needs to be moved a long distance
- Products are shipped to a different location or branch of the same business

(Acme Logistics, 2020).

Freight data are the detailed information about the transportation activities of shipments, whether it is about the cost, shipment dimension, etc…

Freight spends or freight costs are basically how much a shipper pays for the shipment. According to Goodwill (2017), freight transportation is typically the largest cost component of supply chain management. Data from Logistics Management's Annual Study of Logistics and Transportation Trends specifies that average transportation spend is in the range of 10 to 11 percent of revenue for companies with less than $250 million in sales and it is in the range of 2 to 3 percent for companies with revenues above $9 billion. Thus, freight expenses cannot stay undermanaged. Freight costs usually consist of three components, suggested by Rodrigue and Notteboom (2021):

- Linehaul costs: the basic cost to move a shipment from origin to destination. Line-haul costs vary directly with distance.

- Fuel surcharge: A fuel surcharge is an additional charge to cover fuel costs and is dependent on the line haul. The fuel surcharge depends on the average fuel price and can be different for each shipper or industry. Since the cost of fuel fluctuates, it cannot be calculated as a fixed-rate like line haul costs.

- Accessorial costs are extra charges for transportation services including packing, unpacking, long haul fees, and extra pick-ups. Freight carriers may also charge extra fees for trailer detention, re-delivery, fuel increases, and other expenses or extra services.

Freight invoices: **"**A bill rendered by a carrier to a consignee of freight and containing an identifying description of the freight, the name of the shipper, the point of origin of the shipment, its weight, and the number of charges." (Merriam-Webster,2020)

According to Globaltranz (2014), a freight or expense bill for each shipment transported containing the following information:

- Names of consignor and consignee (except on a recon signed shipment, not the name of the original consignor).

- Date of shipment.

- Origin and destination points (except on a recon signed shipment, not the original shipping point unless the final consignee pays the charges from that point).

- The number of packages.

- Description of freight.

- Weight, volume, or measurement of freight (if applicable to the rating of the freight).

- Exact rate(s) assessed.

- Total charges due, including the nature and amount of any charges for special service and the points at which such service was rendered.

- Route of movement and name of each carrier participating in the transportation.

- Address where remittance must be made or address of bill issuer's principal place of business.

These key terms mentioned in this part are communicated daily at the case company, especially in the processes and systems for transportation management.

3.4 Freight Data Handling at the case Organization

This part of the study exploits the responses from the logistics managers regarding how freight data is controlled and processed.

3.4.1 Data sources

Freight data are fragmented to various places in the organization. There are many different sources of freight spend data, which is briefly illustrated in Figure 12 below.

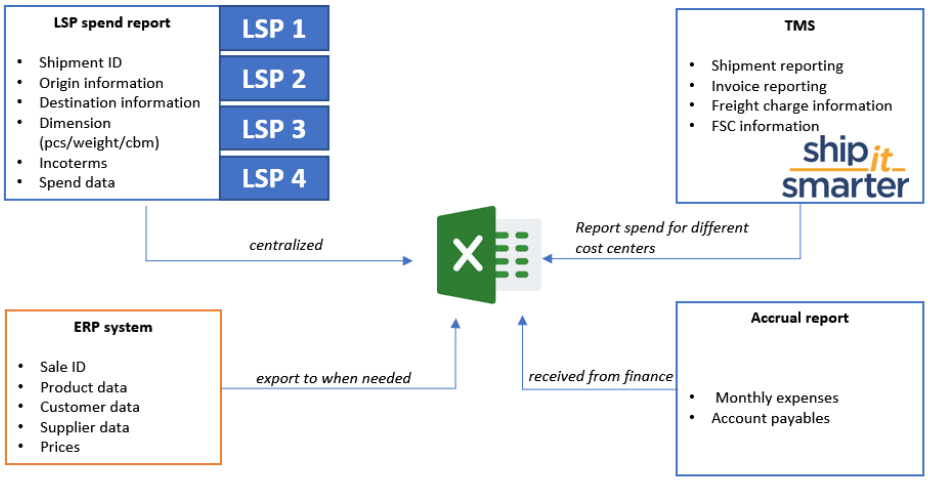


Figure 12. Sources of freight spend data in the case organization.

The first to mention is the ERP system of the organization. ERP is business management software that companies can use to collect, store, a wide range of business activities, and share information across various departments. By integrating transportation management data into its ERP, an organization can link transportation to its other business processes and gain deeper insights into its entire operation. The shipping team could retrieve the ready-to-ship product information from the ERP and proceed with the transportation booking for outbound shipments. The ERP system is used at the case company is Oracle.

Export shipments will be booked via a TMS called Shipitsmater. A TMS (transportation management system) is used to plan freight movements, do freight rating across all modes, select the appropriate route and carrier, and manage freight bills and payments. (Kuebix, 2020) With an order integration between a TMS and an ERP, orders automatically flow from the ERP to the TMS for easy rating, booking, and tendering. Instead of going back and forth between systems and spreadsheets, the order information is automatically populated. Additionally, the TMS could generate a shipment report, from their freight data such as shipment dimension, the cost could be reviewed.

Since Oracle is used across all the department, the finance team also has access and have the control over freight invoices and the full cycle of accounts payable process, which includes invoice data capture, coding invoices with correct account and cost center, approving invoices, matching invoices to purchase orders, and posting for payments. Every month, an accrual accounting report will be distributed by the Finance team to the Logistics manager. Accrual accounting report unveils a complete picture of financial transactions, the accurate income, and the expense of the business. Each department can review its monthly spending with the accrual accounting report. Regarding the logistics team, the actual transportation costs, which are categorized into different transportation account, for example, inbound, outbound spends, or postage spending could be tracked.

As for the Logistics team, the main source of data mostly used is that from LSPs spend reports. This report is useful to track the transport cost of both inbound and outbound shipments. As mentioned above, outbound shipments are booked by the case company via transport integrated systems. While inbound shipments are booked for transport by the suppliers. Therefore, the flow of inbound transport data does not come from the case company. The only way to track freight data for these shipments is from the LSPs spend report. From each carrier, a spend report is sent monthly to update about the total spending and number of shipments executed. The spend data from LSPs reports are the same as that in the freight invoices sent to Oracle, which are then processed to be paid by the finance team. Hence, shipment-related information like names of the consignor and consignee number of packages, weight, volume, or measurement of freight, total charges due are available.

As shown in Figure 12 above, all the freight data from different sources are available in Excel format. It is the only system used by the L&T team for now. Other departments could have tried the different new programs, for example, the Finance department starting this year use Tableau for monthly spend reports for management review.

3.4.2 Data involved with the problem-solving process

The act of dealing with freight data belongs to the daily work in this organization. The case company is a small organization, where ad-hoc transportation decisions are needed on the daily basis to keep the operation on track, and data is the significant factor to support the decision-making process.

The freight data have two important insights. Firstly, they provide useful information, which builds up various options to create or expedite shipments for both inbound and outbound. Secondly, from the cost administration perspective, freight spends data are reviewed monthly to support the cost control of the whole organization.

Currently, one challenge of the team is that there are no metrics or KPIs to control the L&T cost at the local company; even though, the team has a good knowledge of the spend. The transportation data are scattered in many sources, at different departments of the organization. And people are not sharing that information since the local management board does not review transportation spend and act toward transportation cost controlling.

3.4.3 Data involved with the reporting practice

There has been no visualization tool to work with therefore, Excel is still the ultimate choice for reporting and analytics. According to the manager, one obstacle when reporting with Excel is that it contains only dry figures from the square box, as shown from Figure 13, which brings little interest to participants during the meeting. Visualization with charts and graphs is preferable.

	TOTAL FREIGHT	SEA	AIR	COURIER
January	9 333 €	6 757 €	2 576 €	6 426 €
February	40 659 €	33 367 €	7 292 €	8 005 €
March	47 564 €	40 526 €	7 038 €	6 641 €
April	20 108 €	12 577 €	7 532 €	2 606 €
May	32 208 €	13 277 €	18 931 €	5 819 €
June	52 204 €	27 288 €	24 917 €	6 640 €
July	30 223 €	26 671 €	3 552 €	4 085 €
August	31 641 €	20 759 €	10 882 €	4 495 €
September	39 602 €	37 325 €	2 278 €	6 514 €
October	52 874 €	30 385 €	22 489 €	4 747 €
November	102 410 €	18 189 €	84 221 €	5 459 €
December	78 537 €	27 704 €	50 833 €	5 318 €
	537 364 €	**294 824 €**	**242 540 €**	**66 755 €**

Figure 13. Example of freight visualization for current reporting

The figure presents sufficient information about the spending situation of the business in 2019. However, there is not much insight drawn out and visualized from it.

3.5 Key Findings from the CSA

Based on the current information gathered from the above, the findings are identified as strengths and weaknesses, also focus areas of the current problem will be summarized in the sub-sections below.

3.5.1 Strengths and Weaknesses

To begin with, several strengths in the process bring benefits to the daily operation. The team has various sources of freight data, which are transparent and followed very closely. Apparently, data are used to create measurement, to establish a baseline so that organizations could improve their processes and keep moving forward. Since the organization cannot manage what cannot be measured, therefore, the ultimate goal has always been to turn data into insight. Also, by utilizing data, a strong argument for process changes could be elaborated to the management teams or stakeholders. A clear

illustration of argument through the use of data will allow answering the question of why changes are needed and put the stop to the guessing game.

Secondly, it is controversial when naming Excel as the second strength. However, the managers are; up till now, happy when data are stored and retrieved in excel format.

Although Excel is one of the most used tools by companies worldwide and is installed in each business computer, this is not the only - and maybe not the best - tool for reporting. On the one hand, with just the basics of the tools, employees can tackle simple tasks including not-so-complicated calculations and analytics. Excel is everywhere and everybody seems to know how to use Excel just like people are speaking the same language, being in their comfort zones. Thus, while Excel is recognized as an advantage of the current practice, it is one of the weaknesses as well. When a data file is too large, it can make the Excel program run very slowly, especially if all the data is in one file. Trying to break the data down into smaller files can lead to some of it being lost or misplaced.

