December 2024

# BUSINESS INTELLIGENCE FOR SMEs IN SECOND PARTY LOGISTICS

Bachelor's Thesis


Simona Búranová

**UNIVERSITY OF TWENTE**

**BSc Industrial Engineering and Management**

**S2157934**

**UNIVERSITY OF TWENTE**

**Drienerlolaan 5**

**7522 NB Enschede**

**The Netherlands**

**UNIVERSITY SUPERVISORS**

**J.P.S. Piest (Sebastian)**

**I. Seyran Topan (Ipek)**

## MANAGEMENT SUMMARY

This thesis investigates the challenge of low data usage in transport logistics within small and medium-sized enterprises (SMEs) in the Netherlands. It builds upon findings from a study by Evofenedex, which highlighted a low level of digitalization within the logistics sector in 2019.

As Transport logistics, which manages flow and transportation of goods, generates a two-thirds of logistics costs and large amount of data during the realization of transport process. Furthermore, Netherlands hosts Europe's largest seaside port affirming position of Netherlands as transport hub. Impact of extensive ports and transport infrastructure makes logistics an essential part of economy making an efficient data usage notable challenge to improve.

Research into digitalization in Dutch logistics in 2019 showcased that data sharing in the logistics sector frequently relied on outdated systems and phone communication, creating challenges in data connectivity.

| | |
|---|---|
| Data shared by phone | 84,0% |
| Old systems | 30,4% |
| Connectivity problems | 49,9% |

**Table 2 - Data Problems Summary 1**

To further analyse this issue, in this study raw data from 2021 digitalization study is analysed, Chapter 4.3, which revealed ongoing challenges: limited system access to data, widespread reliance on basic tools like Excel, and persistent connectivity issues. Despite advancements in digitalization, many companies continue to struggle with the low integration of systems, lack of data visualization, and minimal use of analytics, all of which impede decision-making and operational transparency. Increased data usage could enable companies to streamline processes, enhance decision-making, and gain a more comprehensive understanding of their operations.

Using the 2021 survey data as a primary source, this study analysed the responses of over 200 participants from the Dutch logistics industry. This broad dataset includes input from companies of varying sizes and transport specializations. Additionally, I conducted a case study with two industry participants to confirm findings and assess the feasibility of a proposed solution.

To address these challenges, this thesis proposes a standardized dashboard based on the OTM data model, providing an accessible entry into Business Intelligence (BI) for SMEs. The Open Trip Model (OTM) is a license-free, Dutch-developed data-sharing framework available to companies in the Netherlands. This model offers a structured way to handle data incompatibility issues, facilitating efficient sharing of large datasets. For Dutch transport companies, implementing the OTM could enhance data consistency, reduce reliance on incompatible systems, and streamline communication. Consequently, the OTM model could be foundational in building a data usage culture within the transport logistics sector.

The dashboard prototype was developed using Microsoft Power BI—chosen for its 2023 ranking among the top BI tools and its compatibility with the most widely used systems in Dutch transport logistics. Power BI's free version offers financially constrained SMEs a scalable solution that can grow as their data needs evolve. The dashboard's visualizations are intended to simplify data interpretation and promote data-driven decision-making.

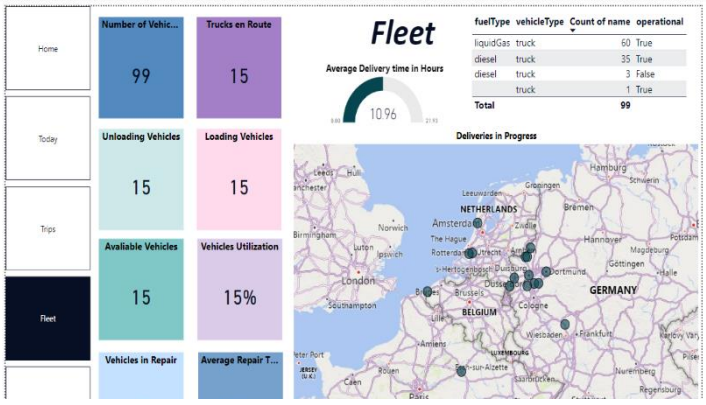



**Figure 1 Dashboard Prototype - Fleet view**

This study follows a Managerial Problem-Solving approach combined with Design Science Research (DSR) principles, establishing a structured framework for analysing data usage challenges within transport logistics. Three key variables guide the assessment of data usage practices and potential areas for improvement:

(1) Number of Systems in Use: The average logistics company in the sample uses three systems, with Excel as the most prevalent tool, particularly among smaller companies. Larger companies, though more likely to use multiple systems, are only minimally leveraging data analytics or monitoring software, with just 22% reporting any form of data analytics usage. Integrating a standardized dashboard, as proposed in this study, would likely add one additional system per company but would also centralize data access, making it more actionable.

(2) Number of Dashboards or KPI Monitoring Tools Available: The study highlights a gap in the adoption of data monitoring tools, particularly in SMEs, which generally lack dedicated KPI monitoring or visualization software. While some companies have implemented basic monitoring tools, there remains significant potential for broader adoption of analytics capabilities, particularly through a structured, user-friendly dashboard that facilitates visual data interpretation.

(3) Perceived Data Usage Among Employees: Insights from the case study indicate that respondents perceive their organizations to be handling substantial volumes of data; however, data analytics applications remain limited. Though employees report some engagement with data analytics, there is room for enhancement, especially in standardizing data visualization and streamlining accessibility. The proposed dashboard is designed to improve data interpretation and operational insight, potentially increasing employees' comfort and skill in using data-driven tools.

While the study is grounded in scientifically accepted methodologies, its findings are constrained by the small sample size of the case study (two respondents). This limited participation restricts the generalizability of the results; however, the case study demonstrates promising potential for the proposed dashboard in practical applications within transport logistics.

In summary, this study recommends that transport companies adopt the OTM framework and leverage Power BI as a first step toward advanced Business Intelligence and data visualization. The standardized dashboard prototype serves as a practical entry point, which can be further customized based on individual company needs. Future collaboration with industry partners could refine this prototype, adding customizations and additional metrics to enhance the dashboard's relevance and usability. Further research could explore similar dashboard solutions in other sectors, such as finance, healthcare, and retail, where data management improvements hold similar value.

# TABLE OF CONTENT

## CONTENTS

## LIST OF ABBREVIATIONS

- SMEs - Small and Medium-sized Enterprises
- KPI - Key Performance Indicator
- OTM - Open Trip Model (a logistics data-sharing model for Dutch companies)
- SUTC - Stichting Uniforme Transport Code (a Dutch standardization initiative for transport and logistics)
- TNL - Transport and Logistics Netherlands (sector organization)
- EU - European Union
- 1PL - First-Party Logistics (direct transport with smaller services)
- 2PL - Second-Party Logistics (basic transport services without extras)
- 3PL - Third-Party Logistics (includes additional services like packaging or warehousing)
- 4PL - Fourth-Party Logistics (consultant-based logistics management)
- BI - Business Intelligence (technology systems for data analysis and visualization)
- MPSM - Methodical Problem Solving Model (used in logistics problem-solving)
- EvoFenedex - A Dutch organization that represents companies in logistics and transportation
- BI tools - Business Intelligence tools
- IT - Information Technology
- DSR - Design Science Research
- DK - Design Knowledge
- IoT - Internet of Things
- ERP - Enterprise Resource Planning
- SDS - Safety Data Sheets
- UN code - United Nations Codes for hazardous materials
- CBU code- code to verify hazardous properties in transport
- Power BI - Microsoft's Power Business Intelligence data visualization tool
- UUID - Universally Unique Identifier
- SAP - Systems, Applications, and Products in Data Processing
- API - Application Programming Interface
- UI - User Interface

# LIST OF FIGURES

# LIST OF TABLES

# 1. INTRODUCTION

In this section Logistics is introduced and explored. The role and importance of data in logistics is examined and observed problem of using this data is discussed. Further aim of this study is explained and further chapters are briefly introduced.

## 1.1. WHAT IS LOGISTICS?

Logistics is a broad term that has many definitions. Further there is no commonly agreed upon definition. Dictionary definition of logistics is a "*detailed organisation and implementation of a complex operation"* or *"the commercial activity of transporting goods to customers"* ("Definition Logistics," 2021).

Internal process of company as production, resource management, planning, warehousing and transport to customers falls under the scope of logistics. To include those processes (Kenton, 2020) uses more appropriate definition of logistics as *"process of managing resources effectively and efficiently"*(Kenton, 2020).

Both of those definition give a good base on what is logistics. Logistic is a complex field covering multiple disciplines. As logistics covers many thigs and processes more refined fields emerged. This assignment focuses on transport logistics, one of the many fields covered.

Transport logistics is specific field best described as focused on *"logistics manages the whole process of realising the transport and therefore distribution of the goods"* (Topolšek, 2018) This is especially important as transport accounts for roughly third to two thirds of overall logistics costs. Transport logistics therefore focuses on transporting good effectively and efficiently. This includes organization of sub processes as cargo handling, loading and unloading of the goods, handover of transported cargo by selected transport method while aiming for lowest cost and time in realisation process.

In todays globalised supply chains transport logistics often includes all modes of transport from freight, air, rail to road transport to reach final destination.

The Netherlands commands the largest seaside port in Europe ("Experience Online," 2022), making it a destination for cargo transfer between modes of transport and countries making transport logistics important to Dutch companies and economy as whole.

## 1.2. DATA IN LOGISTICS

In aforementioned transport all processes needed to arrange said transport generates different types of data. Internal data of company processes of production and planning are needed for organising transport. Then data from transport companies about the status of their actual transport fleet, routing and weather conditions are shared between actors in transport.

All this information and data are important for successful transport and is commonly shared in various means. In Netherlands on average 84% of actors share this data by email or telephone. Further less than half companies working in logistics use their data for reporting and monitoring. (*Nationaal onderzoek Data en digitalisering in de logistiek 2019*, 2019)

This means large amount of data is generated, large amount of said data is shared yet little of that data is actually used for monitoring and improving transport processes.

For the purpose of data sharing Simcan, with cooperation of 16 other companies, developed the Open Trip Model (OTM) to improve data sharing between actors in transport logistics. In order to help transport

companies, the OTM model was donated to Stichting Uniforme Transport Code (SUTC), which is a standardization initiative of the Dutch sector organizations Transport and Logistics (TNL) and Evofenedex, to make it available for all Dutch companies. However, mostly larger organizations are nowadays using the OTM. The majority of Small and Medium enterprises (SMEs) are still struggling with data sharing and data visibility.("Open Trip Model," 2020)

## 1.3. OBSERVED PROBLEM

There are many different logistics and transport companies arranging transport of goods. Those companies can be categorized by what services they offer for their customers. As summarised by van der Werf there are 4 types of transport companies ranging from 1PL - First party logistics company offering direct transport in smaller services to 4PL - Fourth Party Logistics where consultants manage, arrange and hire personnel for all tasks in logistics.

In this research I will focus mainly on Second party logistics companies (2PL) offering transport without minimal extra services included but will also link them with Third-party logistics (3PL) companies who offer also services as packaging or warehousing. ("Nationaal onderzoek Data en digitalisering in de logistiek ", 2019) Further van der Werf documents that that 2PL companies place less importance on IT system. This is further amplified by lack of employees with enough IT skills as mentioned by van der Werf, EvoFenedex survey and European Union statistics.(Klark, 2021; "Nationaal onderzoek Data en digitalisering in de logistiek ", 2019; van der Werf, 2021)

Moreover, European Union (EU) statistics show that the majority of companies are Small and Medium sized enterprises (SME). SME cover roughly 99% of EU companies. 93% companies are micro sized with less than 9 employees, less than 6% are small with up to 50 employees and less than 1% reach medium size with up to 250 employees. Out of which emerges that 99% o EU companies lacks resources (mostly combination of time, expertise and finances) to invest and implement into new technologies.((Klark, 2021))

**Table 1 Company Size Demography in EU**

| Company size | Nr of Employees | Percentage in EU |
|---|---|---|
| Micro | <10 | 93% |
| Small | 10 – 49 | <6% |
| Medium | 50 – 99 | <1% |
| Medium large | 100 – 249 | |
| Large | +250 | |

**Table 2 Data Problems Summary**

| | |
|---|---|
| Data shared by phone | 84,0% |
| Old systems | 30,4% |
| Connectivity problems | 49,9% |

This trend in the lack of use of modern technologies was documented in EvoFenedex survey - the Dutch national survey of digitalization within the Dutch logistics (Nationaal Onderzoek data en digitalisering in de logistiek). This survey from 2019 shows that companies come across a several problems with their data as can be seen in summarizing table 2 above. One of the main findings from this survey is that the majority of data - 84%is shared by email or phone. ("Nationaal onderzoek Data en digitalisering in de logistiek ", 2019) Further documented is that companies struggle with the amount of data that is generated and/or shared which causes problems with finding the right information and sometimes having the same data multiple times. Further reported problems occurring in logistics companies are old systems and there are connectivity issues between various systems in use. This is only aggravated by the lack of training employees have to use said systems for work.(("Nationaal onderzoek Data en digitalisering in de logistiek ", 2019))

Findings from EvoFenedex survey 2019 led me to observation that there is ongoing problem with use of data in logistics. Mapping my observations from EvoFenedex survey, knowledge about OTM and statistics about EU

companies using MPSM method (more in Chapter 2.1 bellow)(Heerkens, 2017) resulted into cluster problem picture as shown in Figure 1 bellow.

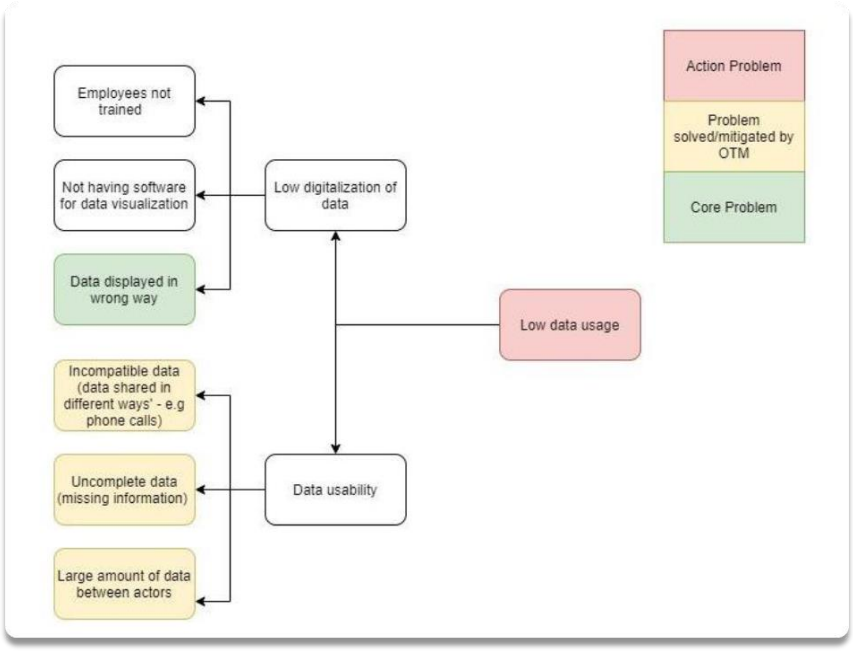



**Figure 2 Problem Cluster**

EvoFenedex survey 2019 reported two main problems as low data usage in companies and trouble in data usability and data digitalization. Following problem threat of Data usability were connected reports of large amount of data being shared, problem of missing information or data being noncompatible (shared by email – 84%) ("Open Trip Model," 2020)

This brings up a point of OTM model initiative for transport companies. As mentioned above in chapter 1.2 Dutch companies are invited to implement and use OTM system for data sharing. Implementing OTM data model (more information chapter 3.2.1) solves problem of duplicate data or incomplete data along with receiving majority of information by email or telephone.

Therefore, focusing more on problem of low digitalization as reported in 2019 survey brings up following findings and reported problems. Most companies struggling with digitalisation reported also employee training, and software problems either not having software for data visualisation or "not understanding the data they have ". As employee training and software company use are internal decisions how data is displayed for interpretation and use is a most pressing problem. Given displaying and making the use of data companies have easier and more intuitive will improve data visibility and therefore even data usage for logistic companies.

Drawing up conclusion from this survey and demographics of EU and therefore Dutch companies leads to my observation that transport companies suffer not using data available to them. Therefore identifying "Data displayed in wrong way" as main core problem of the documented low data usage that can be solved or mitigated.

Building upon the insights from the 2019 survey, the problem cluster outlined in Figure 1 guided the formulation of the main research question: **"HOW CAN DATA USAGE IN TRANSPORT LOGISTICS BE IMPROVED FOR SMES IN THE NETHERLANDS?"** This question stems from the problem definition stage of the MPSM, where action and knowledge questions are raised to address the identified challenges, more in Chapter 2.2 bellow. Further Chapter 2.4.1 also defines norm and reality providing a foundation for understanding current situation. This is later revisited with observations from this research in Chapter 8.

## 1.4. AIM OF THE STUDY

Identifying the problem of data usage within and its associated problem of data visibility in Dutch logistics the aim of this study is to develop a standardized way to display logistics data in form of dashboard. Modern systems and BI technologies offer companies easier way of working with their data. However, companies showcase lack of resources to implement those solution.

Situation as described in 2019 EvoFenedex study suggests that if data is displayed differently overall data usage will improve. This stems from knowledge that companies use mostly Excel sheets (more detailed analysis in chapter 4.3). Said Excel sheets are massive, confusing and hard to navigate.(*Nationaal onderzoek Data en digitalisering in de logistiek 2019*, 2019)

Implementation of BI would be next desired step for companies, yet SME are unable to implement this on their own. To improve this situation, this study first explores stakeholders in logistics to understand the motives ad goals. Further delve into understanding current data practices, systems and the way companies use their data with the goal of developing standardized dashboard.

Dashboard is relatively easy to use visualizing system therefore beneficial even to companies with lack of IT skills. Furthermore, a dashboard with KPI prepared in advance for the user will ease the performance monitoring.

Therefore, in this research I aim to develop a user-friendly dashboard implementing OTM capable of working with current systems in use to improve overall data usage in companies and therefore in Netherlands. The following chapters include the step toward the aim of dashboard development. This includes a description of steps and methodology in Research Design, Literature Review and analysis of current data practices in Dutch logistics. Incorporating those findings later chapters focus on Development of Dashboard, its testing and evaluating.(Palomero & Chalmeta, 2014)

# 2. METHODOLOGY AND RESEARCH DESIGN

In this section research design, methodology and objectives of this study are explained. This chapter details research and knowledge question raised following Managerial Problem-Solving Method. Further Deliverables of this research are established as well as Validity, Reliability and Limitations of this research.

## 2.1. RESEARCH APPROACH AND DESIGN

As noted above there currently is observed problem of low usage of data. Following identified action problem and core problem in chapter 1.3 this section describes the data gathering methods applied in this research.

### 2.1.1. MANAGERIAL PROBLEM SOLVING METHOD

Managerial Problem Solving Method (MPSM) is a systematic approach for managerial problems developed and published by Heerkens & Windel in 2017 (Heerkens, 2017). MPSM follows structured framework while integrating creative and systematic thinking making it suitable methodology for wide range of problems. This method also eases differentiating between knowledge and action problems allowing for several itineration as needed.

MPSM divides problem into 7 step frameworks. Following phases or steps of MPSM user:

1. Defines the problem
   This includes identifying action problem – case of low data usage in Netherlands as well as its core issue of wrong data displaying.
2. Formulates approach
   In second phase includes a strategy how to solve the problem. In this phase research design is formulated and methodologies to use identified.
3. Analyses problem
   Third phase focuses on analysing the problem further. In my research this included a literature review to understand the situation more as well as context analysis to be found in chapter 4 including the analysis of Digitalization survey data set from EvoFenedex.
4. Formulates possible solutions
   This includes a generating possible solution for researched problem. In this phase my proposal to apply dashboard was formulated and possibilities how to do so were researched as part of knowledge questions.
5. Choses solution
   In fifth phase user of MPSM selects most feasible solution based on self-established criteria .
6. Implements solution
   This phase focuses on practicalities of implementing proposed solution in controlled manner.
7. Evaluates solution
   Last phase of MPSM evaluates the effectives of solution while pointing out possible adjustments.