Moreover, Excel is also a standalone application, not fully integrated with other business systems; thus, it does not provide sufficient control managers do not have easy and consistent visibility of the data. Each time employees make changes manually in Excel, there is a risk of introducing errors and compromising accuracy. These mistakes are not only hard to locate further along the process but can also negatively affect the bottom line.

Therefore, the fact that data administration is heavily deepened on Excel could be a limitation for the financial data analysis of the L&T team in the future when more projections and forecasts are needed to improve the freight cost. Figure 14 summarized the strengths and weaknesses identified in the current analytics and reporting practices.

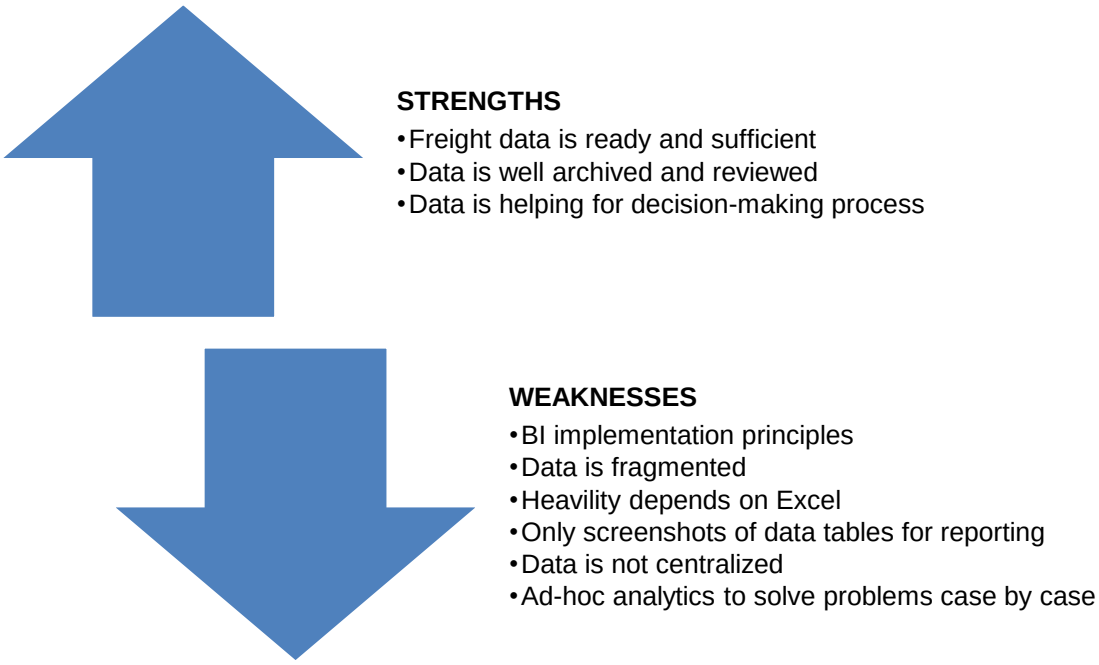


Figure 14. Strengths and Weaknesses of the current practice.

By looking at the figure below, it could be seen that there are no outcomes, as repeating processes, or structured reports after the data archiving process at the case organization. Data have not yet been transferred into informative insight to prevent or improve business obstacles.

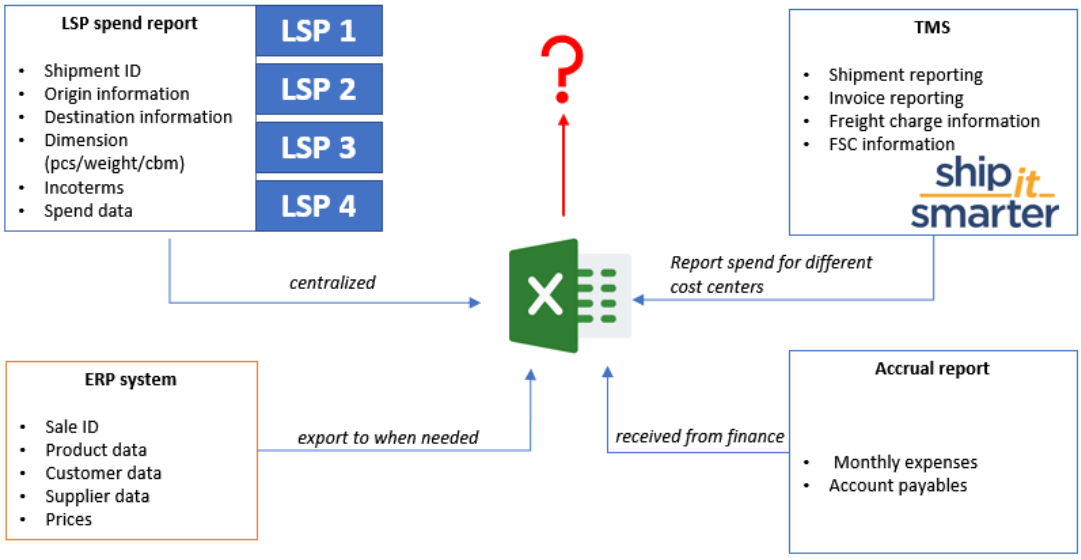


Figure 15. Limitation of BI solution in the current

Additionally, the above challenge has been the topic among the team but as mentioned "who are willing to step out of their comfort zone", there is currently limited understanding of new tools, and new concepts such as Business Intelligence seems to be more unfamiliar.

3.5.2 Selected Focus Areas

When the business's data requirements overtake Excel's abilities and this tool starts becoming an obstacle that holds the business back. Business Intelligence is thought to be a solution. However, three critical weaknesses should be looked into when planning for the implementation of the ideas.

Focus 1: More understanding and practices of Business Intelligence

Focus 2: More Data visualization platform to use

Focus 3: More competence to decide which tool would be appropriate

The next section aims at finding suggestions from existing knowledge and literature, based on which a conceptual framework is built. It is a synthesis of the literature that will address the three above selected issues.

4 Existing Knowledge for Improving the Use of Business Intelligence, Data Visualization, and Relates Competencies and Tools

This section discusses the key concepts and tools to form the conceptual framework of this study. The conceptual framework suggests solutions to the business challenges, so that for each identified focus, corresponding existing knowledge is searched for to find key ideas helping in the next steps of this thesis.

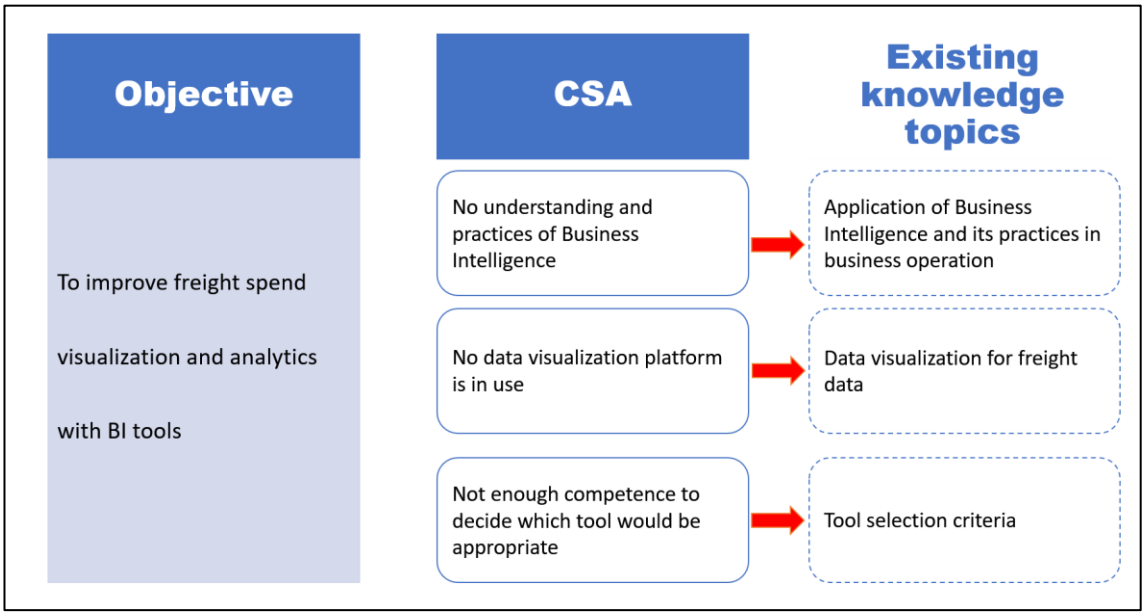


Figure 16. Existing knowledge elements for the study informed by CSA findings.

4.1 Application of Business Intelligence in Business Operation

The concept of intelligence was first proposed in 1967 by an American professor named Vilensky (H. Wilensky,1967). It further developed in the 1980s alongside computer models for decision-making and turning data into insights before becoming a specific offering from BI teams with IT-reliant service solutions. It is not a software or a program, instead, Business Intelligence (BI) can be defined as the process of making the decision by collecting, storing, transforming, and analyzing the data by using tools and technologies It is a group of applications that are used to transform data into information that can be readily consumed by the company's employees to monitor and execute their functions effectively. (Loshin, 2003.)

Recognized as one of the top vendors for BI tools in the market, Tableau has several case studies of how BI can transform business operations. It states that:

> "Business intelligence can help companies make better decisions by showing present and historical data within their business context. Analysts can leverage BI to provide performance and competitor benchmarks to make the organization run smoother and more efficiently. Analysts can also more easily spot market trends to increase sales or revenue. Used effectively, the right data can help with anything from compliance to hiring efforts." (Tableau, 2021.)

To cope with the rapid changes of the business world, many companies strive to be more data-driven, the need to share and collaborate through data is expected to increase. Therefore, recognizing the importance of BI and its solutions can put companies further ahead of the race.

As one cited case example, with the help of BI tools, the visibility of the operation from financial services firm Charles Schwab has increased. A comprehensive view of metrics and areas of opportunity can be tracked and reviewed with the tool from all of their branches across the United States, bringing all of their branch data into one view. (Tableau, 2021.)

4.2 Data Warehouse

Data warehouse means a large collection or storage of data which is used to carry out different BI practice. Simply put, a data warehouse periodically pulls data from different sources to prepare for analysis or other BI solutions, data is gone through the ELT process to be Extracted, Loaded, and Transformed into the standard that is best suited for other integrated BI tools. One of the best-known data warehouse software defines the concept as:

> "A data warehouse centralizes and consolidates large amounts of data from multiple sources. Its analytical capabilities allow organizations to derive valuable business insights from their data to improve decision-making. Over time, it builds a historical record that can be invaluable to data scientists and business analysts. Because of these capabilities, a data warehouse can be considered an organization's "single source of truth." (Oracle, 2020)

Once data has been collected, processed, and stored in the data warehouse, more BI processes can be developed from this point. These processes are suggested by Jayanthi (2009) and listed in the table below.

Table 4. Current BI Techniques (Jayanthi,2009)

BI process	Explanation
Predictive modeling	Predict value for a specific data item attribute
Characterization and descriptive data mining	Data distribution, dispersion and exception
Association, correlation, causality analysis (Link Analysis)	Identify relationships between attributes
Classification	Determine to which class a data item belongs
Clustering and outlier analysis	Partition a set into classes, whereby items with similar characteristics are grouped together
Temporal and sequential patterns analysis	Trend and deviation, sequential patterns, periodicity
OLAP (OnLine Analytical Processing)	OLAP tools enable users to analyze different dimensions of multidimensional data. For example, it provides time series and trend analysis views.
Model Visualization	Making discovered knowledge easily understood using charts, plots, histograms, and other visual means
Exploratory Data Analysis (EDA)	assumptions or models; goal is to identify patterns in an exploratory manner

Depending on the need of the organizations, the output of DW is varied. In this study, the focus is placed on Data visualization.

4.3 Visualization of Freight Data

4.3.1 Data visualization introduction

The explosion of data in the different industries places a challenge as how to interpret and make sense of it to support business operation. According to Helbing and Balietti ((2011) and Manyika et al.(2011), around 1200 exabytes were generated annually in 2010 and it is predicted to grow by 40% annually in the future. In the previous section, the concept of a data warehouse has been introduced. Once the data warehouse, which contains all the required data for business operations has been set up. The next step is the output of the data warehouse, which are some kind of reports or analytics that make the data useful. And one of the more common ways to process those outputs is through data visualization (Tableau, 2021).

Data visualization is a technique to presents data through graphical displays. Through such visual elements, it is more accessible for viewers to observe and understand different characteristics of data such as trends, outliers, or patterns… (Sahay, 2017)

Additionally, visualization could be considered of great importance for problem-solving because through the exploratory process, data visualization presents an illustration that can explain and speak for the solution of raised challenges. As Brodbeck, D., Mazza, R., & Lalanne, D. (2009) stated:

> ‘‘The goal of visualization is to aid our understanding of data by leveraging the human visual system’s highly tuned ability to see patterns, spot trends, and identify outliers. Well-designed visual representations can replace cognitive calculations with simple perceptual inferences and improve comprehension, memory, and decision making. By making data more accessible and appealing, visual representations may also help engage more diverse audiences in exploration and analysis’’. (Brodbeck, D., Mazza, R., & Lalanne, D, 2009:27-46)

After all, data visualization helps users to develop an understanding of data through which insight is created to support decision processes and problem-solving for business

operation. Equipped with a powerful tool, it could be an effective way of storytelling with data to enhance the competence of a team or an organization.

Visualization is not high-leveled or complicated scientific concept. In everyday routines, everyone has encountered different types of graphs or tables used to describe the key features of data like in Figure 17 below.

Figure 17. Examples of the visual display using different charts and graphs (Boostlabs, 2019)

It could be a bar chart, pie chart, line graph, etc. that are used to combine or summarize information in some basic scenarios such as the sum of total spends, sales, and revenue of products in the defined period of time... (Sahay, 2017:37) indicates that there are three main types of information displays used for visualization:

- Tables: used to look up specific values from data organized in rows and columns.
- Graphs: are used to show relationships among data
- Information visualization is the use of diagrams an or charts to demonstrate the results of information.

These visualization displays can be easily created using basic business IT programs like Excel, Word, or PowerPoint. However, with the advancement of modern technology, high-quality and complex are available to process a bigger volume of data with high-quality and complex visualization solution. And dashboard is that solution, considered to be one of history's best innovations in business intelligence in terms of visualization practice. Defined by Klipfolio (2021):

> "A data dashboard is an information management tool that visually tracks, analyzes and displays key performance indicators (KPI), metrics and key data points to monitor the health of a business, department or specific process. They are customizable to meet the specific needs of a department and company. Behind the scenes, a dashboard connects to your files, attachments, services and API's, but on the surface displays all this data in the form of tables, line charts, bar charts and gauges." (Klipfolio, 2021)

Figure 18 is an example of a Visualization dashboard created by Microsoft Dynamics NAV. It could be seen from the dashboard that many different charts and data tables are combined into one single view to offer a quick review of the whole operation. Many dimensions of data are highlighted at the same time, which is more effective when manually analyzing raw data with the traditional Excel.

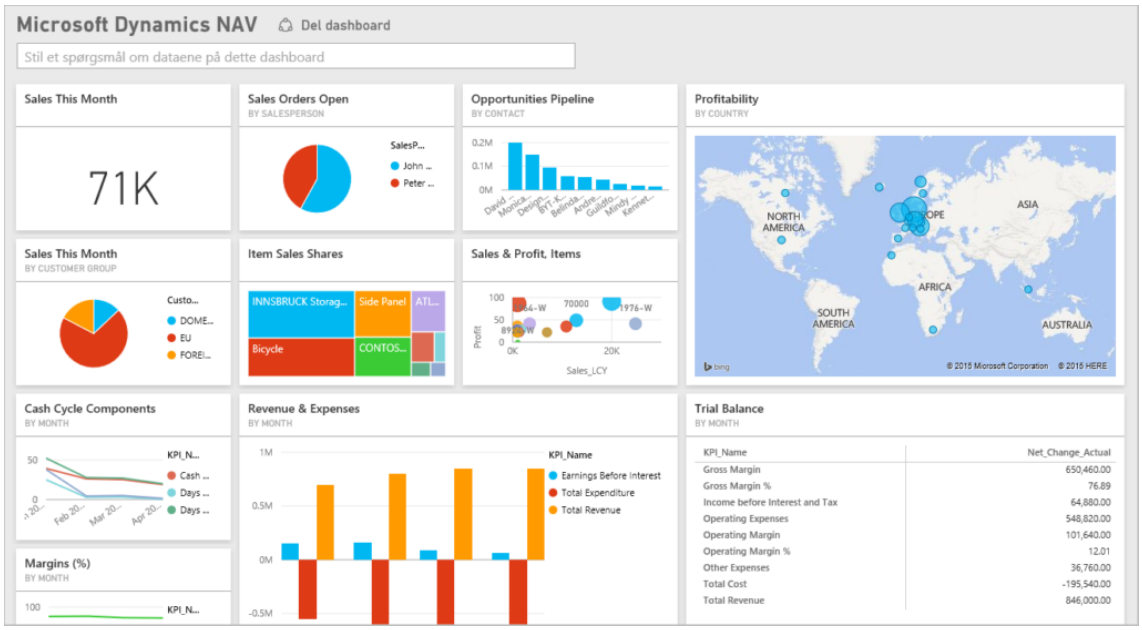


Figure 18. Data visualization dashboard for analytics (Sievo, 2021)

Dashboard is tracked by defined KPIs and present in form of graphics. Even for non-technical users can review and understand what are shown, which form the foundation for more business discussion and investigation into the business problems.

Furthermore, visualization by dashboard makes reporting and analytics more efficient. Data processed by the dashboard is stored on the cloud network, which is easily shared among connected user accounts. When it comes to reporting and analytics work, dashboard save time by cutting manual work of finding data from different sources, adding to Excel sheets, performing analysis, and generating results with final a report. Once a dashboard has been designed and connected with data sources or data warehouse, reporting and analytics work is updated automatically in real-time periodically whenever there are new updates to data sources. The dashboard display is always kept up to date on the cloud which puts ease on the virtual work environments, as well as team collaboration. (Klipfolio, 2021.)

4.3.2 Visualization of freight data

As learned from the previous sections, optimized solutions are made based on data and how many business performers make sense of it through the help of visualization. Legacy Supply Chain Services (2015) argued that visualization of data without considering the context does not illustrate the true meaning of the data and its correlation. Transportation consists of many variables to optimize its performance. Therefore, the visualization of freight data should be contextual data visualization, through which a specific transportation question is answered. Figure 19 is a decent example of contextual data visualization for airfreight transportation.

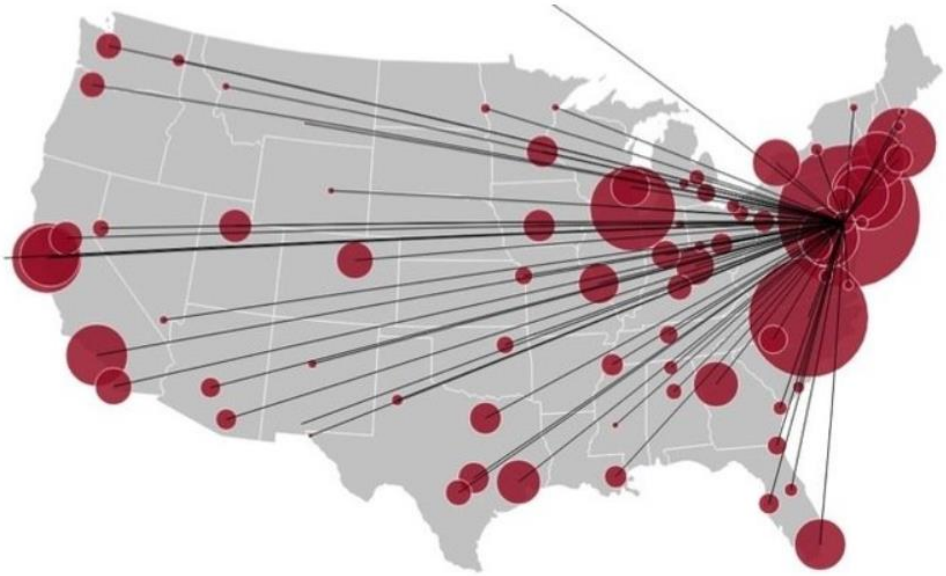


Figure 19. Airfreight Transportation Route Mapping (Legacy Supply Chain Services, 2015)

The graphic proves the density of air freight transportation departed from a distribution facility location. In order to create such a visualization, the variables involved are the cost, volume, and service mode factors. Compared to a basic bar chart in Figure 20 processed by spreadsheet, this type of visualization is more enhanced and implies better investigation into the route mapping issues.