Furthermore, MPSM uses terminology of variables giving user a clear problem definition and measurement. Then ability to switch between action and knowledge problem as need arise further simplifies research allowing several iterations.

### 2.1.2. DATA GATHERING METHOD – SYSTEMATIC LITERATURE REVIEW

As a part of this research systematic literature review was conducted. This involved identifying keywords for research and knowledge questions presented below. Those keywords were used for search in scientific databases – mainly database Scopus as scientifically approved and review database with wide variety of topics

and fields covered. This search was filtered by several criteria for relevance depending on topic researched among others by publication date to ensure high quality of results.

Further sources were found by following the cited literature of promising texts or by visiting technological review forums. Additionally, my sources include completed works from fellow students researching similar topics and providing unique perspective for my research. Full details of literature search can be found in Appendix.

Further data gathering method was analysis of EvoFenedex data sheet mentioned several times above. This data set contains answers to survey about data use, practices and beliefs in Dutch logistics industry and therefore counts as study of secondary data for this research. This data set contains answers to 35 questions from 206 companies offers valuable view into current practices. Analysis of this data resulted in displaying the answers to questions relevant for this research as graphs and figures for easy understanding. These findings are detailed in Chapter 4.4 bellow wit larger variety of visuals provided in the appendix.(*Nationaal onderzoek Data en digitalisering in de logistiek 2021*, 2021)

Lastly as last data gathering method case survey study in company was concluded. This was online survey in logistics transport company gathering first hand confirmation about data usage, opinions on working with data as well as evaluation of dashboard by intended end users. This survey included a series of question based on their aim. Series of quick yes/no questions, scaled questions and open-ended questions to gather opinions were used to gather first hand evidence and conclusions of data usage.

## 2.2. RESEARCH AND KNOWLEDGE QUESIONS

Following the noted and observed problem with data in logistics I applied problem clustering method (Figure 1 above). Following the problem cluster and observations noted by peers (*Nationaal onderzoek Data en digitalisering in de logistiek 2019*, 2019) I identified my action problem as "Low data usage". Further following MPSM phase 1 – problem definition action and knowledge questions were raised. Thus, from the problem cluster in Figure 1 main research question was formulated: "**HOW TO IMPROVE DATA USAGE IN TRANSPORT LOGISTICS IN SMES IN NETHERLANDS?".**

Continuing following MPSM phases Knowledge questions appeared along its phases. Following Table 3 offers a summary of all research questions raised in this research and offers more detailed explanation and process below:

| | Research Question | MPSM Phase | Research type | Research Purpose | Type of Data | Data Gathering method |
|---|---|---|---|---|---|---|
| **1** | **Stakeholders Perspective** | | | | | |
| **a** | Who are stakeholders in transport logistics? | 1 | Qualitative | Descriptive study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **b** | What are the stakeholders' goals? | | Qualitative | Descriptive study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **c** | What information do they want/need to evaluate transport performance? | | Qualitative | Descriptive study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **2** | **BI Dashboard data** | | | | | |
| **a** | Who will be the users of standardized dashboard? | 2 | Qualitative | Descriptive study | Secondary data | Literature Review |
| **b** | What KPIs are needed to evaluate transport performance? | | Qualitative | Reporting study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **c** | What data is needed for those KPI? | | Qualitative | Descriptive study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **d** | Who has this data? | | Qualitative | Descriptive study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **3** | **BI tools available** | | | | | |
| **a** | Which BI tools or programs are currently commonly used in Dutch industry? | 4 + 5 | Qualitative | Reporting study | Secondary data | Literature Review + Analysis of EvoFenedex 2021 data sheet |
| **b** | What are criteria needed to select BI tool? | | Qualitative | Descriptive study | Secondary data | Literature Review |
| **c** | Which tool to use in this research? | | Qualitative | | Secondary data | Literature Review |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4** | **Dashboard Testing** | | | | | |
| **a** | How to test BI/dashboard functionality? | 6 | Qualitative | Experimental research | Secondary data | Literature Review |
| **b** | What criteria's are to test dashboard performance? | | Qualitative | Experimental research | Secondary data | Literature Review |
| **c** | How can the dashboard be tested? | | Qualitative | Experimental research | Primary and Secondary data | Literature Review and Case study |
| **5** | **Validation of dashboard** | | | | | |
| **a** | How can validity of BI/dashboard be evaluated? | 7 | Qualitative | Experimental research | Secondary data | Literature Review |
| **b** | What is the perceived usefulness of the standard(izable) dashboard in practice? | | Qualitative + Quantitative | Experimental research | Primary data | Case study with Survey |

**Table 3 Research Questions**

Continuing with phase 1 of MPSM of problem identification knowledge problem appeared. To understand the problem of data usage in transport logistics I need to understand its stakeholders as well. From this first Research question about Stakeholders Perspective was formulated.

Therefore, this part of my research aims to identify who are the stakeholders in logistics processes, further investigate company stakeholders' perspectives and identify which stakeholders' roles in transport logistics and then their aims and goals. This will help to answer what the general goal of the transport company is and what they want to know about company performance.

Those question are further answered by literature search of stakeholder in logistics in chapter 3.1 and then by analysis of EvoFenedex data set in chapter 4.

Then following phase 2 of MPSM focuses on formulating solution. In this section dashboard is proposed a solution to data visualisation problem and further knowledge questions to achieve this arise. Therefore, second section of research question concerning Business Intelligence and Dashboard data arises. Here are questions raised to identify intended users of proposed dashboard and what data should said dashboard showcase. Further questioning intended KPIs, where to find this data and who has it are raised. Answers are given by literature study but mainly are answered by analysis of EvoFenedex datasheet. This datasheet providing invaluable and current view into happening in Dutch logistics offering various insights.

Phase 3 to analyse the problem further includes analysis of above-mentioned dataset and insights from his are in chapter 4.

Phase 4 then focuses on formulating solutions and phase 5 follows by choosing solution. As those phases are tightly interconnected in this research I raise and answer questions to them together. As mentioned above during phase 2 I proposed applying dashboard. Therefore, in phases 4 and 5 I focused on researching how to do so. In this section questions of BI tools already in use were raised and will be answered in Chapter 4 from dataset analysis. Further questions about currently available tools, offering of BI software and choosing one are answered in literature review of said tools.

Answers to those questions in phases of MPSM 1 to 5 give me necessary information and background for development of proposed dashboard which is detailed below chapter 5 with proposed design, metrics and further details.

Phase 6 of MPSM – Implementing solutions however yields further knowledge questions. Therefore, in knowledge question 4 about Dashboard testing literature search is conducted on how to implement and evaluate the functionality of dashboard.

Then reaching last 7th phase of MPSM – Evaluating the solution. For this purpose, literature search of how dashboard can be validated is conducted followed by a case study about usefulness of dashboard. This is survey done in company as a survey (see description in section 6.1.2. above). This is done to evaluate design of dashboard, usefulness of proposed KPI’s and to gather insights into what employees working with data would like to change.

Further to evaluate dashboard and quantify this research MPSM encourages to measure reality before applying solution to what should be norm. This is based on measuring variables before and after implementing solution to better evaluate usefulness.

## 2.3. DELIVERABLES

This research will result in several deliverables. First deliverable being this written thesis documenting my research and findings. As introduced earlier I describe current situation of data usage in Netherlands in chapter 1, following with research design in this chapter 2, further analysis of current situation in chapters 3 and 4. Following is design and development of proposed solution dashboard in chapter 5 and then its testing and evaluation in chapters 5 and 6 with conclusion in chapter 8.

Accompanying this is proposed dashboard as second deliverable. This includes documentation for KPI and dashboard design and accompanying documentation.

- EvoFenedex – data sheet with analysiss results

## 2.4. VALIDITY AND RELIABILITY OF RESEARCHER LIMITATIONS

### 2.4.1 VALIDITY

Validity of concept is about measuring what was intended to be measured (Heerkens, 2017). In this research, both internal, external and construct validity are important to uphold.

Internal validity concerns with research integrity. Internal validity ensures that proper research design and methodology was selected and used appropriately. To meet the requirements of internal validity I use scientifically approved research methodology of MPSM as a base. This fulfils the concern of appropriate methodology selection leaving concern of possible bias in selection of MPSM methodology instead of another. To further uphold research validity consistency in following said method is important and preventing bias which while gathering data which will be also further touched upon in survey collection. Additionally, it is important to point out bias from maturation – time passage. As time progresses trends in data usage change especially with nowadays fast improvement in technology.(Heerkens, 2017)

External validity concerns how this research can be applied to other fields. This research is intended for specific field of interest so external validity is partly fulfilled. Dashboard is developed for target group of transport logistics so partial applications are possible in other logistics fields.

Companies from other sector falls out of scope of this research so applying dashboard for them may be beneficial but will not fulfil their needs as they were not intended target. Replicating this research and adjusting for different fields is possible but we can expect the results will vary depending on the field. As this dashboard and research is intended for specific field where it will be also tested with survey this research fulfils requirements of this research and external validity for companies in the field of transport logistics.(Heerkens, 2017)

Construct validity concerns how accurately measurements or definitions reflect reality. Construct validity fulfilment is achieved by following scientifically valid methodology, further this is achieved by proper definitions of terms and variables. Further point in meeting construct validity is through using EvoFenedex survey for measurements and survey design speciation for measuring confirmation.(Heerkens, 2017)

For this research, as outlined in the validity concerns above, three variables were selected to document the data situation using the MPSM method and are introduced below.

- Variable 1: Number of Systems in use
  Collect number of data systems company uses compared to the report of Nationaal Onderzoek data en digitalisering in de logistiek
- Variable 2: Number of dashboards/ KPI monitoring available
  Collect number of systems used to keep track of logistics performance

- Variable 3: Perceived data usage
  Collected opinion of company employees about the amount of data available and data used for monitoring performance or some analytics.

### 2.4.2 RELIABILITY

Reliability is concerned with the consistency and stability of research. (Heerkens, 2017) For this assignment this means that reviewing the same starting data will reach the same conclusion. Further, my research design and methods must be consistent and have reliable sources to be reliable themselves.

Reliability concerning the dashboard is more complicated. A case study will prove dashboard validity for the said company yet for the dashboard to fully confirm reliability a case study would have to be concluded in multiple companies reaching the same results. This however is beyond the scope and capability during this assignment so better confirmation is not possible and under the assumption that if the dashboard is standardised then similar companies will achieve similarly expected results for its reliability.

### 2.4.3 LIMITATIONS

One of the limitations of this study as mentioned in the previous section is its reliability is not having the capacity to confirm results in multiple companies. This can be further influenced by the willingness of employees to collaborate and state their opinion as is possible with every survey.

# 3 LITERATURE REVIEW

In this chapter literature review to knowledge questions detailed in previous chapter 2.2 can be found. This includes 5 sections with answers to appertaining knowledge questions about stakeholders, their data, BI tools available as well as implementation and evaluation of dashboard are answered.

Findings detailed bellow are results keyword search and then following sources of those sources. Details of literature search and filtering methods are in appendix.

## 3.1 STAKEHOLDERS PERSPECTIVE

The first research question focuses on stakeholders' perspective in logistics. The first question who are the stakeholders - both internal and external in logistics, what are their goals and what information are needed to evaluate transport from the stakeholders' perspective?

### INTEGRATION OF BLOCKCHAIN TECHNOLOGY IN MARINE SUPPLY CHAIN

Balci and Sucuru-Balci's study on integrating blockchain technology into the marine supply chain shows insights of adoption of new technology into supply chain as well maps stakeholders in transport section.(Balci & Surucu-Balci, 2021) While marine and road logistics differ this study closely describes stakeholders in transport which is closely similar to road logistics. Further Blockchain – data sharing mechanism, as defined bellow further highlights the impact of data sharing on transport logistics.

Blockchain technology, a transparent information-sharing mechanism, allows data to be stored in linked blocks forming a chain.(Amazon)

In this research Balci and Balci's identifies the following stakeholders in the marine supply chain:

- container lines
- ports/terminals
- freight forwarders/3PLs
- beneficial cargo owners
- custom authorities
- banks
- trade associations
- government authorities
- insurance companies
- software companies
- customs brokers.

Through stakeholder interviews, the study collected perspectives on innovation, transparent data sharing, and blockchain adoption. Despite potential benefits, barriers such as lack of trust, insufficient understanding, financial constraints, and inadequate training were highlighted. Notably, these barriers align with my research on SMEs in logistics, reinforcing the significance of my findings.

Balci and Balci observed that banks and customs brokers had a minor impact on technology adoption, while container lines, ports/terminals, freight forwarders, beneficial cargo owners, and customs authorities were the most influential. Container lines were identified as pivotal stakeholders, advocating for the creation of trade unions to streamline data sharing. In contrast, third-party logistics providers (3PLs) and SME cargo owners resisted data sharing to maintain business competitiveness.

These findings allow me to draw parallels between stakeholders in marine chains and general transport logistics companies. The identified stakeholders (shippers, transporters, government entities, service providers, and data

providers) are crucial and influential in research, underscoring the need for user-friendly technology tailored to SMEs to enhance technological and data advancement within the sector.

### DETERMINANTS IN ADOPTING THE INTERNET OF THINGS IN THE TRANSPORT AND LOGISTICS INDUSTRY

Rey et al. observed that the transport and logistics sector is likely to adopt the Internet of Things (IoT) to improve tracking, distribution, and analytics, enhancing overall performance. The study confirms that company size affects technology adoption, with larger companies more capable of introducing new technologies, while SMEs compensate through absorptive capacity methods.(Rey, Panetti, Maglio, & Ferretti, 2021)

### SHAREHOLDER INTERACTION AND COMPANY PERFORMANCE - SHAREHODERS ACTIVISM IN INDIA

Research from India observed that both governmental and private stakeholders become more involved and interested when a company achieves positive financial results. This highlights the connection between financial performance and stakeholder engagement. Factors such as ownership percentages, company size, and the potential to exert influence contribute to their involvement, emphasizing the importance of understanding stakeholders' motives and positions on the power/interest grid in my research.(Shingade, Rastogi, & Panse, 2022)

### UNDERSTANDING INTERNAL STAKEHOLDERS IN LOGISTICS COMPANIES

Further Logistics Bureau, a logistics and supply chain company share on their company website their own analysis of important individuals and departments with direct impact and interest on companies' performance. This list of them identifies key internal stakeholders includes: (Bureau)

- Management: This includes executives, directors, and managers who oversee the overall operations of the company. They set strategic goals, make key decisions, allocate resources, and ensure that the company's objectives are met.
- Operations Team: This group manages the day-to-day activities involved in transporting goods from one location to another. It includes warehouse managers, transportation coordinators, freight handlers, and other personnel responsible for ensuring the smooth flow of goods through the supply chain.
- Supply Chain Management: This group oversees the end-to-end supply chain process, from procurement to distribution. They manage vendor relationships, optimize inventory levels, and implement strategies to improve supply chain efficiency and responsiveness to customer demands.
- Fleet Management: This group oversees vehicles and their readiness. This group is responsible to ensure that there are enough vehicles suitable for requested transport and management of said delivery.
- Warehouse and Distribution Team: This team is responsible for managing the company's warehouses, distribution centres, and inventory. They oversee the storage, handling, and movement of goods within the company's facilities.
- Sales and Marketing: These stakeholders are responsible for generating revenue by attracting and retaining customers. They develop marketing strategies, negotiate contracts, and maintain relationships with clients to secure business for the company.
- Finance and Accounting: This department manages the company's financial resources, including budgeting, financial reporting, invoicing, and payment processing. They monitor expenses, analyse financial data, and ensure compliance with accounting standards and regulations.

- Human Resources: HR is responsible for recruiting, training, and managing the company's workforce. They handle employee relations, performance management, compensation, and benefits administration to ensure that the organization has the right talent to support its logistics operations.
- Technology and IT: In today's digital age, technology plays a critical role in logistics operations. IT stakeholders are responsible for managing and optimizing the company's technology infrastructure, including transportation management systems, warehouse management systems, and other software solutions used to streamline operations and improve efficiency.
- Quality Assurance and Compliance: These stakeholders ensure that the company adheres to industry regulations, safety standards, and quality control procedures. They conduct audits, inspections, and risk assessments to identify and mitigate potential risks that could impact the company's operations or reputation.

#### CONCLUSION

In logistics sector several external and internal stakeholders influence transport companies. Key external stakeholders include government, cargo owners and freight forwarders/ 3PLs meaning transport companies. Those stakeholders have biggest impact on shaping the environment and transport operations.

From internal perspective companies rely on many departments. Focusing on departments handling data of logistics companies my internal stakeholders in this research are departments of management, operations and fleet management. Departments as warehousing, planning & scheduling or distribution teams with supply chain management falls under the scope as secondary stakeholders.

Motivation of stakeholders and companies is not surprisingly generating revenue. In transport logistics this focuses on efficiency in transport, smooth flow of goods and satisfying customers. Emphasizing point of happy stakeholders more likely to adopt new technologies if they see benefits to enhance profitability.

## 3.2 BI DASHBOARD DATA

In this research question the BI Dashboard data are on focus. In this section the questions of who will benefit most from the usage of the dashboard, and what KPIs are needed to evaluate performance and keep stakeholders satisfied. After identifying what KPIs to use questions of what data is needed for those KPIs and who has this data are answered. Further documentation about Open Trip Model is located here for its ties to how data is used.

### 3.2.1 OPEN TRIP MODEL

The Open Trip Model (OTM) is a data-sharing model developed for sharing logistics data. This system is freely available for Dutch logistics companies and in this section of literature review official information about the model are summarized as well as studies researching its applications and capabilities.("Open Trip Model," 2020)

#### 3.2.1.1 OTM BACKGROUND

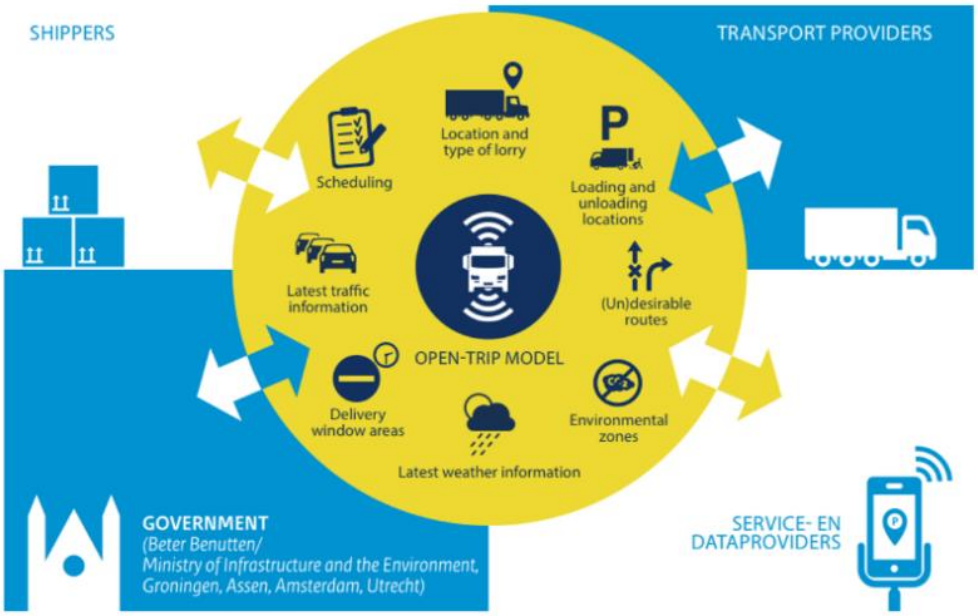



**Figure 3 OTM - Actors in Logistics**

Development of OTM was initiated by the company Simcan and focusing on supply chain and logistics optimizations. Simcan, together with 15 more companies working in the sphere of Dutch transport, logistics and data management developed OTM.(Simcan)

In 2018 then Simcan donated OTM to Stichting Uniforme Transport Code (SUTC - Uniform Transport Code Foundation), a company working on logistical and IT standards, for further development. SUTC on behalf of the Dutch Transport and Logistics Organization (TNL) manages and continues improving OTM. (Model, 2022c; SUTC)

OTM is a license-free, user-friendly and cost-efficient model available for all logistics companies. OTM is classified as a lightweight model for sharing data between companies. OTM is specifically focused on providing real-time shipment data between logistics parties allowing them to connect multiple parties at the same time to the same data. OTM is compatible with SUTC and Simcan solutions used within the Netherlands allowing further compatibility between already in use systems.

Furthermore, OTM is open for modification making specific customization for companies possible and allowing room for development besides requesting a specific feature to be considered. (Model, 2022b)

Despite documented results of improving data sharing within companies that implemented OTM, OTM is mostly used by large companies. Meaning SMEs would largely benefit from improved data sharing of OTM interaction still slow and low. (*Nationaal onderzoek Data en digitalisering in de logistiek 2019*, 2019)

#### 3.2.1.2 OTM RESEARCH

##### EVALUATING THE USE OF THE OPEN TRIP MODEL FOR PROCESS MINING: AN INFORMAL CONCEPTUAL MAPPING STUDY IN LOGISTICS

In research authors present a review suitability of OTM for process mining in logistics. Authors examine OTM framework and structure for data use highlighting the standardized approach for data exchange using entities and actors model approach.

Further authors scrutinized OTM flexibility and openness reaching conclusion of OTM suitability for advanced analytics with feasible real time results. Noting possible applications of data analytics and data mining by OTM adoption with suggestion for further research extend of its capabilities. (Piest, Cutinha, Bemthuis, & Bukhsh, 2021)

### A REINFORCEMENT LEARNING PLATFORM FOR SMALL AND MEDIUM-SIZED ENTERPRISES IN LOGISTICS

This research explores suitability of OTM for data analytics. Authors describe the potential of OTM for operational optimization of process in logistics by engaging shareholders as shippers and government in OTM as user friendly graphical interface. Further delving into examination of OTM layered architecture supporting integration of systems.

Authors here validate and conclude on OTM suitability or reinforced learning programs for improved data processing and more reliable data. This article highlights the OTM's suitability as starting point for data but also points out lack of real-life cases despite shown theoretical possibility. {Piest, 2021 #55}

## 3.3 BI TOOLS AVALIABLE

In the third research question, various BI tools available are explored. In this section available tools and programs are gathered and compared to select which tool will be most beneficial to use for the dashboard and SME companies' needs.

The initial overview of BI tools was conducted as literature search, primarily using online magazines and websites offering user and testers ratings and reviews. This comparison on capabilities and advantages of specific BI programs is detailed in Chapter 5.5 Software alternatives as part of development of dashboard.

After identifying the top contending software's, the next step was choosing a software and therefore establishing selection criteria. Reviewing software portals and IT blogs several factors were pointed out under similar names for choosing the right software. Peer reviewed guidelines from LinkedIn propose a five-step approach. This include reviewing user and expert opinions, assessing data to be handled, and evaluating the software in terms of ease of use, flexibility and scalability.

This criterion was consistent across different sources albeit under slightly different terminology. Those criteria are to evaluate and select software are: (Beek) ("How To Choose A Business Intelligence (BI) Platform," 2023) (Lobo) (Marchand) ("How can you select a BI tool that balances advanced features with ease of use?," 26 October 2023)

- Functionality, Presentation, Data Visuality
- Reporting, Dashboarding, Analytics capabilities
- Integration and Connectivity to other systems
- Mobility and communication
- Ease of use and learning curve
- Customization
- Pricing
- IT support

## 3.4 DASHBOARD TESTING AND IMPLEMENTATION

Fourth research question focuses on dashboard testing and implementation. In this part research into how to evaluate the dashboard and its performance can be confirmed is documented plus how the implementation of the dashboard can be performed is documented.

#### UNDERSTANDING BIG DATA ANALYTICS CAPABILITIES IN SUPPLY CHAIN MANAGEMENT: UNRAVELLING THE ISSUES, CHALLENGES, AND IMPLICATIONS FOR PRACTICE

In this study Kumar at al. offers an overview on implementing Data Analytics into supply chain. This work highlights the gains of implementing big data analytics as benefit of real time information, more cohesive insight and data visualisation benefits for understanding complex data. Furthermore, they point out general challenge of implementing are not only time and financial resources but also privacy issues.

Challenges of implementation that are relevant to my research are scalability, analysing high volume of data particularly potential of handling large datasets, maintaining data quality and accuracy. (Arunachalam, Kumar, & Kawalek, 2018)

#### AN ANALYSIS OF THE USE AND DIFFICULTIES IN INTRODUCING INFORMATION TECHNOLOGY AND INFORMATION SYSTEMS IN TRANSPORT AND THE TRANSPORT INFRASTRUCTURE

This article explores the implementation of IT systems in Russian Transport infrastructure and how technology can enhance transport management This article highlights and underscores the importance of standardization while implementing new technology and importance of cybersecurity. Further identifies importance of integration capabilities for successful implementation. (Kabanov, Azarov, & Mayboroda, 2019)

#### DASHBOARD DESIGN AND IMPLEMENTATION A STEP-BY-STEP GUIDE

This article by Daryl Orts explains and summarizes key factors in dashboard design and implementation. He outlines a 4-step approach for successful implementation where he stresses importance of proper planning – identifying metrics and data needed while focusing on needs of primary users and deliverability. In the next step to design and confirm data sources and programming deeded to set up dashboard with building dashboard as third step. There he highlights importance of defining user interface and right data visualisation. And lastly stresses the importance of proper maintenance and improvements after realization. (Orts, 2007)

## 3.5 EVALUATION OF DASHBOARD

### 3.5.1 THE DSR FRAMEWORK - HEVNER ET AL. 2004

Design Science Research (DSR) is a problem-solving paradigm focused on enhancing technology and science knowledge through the creation of innovative artifacts. These artifacts address real-world problems and improve application environments, producing both the artifacts themselves and new design knowledge (DK) that explains their impact.

DSR involves:

- Identifying and motivating a research problem.
- Defining objectives for a solution.
- Designing and developing the artifact.
- Demonstrating the artifact's use.
- Evaluating the artifact's effectiveness.
- Communicating findings to stakeholders.

The evaluation process includes assessing problem identification, solution design, solution instantiation, and solution use.

Applying DSR framework to my research would include applying this methodology to confirm and evaluate problem occurrence, problem depth, proposed solution and feasibility of proposed solution as case study in

company. This would include gathering empirical data to validate and refine my research problem and proposed solution.

- Problem Confirmation: Include questions that assess the importance, novelty, and feasibility of the problem.
- Problem Depth: Ask respondents to provide detailed insights into the current state and challenges related to the problem.
- Proposed Solution: Evaluate the simplicity, clarity, and consistency of your proposed solution through targeted questions.
- Effectiveness of Proposed Solution: Measure the artifact's ease of use, fidelity with real-world phenomena, robustness, effectiveness, efficiency, and external consistency by asking respondents about their experiences and observations.

## 3.6 LITERATURE REVIEW CONCLUSION

The literature review has provided insights into the key aspects of transport logistics, an comprehensive understanding of the stakeholders, data requirements, and BI tools relevant to the evaluation of transport performance in the logistics sector.

### STAKEHOLDERS IN TRANSPORT LOGISTICS

Stakeholders in transport logistics include a wide range of participants such as transport companies, suppliers, clients, and regulatory bodies. Each of these stakeholders has specific goals related to transport performance. The primary goals of stakeholders generally focus on optimizing cost-efficiency, improving service quality, ensuring compliance with regulations, and maintaining timely deliveries. Stakeholders value accurate data related to transit times, cost-effectiveness, service reliability, and environmental impacts to evaluate and enhance transport performance.

### BI DASHBOARD DATA

The standardized BI dashboard is intended to be used by logistics employees and managers of COMPANIES, analysts, and other key decision-makers within logistics companies. To effectively evaluate transport performance, certain key performance indicators (KPIs) are essential. KPIs such as on-time delivery rates, cost per mile, fuel consumption, customer satisfaction, and route efficiency provide a comprehensive view of transport operations. In order to track these KPIs, stakeholders require data such as real-time tracking information, financial records, customer feedback, and environmental data. This data is typically held by logistics companies, transport providers, and third-party data vendors, although access to this information can be restricted due to company policies and data privacy concerns.

### BI TOOLS AVALIABLE

There are many tools used for data visualization and their comparison can be found in Chapter 5.5. When selecting a BI tool for logistics companies, certain criteria are crucial. These include ease of integration with existing systems, user-friendliness, scalability, and the ability to process and analyse large volumes of data efficiently. For this research compatibility and scalability are important criteria’s.

### DASHBOARD TESTING AND IMPLEMENTATION

To ensure the functionality of the BI dashboard, through testing via pilot programs, user feedback, and performance testing is recommended. Test should focus on valuating the dashboard's usability, accuracy of data presentation, and system responsiveness and include performance review of user interface responsiveness, the precision of the data provided, and the dashboard’s ability to handle large datasets in real-time

## EVALUATION OF DASHBOARD

Dashboard and problem can be validated using Design Science Research (DSR) is a problem-solving paradigm. The perceived usefulness of the dashboard will be determined through a combination of qualitative and quantitative data from case studies and surveys, capturing both user experience and the effectiveness of the dashboard in real-world scenarios.

# 4 CONTEXT ANALYSIS

This chapter focuses on understanding and observing happenings in the transport industry. Stakeholders, both internal and external, are observed for their impact on logistics and analysis of EvoFenedex digitalization survey 2022 places those findings into context.

## 4.1 EXTERNAL STAKEHOLDERS

In logistics, there are many actors and stakeholders. In this case, those are external stakeholders influencing the logistics process on a wide level without concrete influence on the transport logistics company. There are 4 main stakeholders identified in the transport supply chain by literature and OTM.

Those are Shippers, Transporters, Government and Service and data providers who need to share data during transport processes making them external layer of stakeholders from a transport company perspective. (Model, 2022d)This makes them a layer of external stakeholders for company - the transporter in question

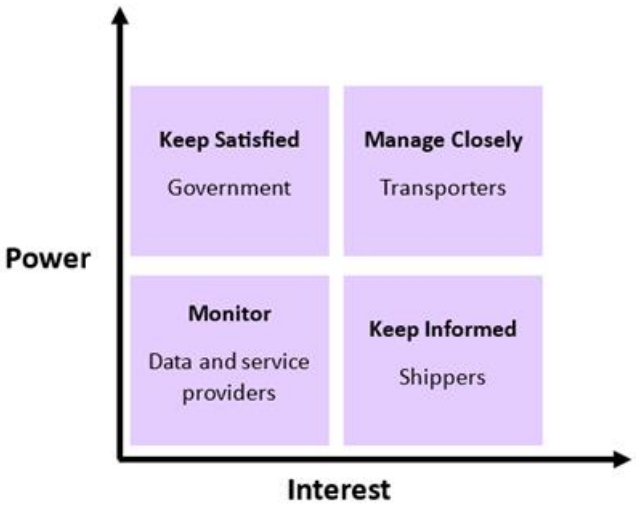



Figure 4 Power Interest Graph of Stakeholders

Starting from actual 2PL or 3PLcompanies - transporters as stakeholders hold the most power and interest within their company. Company stakeholders be it directors or shareholders have enough power to influence the run of the company and interest to continue making profits. This places transporters - and therefore the company itself at managing closely level. Therefore, transporters hold the decision of what changes or practices can and will be implemented in reality. Making shareholders of company responsible for its decisions.

Shippers - customers in need of transport have a large interest in how transporters run a company but have limited power over transporters' actions. An example of this is shipper who had bad experience with a transporter is more likely to switch to a different transport company, but satisfied customer will me more interested in getting updates and requesting possible improvements. This places Shippers into keep informed section on the power/interest grid from the perspective of this assignment.

The government as a stakeholder has large power in logistics field by the extension of managing current legislation and managing transport routers. This means the government has either a direct impact on transporters via laws and regulations or an indirect impact arising from managing transport routes. Further government has no direct link to influence internal processes of transport companies placing them into keep a satisfied level on power and interest grid.

Lastly, Data and service providers have a smaller interest in transport companies and while they can influence the running of the transporter by their services they still place on low power and low-interest section. Therefore, monitoring and keeping a stable beneficial relationship with service providers is necessary without spending extra effort. (Team)

In summary looking at all stakeholders' interactions, power and capabilities places them into 4 different grids. This gives me Government and Data and service providers shaping constrain on projects of 2PL and Shippers

influencing them while Transporter the 2PL company makes decision within those constrains. Henceforth, transporters as company depends on its business plan and internal stakeholders.

## 4.2 INTENAL STAKEHOLDERS

In a Second-Party Logistics (2PL) transport logistics company, internal stakeholders play crucial role in smooth functioning of company. Recognising those departments as stakeholders of company showcases that meeting departments needs can significantly increase business of whole company.

Each department has specific needs and responsibilities to perform in company however specific department hold more importance and impact based on 2PL primary offer of transport with minimal services.

To show relationship between departments and external some external actors onion diagram below shows the interactions.(Olson, 2013)

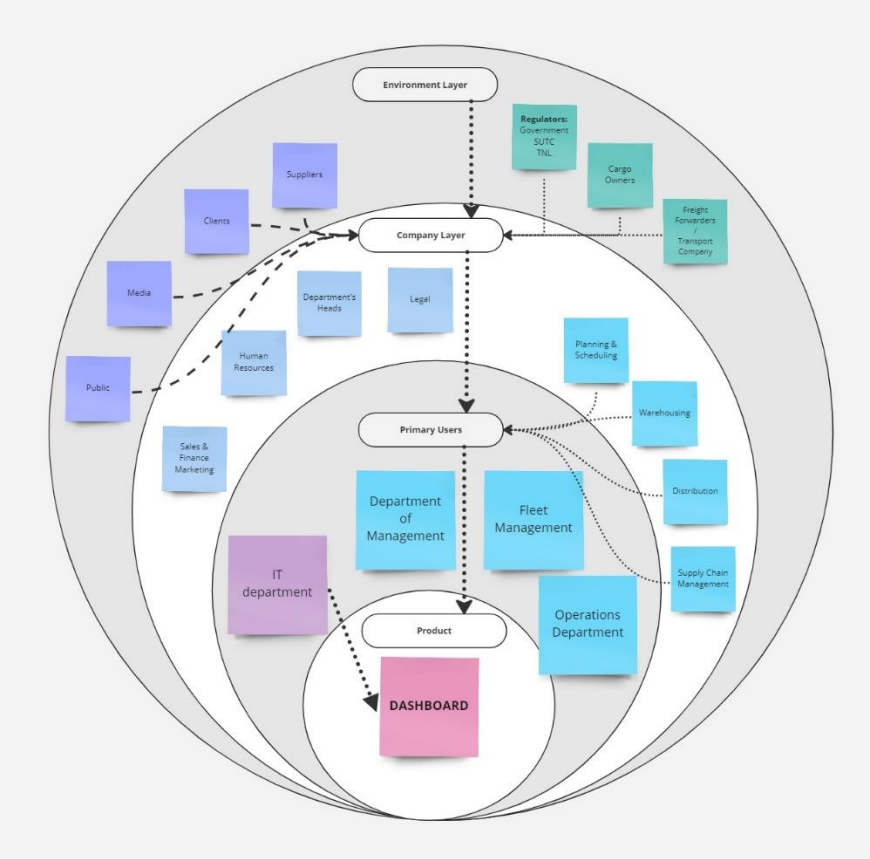



**Figure 5 Onion Diagram of Dashboard Uses**

In the first layer of onion diagram is the product – the dashboard itself serving as central tool for data visualization and decision-making support. Following on the second layer are the identified primary users. Those are departments shown in blue, namely department of Management, Fleet Management and Operations. Along side department of IT is also primary users as technical support to ensure smooth running.

On third layer – the company layer are 2 groups of departments. Blue depicted departments of Planning & Scheduling, Warehousing, Distribution or Supply Chain Management will find the dashboard useful in a limited way. Those departments are not intended users however they may find insights relevant to their departments making them secondary users.

Rest of departments in third layer shown in light blue do not encounter dashboard but they interact with other departments so may come across insight from dashboard during they work from other departments.

Lastly in forth layer relationship between external actors comes into light. Freight forwarders – transport companies and for my research 2PL companies interact with external parties so 2 groups here need to be highlighted. Group in green contains regulators who influence company business and group in purple that frequently interacts with company so may find some of insight from dashboard from employees.

## 4.3 INDUSTRY FINDINGS

This section provides descriptions and insights gained from analysis of data set from EvoFenedex digitalization survey 2022. This data set offers statistically significant findings into current data practices representing whole industry. Covering 206 companies, various fields in logistics and company sizes the survey highlights data practices valid in representation of whole sector.(*Nationaal onderzoek Data en digitalisering in de logistiek 2021*, 2021)

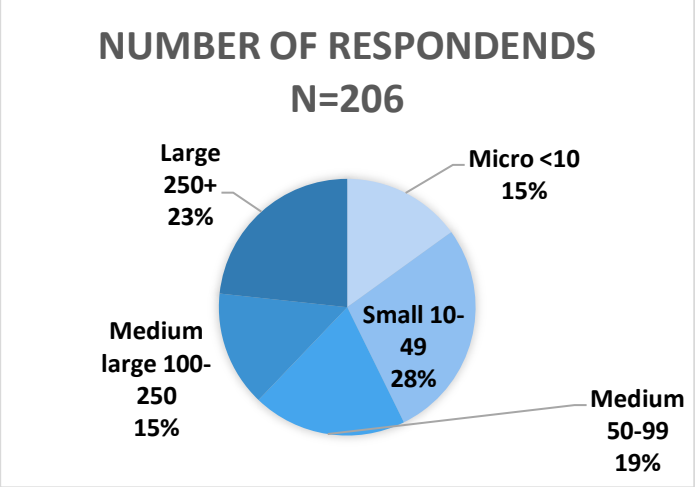



Figure 6 Survey Respondents Division

One of the key findings of the survey is the varied opinions among respondents regarding the adequacy of data available to them. While a majority (#62%) believes they invest enough in data management and visualisation, the opinions differ significantly among respondents when considering the size of the companies. Interestingly, micro companies tend to be reticent about whether they invest enough and their financial situation, with a considerable portion refusing to answer this question

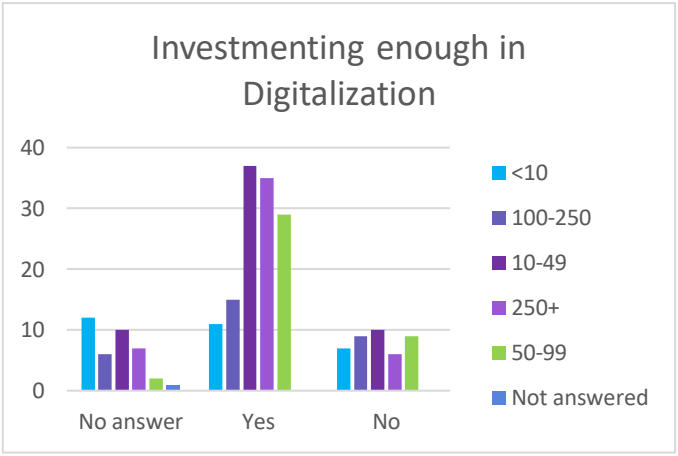



Figure 7 Investment in Digitalisation by Companies

Moreover, almost half (#45%) of all companies agree that they have access to data they need both internally and externally. This view is similarly shared within Small and Micro companies at 48% and further 46% of Micro companies agrees to having access to data they need. However, while almost half companies (#46%) has enough access to data roughly third of companies (#37%) disagrees showing small differences in ration if they have enough data or no.

This highlights a point that even if SMEs have access to data, they still have problems with using it. This point is further showed in statistics bellow.