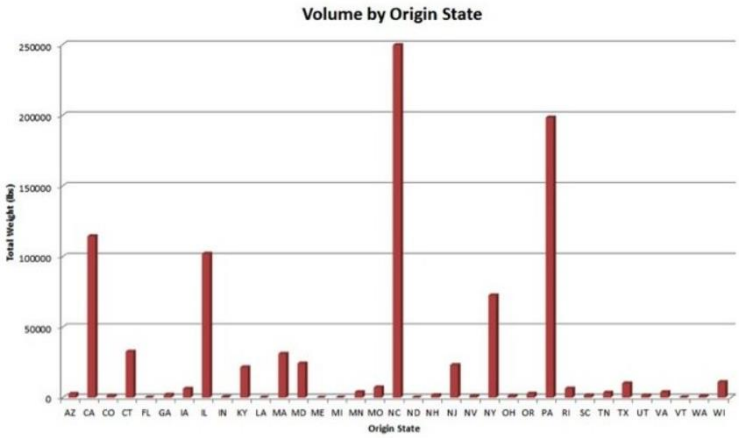


Figure 20. Example of basic data visualization by spreadsheet (Legacy Supply Chain Services, 2015).

With the help of advanced data visualization tool, decision making process for the transportation industry is brought to an upper level, as Legacy Supply Chain Services, (2015) quoted:

> "Making decisions requires more than just data. It requires information – which only comes when data is analyzed and presented with contextual intelligence. Having this tool allows you to move to the next level of supply chain visibility – taking data, no matter how complex, and presenting it in a way that allows real decision making." (Legacy Supply Chain Services, 2015)

All in all, to optimize the use of freight data, data visualization offers solutions in the perspective as:

1. Visual analytics capabilities: insights gained from the aggregation of transportation freight data elements (cost, volume, shipment quantities…)

2. Reporting capabilities: reporting practices are enhanced with contextual graphics created by advanced algorithms and business intelligence. The entire business is visualized from both a predictive and historical perspective.

(Roumiantseva, 2018: 20.)

4.4 Selecting a Suitable Data visualization Tool to Optimize BI Solutions

It is critical to select a BI tool to correct mistakes and optimize the operation. In this sub-section, for the process of getting one, three aspects are examined in the order of BI system infrastructure, defining key users and tools' capabilities.

4.4.1 IT infrastructure of Business Intelligence system

A well-designed BI infrastructure is behind all the powerful solutions that help companies to achieve advantages with visibility into business management. It is considered to be a multi-layered set of operational systems funneled by metadata such as shown in Figure 21. Metadata are variables such as dates, authors, costs, resources, or whatever critical for the system users and processes in the daily operations of a company. (Halonen, 2016)

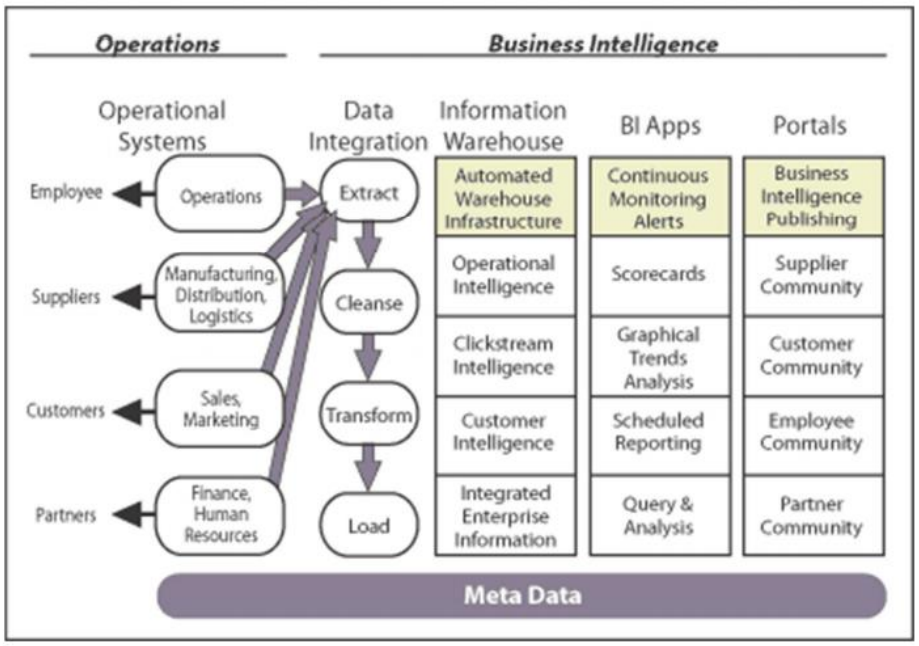


Figure 21. Business Intelligence operational system (Halonen, 2016)

Simply put, a typical BI system presented in Figure 22 consists of three key elements namely operational systems, data warehouse, and analytical tools. Sources of the data could be one or a combination of systems such as Customer Relations Management (CRM), Supply Chain Management (SCM), Enterprise Resource Planning (ERP), Financial Management System (FMS).

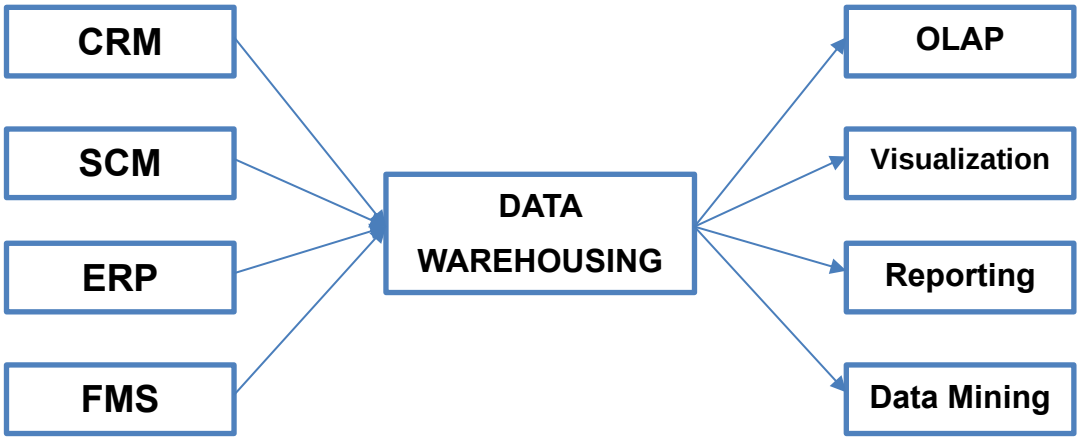


Figure 22. Illustration of a BI system

From these systems, the data are extracted, transformed, load and stored in Data Warehousing (DW). With the help of other BI tools and applications, the data stored in

DW will be used to carry out Online Analytical Process (OLAP), Visualization, Reporting, or Data Mining. On the technical side, raw data is collected from the business's activities. Data is processed and then stored in data warehouses. Once it is stored, users can then access the data, starting the analysis process to answer business questions

Since BI systems require hardware, software, and networking capabilities to handle and process data efficiently, to implement the BI tools in an organization, aspects such as the size of the organization, how complex the processes are, the cost and technical features should be taken into consideration to set up the process for business development with the most suitable tool.

4.4.2 Defining key users for the chosen tool

The next question to ask after knowing the IT system requirement is who is going to use the tool, how much time, and how capable would the users of the data are going to spend on visualizing it.

As stated previously, even non-technical users can understand, review and process Data visualization. However, based on the consumption of time which the user is willing to spend on viewing the data visualization tool, suggested by (Hailemicheal, 2016), there are three types of implementation approach to be built. By understanding clearly each approach, the implementation phase is easier to be carried out.

1. Infographics: this approach is mostly for business executives who only have time for the final visualization of data. And they are not so keen on doing the "real work".

2. Dashboards: is for user who has time to play with the data to bring out the final visualization. These users need to understand the data and perform simple functionalities such as filtering, extents of the results through time, assessing the findings from different aspects, etc. Deep technical aspects of data are not required as long as they understand how to use the tool and what capability is available to interact with data.

3. Analytical tools and applications: This is for Data Analysts, data experts, developers, and designers who tend to have interest to dig deeper with high technical skills.

(Hailemicheal, 2016:4)

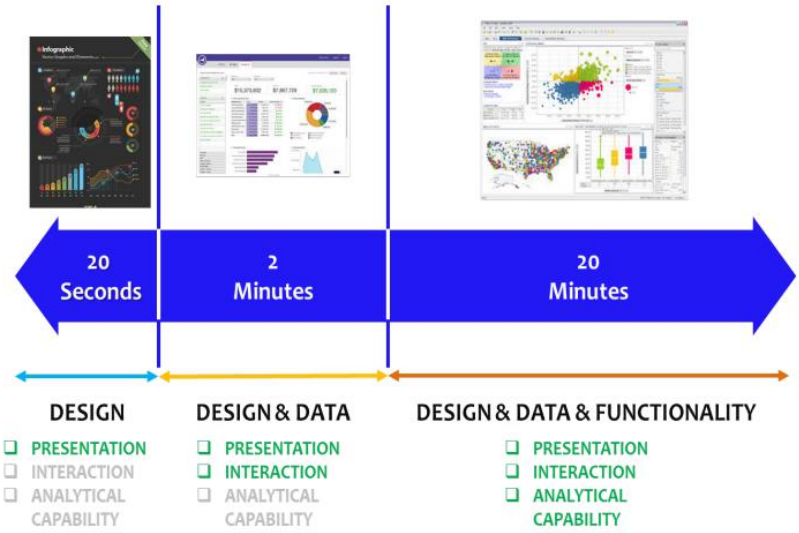
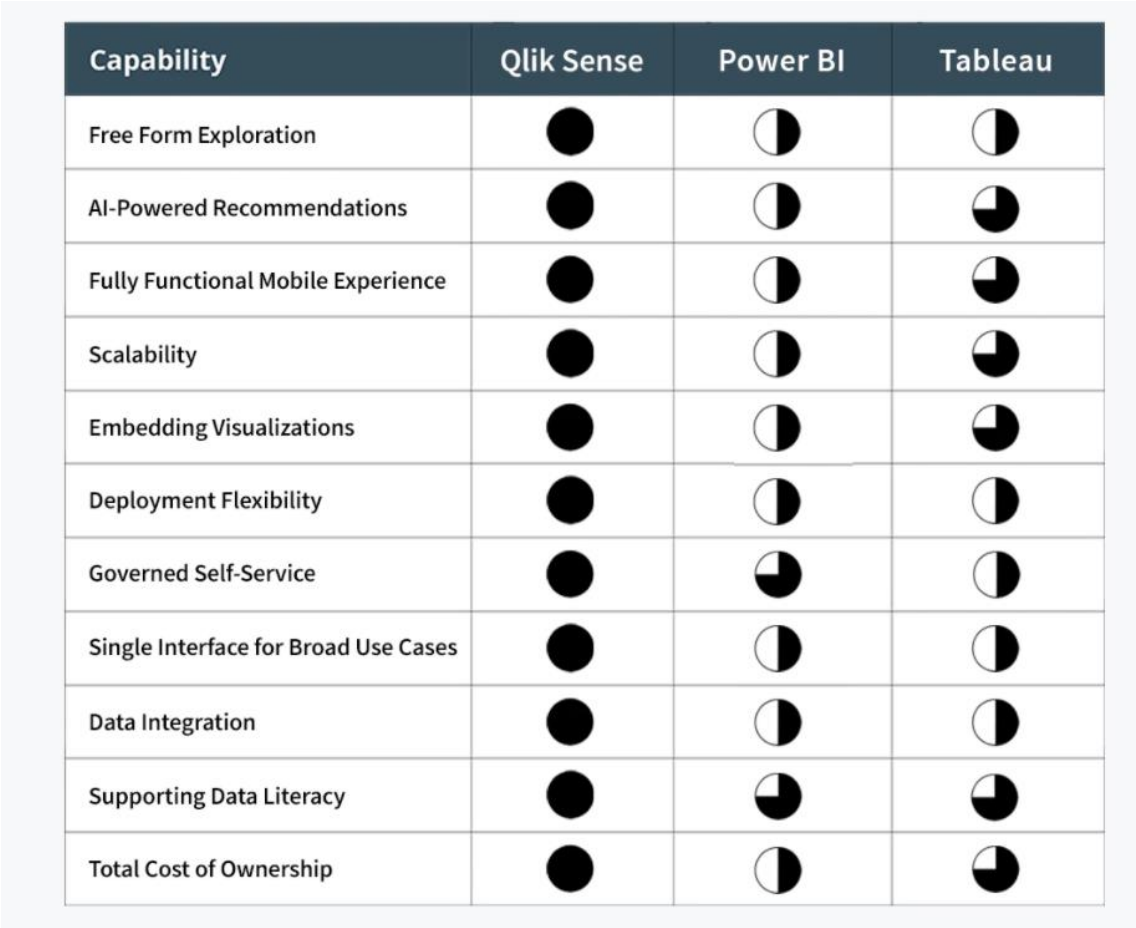


Figure 23. Data visualization tools and their user's exploitation time (Hailemicheal, 2016:5)

As it is shown in Figure 23, three types of users are differentiated based on their involvement from the starting point of designing up to the end products.

4.4.3 Capabilities of visualization tools

There are dozens of data visualization tools to choose from and it's not easy to figure out which is best for the organization. The current three top tools in the market are Power BI, Tableau, and Qlik. Based on the key capabilities of the best data visualization software, they have been compared as shown in Figure 24.



Capability	Qlik Sense	Power BI	Tableau
Free Form Exploration	●	◑	◑
AI-Powered Recommendations	●	◑	◕
Fully Functional Mobile Experience	●	◑	◕
Scalability	●	◑	◕
Embedding Visualizations	●	◑	◕
Deployment Flexibility	●	◑	◑
Governed Self-Service	●	◕	◑
Single Interface for Broad Use Cases	●	◑	◑
Data Integration	●	◑	◑
Supporting Data Literacy	●	◕	◕
Total Cost of Ownership	●	◑	◕

Figure 24. Comparison of top data visualization tool (Qlik, 2021)

As recorded from (Qlik, 2021), tool capability in Figure 24 could be summarized as below:

- Free Form Data Exploration**:** the ability to use data from unlimited sources.
- AI-Powered Recommendations: the ability to analyze data from diverse angles with the power of AI, machine learning, and augmented analytics.
- Fully Functional Mobile Experience: the ability to create rich data visualizations on any device, even with mobile applications.
- Scalability: the ability to bring data together from multiple sources in near real-time.
- Embedding Visualizations: the ability to visualize and analyze data using everyday applications.

- Deployment Flexibility: the ability to deploy data regardless of platform or cloud architecture.
- Single Interface for Broad Use Cases: the ability to offer the same interface to perform visualization, augmented analytics, dashboards, self-service data exploration, or BI reporting.
- Data Integration: the ability to integrate data from across the enterprise and provide business users with a data catalog
- Supporting Data Literacy: the ability to support users with data literacy, helping them understand how to analyze and communicate with visual data.

Based on the suggested capability from top visualization tools in the market, companies can decide how powerful, how many capabilities the ideal visualization they are going to implement for their business.

4.5 Conceptual Framework of This Thesis

This section draws a conceptual framework of this thesis. The conceptual framework is used further in Section 5, for building a proposal to solve the issues found in the current state analysis. The framework consists of three elements Application of BI in business operation, Data visualization for freight data and Visualization tool selection criteria.

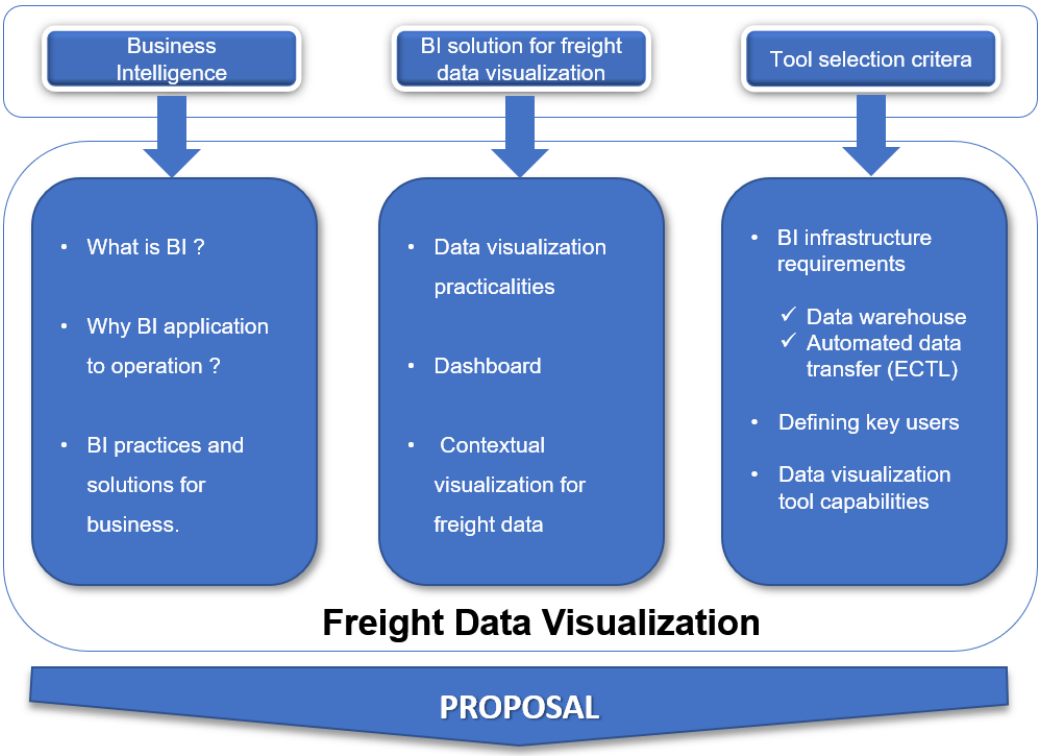


Figure 25. Conceptual framework to improve freight data visualization

Figure 25 illustrates the conceptual framework to improve freight data visualization. First, it is the business intelligence know-how that points out new practicalities and solutions that companies can consider applying for improving operational processes. Secondly, the modern data visualization concept is exploited. It is among many other practices of Business Intelligence, which is expected to bring the supply chain visibility to the next level. Especially, transportation data is considered complex, simple visualization charts or graphs cannot solve the problems faced by logistics specialists. Criteria for visualization tool are the last topic to cover in this framework as selecting the right Business Intelligence tool for your company is not easy since there is a growing number of BI vendors in the market, which offer several different tools with countless of functionality. Therefore, the company itself needs to understand first what their needs are and what are the barriers to pick out the most desired tools which are compatible with the existing operating environment.

In the next section of this thesis, the initial proposal is built with key stakeholders from the case company.

5 Building Proposal for the Case Company

This section presents the steps to build the initial proposal for this study. It merges the results of the current state analysis in Section 3 and the conceptual framework in Section 4. Also, at this stage, Data 2 is conducted with stakeholders whose suggestions are highly taken into consideration toward the final results.

5.1 Overview of the Proposal Building Stage

The aim is to build a proposal that can solve issues identified in the current state analysis. Suggestions for the solution are partly based on the corresponding findings stated in the framework.