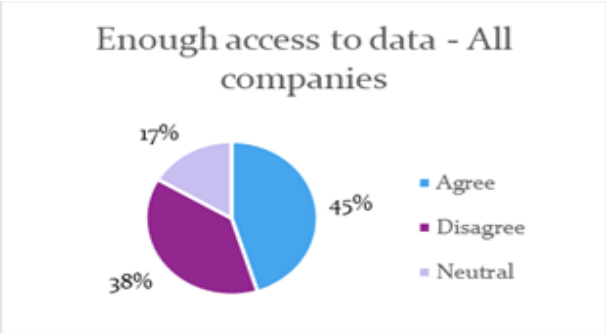



Figure 8 Access to Data All companies

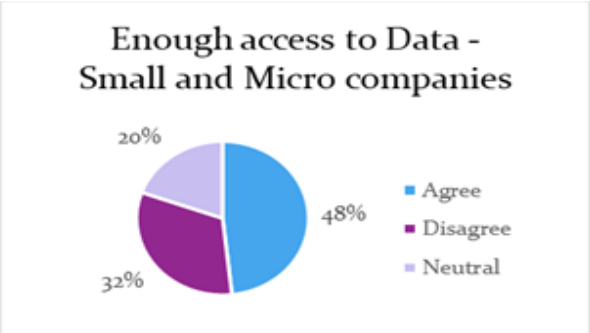



Figure 9 Access to Data Small and Micro Companies

Further analysis of companies concerning their data behaviour shows that besides data collected internally (systems, emails, phone calls, etc…) they have limited access to data from several external sources.

Among the data from external sources most used is data from logistic partners – 46% and data from customers is right behind with 43% of companies using this data. Data from suppliers and government agencies falls behind and data from various platforms is rarely used by companies

Analysing how size of the company influences their access to external data shows that while Micro companies on average access external data minimally there are outlier compared to other companies.

Both small and medium companies are close to average with accessing external data and showing all other companies access external data regularly with average of every company accessing at least one external data source and large companies two sources on average

| Data source | Respondents | Percentage |
|---|---|---|
| Customers | 88 | 43% |
| Suppliers | 73 | 35% |
| Logistics partners | 95 | 46% |
| Platforms | 24 | 12% |
| Government / enforcement agencies | 46 | 22% |

Table 4 External Data Sources

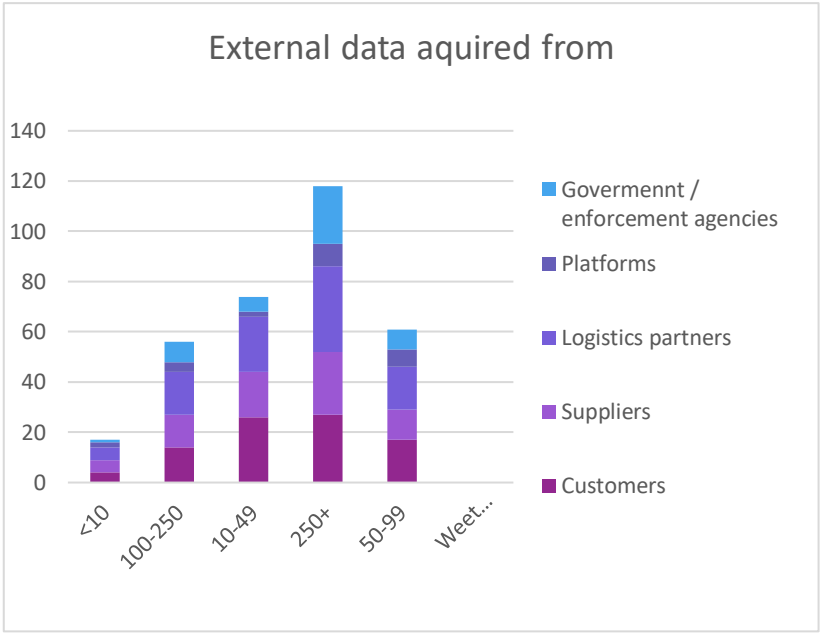



Figure 10 External Data Sources

This confirms previously observed point of SMEs having access to data both internal and external. With companies having access to data their lack of use of it further proves their lack of knowledge or financial means to use data effectively. This is also shown on page below about how they use the systems they have access to.

| Company size | Number of employees | Number of respondents | Times accessed external data | Average access per company | Average access per system |
|---|---|---|---|---|---|
| Micro | <10 | 31 | 17 | 55% | 0,5 |
| Small | 10-49 | 57 | 74 | 130% | 1,3 |
| Medium | 50-99 | 40 | 61 | 153% | 1,5 |
| Medium large | 100-250 | 30 | 56 | 187% | 1,9 |
| Large | 250+ | 48 | 118 | 246% | 2,5 |
| Together | | 206 | 326 | 158% | 1,6 |

Table 5 Access to External Data

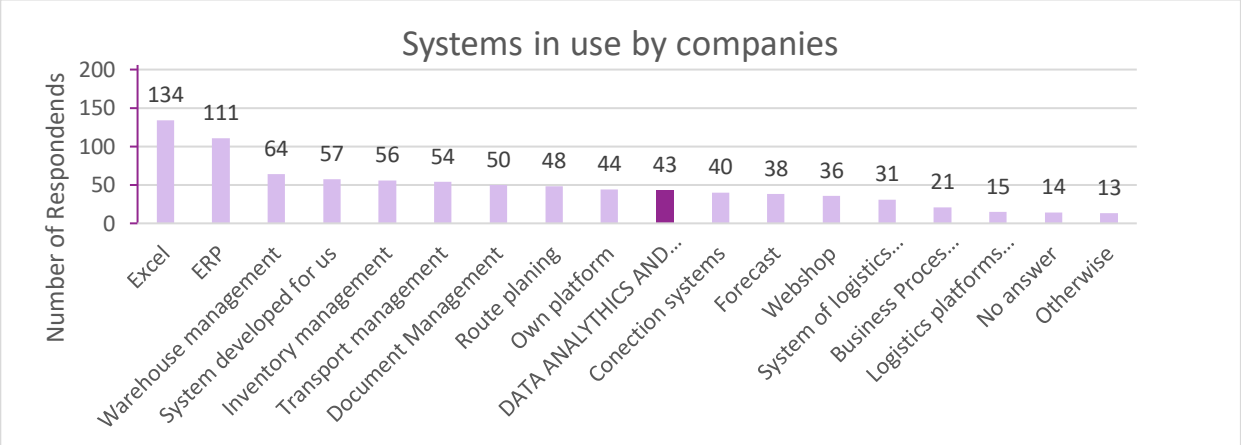



Figure 11 Systems in Use

Analysing the responses about the data usage, systems in use and practices within these companies reaffirms the dominance of Excel as the most utilized data program from previous findings. Yet this percentage is lowered from 80 to 62% from 2019 signifying a shift and willingness into easier data usage practices. This is further highlighted by a noticeable shift towards more advanced tools, with ERP systems emerging as the second most popular choice after Excel. Other data programs are progressively less utilized in comparison. Particularly noteworthy is the increasing adoption of data analytics and visualization programs, with approximately 21% of respondents now employing such tools, while still relatively low percentage marking a significant increase from previous years.

Furthermore, analysis of responses shows that companies are slowly increasing the number of systems they are using even if said number is still low. Comparing how many systems are used and how many companies are using them shows that on average Micro company uses only 1 system, increasing said number up to 5 systems per company on average in large companies.

This means that system use is very limited in Micro companies. Based on statistics we can conclude that several companies do not use any systems in their work. Half of companies uses Excel sheets. But concrete ratio between companies not using any system and companies using multiple is uncertain as average in this case skewers the perception.

| System in Use | Respon-dents | Percentage |
|---|---|---|
| Excel | 134 | 65% |
| ERP | 111 | 54% |
| Warehouse management | 64 | 31% |
| System developed for us | 57 | 28% |
| Inventory management | 56 | 27% |
| Transport management | 54 | 26% |
| Document Management | 50 | 24% |
| Route planning | 48 | 23% |
| Own platform | 44 | 21% |
| DATA ANALYTHICS AND VISUALISATION | 43 | 21% |
| Connection systems | 40 | 19% |
| Forecast | 38 | 18% |
| Web shop | 36 | 17% |
| System of logistics provider | 31 | 15% |
| Business Process Management/Workflow | 21 | 10% |
| Logistics platforms (market place, bookings) | 15 | 7% |
| No answer | 14 | 7% |
| Otherwise | 13 | 6% |

Table 6 Systems in Use

Small and medium sized companies however do use systems 3 and 4 respectively on average. This connects to observation from 2019 EvoFenedex survey where roughly 30% of systems were considered old and roughly 50% had connectivity problems. Combining multiple old or unconnected systems presents a problem for the usage of data and possibilities for improvement by adapting and changing the way data is used by implementing OTM and dashboard for data visualization.

| Company size | Average nr. of systems in use per company |
|---|---|
| Micro | 1 |
| Small | 3 |
| Medium | 4 |
| Medium large | 4 |
| Large | 5 |

**Table 7 Average systems in use by company**

The actually observed way how companies use this data is also very varied. The most reported use of data between companies is reporting with approximately 70% of companies reporting results in some form. Followed closely by trio of supporting decision making by 65% companies, signalling deviations and deceptions by 63% and analysing and improving performance by 61% of companies.

Those numbers show promise for data usage but also means potential discrepancies between reported and proclaimed use of systems and data by companies with observations of actual general data usage. This implies that while 70% of companies reports use of data for monitoring the extend and their capabilities in this are either varied or low to lead to general low data usage.

### 4.3.1 SUMMARY AND CONCLUSION OF INDUSTRY FINDINGS

Overall, the EvoFenedex survey of 2019 highlighted a problem with data usage in logistics in Netherlands while the 2021 survey shows a depts and particulars of this problem. Combining the knowledge from analysing of responses of participating companies highlight for me the fact that SMEs lack the knowledge how to improve the use of their data and systems. Reasons for this will vary but possible solution to this observation can be dashboard improving data visualization and connectivity of their systems in easier way proving this research is on the right track.

Analysis of EvoFenedex survey 2021 offers valuable answers about data usage, data availability, challenges faced by companies and provides an actionable information for development of dashboard. This highlights the need of dashboard with high connectivity capabilities.

## 4.4 FINDINGS TAKE AWAY

The finding and insight provided in chapters 3 and 4 brings attention to several areas in new light. Combining those findings into more coherent summary provides an easier understanding of key aspects.

External stakeholders as government influence company via compliances with legislative framework. Conversely cargo owners have small power to impact company internal direction but shapes then via contracts and service satisfaction.

Internal stakeholders, comprise of various departments and their heads. Those stakeholders run the company and shape the direction and activities gong on. Those relationships can be seen on onion diagram above.

Industry analysis offers various insights and reveal a discrepancy between perceived and actual investment situation.

Despite believing they invest sufficiently, fewer than 50% of companies agree they have the necessary data. Data frequently originates from customers and logistics partners besides internal sources. This indicates large amount of data being shared without system support. Further there is documented lack of use of data analytics and visualisation where only 21% f companies use this. The predominant use of Excel sheets underscores confusion and inefficiencies in data management, highlighting the gap between actual data usage and the perceived adequacy of digital investments.

Those and other insight in chapter 4.3 above highlights a generalised profile of company as a recipient of IT help.

**Profile of a Typical Company as a Dashboard User**:

- **Company Size**: Small, with fewer than 10 employees.
- **Financial Situation**: Limited, facing financial constraints.
- **IT Infrastructure**: Minimal, lacking substantial IT support and resources.
- **Systems in Use**: Generally limited to three basic systems on average.
- **Preference**: Seeks easy-to-use and implement solutions.

- Prioritize main transport activities.
- Present data efficiently and effectively to support decision-making and operational efficiency.
- Importance of connectivity and compatibility to systems already in use.

Therefore, dashboard for those companies requires user friendly and easy to navigate solution prioritising main transport activities helping companies by enhancing their understanding and efficiency in overall business success.

# 5 DASHBOARD DEVELOPMENT

Business intelligence plays an important role in transforming raw data into actionable insights. In this section development and proposed design of dashboard is discussed with aim of leveraging presenting data in visually appealing manner and metric presented data to improve data understanding in logistics.

## 5.1 DASHBOARD DEVELOPMENT PROCESS

Development of the dashboard originated from EvoFenedex digitalization survey 2019 and 2021. Analysis of survey results from 2021 provides critical insight into current state of digital tools and practices within Dutch logistics. (See Chapter 4.3 – Industry Findings for details) Following those practices and aligning dashboard design with these finding ensures better tailored design suitable for intended users.

Based on this information and various literature I am proposing implementing dynamic dashboard with multiple pages tailored for specific purposes. The aim is creating standardised dashboard while offering space for adjustments for needs of individual companies. By developing a standardized but dynamic dashboard that can be later tailored to needs more specifically will allow companies to streamline their operations and manage and use data they have available for business effectively.

Development of standardizable dashboard for transport logistics begins in Chapters 3.2.1 – section OTM and continues in Chapter 4.3 – Industry Findings by understanding stakeholders in logistics, metrics specific for logistic company performance and data involved in the process.

Following knowledge gained from those insights about currently used systems, their abilities and capabilities I came up with conclusion that implementing OTM and BI tool should help companies in their daily work. Recalling findings on current BI tools available and their abilities (Chapter 3. 3 BI tools available) selection of Microsoft BI tool for its integration capabilities (reported problem of connectivity issues survey 2019,2021), visualization and easy user interface while maintaining scalability.

## 5.2 DASHBOARD DESIGN

The proposed dashboard design focuses on creating a user-friendly interface tailored for transport sector. This incorporates a clearly defined space sections visually separating always present navigation panel from main part of screen. This layout was proposed for its ease of navigation and usability for faster learning curve for users with limited IT skills. Clean and minimalistic design ensures more efficient and effective use of dashboard by users.

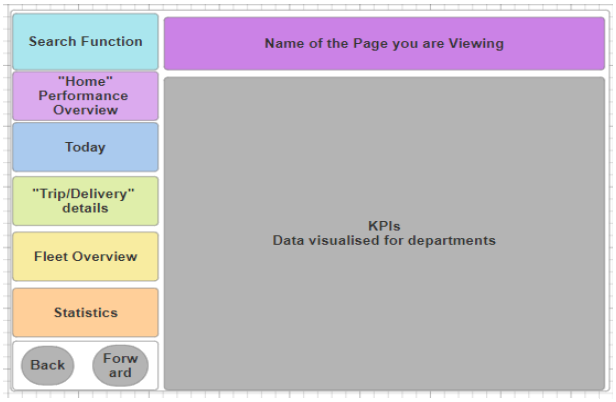



**Figure 12 Dashboard Design Vision**

The design of navigation panel features a multiple specialized pages catering for different departments and information needs of various users. This includes a page for different departments and metrics relevant to their operations. This allows users to switch between panels and drill down into detailed information as they need.

Additionally, dashboard includes a separate customizable statistics page. This allows customisation based on companies' individual needs or display more KPI's according to customer preference. Overall, the dashboard design focuses on prioritizing the user friendliness and efficiency to cater to customers needs regardless of their technical expertise. Specialized pages and straightforward navigation system enhances the ability to users to

make informed decisions and helps with reported problem of data visualization. KPI and Data Selection{Yigitbasioglu, 2012 #54}

## 5.3 KPI AND DATA SELECTION

The context analysis in Chapter 4 provided a detailed insight on profile of the company's needs and the key focuses for the dashboard and its users. This analysis helped identify the areas for improvement in the logistics process and outlined the primary goals for the dashboard design. It became clear that the dashboard needed to serve the specific needs of the company's departments, providing actionable insights that would enhance decision-making and operational efficiency

Following this Chaters 5.1 and 5.2 above outlined the development of dashboard into 5 distinct pages – providing strict structure for easier finding of information. Each page focuses on a specific area of information, aligning with the needs of departments identified as the most likely to benefit from the dashboard. This structure ensures that each section offers valuable sectional insights into aspects enabling users to quickly access data most relevant and needed for their position.(Iankoulova, 2012) (Elfriede Krauth, 2005) {Milenković, 2021 #53}{Do¨rnho¨fer, 2016 #56}Those pages are:

- Home overview
  Main page with performance overview. Displays KPIs aimed at assessing effectiveness and efficiency of operations. Proposed metrics are also tied to customer satisfaction to provide comprehensive overview.
- Today page
  Provides real time snapshot of daily operations for accurate up to date monitoring of activities.
- Trip page
  Focuses on details of individual trips or transport offering in depth delivery monitoring and overview of transport details.
- Fleet page
  Summarizes status and utilization of fleet, highlighting vehicles number of available or in repair vehicles aiding in planning and operational adjustments.
- Statistics
  Dedicated as more company customization area or metrics not falling under other categories. This page serves as flexible overview of additional metrics for tailored to needs.

The selection of KPIs on each page was guided by combination of literature review, dashboard design principles and finding from context analysis in chapter 4. Mixture of those factors ensures KPIs aligned with focus of page offering targeted insights. KPIs were chosen for their relevance and usefulness to cater to specific departments of transport company helping them make informed decisions.

KPIs selected for each page and detail for them are on the pages bellow.

Home page of the dashboard provides a comprehensive performance overview in terms of several KPIs for assessing effectiveness and efficiency of transport operations. This page includes information not only for performance overview but said proposed metrics also correspond to customers satisfaction with ordered transport.

| Home Overview page | | | | | |
|---|---|---|---|---|---|
| **KPI** | **Explanation** | **Data Needed** | **Calculation** | **Source** | **Note** |
| **Response Time** | Difference between requested delivery time and actual delivery time | - endDate (trips database)<br>- requestedDelivery | endDate – requestedDelivery | Trip logs of OTM<br>Consignment logs of OTM | Not realised in prototype<br>Dataset does not include Requested Delivery |
| **Order Fulfilment** | Percentage of completed orders this month | - count consignment Created (consignments database)<br>- consignment status (consignment database | $\frac{Number\ of\ Fulfilled\ Orders}{Number\ of\ Orders\ Placed} \times 100$ | Consignment logs of OTM | Partly realised from order status<br>Dataset does not include requested delivery date |
| **Truck Utilization** | Percentage of trucks available to use | - count of available vehicles<br>- total number of vehicles | $\frac{Number\ of\ Trucks\ in\ Use}{Total\ Number\ of\ Trucks} \times 100$ | Vehicles logs of OTM | Realised |
| **On-Time Shipping** | Percentage of orders shipped on time | - count of (scheduled shipment time – startTrip time)<br>- count of shipments in months | $\frac{Number\ of\ On\ time\ Shipment}{Total\ Shipments} \times 100$ | Consignment logs of OTM<br>Trip Stops logs of OTM | Not realised in prototype<br>Dataset does not include data needed |
| **On-Time Delivery** | Percentage of orders delivered on time | - count of shceduledDelivery time and endTrip time | $\frac{Number\ of\ On\ time\ Delivery}{Total\ Deliveries} \times 100$ | Trip Stops logs<br>Consignment logs | Partly realised from order status<br>Dataset does not include requested delivery date |
| **On-Time Receiving** | Percentage of orders received on time | - count of scheduled Receiving time and startTrip time | $\frac{Number\ of\ On\ time\ Receivings}{Total\ Receiving} \times 100$ | Trip Stops logs<br>Consignment logs | Not realised in prototype<br>Dataset does not include data needed |
| **Number of Orders This Month** | | - count consignment Created | Count of orders placed in current month | Order Management System | Realised |

**Table 8 KPI - Home overview**

The Today Page of the dashboard provides a real-time snapshot of the day's operations, enabling users to monitor and manage current activities effectively. This section details the proposed KPIs, the calculations required for each KPI, and the sources of data.

| Today page | | | | | |
|---|---|---|---|---|---|
| **KPI** | **Explanation** | **Data Needed** | **Calculation** | **Source** | **Note** |
| Number of Trips Today | Number of trips scheduled or in progress | - count startTrip timestamp | count startTrip timestamp | Trip Stops logs | Partially realised on monthly basis from order status on Home page |
| Number of Trucks in Use | Truck availability – number of trucks in use | - count of truck market in use | count of truck market in use | Consignment logs<br>Trip Stops logs | Partially realised on monthly basis from Consignment status on Fleet page |
| Number of Cities to Deliver To | Number of destinations(cities) to deliver | - count distinct of Reference Location City | count distinct of Reference Location City | Trip Stops logs | Partially realised on monthly basis from Consignment status on Fleet page |
| Drill Down Lists of Deliveries with Info | Delivery details (destination, cargo, customer, etc.) | - trip ID to dig up consignment details | Filtering based on consignment ID | Consignment logs<br>Consignment Goods logs<br>Trips logs | Not realised |
| Map with Delivery Places | Delivery destination coordinates | - reference Location | display reference location on map | Trip Stops logs | Partially realised on monthly basis from Consignment status on Fleet page |