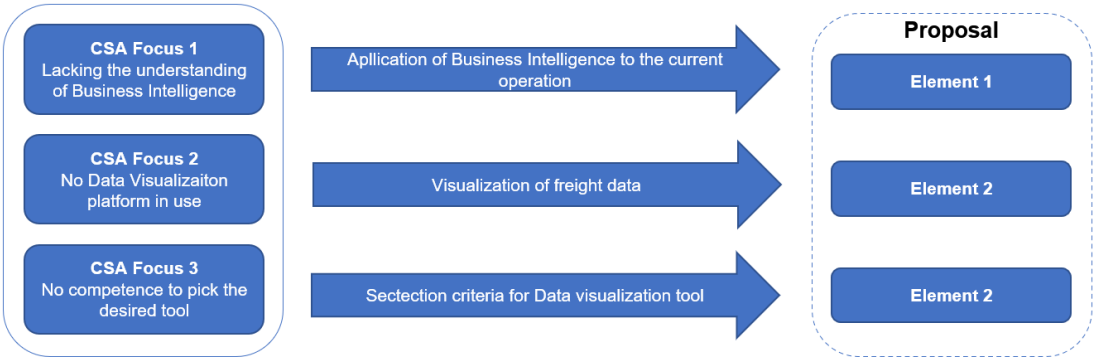


Figure 26. Key CSA findings and suggestions from the conceptual framework merged towards the proposal.

As stated in Figure 26, each element of the proposal is conducted based on the selected focus area of CSA. Concepts from the framework act as bridges to the suggested proposal. The best practice and available knowledge were searched for three topic areas. First, key ideas of how Business Intelligence can transform the current process work were identified. Second, for the specific freight data visualization practice, literature on data visualization and its benefit was discovered. Finally, fundamental criteria for tool selection were discussed to prepare the case company for choosing the suitable data visualization tools.

Together with the findings from the framework, the proposal was built in a co-creative manner with the key stakeholders of the case company from the freight data process. This co-creation stage of the proposed building makes Data 2 collection which is conducted through interviews and discussion with the stakeholders. The results of Data 2 are suggestions for the proposal which will be discussed in section 5.2.

The next sub-sections describe the stakeholder's suggestions as in Data 2 findings and formulate the improvement proposal for the case company. The main inputs for the proposed building will be Data 1 (findings from CSA, earlier), Conceptual Framework (input from literature), as well as Data 2 (from this round of data collection).

5.2 Findings of Data Collection 2

This sub-section concentrates on identifying suggestions from the key stakeholders, who are the logistics manager and IT specialist from the case company. Data collection 2 consisted of stakeholder suggestions to the issues found in the current state analysis. Table 5 illustrates the issues discussed and suggested in Data 2 collection. In the first column, the table shows the main area where the particular issue occurs. In the second column, it shortly names the suggestion for the issue, and in the third column, it describes the suggestion to each particular issue.

Table 5. Suggestion to develop the initial plan.

CSA (key results)	Input from literature	Issues raised in Data 2	Suggestions
Understanding of Business Intelligence system	Business Intelligence benefits to the company : • Handle big data • Data warehouse helps to centralize operation data	1. The current data process heavily depended on Excel. 2. Data is fragmented from many sources, and the amount is increasing, which will too big for Excel to handle in the future.	1. Excel is like one of the cultures of the company. Hence, whatever tool is to build, it should be compatible with Excel 2. The data warehouse is needed so that freight data is centralized. BI is a big concept that cannot apply in one or two days. Suggest starting first with available data and Excel Querry as a data warehouse.
No Data visualization platform is in use	Visualization for freight data • Contextual visualization • Dashboard	3. Lacking visualization in reporting practices 4. No automatic dashboard set up for operation review	3. Visualization is helpful in case viewers can understand what they interpret. Suggest having a demo presentation of what to visualize based on available freight data. 4. Consider the metrics for monthly review with visualization: cost/shipment, cost/chargeable weight…
No competence picked the desired tool.	Selection criteria for a data visualization tool. • IT infrastructure • Key users • Tool capability	5. What are the currently available tools in the company network?	5. Power BI and Tableau are available in the company network. But Power BI comes with the Microsoft package so it can be installed and used right away. Both Tableau and Power BI work with data stored in Excel. 6. Tableau is for data analysts, and Power BI is better suited for a general audience.

The summary of inputs from Data 2 is be done separately for each elements of the Proposal in the next sub-section.

5.3 Initial Proposal

This section presents the initial proposal for the business challenges. Suggestions are made for three focused elements found from previous sections.

5.3.1 Element 1: Improving Business Intelligence know-how

The case company has little understanding of Business Intelligence. Their current data process heavily depends on the Excel platform. Freight data is fragmented from different sources. Also, it is currently growing in volume, which is expected too big for Excel to handle resulting in the slow-down of processing transportation data. It is an open question for stakeholders to consider BI solutions implemented in the work process to improve and increase the efficiency of resources. The inputs from literature about Business Intelligence were discussed with the logistics manager, especially the concept about data warehouse because it can help with the current issue of fragmented data and acts as one of the IT requirements to build a data visualization tool, the main objective of this thesis.

Despite being impressed by the powerful BI solution, the logistics manager insisted that:

> "Excel is like one of the cultures of the company. Hence, whatever tool is to build, Excel shouldn't be excluded. BI is a big concept that cannot apply in one or two days."

It was positive feedback as helps to draw the limitation for the suggestion. It goes without saying that BI is a big concept and requires more work for planning and implementation depending on the scale of the desired results. Therefore, as for this studied problem, Business Intelligence can be started at the introductory level: using what is available at the minimum resources.

Figure 25 has been introduced in the CSA earlier as showing where data is looked for and archived to different Excel Workbooks. For the logistics team, to improve the

visualization of freight data. All necessary data should be centralized. And with the restriction raised above, Excel Power Query is suggested as a solution for Element 1 of this study.

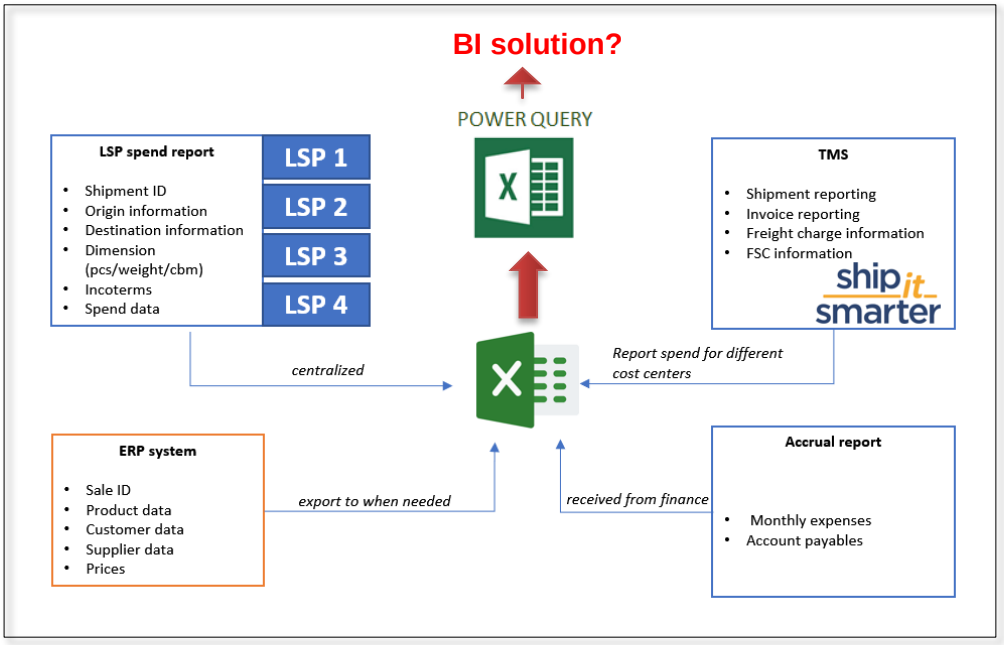


Figure 27. Power Query as the solution for freight data warehouse

Excel Power Query concept has been introduced in the conceptual framework. It is a business intelligence tool available built in Excel. The tool has all the basic functionality of a data warehouse as being able to import data from many different sources then clean, transform and reshape to prepare for other BI solutions such as visualization, reporting, or analytics. Moreover, Power Query is connected with most of the data visualization tools like Power BI, Qlik, or Tableau. Therefore, it is suggested to implement Power Query into current work to be ready for the next step.

As explained above, BI concepts should be started at the introductory pace, and introducing the usage of Excel Power Query to the team is the first step for the implementation of the whole project.

5.3.2 Elements 2: Data Visualization as the BI solution

The second focus of CSA is that there is no data visualization platform is in use at the case company which results in lacking enhanced visualization for reporting practices, poor visibility of the transportation operation as there is no automatic updated dashboard for business metrics.

As learned from the Conceptual Framework, everything starts with data. It is processed and stored in the data warehouse. Then a BI solution is picked as the output of the process. In this case, a dashboard for freight data is the goal to reach. Because it is efficient for both reporting and analytics purposes.

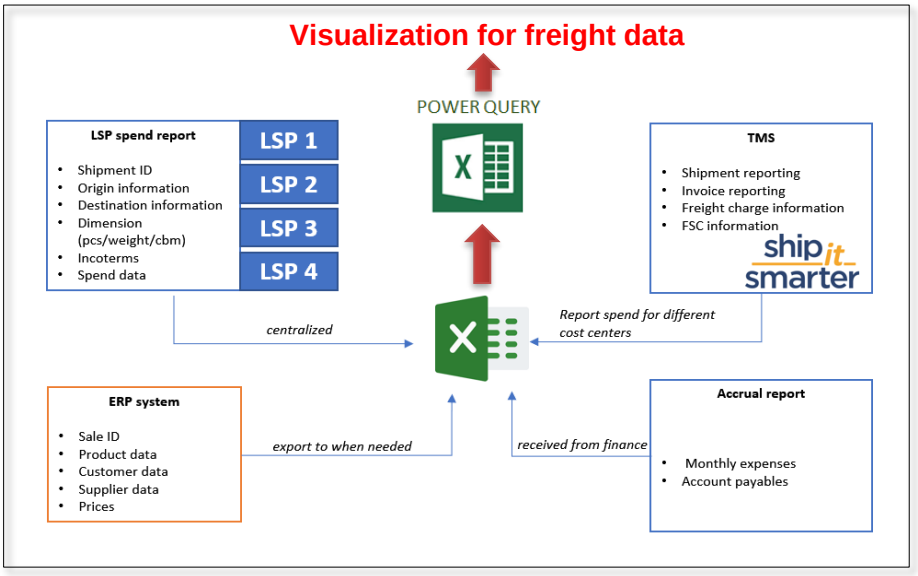


Figure 28. Data visualization as the output of the BI system

Additionally, the dashboard is tracked by KPIs. Therefore, through the discussion with logistics managers, the below metrics should be taken into consideration when building the dashboard:

- Total freight spends excluded VAT from each LSP
- Total shipments from each LSP
- Total volumes and chargeable weight from each LSP
- Cost per shipment

- Cost per chargeable kg
- Freight spend of inbound/outbound transportation
- Total freight spends for each mode
- Total freight spends per month
- Total shipments per month
- Etc...