**Table 9 KPI - Today page**

The Trip Details Page of the dashboard provides in-depth information about individual trips, enabling users to monitor and manage specific delivery activities. This section details the proposed KPIs, the calculations required for each KPI, and the sources of data.

| Trip page | | | | | |
|---|---|---|---|---|---|
| **KPI** | **Explanation** | **Data Needed** | **Calculation** | **Source** | **Note** |
| Trip Identification | Unique trip ID | - Trip ID<br>- Consignment ID | Display data | Trip stops logs | Not realised<br>Filtering |
| From A to B Locations | Starting and ending locations | - Reference location delivery Cty<br>- Reference location start place | Display data | Trip stops logs | Not realised<br>Prototype dataset does not include start location |
| Vehicle Information | Vehicle ID, vehicle details (make, model, capacity) | - Vehicle ID | Display data | Vehicles logs | Not realised<br>Filtering |
| Expected Transport Time | Scheduled departure time, scheduled arrival time | Scheduled Arrival Time - Scheduled Departure Time | Display data | Consignment logs | Not realised<br>Prototype dataset does not include this data |
| Loading Time | Loading start time, loading completion time | Loading Completion Time - Loading Start Time | Average loading time | Vehicles logs<br>Trip logs<br>Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |
| Unloading Time | Unloading start time, unloading completion time | Unloading Completion Time - Unloading Start Time | Average unloading time | Vehicles logs<br>Trip logs<br>Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |
| Customer Details | Customer name, address, contact information | - Consignment ID<br>- Customer ID | Display data | Consignment logs<br>Trip Stops logs | Not realised<br>Prototype dataset does not include this data |
| Cargo Details | Cargo description, quantity, weight | - Consignment ID<br>- Consignment Goods ID | Display data | Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |
| Warnings for Paperwork (SDS, UN Codes, CBUs) | Required documentation status | - Consignment Goods ID | Display data | Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |

**Table 10 KPI - Trip Details**

The Fleet Overview Page of the dashboard provides a comprehensive summary of the fleet's status and utilization, enabling users to monitor and manage the vehicle fleet effectively. This section details the proposed KPIs, the calculations required for each KPI, and the sources of data.

| | | Fleet overview page | | | |
|---|---|---|---|---|---|
| **KPI** | **Explanation** | **Data Needed** | **Calculation** | **Source** | **Note** |
| Number of Vehicles | Number of vehicles owned by company | Total count of vehicles in the fleet | Count of Unique Vehicle identification | Vehicles logs | Realised |
| Vehicle Utilization | Utilization of vehicles available | Number of vehicles in use, total number of vehicles | $\frac{Number\ of\ Trucks\ in\ Use}{Total\ Number\ of\ Trucks} \times 100$ | Vehicles logs<br>Consignment logs | Realised |
| Types of Vehicles | Number and differences in vehicles owned | List and count of vehicle types | Count of Vehicle types | Vehicles logs | Realised |
| Currently Available Vehicles | Number of vehicles ready to be used | Number of vehicles available for use | Count of Vehicles marked as Avaliable | Vehicles logs | Realised |
| Loading Vehicles | Number of vehicles loading cargo | Number of vehicles currently being loaded | Count of Vehicles Being Loaded | Vehicles logs<br>Trip logs<br>Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |
| Unloading Vehicles | Number of vehicles unloading cargo | Number of vehicles currently being unloaded | Count of Vehicles Being Unloaded | Vehicles logs<br>Trip logs<br>Consignment cargo logs | Not realised<br>Prototype dataset does not include this data |
| Vehicles En Route | Number of vehicles en route | Number of vehicles currently on their way to a delivery destination | Count of Vehicles En Route | Consignment logs | Realised from Consignment status |
| Vehicles in Repair | Number of vehicles in repair | Number of vehicles currently undergoing repair | Count of Vehicles in Repair | Vehicles logs | Realised |
| Expected Average Repair Time per Vehicle | Average repair time of vehicle | Repair start time, repair completion time | Average(Repair Completion Time - Repair Start Time) | Vehicles logs | Not realised<br>Prototype dataset does not include this data |

**Table 11 KPI - Fleet overview**

The statistics page of the dashboard provides users with space for tailoring customers data needs. Statistics page offers a space for monitoring KPI not falling under specific department or for monitoring other company metrics as needed. In this section I offer a brief example of possible metrics that may be interesting for transport companies with short description and short calculations.

This section is not intended to be implemented in my dashboard prototype but offers further KPIs that I contemplated for dashboard.

- Average Delivery Time
- Average Loading time
- Average Unloading time
- Order Accuracy rate
- Customer Satisfaction
- Driver Performance
- Incident rate
- Fuel Efficiency
- Revenue per mile
- Cost pe delivery

## 5.4 TECHNICAL DEVELOPMENT

The technical development of dashboard includes and starts with comprehensive process of identifying key performance indicators – KPI. This includes a data needed for calculations and relevant data sources. For those metrics table depicting full definitions can be found in section above which was updated based KPI realization in prototype based on data availability and feasibility using sample dataset. (O'Byrne, Jan 24, 2024, May 3 2022)

OTM visualisation of entities and actions, see bellow, illustrates how actors and vents interact in logistics processes. This serves as framework for organizing data in OTM in logical framework across different sections for example details about truck are under entity details in vehicle logs. This visualisation by OTM further served as efficient way to link those datasheets in Power BI using ID and Uuid numbers to create relations between databases. (Model, 2022a, 2023)

In the prototype many-to-many relationships were used frequently when linking databases. This relationship allows for cross referencing between those tables which can be beneficial for some analyses. While this approach was suitable for prototype, I must note down this approach may not be suitable with more robust datasets as it has potential to slow down the performance. Therefore, I recommend reviewing this periodically and if necessary to update the relationships. Changing the relationship to one-to-many would improve the system performance but could result in some data not being found based on direction of relationship which is something to consider during the refinement if/as needed.

Significant part of dashboard development was uploading sample dataset and then preparing said data within Microsoft Power BI. As primary data consisted mostly of text string values with some numerical or date values, many of said data columns required data type conversion. Example of this is conversion of columns with address details from string format to geographical reference – cities, states. While this conversion was implemented in prototype to visualise deliveries, there is potential for further refinement and more extensive uses later.

Furthermore, while data preparation was essential for functionality of dashboard, another thing to implement was columns manipulation in particular generation of new columns with data needed for KPI calculations. This included for example duplicating and splitting date/time columns to ease filtering capabilities.

While prototype dashboard demonstrates viability of using OTM model as base for dashboard structure several areas offer possibilities for improvement. Prototype showcases the possibilities of filtering but not to the full

extent of capabilities of Power BI. Additionally, not all KPI of filters were realised in prototype due to missing data. This something to adjust according to companies' data availability.

Further possibility to adjust on company case by case basis is colour scheme of dashboard. Prototype offers an intuitive interface for user friendly navigation that be further customised in companies' colour or design.

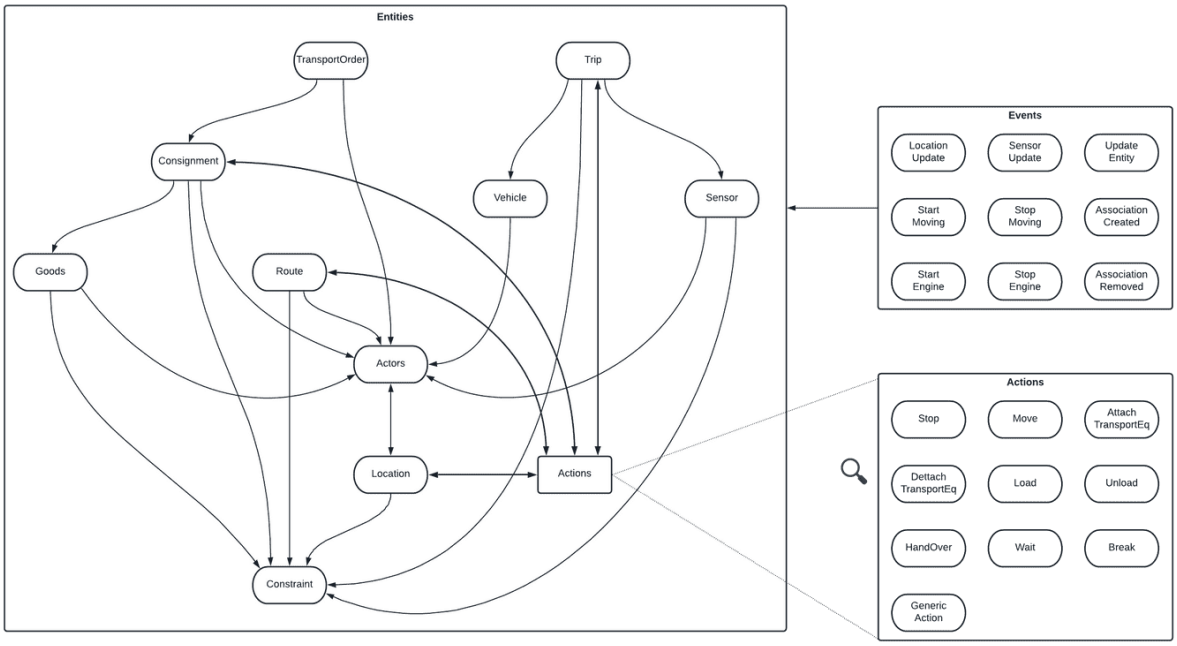



**Figure 13 OTM - Official Visualisation of Entities (Model, 2022a)**

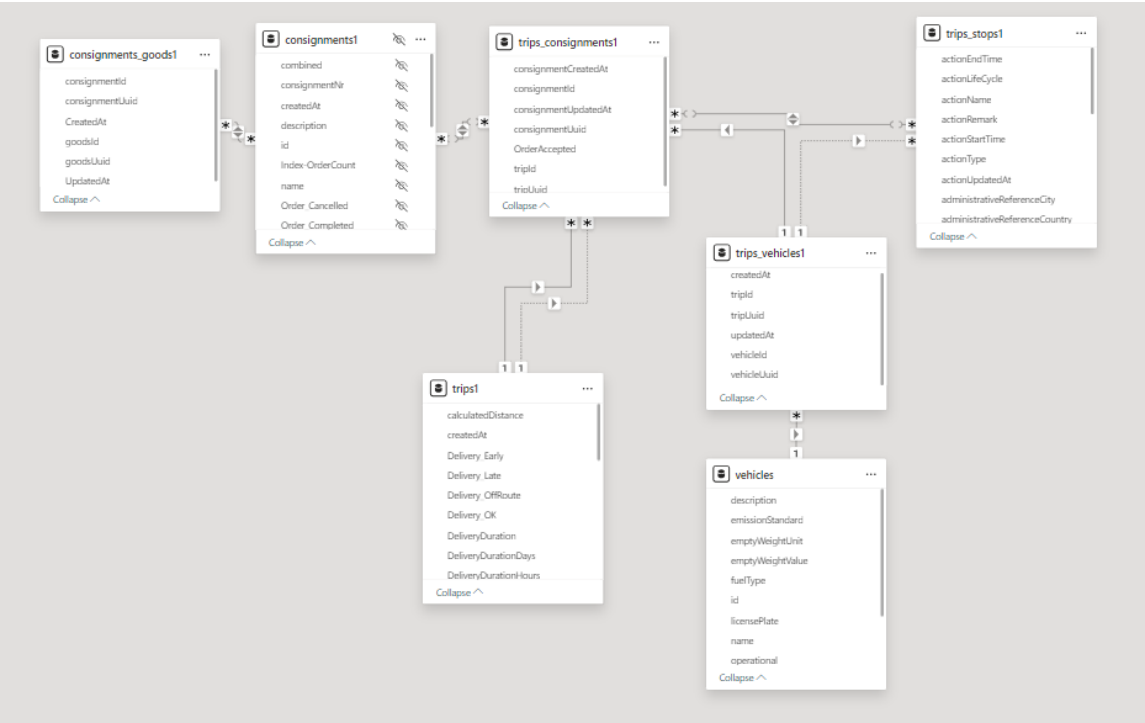



**Figure 14 Dashboard Database Set-up based on OTM**

## 5.5 SOFTWARE ALTERNATIVE

Starting with understanding the options currently available on the market IT magazines, blogs and websites offer a quick review of popular BI tools and software. All BI tools on the market collect and analyse data with different specializations per software. What are those specifics and how that software perform were tested and reviewed by the authors offering a quick summary of currently best-performing software.

Table X in appendix gives a comparative overview of how 4 different IT websites rate the best programs of 2023 and one comparison from 2022 to highlight changes and indicate improvements to software's. This includes pages of:

1) Select Hub – Reviewed overall customers satisfaction while using those programs. (Kaur, Roy, Roy, & Lowe, 2023)
2) Zapier - Reviewed and listed tools based on ease of use, data management, integration, and data automation among other criteria. (Strauss, 2023)
3) Coursera - Reviewed the most cited and commonly used IT websites in no order. (Staff, 2023)
4) Passionned - Reviewed the best-performing tools and listed them in order of popularity. (Beek)
5) Mopinion - Listed the best-performing tools of 2022 in order of popularity. (Haije, 2022)

Table 8 bellow focuses on differences of customers' ratings and opinions of tools based on functionality by Select Hub. (Kaur et al., 2023) This compares customers' overall opinion with their rating of specific functionalities of BI tools. For closer review - Dashboarding and Data visualisation, Reporting and Connectivity are compared across software as more important criteria for my research

| Rating | Overall rating | Dashboarding and Visualisation | Reporting | Data sources Connectivity |
|---|---|---|---|---|
| 1 | Power BI | Tableau | Dundas BI | Spotfire |
| 2 | Oracle Analytics Cloud | Sap Analythics Cloud | Sap Analythics Cloud | Domo |
| 3 | Spotfire | Yellowfin BI | Yellowfin BI | Sisense |
| 4 | Qlik Sense | Oracle Analytics Cloud | Oracle Analytics Cloud | Zoho Analythics |
| 5 | Dundas BI | Domo | ibi | Power BI |
| 6 | SAS Visual Analythics | Power BI | Tableau | Siemma |
| 7 | Domo | Qlick Sense | Sisense | ClicData |
| 8 | Sisense | Dundas BI | SAS Visual Analythics | Klipfolio |
| 9 | Tableau | Infor Bist | Power BI | Qlik Sense |

| | | | | |
|---|---|---|---|---|
| 10 | Sap Analythics Cloud | SAS Visual Analythics | Qlik Sense | Oracle Analytics Cloud |

**Table 12 BI Software Comparison**

This highlights that there are currently 5 market favourites for common and good performing software: Power BI, Tableau, Sisense, Dundas BI and Qlik Sense with varying selling points.

- Power BI is Microsoft's solution to connecting and integrating other Microsoft programs and commonly used software for BI. ("Power BI - Data Visualization - Microsoft Power Platform," 2023) Further the connectivity of Power BI to other mediums as social media to collect and incorporate data for visualisation makes powerful and popular tool with easier implementation. (Strauss, 2023) (Pedamkar, 2023)
- Tableau is an analytics platform offering an intuitive and easy way to manage and visualize data. (Tableau, 2023) Comes with prebuilt interface, easy to set up analytics but is a purely visualising interface with statics but lacks incomparability of other software's. (Pedamkar, 2023)
- Sisense offers analytics for customer programs to achieve data visualisation and data insights to support data-driven decisions for customers. Further notable is their quick management of large data sets and the possibility to use prediction with real-time applications. (Sisense, 2023) (Haije, 2022)
- Dundas BI offers flexibility and high customization for customers. Older software compared to the other 4 but still competing with simple drag in design, and flexibility in visuals and reports. (Staff, 2023) (Sisense, 2023)
- Qlik Sense is another powerful tool known for its visualisation and highly interactive interface. Popular for its touchscreen interaction along with advanced analytics enabling the "search and language" feature for its users. (Haije, 2022) (Sense, 2023)

This comparative analysis highlights the significant differences among the top BI software options, demonstrating that there is no one-size-fits-all solution. The best choice of software largely depends on the specific needs and priorities of each organization.

While all reviewed tools are user-friendly and compatible with the requirements of logistics companies, Power BI is particularly recommended due to its seamless integration with other Microsoft products, which many organizations already use making the transition and connectivity smoother therefore being the choice of program in this research.

However, given the adaptability of these BI tools, it is possible for logistics companies to customize and apply the proposed dashboard for monitoring their specific needs with other software's. By leveraging the unique strengths of each tool, companies can enhance their data analysis and visualization capabilities, ensuring efficient and effective data management with their selected software.

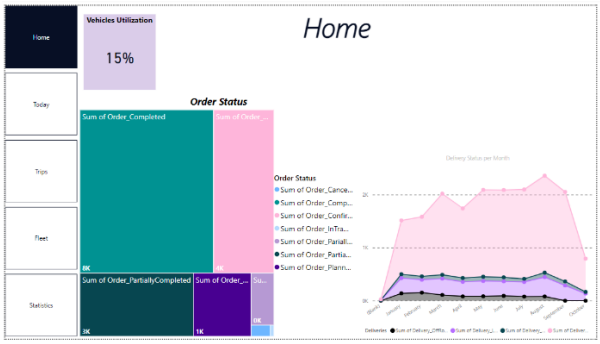
## 5.6 DASHBOARD PROTOTYPE

This section introduces the prototype of standardized dashboard for transport logistics companies as solution to improve data usage. This dashboard was developed using Microsoft Power BI based on several factors.

Microsoft Power BI is currently among the high ranked and recommended data analytics and visualisation software. One of the main reasons for its choosing and recommendations is due to its compatibility. Power BI connects to large number of systems already in use in Netherlands (see Table 6.) as well as seamless integration with other Microsoft software's as Excel which is most used program. In Netherlands. This is extremely important factor in choosing due to reported troubles with systems connectivity (see Table 1). Power BI therefore offers a seamless step in digital transformation for companies and even offers cost-effective entry trough its free version. This helps even small companies or companies under financial strain with functionality

of dashboard and offers a potential for scale up usage as needed unlocking more advanced features later when necessary.

As outlined in Section 5.3, not all proposed KPI's could be realized in the prototype due to the limited availability of data in the sample set. However, the dashboard includes KPI's prioritized for their relevance and usability, maintaining a user-friendly interface. Prototype design emphasises minimalism and the use of pastel colours to create a professional yet approachable aesthetic. Current colour scheme was chosen to provide necessary contrast between colours while visually matching. Moreover, colours and other details can be customized to align with company branding colours or used colour codes in company.



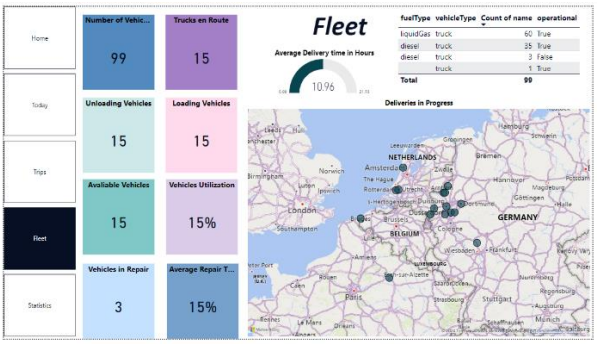
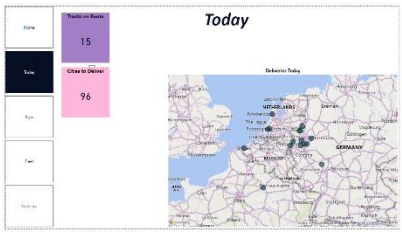




Figure 15 Dashboard - Home page Figure 16 Dashboard - Fleet view

The prototype focused on the Home Overview and Fleet pages. Home overview focus was on quick performance overview and Fleet pages offers comprehensive summary of fleet situation. Dashboard prototype has basic filtering on monthly basis but require further refinement for optimal usability and to offer insight per day. Also dashboard bas build on historical data therefore does not have real time updates.





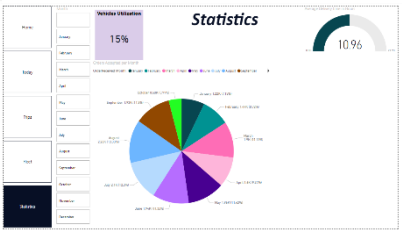



Figure 17 Dashboard - Today page Figure 18 Dashboard - Trips page Figure 19 Dashboard - Statistics page

To summarize, the prototype showcases a practical and scalable solution for standardizing dashboards in the transport logistics sector. Designed with a focus on usability, essential KPIs, and customization options, it offers companies a solid foundation for improving data-driven decision-making. While enhancements like advanced filtering and real-time data integration remain areas for future development, this prototype provides a valuable starting point, particularly for SMEs, to better utilize their data and streamline operations effectively.

# 6 DASHBOARD APPLICATION AND TESTING

Implementation of new system as dashboard involves thorough testing and planning beforehand to ensure smooth running. While as part of this research no actual implementation is to be done, this chapter outlines preparation and steps for real life application and functionality. (Orts, 2007) {Yigitbasioglu, 2012 #54}

## 6.1 COMPANY PREPARATION

For successful implementation company applying new software needs to ensure its smooth running by background preparation. This involves setting up goals and timeline for implementing dashboard.

Selection of software for dashboard is another crucial step as software needs to meet the companies constrains and needed functionality. This includes evaluating software's functionality and features, future scalability and most importantly connectivity to current systems and integration options. Based on information in chapters 7.3 and 9.5 I recommend choosing Microsoft Power BI as a software with good scalability for advanced data application in future and convenient connection to other Microsoft software's already readily in use nowadays.

Further company needs to assess its business and data needs. My proposed dashboard targets 3 sections of interest for logistic companies but leaves room for customization to support concrete strategic goals.

1) Evaluate and Set-up company goals, aims and targets
2) Select software and assess computability with existing systems
3) Customize KPI based on company specific needs

## 6.2 DASHBOARD PREPARATION

After software selection, next step is preparing companies infrastructure for dashboard implementation. This includes downloading and setting up software account. Connecting software with existing systems and ensuring data integration and database connection for dashboard. Properly connected and integrated software's will ensure smooth running later and prevent reported connectivity problems later appearing. This includes access to various Excel sheets databases, systems used by 2PL as ERP or Warehouse management systems to ensure proper channels from the start to prevent future problems.

Integrating software's properly from beginning will provide real time insights and setting up structure system will create structured data repository and management when in use preventing data lagging or crashing.

1) Download and Instal chosen software
2) Establish connection between all relevant business systems
3) Recommended to set up OTM systems for data structure
4) Set up and configure data integration for effective retrieval and data quality
5) Ensure synchronisation and real time data
6) Set up dashboard

## 6.3 SET - UP

Important step of implementing new system is personal training. Conducting an employee training and explaining dashboard interface, capabilities, how to interpret data and utilize this knowledge. Furthermore, access level of employees and user accounts needs to be evaluated by company if and how it is necessary to prevent information leak.

1) Define access levels and set up user accounts
2) Conduct workshops for users, provide material about dashboard, application and interface
3) Provide technical support, especially during start up and implementation

## 6.4 TESTING

Meticulous testing is necessary before dashboard starts to go live to prevent any unforeseen problems. This includes thorough functionality testing that dashboard operates as intended, data is accurate and stored properly. Further checking if data delivers the results intended and interface responds properly. This is a critical thing to prevent and catch any bugs in the system before going live.

Further performance needs to be tested to ensure connected systems perform well under different conditions. This involves simulating large data volumes and user interactions before slowing or crashing to identify possible weak spots.

Lastly users need to test dashboard interface to confirm it meets company needs and expectations. This tests dashboards ease of use and confirm if dashboard contains all data needed for daily performance.

1) Test dashboard features individually
2) Test data for accuracy
3) Simulate system stability
4) Test interface responsivity
5) Collect and implement feedback on usability and functionality

# 7 DASHBOARD EVALUATION

Evaluating effectiveness of a dashboard within transport company is necessary to ensure it meets its operational needs and helpfulness to users. This chapter details the use of Design Science Research (DSR) framework detailed in chapter 7.5 to assess the dashboard performance in case study evaluation by questionnaire in 2PL company. After detailing the steps of DSR as sections of questionnaire and its results are discussed.

## 7.1 DESIGN SCIENCE RESEARCH METHODOLOGY AND EVALUATION SECTIONS

Design Science Research (explained in chapter 7.5.2.) is a framework that deals with creation of innovative artifacts and evaluating their impact. DSR applied to my research into improving data usage by adaptation of dashboard splits evaluation of dashboard into several sections.

### 7.1.1 PROBLEM IDENTIFICATION AND CONFIRMATION

In DSR methodology initial step is to confirm the existence and significance of problem occurring. By assuring this is indeed occurring problem shows that this research is grounded in reality. As this study is focused on current data and visualization in logistic companies it is crucial to verify that observed issues are occurring and impactful before validating the proposed solution.

So as first step to validate my research in case study is to validate and assess current data practices and data visualisation in company. This assessment to identify observed problems in company will confirm the significance of data problems and therefore relevance and applicability of this research.

### 7.1.2 PROBLEM DEPTH

After confirming the existence of problem, next step is to evaluate the depth and impact of the problem. This includes evaluating impact of observed data issues and understanding the challenges in working with said data. This involves input from several departments' employees working in logistics about their experience with working and data practices and their impact on daily work. Further identifying correlation between data practices and impacts on data performance if there is clear correlation between data issues and tangible problems.

### 7.1.3 PROPOSED SOLUTION

As third step of DSR methodology includes evaluating the proposed solution. This focuses on assessing how proposed dashboard will address identified issues. This evaluation addresses design and impact on addressed clarity, simplicity and influence on problem. Further evaluating ease of use and simplicity of instructions and interactivity and track how data is now moving within systems.

This section of should indicate expected outcome of improved data quality and integration. Furthermore, there is expected reported potential in effectives, efficiency and productivity regarding data usage.

### 7.1.4 EFFECTIVENESS OF PROPOSED SOLUTION

As 4th and last step of DSR is to validate the efficiency of implementing the proposed dashboard. This includes feedback from indented users via questionnaire and addressing their observations. Then analysing potential for improved decision making and overall impact. Receiving positive response to those 4 topics showcases that proposed dashboard not only addresses the problem of data visualisation but offers a measurable improvement. This final validation showcases the success gain if dashboard is implemented.

## 7.2 QUESTIONNAIRE SET UP AND QUESTIONS

Questionnaire for case study follows above described DSR methodology to section question. This questionnaire closely follows the DSR starting with section 1 confirming problems with assessing data and data usage. Following 2nd section which questions the importance of data corresponding to evaluating depth of the problem. 3rd section while not corresponding to DSR evaluates employees' insights on what they want when working with data. As 4th section dashboard is evaluated on proposed KPI and benefits of implementation. And lastly in 5th section dashboard design, friendliness of use and impact is evaluated as last step of DSR.

Questionnaire is based mainly on closed answer questions for quicker analysis. This includes yes/no questions or weighted scaled questions. Further open-ended questions are used to collect feedback or opinions of respondents about topics. This questionnaire further collects no private information's alleviating concerns of privacy issues.

## 7.3 QUESTIONAIRE RESULTS

The case study involved two respondents: one from a medium-sized 2PL logistics company and a logistics consultant who works with multiple companies.

Regarding the data in logistics and confirmation of existing challenges in logistics both respondents confirmed that current logistics operations involve a large volume of data generated and utilized within company systems. While they agreed on the significant amount of data available, their experiences with data-sharing methods differed. The logistics company reported minimal data exchanged through emails or phone calls, reflecting a positive shift from a 2019 EvoFenedex study. In contrast, the consultant still encountered substantial data sharing via these channels. Opinions also varied on the ease of locating data, but both highlighted a high volume of duplicate data within systems.

Exploring the depth of problem with logistics data both respondents confirmed they are frequently using various BI tools monitoring tools. Both confirmed that there is enough data available for daily operations, but they recognized areas for improvement. The logistics company strongly supported the idea of standardizing data presentation or enhancing visualization methods. Meanwhile, the consultant's response was more cautious, suggesting that the benefits would depend on the specific visualization and company requirements. A shared observation was the need to improve employees' soft skills and create a more logical structure for data handling. Showing that even recorded 21% of companies using BI still experience troubles with data.

Evaluating the Dashboard and Key performance indicators were generally well – received. The logistics company found the dashboard helpful and easy to understand, affirming that it improved data comprehension across departments. On the other hand, the consultant offered a more critical view, noting that while the metrics were not necessarily harmful, they were not directly beneficial to his work. Nevertheless, both agreed that a standardized dashboard would enhance inter-departmental understanding of data.

Lastly in final section both respondents agreed that the dashboard was easier to navigate and aided in data interpretation, meeting one of the primary objectives. They suggested that the layout and colour scheme could be adjusted based on company preferences to further optimize usability.

## 7.4 DASHBOARD EVALUATION

Following the finding in chapter 4.4 about current transport situations regarding the data main objectives for the dashboard development were prioritizing main transport activities, ease of navigation and understanding dashboard while addressing connectivity and finances related problems.

Feedback from respondents to my survey indicates that dashboard shows promising potential and meets the main objectives. As both respondents indicated the dashboard as helpful or potentially helpful for understating data. As the consultant pointed out in questionnaire proposed dashboard is neither helpful nor unhelpful in his

line of work. However, a transport company was more intrigued and liked the proposed dashboard stating that more visuals for data as helpful in navigating and understanding. Also highlighting the agreed upon need for more standardized dashboard and standardized data metrics. Showing more standardized measurements across company as step o solve data issues within company even if some customization might be necessary to address company specific needs.

Addressing the challenges of connectivity and finance using specific BI software can solve or mitigate those points. For this dashboard prototype Microsoft Power BI was used, and I recommend as tool to utilize for its connectivity and integration with existing Microsoft products, many programs. Further highlighting that even Micro or Small companies are capable of utilising free version of Power BI to achieve results alleviating their financial concern.

Potential for improvement was pointed out in adjusting the layout and colour scheme which fall under company possible adjustments. Those modifications have potential to further improve employee's navigation of dashboard while retaining dashboard original capabilities.

Overall, my conclusion is that dashboard meets its main objectives of being user friendly, data navigation and connectivity while addressing financial concerns of SMEs and showing room for further personalisation and refinement for personalised enhancement.

## 7.5 EVALUATION CONCLUSION

The primary goal and research question of this study "How to improve data usage in transport logistics in SMEs in the Netherlands?" is addressed as series of knowledge questions to analyse the observed problem of data usage propose solution and uses set of three variables to measure and reflect the state of current data management.

Those three variables as introduced in Chapter 2.4.1. are Number of Systems in Use, Number of Dashboards or KPI monitoring tools available and perceived data usage. To assess the first two variables analysis of data from *Nationaal Onderzoek Data en Digitalisering in de Logistiek* (EvoFenedex 2021) was concluded as part of this study – Chapter 4.3. Perceived data usage was answered in case study questionnaire.

Starting with second variable - Number of dashboards/ KPI monitoring available analysis shown in Table 6 shows how often and which systems are used in companies. This shows that only 21% of companies use dedicated system for data analytics/visualisation/monitoring. Further main system in use is Excel which has potential for data analysis but lacks efficiency.

Moreover, as shown in Table 7 – Variable Number of systems in use is on average 3 and there is expected relationship between size of company and number of systems. The larger the company the more systems with Micro companies using 1 and large companies 5 systems on average.

Variable Perceived data usage measures how people in logistics companies experience working with data. The questionnaire results shows that there is large amount of data in daily work and even with BI available for tasks.

Combining the findings about state of variables I can conclude standardized dashboard based on OTM data format shows a promise as solution to consolidate and present data in more visual and interpretable format how to streamline data accessibility and usage.

# 8 CONCLUSION AND FUTURE POSSIBILITIES

This thesis addresses the observed problem of low data usage in Dutch transport logistics for small and medium sized enterprises (SMEs). Through structured approach, this research observes and analyses data of current situation and proposes solution aimed to increase data usability and accessibility.

## RESEARCH QUESTIONS

This thesis documents and addresses the challenge of low data usage within transport logistics in Netherlands focusing more on SMEs. The main research question "How to improve data usage in transport logistics in SMEs in the Netherlands?" seeks to identify and propose practical way to improve accessibility and usability of data.

This study was prompted by findings from 2019 digitalization study showing problems with data however analysis of 2021 survey data reveals gap between investment in digital tools and actual data management. Specifically, the 2021 EvoFenedex survey data shows that while 45% of companies believe they invest enough in digitalization only 21% uses software for monitoring, visualisation or reporting.

To evaluate the situation three variables were introduced to assess current data practices and show areas for improvement:

### NUMBER OF SYSTEM IN USE

This variable was used to quantify the data system in use by SMEs and results shows companies reliance on basic non-specialized tools as Excel or ERP in their operations over specialised logistics platforms. Analysis from EvoFenedex 2021 data in section 4.3 – Table 7 demonstrates fragmented data environment.

### NUMBER OF DASHBOARDS/KPI MONITORING TOOLS AVAILABLE

This metric tracks the extent of dashboard or other KPI monitoring tools in logistics performance tracking. Highlighting the fact that only 21% of companies use dedicated BI tools (Section 4.3 – Table 6) suggesting a gap between available resources and their application in day-to-day operations. Lack of BI limits the effective visualisation contributing to lack of usage in accessible data.

### PERCEIVED DATA USAGE

This variable captures perception of data within organization. Feedback from case study indicates that even respondents belonging to the 21% of companies using data monitoring tools perceive and use large quantity of data in their work. Survey findings confirm still present challenges in accessing and using data even with BI available.

Throughout these variables, this study not only highlights specific data challenges but also validates the potential of an OTM based dashboard solution. Reaffirming the need for easily accessible BI solutions and potential for standardised data monitoring via visualisation for data enhancement in transport logistics.

## CONTRIBUTION TO THEORY AND PRACTICE

This research was built on prior studies of suitability of Open Trip Model – OTM for data mining and analytics'. OTM is a light weigh data sharing model for transport logistics. OTM is predominantly used by large companies despite being license free program. This study confirms that the OTM model is also suited for data visualisation applications – particularly in form of dashboard. This allows to combine OTM's capability to solve or mitigate large volumes of data being shared in wrong format with data visualisation software to streamline the data.

Adopting data visualisation technique as standardized dashboard for transport logistics allows easy access to key performance indicators (KPIs) and therefore improve and ease decision making.

This showcases that SMEs adopting OTM can benefit from standardized metrics and data visualisation approach.

## LIMITATIONS

This research followed a structured Managerial Problem-Solving Method allowing for clear and systematic approach of defying and measuring variables. Research shows promising results in improving data usability in logistics but is limited by small sample size. While main findings were based on analysis of raw survey data with larger sample size (n=206) case study sample constrains generalization of results. Larger case study sample from target group could provide more comprehensive understanding. Furthermore, the scope and limitation of dashboard prototype due to data sample and time constrains needs to be considered in findings. Additionally, because dashboard solution is a prototype it may require further refinement based on logistics companies demands and further and broader testing should be considered to evaluate this on larger scale.

## RECOMENDATIONS FOR PRACTICE

To address the data usage within logistics, it is recommended for SMEs to adopt a standardized OTM based dashboard for data visualisation and easier decision making. Focusing on visualisation of available data helps employees better interpret information, see patterns and trends in data and therefore achieve better informed decisions. KPIs identified and used in prototype dashboard provide good starting point for SMEs not used to working with their data but further focus on possible refinement of those metrics. Along with implementation of dashboard and BI training with those software's is recommended. Dashboard prototype focused on user - friendly interface but basic training in use of dashboard will allow for easier implementation. Additionally, company specific authorisation needs to be addressed if relevant to company situation. Lastly reviewing the situation company data is recommend ensuring good fit and responds to shifts in logistics operations over time.

## FUTURE RESEARCH AND DEVELOPMENT

I recommend furthering this research with larger sample and refine the dashboard to better suit companies. Broader data range than sample data will further increase its utility and show possibilities to apply in similar fields. Closer collaboration within logistics industry partners to incorporate feedback and align closer tailoring of KPIs for individual transport companies is another possibility. Specifically, to increase dashboard capabilities by improving and tailoring search function within dashboard closer to companies needs.

Furthermore, there is possibility of scalability of application of dashboard and BI tools out of logistics into various other sectors. Tailoring the dashboard for specific field to help improve data visibility in fields like manufacturing or healthcare by providing clear visual representation of data into actionable information's for users.

# 9 REFERENCES


Amazon. What is blockchain? Blockchain technology explained. Retrieved from https://aws.amazon.com/what-is/blockchain/

Arunachalam, D., Kumar, N., & Kawalek, J. P. (2018). Understanding big data analytics capabilities in supply chain management: Unravelling the issues, challenges and implications for practice. *Transportation Research Part E: Logistics and Transportation Review, 114*, 416-436. doi:https://doi.org/10.1016/j.tre.2017.04.001

Balci, G., & Surucu-Balci, E. (2021). Blockchain adoption in the maritime supply chain: Examining barriers and salient stakeholders in containerized international trade. *Transportation Research Part E: Logistics and Transportation Review, 156*, 102539. doi:https://doi.org/10.1016/j.tre.2021.102539

Beek, D. v. (19 November 2024). Select the right BI tool in 7 steps. Retrieved from https://www.passionned.com/bi/tools/choosing-and-selecting-bi-tools/

Bureau, L. Understanding internal stakeholders in logistics companies. . Retrieved from https://www.logisticsbureau.com/understanding-internal-stakeholders-in-logistics-companies/

Definition Logistics. (2021). Retrieved from https://www.lexico.com/definition/logistics

Elfriede Krauth, H. M., Viara Popova, Martijn Schut. (2005). *PERFORMANCE MEASUREMENT AND CONTROL IN LOGISTICS SERVICE PROVIDING*. Paper presented at the Seventh International Conference on Enterprise Information Systems - Volume 2.

Experience Online. (2022). Retrieved from https://www.portofrotterdam.com/en/experience-online

Haije, E. G. (2022, 6 April 2022). Top 15 Business Intelligence Tools in 2024: An Overview. Retrieved from https://mopinion.com/business-intelligence-bi-tools-overview/

Heerkens, W. (2017). *Managerial Problem Solving Method*

How can you select a BI tool that balances advanced features with ease of use? (26 October 2023). Retrieved from https://www.linkedin.com/advice/0/how-can-you-select-bi-tool-balances-advanced-5y3yf

How To Choose A Business Intelligence (BI) Platform. (2023). Retrieved from https://www.tableau.com/business-intelligence/how-to-choose-bi-platform

Iankoulova, I. (2012). *Business intelligence for horizontal cooperation: measuring the performance of a transportation network sharing cooperation between logistics companies.* (Master). University of Twente, Retrieved from https://purl.utwente.nl/essays/61588 (61588)

Kabanov, A., Azarov, V. N., & Mayboroda, V. P. (2019). An Analysis of the Use and Difficulties in Introducing Information Technology and Information Systems in Transport and the Transport Infrastructure. *2019 International Conference "Quality Management, Transport and Information Security, Information Technologies" (IT&QM&IS)*, 192-196.

Kaur, R., Roy, S., Roy, M., & Lowe, H. (2023, 12 November 2024). Best Business Intelligence Tools Of 2023.