According to the logistics manager, visualization is helpful in case viewers can understand what they interpret. He suggested having a demo presentation of what to visualize based on available freight data with him and his boss later as the whole team understands correctly what is going to be implemented.

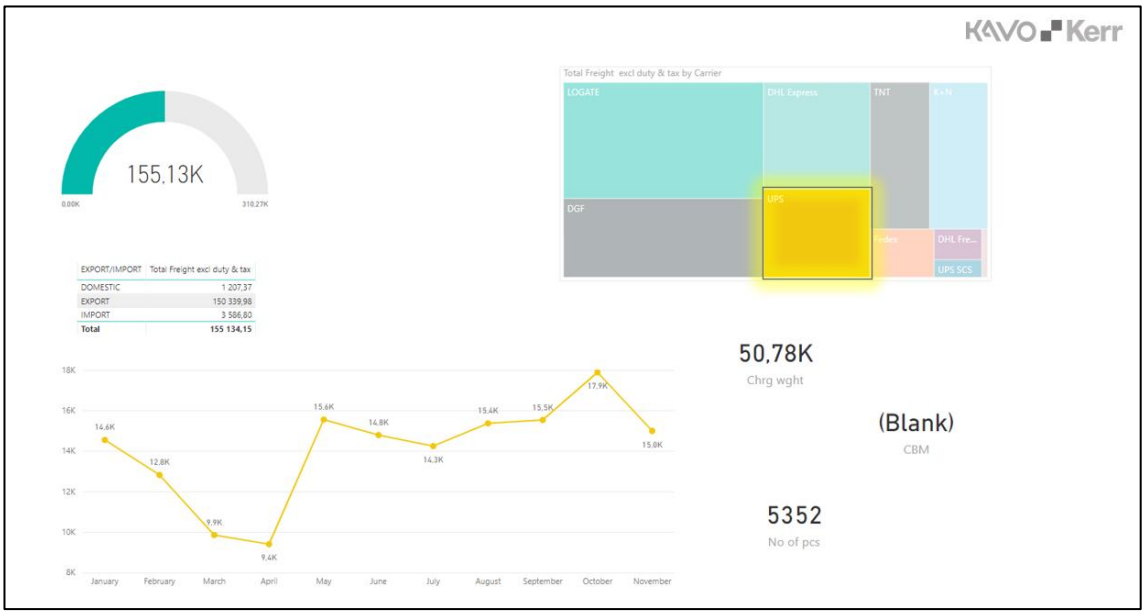


Figure 29. A demo of freight visualization

The above figure is the first demo prepared with transportation data in 2019 and it is expected to modify more after the discussion until the whole team is sure as how to design a report that can be used on a monthly basis for meetings with the management.

5.3.3 Elements 3: Selection criteria for tool selection

The last issue raised in the CSA is how to pick the suitable tool available in the market from BI vendors. The key criteria are identified from the Conceptual Framework as what the IT requirements are, who the key users are, and which capability is needed from the tool. For the IT-related question, a discussion was done with an IT specialist from the case company. A short description of the study was explained to him, especially the need for advice on which tools are available and compatible with the current working environment.

Tableau and Power BI are two available tools for visualization. Currently, Tableau is used by the Finance department locally and globally and the main data sources are from Oracles. There was a different project carried out a couple of years ago to make the integration and have Tableau in practice. It was a larger scale project because both local and global (EMEA, APAC, North America) departments were involved in terms of data, human and other resources.

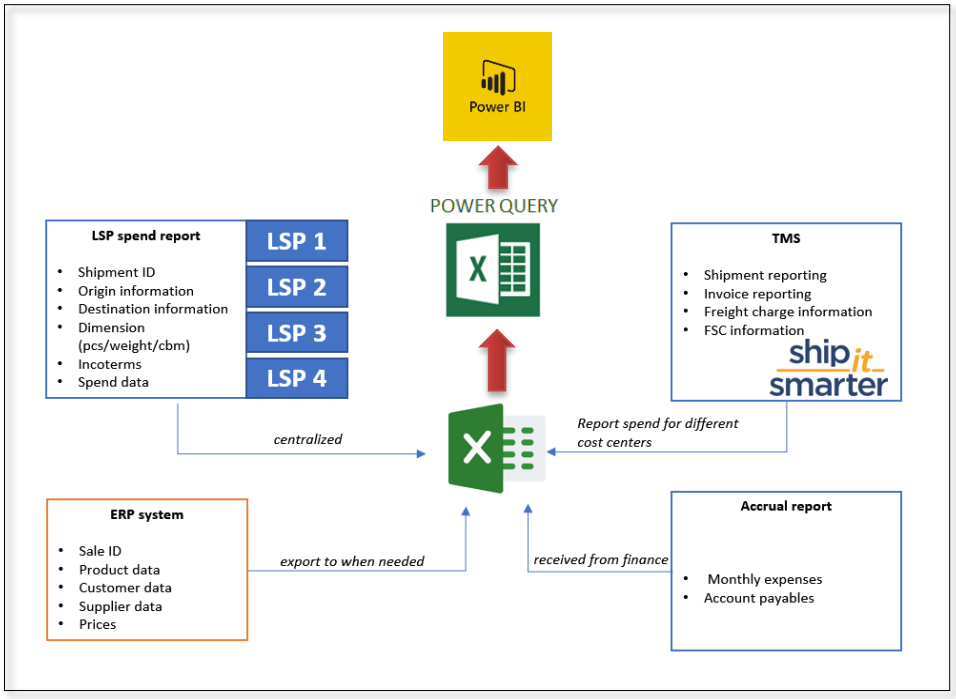


Figure 30. Power BI as a selected data visualization tool

As this study is conducted just for a local team, and Power Query has been selected as the data warehouse, Power BI is suggested to be a solution for testing. It comes with Microsoft Business Package so the tool can be quickly activated.

The next criteria to consider is defining the key users of the tool. As suggested by the logistics manager, he is not so keen on taking any extra work for the new visualization process. Therefore, the author, the logistics specialist of the team will be the BI key person. As for this testing phase with the new tool, the author will be responsible for data collection, building Power Query warehouse, and conducting Power BI dashboard. The ready-to-review new freight data dashboard then will be justified and commented by the logistics manager and his boss for improvement and decide whether it can be applied to the current operation.

5.3.4 Suggested timeline for the improvement plan

By combining all the suggestions and explanation for the three above elements, an improvement plan with a suggested timeline is presented in the figure

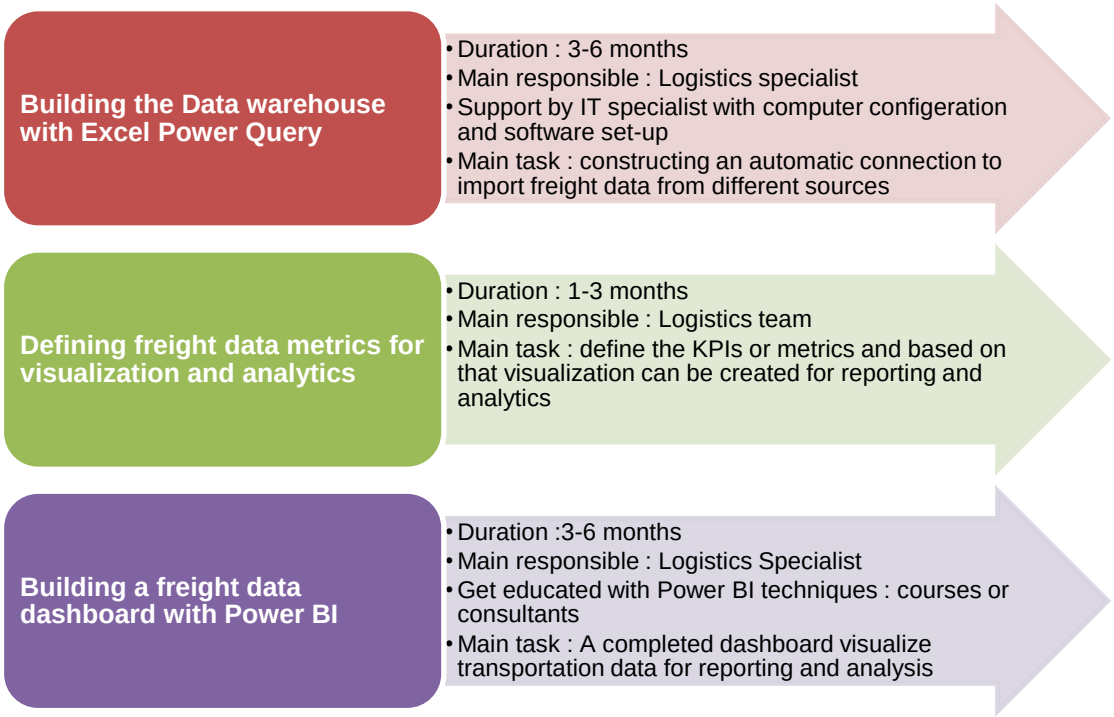


Figure 31. An improvement plan with a suggested timeline

The first phase of the plan is expected to last from 3 to 6 months. It is a crucial step as building a data warehouse is like laying a concrete foundation to initiate further steps. The logistics Specialist is agreed as the key BI person for the project so she is mainly responsible for this phase. The main task of this phase is to figure out, firstly, where the transportation data is stored within the organization systems? Are there any other places rather than those addressed in the CSA? Secondly, how to import those data automatically to Excel with Power Query every month, and whenever the data sources are updated, the new data warehouse is refreshed. And how to perform these tasks with Excel Power Query, it's an open question as to seek help from BI consultants or the logistics specialist would look for training from some institutions.

The second phase involves participants from the whole Logistics team. It's significant to have everyone's understanding aligned about which metrics represent the operation the best. Only when the KPIs or metrics have been identified, would the visualization be useful. Because the metrics are always the core data that can provide insights to solve the business challenges. This phase may take around 1 to 3 months.

When the data warehouse and metrics are ready. It is time to build the dashboard with the chosen tool, Power BI. This phase may take longer up to 6 months. Because similar to phase 1, it is necessary to decide how the BI person of the team gets educated about the tool. It was suggested by the logistics manager that a person from the team should perform this task because he or she gets a clear understanding of the operation work, which brings benefits to the visualization and analytics practices.

The overall timeline of the improvement plan is around one to one and a half years depending on the details picked up along the way. Different demos and versions of the dashboard will be tested among the team during local and EMEA meetings. The final result is expected to be reviewed by the management seeking feedbacks regarding how BI can positively transform the logistics work for the business in Finland.

6 Validation of the Proposal

This section reports on the results of the validation stage and points to further developments to the initial Proposal. At the end of this section, the Final proposal and recommendations are presented.

6.1 Overview of the Validation Stage

This section validates the proposal developed in Section 5. The initial proposal is tested by the decision makers of the case company. Approval or disapproval of the proposed improvement is also indicated.

Proposal of this study was validated by the logistics manager of the case company. He is the main stakeholder for the current transportation operation. Also, freight data analysis and reporting are his accountability. In that sense, he is aware of what the proposal is about and whether it is necessarily to be carried out. Because the main question to answer is whether the new improvement for data visualization can really assist him with his duties.

In the next sub-sections, the feedback to the proposal is discussed.

6.2 Findings of Data Collection 3

To validate the proposal, Data collection 3 was conducted as an open discussion with the logistics manager through MS Teams. He commented that all focus areas of the proposal are already known amongst he and his manager from global entities, but there was still hesitance to make any improvements due to limited resource especially during this Covid eras. Furthermore, it is acknowledged by him that the proposal is somehow so ambitious for the researcher to carry out alone, which may sabotage other daily work duties.

On the other hand, he and other logistics managers of the global branches do not speak IT languages. Therefore, in case this proposal can be brought to the next level which needs approval from higher-level executives, IT specialist should be involved together with a

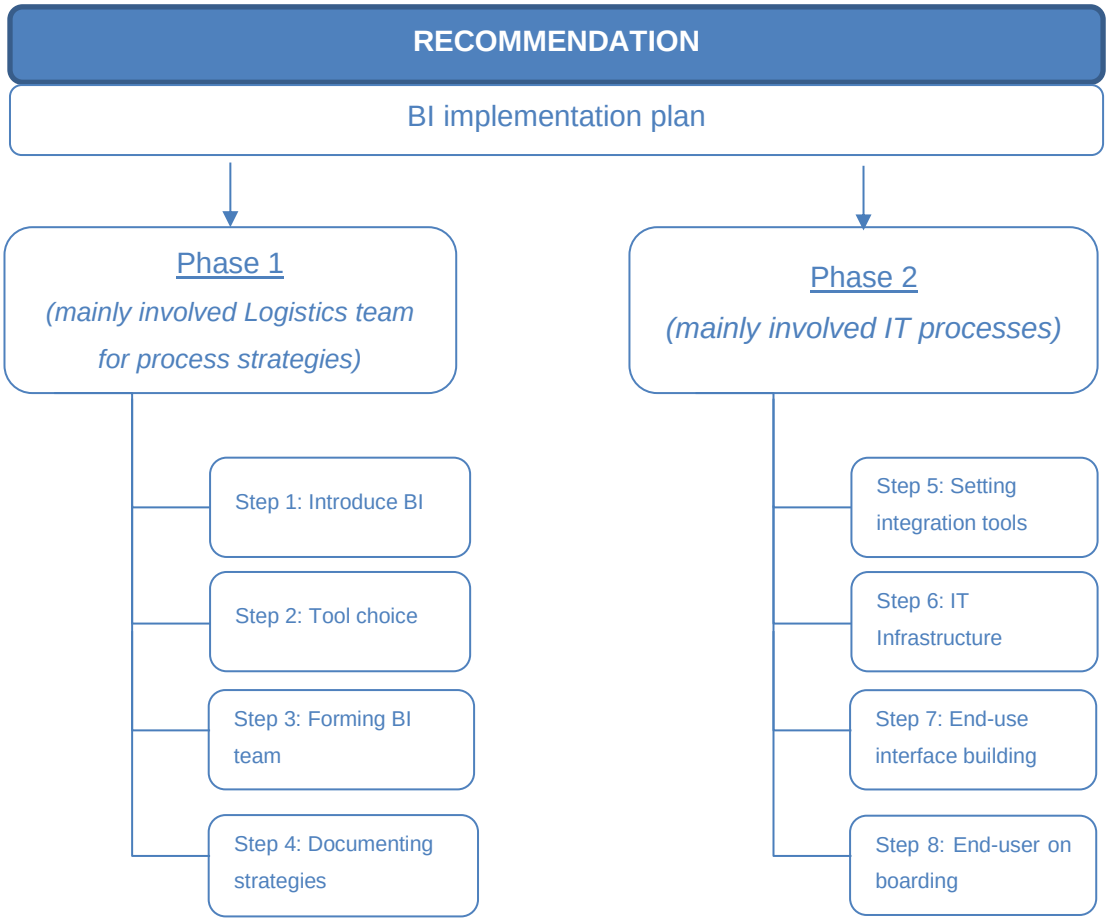


Figure 32. Recommendation for BI implementation Altexsoft (2019),

a representative from the logistics team. But as for now, the researcher can continue to test the proposal with available data and ready-to-support IT workers and software in the local network. One hour per working day is allowed for this project. Whenever proof of work is done as the freight dashboard is ready. Further discussion for more researches could be discussed. Figure 32, suggested by Altexsoft (2019), describes his idea as how the proposal should be carried out in case more stakeholders are involved in the future.

7 Conclusion

This section discusses the summary and conclusions of the thesis. It contains summary of the thesis, managerial implications, and evaluation of the thesis in terms of outcome vs objective, and reliability and validity of this thesis.

7.1 Executive Summary

The business challenge of this study was to improve the data visualization for transportation data to support the logistics manager's reporting practices and analysis to optimize the freight spend for inbound and outbound shipments of the case company. Logistics cost is a major part of the cost of good sales, therefore, optimization of spend is the ultimate goal.

This study was conducted by using qualitative research methods. Data was gathered through interviews and discussion. The selected research approach is action research because improvements were suggested based on evidence gathered from the deep involvement with the case company. The whole process is involved with the key stakeholder, who is the logistic manager of the case company. Firstly, the current state analysis was carried out to understand the status quo of the studied issues. Focus areas were identified from the CSA and solutions for them were searched from existing ideas and literature to build the Conceptual Framework of the study. Findings from those processes are all taken into account when building the proposal for improvement.

As the outcome, this study proposes an improvement plan for applying the BI concept to the current process work at the introductory level. The output is the freight data dashboard which is build based on Power Query and Power BI tool.

The proposal suggests that a data warehouse should be built first so that data visualization tool can be implemented. Data is available from the company systems and archived. The next step is to take actions with Power Query to centralize them into one source. Metrics to build the freight data dashboard were agreed upon with key stakeholders. Whenever data warehouse is ready, it could be integrated with the ready-to-install Power BI, as the chosen data visualization tool for this project. The final freight

dashboard is agreed to be reviewed by key stakeholders whether it is good enough to be used for reporting and analytics or more improvement should be considered.

7.2 Thesis Evaluation

The researcher's objective in this thesis was to develop a visualization routine for the freight data process. To carry out the plan, the researcher worked closely with the key stakeholders through interviews and discussion. There were many positive feedbacks and suggestions from the key stakeholder, which were relevant to the study.

The business problem was identified by the researcher during daily work, which triggers the idea as to carry out this study. Besides, the involved stakeholder is just a single logistics manager from the team of two, including the researcher, from the case company. Therefore, the researcher's neutrality can be criticized.

Through the process of researching for the solutions from existing literature, it keeps persuading the researcher that Business Intelligence is the key to the future. It is helpful for companies that can recognize its importance and making the move from now, even it's just a small step. The most important thing is to be aware of the changes and available solutions offered by advanced technologies. Arguably, the correct literature topics were picked and presented in this study. At least, the chosen points were well communicated with the key stakeholder, who give the green light to test the proposal with company resources.

7.3 Closing Words

Improving the data visualization for freight data is the first step to apply Business Intelligence into the supply chain work at the case company. With the dashboard built by BI data visualization capability, key users from logistics team can identify transportation problems such as which transport mode costs the most or where the majority of the freight spend is.

Even though, logistics does not help to bring more profits to manufacturing firm like the case company, but it consumes a big portion of production cost as for inbound logistics

to get the raw material, as well as outbound logistics to bring finished products to final customers. Especially in this Covid time, global transportation faces a big challenge as airfreight slots are reduced due to airports shutting down or limited numbers of containers from the ocean transportation. Transportation cost has been increased tremendously. Therefore, improvement with data visualization with BI tool can enhance both reporting and analytics capability to unhide the trends and stories from transportation data.

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Interview questions

DATA COLLECTION 1

1) How often you need to deal with freight data in your organization and do they bring benefit to the decision-making process?
2) What are the current sources to retrieve freight data?
3) What are important insights that you expect to gain from freight data?
4) What are the systems used to archive and perform cost analytics or spend forecasting?
5) Does it bring any value to your department and the company to develop better the freight data visualization and analytics?
6) What are current challenges with the control of the freight spend, from the system point of view?
7) Are there currently any metrics or KPIs to control the L&T process? If not, would propose some main points to consider when carrying out freight spend visualization and analytics?
8) What are your opinions towards Business Intelligence tools in managing freight data for in-depth analytics?