Kenton, W. (2020). How Logistics Work. *Investopedia.* Retrieved from https://www.investopedia.com/terms/l/logistics.asp

Klark, D. (2021). Europe: number of SMEs Retrieved from https://www.statista.com/statistics/878412/number-of-smes-in-europe-by-size/

Lobo, K. (29 July 2024). A comprehensive BI tool comparison for the best fit. Retrieved from https://www.analytics8.com/blog/bi-tool-comparison-choosing-the-best-analytics-tool-for-business/

Marchand, K. Top 7 things to consider when choosing a BI Tool. Retrieved from https://www.dundas.com/resources/blogs/introduction-to-business-intelligence/top-7-things-to-consider-when-choosing-a-bi-tool

Model, O. T. (2022a). Overview of Open Trip Model V5 Retrieved from https://otm5developerportal.redoc.ly/developer-portal/otm_overview/

Model, O. T. (2022b). page About. Retrieved from https://www.opentripmodel.org/page/about

Model, O. T. (2022c). Page Documents. Retrieved from https://www.opentripmodel.org/docs

Model, O. T. (2022d). Page Home. Retrieved from https://www.opentripmodel.org/

Model, O. T. (2023). OTM v5 documentation Retrieved from https://otm5.opentripmodel.org/

Nationaal onderzoek Data en digitalisering in de logistiek (2019). *2021*(5 Novemeber 2021). Retrieved from https://www.evofenedex.nl/kennis/supply-chain-management/data-en-digitalisering/nationaal-onderzoek-data-en-digitalisering-de-logistiek-2019

*Nationaal onderzoek Data en digitalisering in de logistiek 2019*. (2019). Retrieved from https://www.evofenedex.nl/kennis/supply-chain-management/data-en-digitalisering/nationaal-onderzoek-data-en-digitalisering-de-logistiek-2019

*Nationaal onderzoek Data en digitalisering in de logistiek 2021*. (2021). [Excel Survey Raw Data].

O'Byrne, R. (Jan 24, 2024). Logistics KPI Tips – Key Performance Indicators. Retrieved from https://www.logisticsbureau.com/logistics-kpi-tips-key-performance-indicators/

O'Byrne, R. (May 3 2022). Supply Chain Key Performance Indicators: Tips to Get them Right. Retrieved from https://www.logisticsbureau.com/kpi-key-performance-indicator/

Olson, D. (2013). Stakeholder Onion Diagram. Retrieved from http://www.bawiki.com/wiki/Stakeholder-Onion-Diagram.html

Open Trip Model. (2020). Retrieved from https://www.opentripmodel.org/

Orts, D. (2007). Dashboard Design and Implementation A Step-by-Step Guide.

*KMWorld*. Retrieved from https://www.kmworld.com/Articles/ReadArticle.aspx?ArticleID=18852

Palomero, S., & Chalmeta, R. (2014). A guide for supply chain integration in SMEs. *Production Planning & Control, 25*(5), 372-400. doi:10.1080/09537287.2012.698422

Pedamkar, P. (2023, 6 March 2023). Tableau vs Power BI vs QlikView. Retrieved from https://www.educba.com/tableau-vs-power-bi-vs-qlikview/

Piest, J. P. S., Cutinha, J., Bemthuis, R., & Bukhsh, F. (2021). *Evaluating the Use of the Open Trip Model for Process Mining: An Informal Conceptual Mapping Study in Logistics*.

Power BI - Data Visualization - Microsoft Power Platform. (2023). Retrieved from https://www.microsoft.com/en-us/power-platform/products/power-bi

Rey, A., Panetti, E., Maglio, R., & Ferretti, M. (2021). Determinants in adopting the Internet of Things in the transport and logistics industry. *Journal of Business Research, 131*, 584-590. doi:https://doi.org/10.1016/j.jbusres.2020.12.049

Sense, Q. (2023). QLIK Sense | Modern Analytics. Retrieved from https://www.qlik.com/us/products/qlik-sense

Shingade, S., Rastogi, S., & Panse, C. (2022, 25-29 April 2022). *Shareholders' Activism in India: Understanding characteristics of companies targeted by activist shareholders using discriminant analysis.* Paper presented at the 2022 IEEE Technology and Engineering Management Conference (TEMSCON EUROPE).

Simcan. Home page. Retrieved from https://www.simacan.com/nl

Sisense. (2023, 25 September 2024). Intelligent Data Analytics Software - SISENSE. Retrieved from https://www.sisense.com/

Staff, C. (2023, Oct 28, 2024). 6 Business intelligence tools you need to know. Retrieved from https://www.coursera.org/articles/bi-tools

Strauss, L. (2023, August 5, 2024). The best business intelligence (BI) software in 2023. Retrieved from https://zapier.com/blog/business-intelligence-software/

SUTC. Retrieved from https://www.sutc.nl/en_US

Tableau. (2023). What is Tableau.

Team, M. T. C. Stakeholder Analysis. Retrieved from https://www.mindtools.com/aol0rms/stakeholder-analysis

Topolšek, D., Čižiūnienė, K., & Cvahte Ojsteršek, T. . (2018). Defining transport logistics: a literature review and practitioner opinion based approach. . *Transport, 33*, 1196-1203. doi:https://doi.org/10.3846/transport.2018.6965

van der Werf, D. (2021). *Information Technology and Data Use in 1PL - 4PL Logistic Companies.* University of Twente, Retrieved from http://essay.utwente.nl/86836/

Nationaal onderzoek data en digitalisering in de logistiek (2019), Evofenedex, TLN, Beurtvaartadres, Available online. URL https://files.m13.mailplus.nl/user2110537/28822/Rapport_data_en_digitalisering_2019.pdf

# APPENDIX A – DASHBOARD DOCUMENTATION

The dashboard was developed as a foundational tool for implementing business intelligence (BI) within the logistics sector. Its primary goal is to visualize data effectively, enabling improved data usage and more informed decision-making. The design focuses on core transport activities, targeting fleet departments, operations teams, and management as its primary users. Recognizing the current state of digitalization in the industry, the dashboard was built to prioritize an intuitive and user-friendly interface.

To create the dashboard, Microsoft Power BI was chosen due to its robust capabilities for data visualization and analysis. The prototype dataset was derived from a logistics company, structured according to the OTM data-sharing model, and contained multiple Excel sheets.

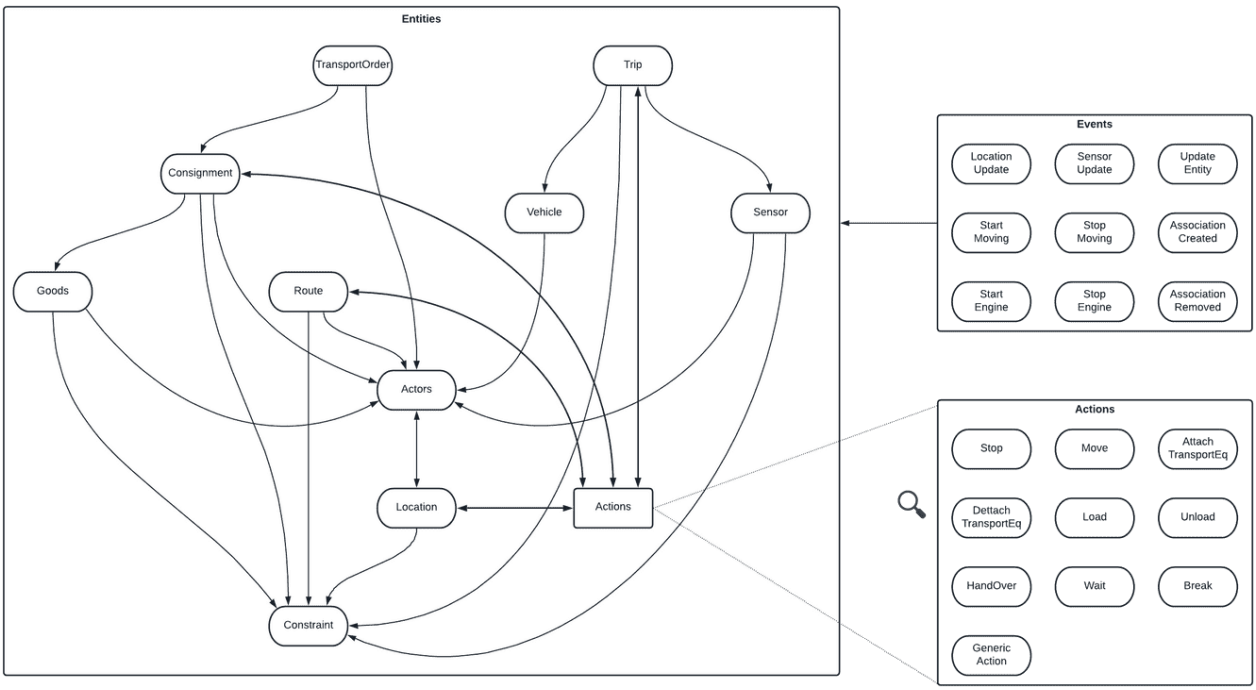



**Figure 20 OTM - Official Visualisation of Entities (Model, 2022a)**

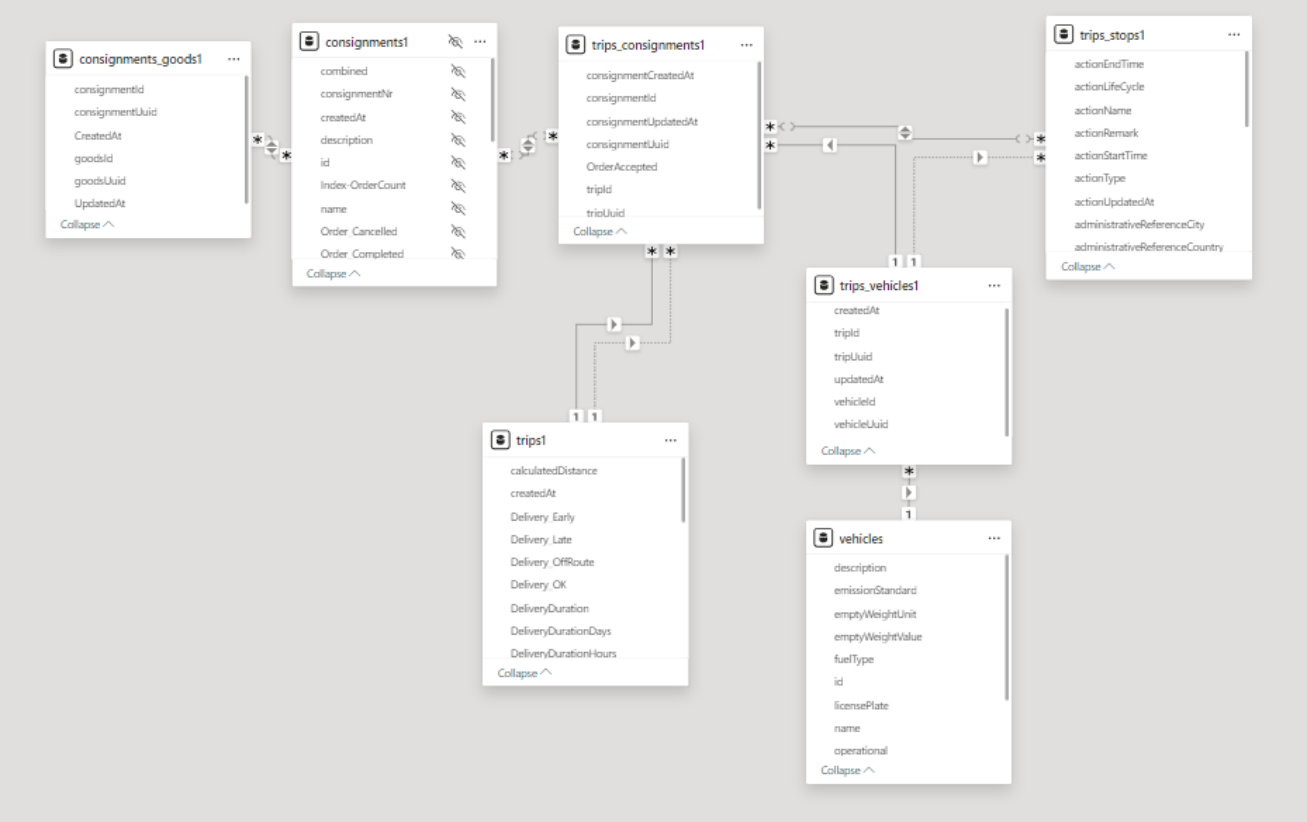



**Figure 21 Dashboard Database Set-up based on OTM**

Data preparation involved the following adjustments:

- Sorting and organizing data using Power BI's built-in features.
- Adjusting column types to ensure data compatibility.
- Splitting columns by delimiters (e.g., separating date and time into individual fields).
- Duplicating columns and filtering/replacing values to create binary-valued fields for actions, replacing text string data formats.
- Adding conditional columns to convert string-based data into binary/numerical formats or statistical summaries.

This relational model allows seamless integration of data, supporting dynamic filtering and detailed insights. Additionally, all transformations and adjustments made during the development process are transparently recorded within Power BI, ensuring traceability.

The KPIs outlined in Section 5.4 of the thesis were calculated using the prepared data, and recommended visuals were applied where feasible. While the current setup supports intuitive filtering and basic functionality, additional refinements are required to optimize its usability. The prototype does not yet include real-time data integration, as the dataset provided was static and historical.

The dashboard highlights several key features, including its intuitive design and ability to filter and adjust values dynamically. Despite some limitations, such as the absence of real-time data and incomplete data for certain metrics, it provides a solid foundation for further development. Future improvements could focus on refining filters, expanding the dataset, and integrating real-time data feeds to enhance its utility and relevance.

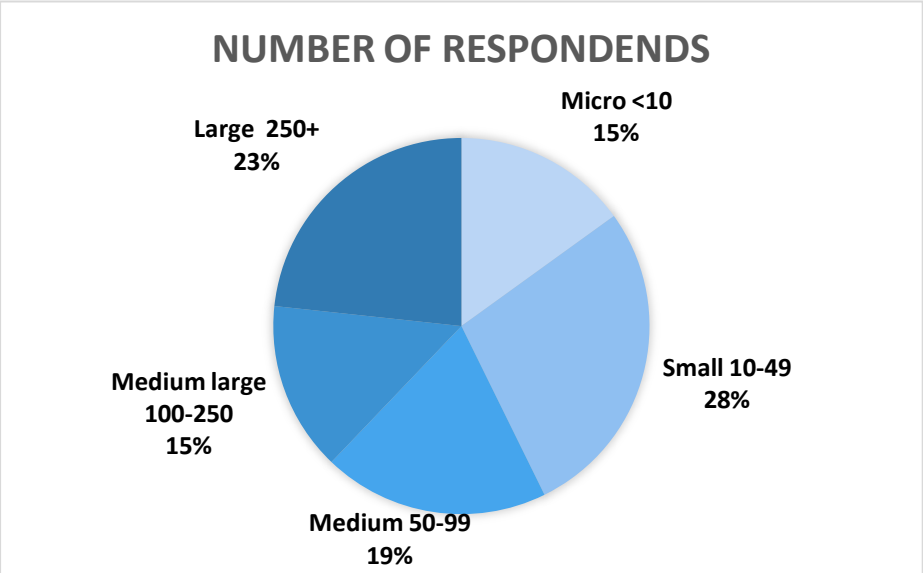
## APPENDIX B – INDUSTRY FINDINGS RESULTS AND FIGURES

To evaluate the current state of digital adoption, EvoFenedex conducted a comprehensive digitalization survey in 2021. This appendix presents the analysis of the raw survey data to actionable insights and assess the industry's readiness to embrace digital transformation.

This included organizing and structuring the raw survey responses using Microsoft Excel. Further analysing the data using pivot tables and filtering before using diagrams to transform data into easier to interpret formats. Subsequently, graphs and visualizations were employed to highlight patterns and trends, ensuring clarity and relevance in addressing the survey's focal questions.

Focusing on questions concerning investment in digitalization's, systems use and similia across different company sizes. Those findings contribute to higher understanding on digitalization within logistics industry.

### COMPANY SIZE ANALYSIS:

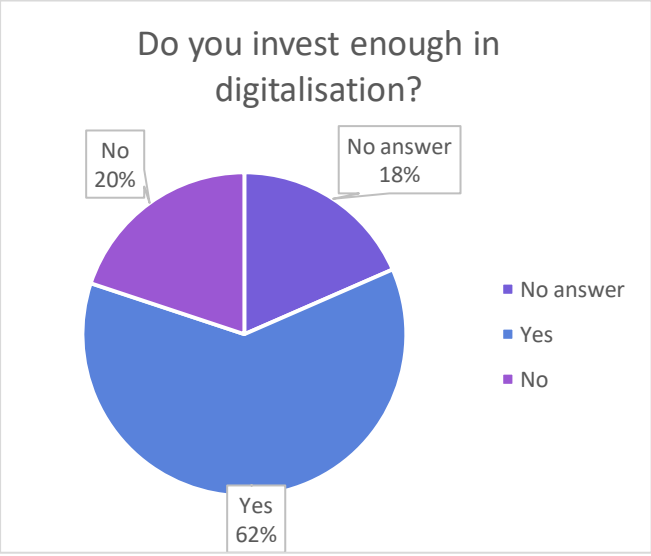


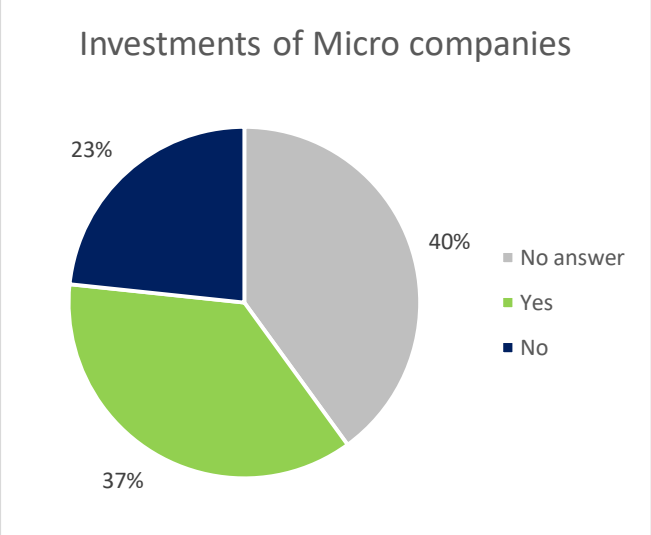

### Q29 YES/NO QUESTION – "DO YOU INVEST ENOUGH IN DIGITALIZATION?"

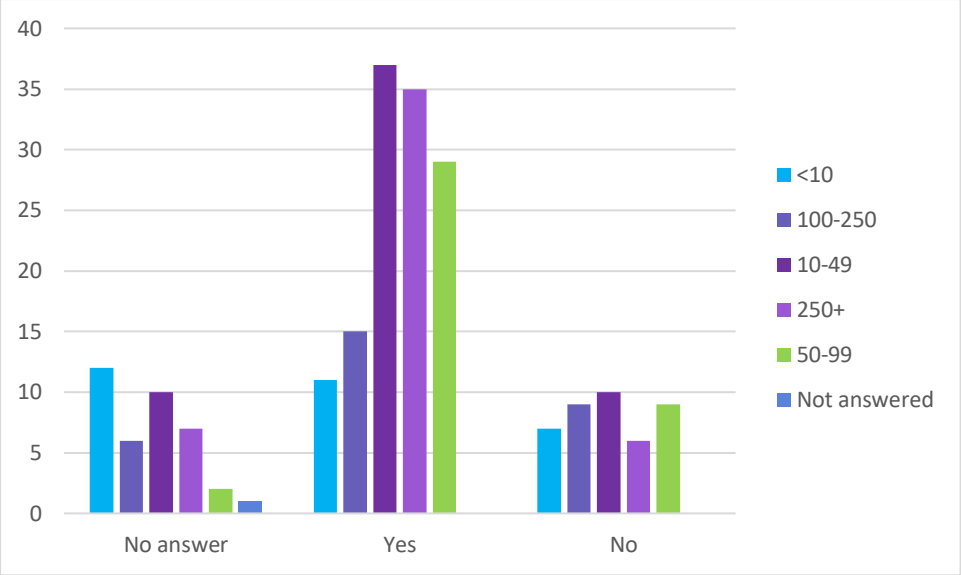
This question explores whether companies believe they are investing enough in digitalization, providing insights into their self-assessed commitment to adopting digital tools and practices.

| Investing Enough? | Nr of responses |
|---|---|
| No answer | 38 |
| Yes | 127 |
| No | 41 |
| **Grand Total** | **206** |

| | Company size | | | | | | |
|---|---|---|---|---|---|---|---|
| **Investment in Digitalisation** | **<10** | **100-250** | **10-49** | **250+** | **50-99** | **Not answered** | **Total** |
| No answer | 12 | 6 | 10 | 7 | 2 | 1 | 38 |
| Yes | 11 | 15 | 37 | 35 | 29 | | 127 |
| No | 7 | 9 | 10 | 6 | 9 | | 41 |
| **Grand Total** | **30** | **30** | **57** | **48** | **40** | **1** | **206** |



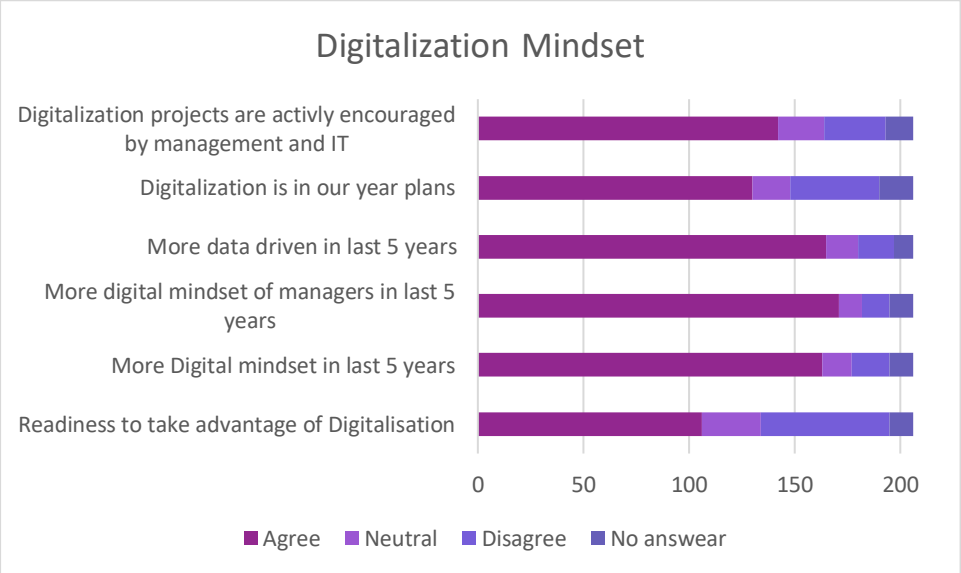






## Q28 AGREEMENT WITH STATEMENTS – DIGITALIZATION

Analyses company attitudes toward digitalization, including readiness, management support, and integration into strategic plans, highlighting the industry's overall mindset and progress.

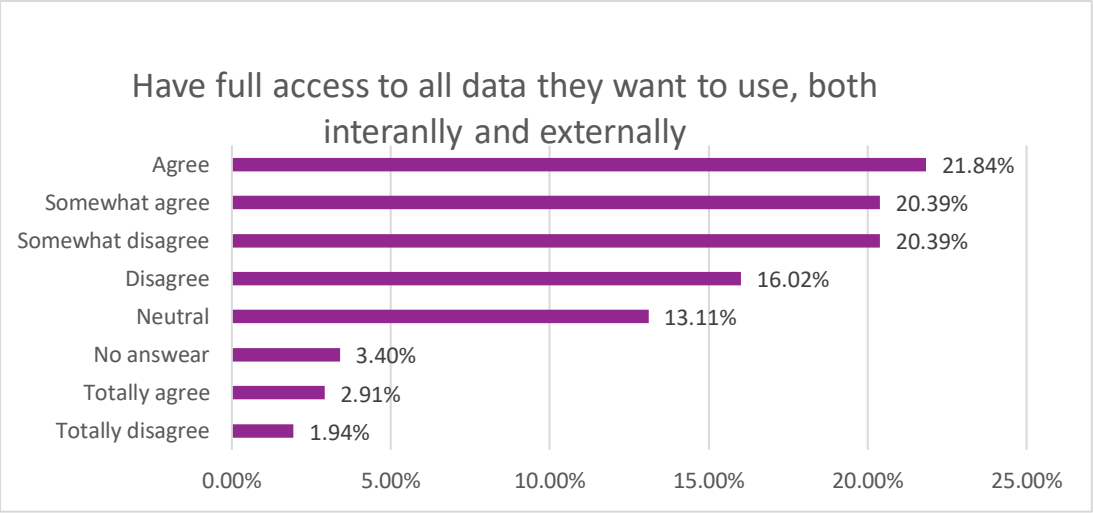
| ALL COMPANIES | Readiness to take advantage of Digitalisation | More Digital mindset in last 5 years | More digital mindset of managers in last 5 years | More data driven in last 5 years | Digitalization is in our year plans | Digitalization projects are actively encouraged by management and IT |
|---|---|---|---|---|---|---|
| Agree | 106 | 163 | 171 | 165 | 130 | 142 |
| Neutral | 28 | 14 | 11 | 15 | 18 | 22 |
| Disagree | 61 | 18 | 13 | 17 | 42 | 29 |
| No answer | 11 | 11 | 11 | 9 | 16 | 13 |



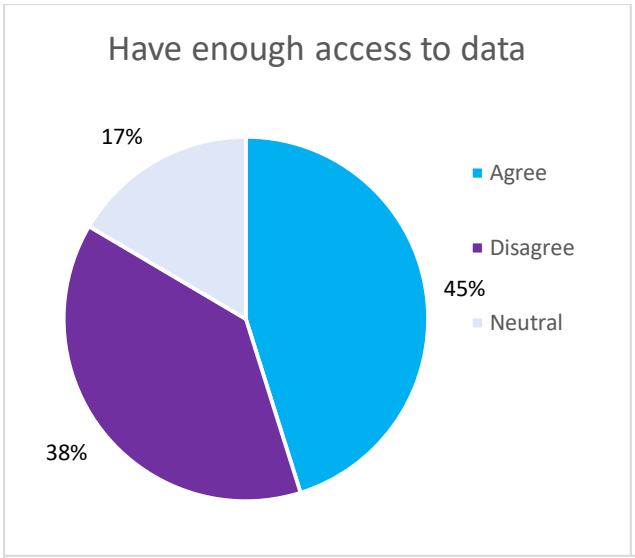
## Q15 – AGREEMENT WITH STATEMENT "WE HAVE FULL ACCESS TO ALL DATA WE WOULD LIKE TO USE, BOTH INTERNALLY AND EXTERNALLY."

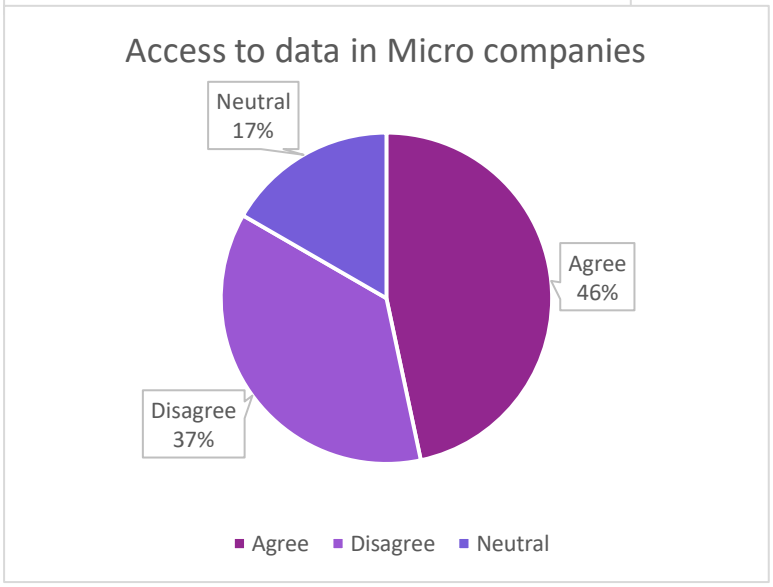
Investigates the extent to which companies have full access to internal and external data, uncovering potential barriers to informed decision-making.

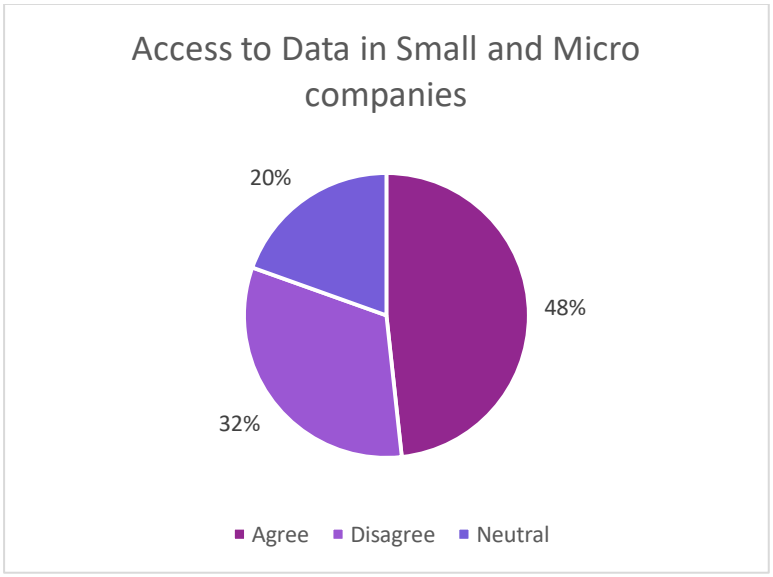
| Row Labels | Count of Agreement |
|---|---|
| Somwhat agree | 42 |
| No answer | 7 |
| Mee oneens | 33 |
| Neutral | 27 |
| Volledig mee eens | 6 |
| Agree | 45 |
| Volledig mee oneens | 4 |
| Dis | 42 |
| **Grand Total** | **206** |




| | |
|---|---|
| **Agree** | **93** |
| **Disagree** | 79 |
| **Neutral** | 34 |
| **Total** | 206 |


Have enough access to data
17%
45%
38%
Agree
Disagree
Neutral


Access to data in Micro companies
Neutral 17%
Agree 46%
Disagree 37%
Agree
Disagree
Neutral


Access to Data in Small and Micro companies
20%
48%
32%
Agree
Disagree
Neutral

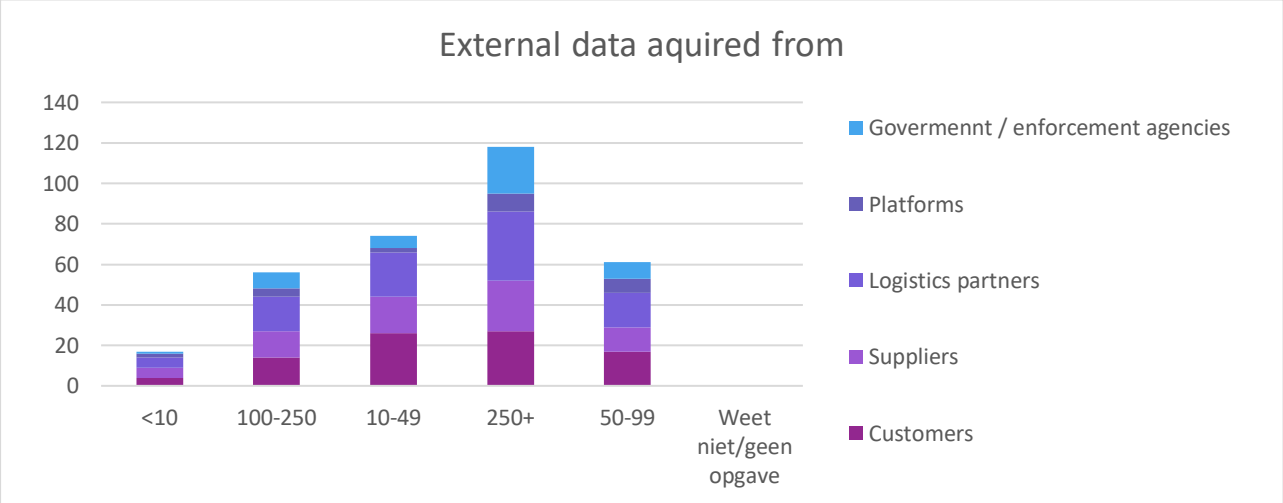
## Q23 MULTIPLE SELECTION QUESTION – EXTERNAL DATA

Identifies which external data sources (e.g., customers, suppliers, or platforms) companies use most frequently, offering a perspective on the breadth of their external collaborations.

| Company size | Customers | Suppliers | Logistics partners | Platforms | Government /enforcement agencies | Together |
|---|---|---|---|---|---|---|
| **<10** | 4 | 5 | 5 | 2 | 1 | 17 |
| **100-250** | 14 | 13 | 17 | 4 | 8 | 56 |
| **10-49** | 26 | 18 | 22 | 2 | 6 | 74 |
| **250+** | 27 | 25 | 34 | 9 | 23 | 118 |
| **50-99** | 17 | 12 | 17 | 7 | 8 | 61 |
| **Grand Total** | **88** | **73** | **95** | **24** | **46** | 326 |

| | Responded | Respondents | Percentage |
|---|---|---|---|
| **Customers** | **88** | **206** | **43%** |
| **Suppliers** | **73** | **206** | **35%** |
| **Logistics partners** | **95** | **206** | **46%** |
| **Platforms** | **24** | **206** | **12%** |
| **Government / enforcement agencies** | **46** | **206** | **22%** |

| Company size | Number of employees | Number of respondends | Times accessed external data | Average access per company | Average of accessing external source |
|---|---|---|---|---|---|
| **Micro** | <10 | 31 | 17 | 55% | 3,4 |
| **Small** | 10-49 | 57 | 74 | 130% | 14,8 |
| **Medium** | 50-99 | 40 | 61 | 153% | 12,2 |
| **Medium large** | 100-250 | 30 | 56 | 187% | 11,2 |
| **Large** | 250+ | 48 | 118 | 246% | 23,6 |
| **Together** | | 206 | 326 | 158% | 65,2 |



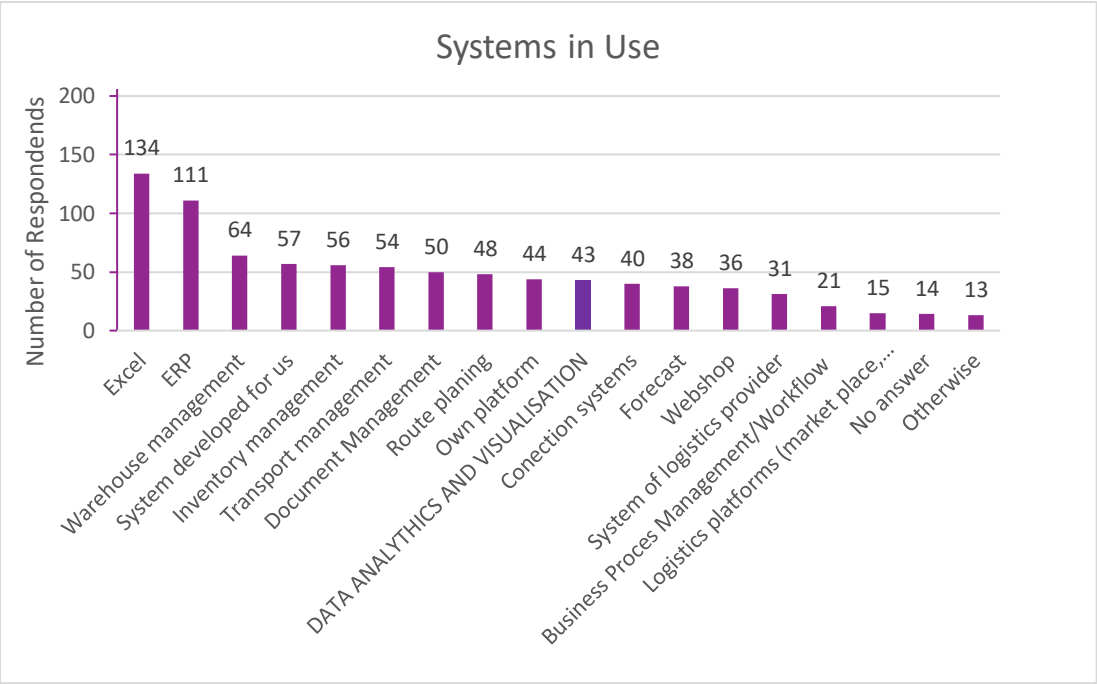

## Q12 MULTIPLE SELECTION QUESTION – SYSTEMS IN USE BY COMPANY

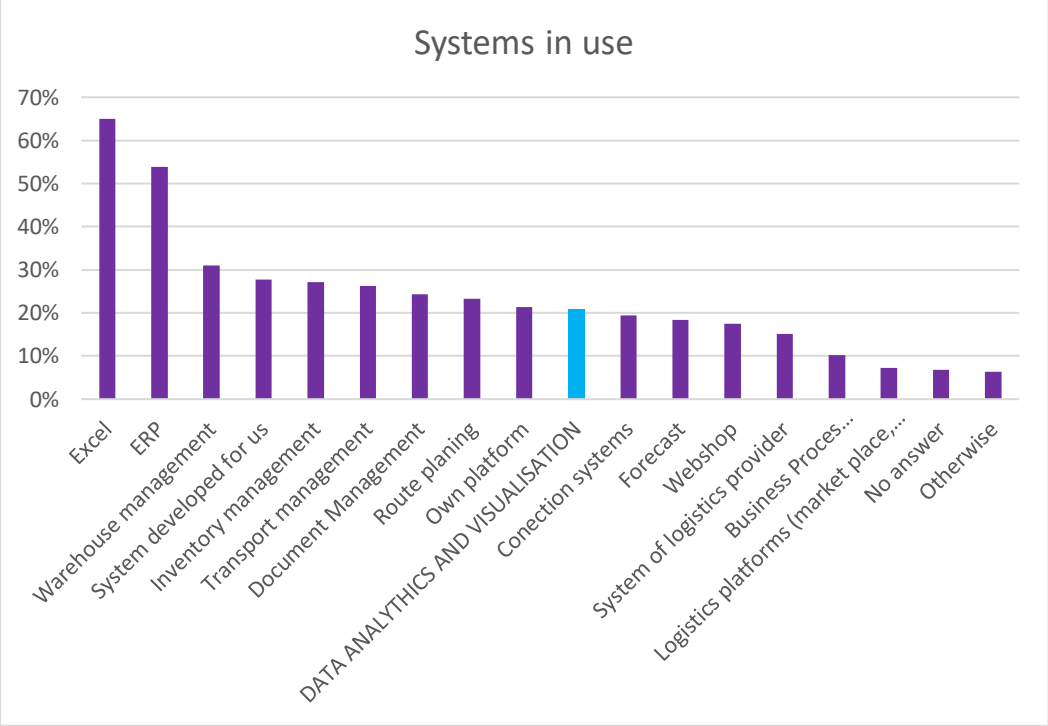
Examines the digital systems currently used within companies, showcasing the prevalence of tools like Excel, ERP, and WMS across the industry.

| Row Labels | Count of Excel | Count of Enterprise Resource Planning (ERP) | Count of Warehouse Management System | Count of System developed for us | Count of Inventory management system | Count of Transport Management System | Count of Document Management System | Count of Route Planning | Count of Own platform (klantportaal, control tower) | Count of DATA ANALYTHICS AND VISUALISATION | Count of System for making custom connections |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <10 | 17 | 2 | 1 | 4 | 5 | 1 | 2 | 3 | 3 | 1 | 2 |
| 100-250 | 19 | 22 | 15 | 10 | 6 | 10 | 9 | 5 | 6 | 7 | 6 |
| 10-49 | 30 | 22 | 8 | 13 | 11 | 9 | 10 | 16 | 5 | 4 | 9 |
| 250+ | 37 | 38 | 28 | 19 | 19 | 23 | 22 | 16 | 21 | 24 | 13 |
| 50-99 | 30 | 26 | 12 | 11 | 14 | 11 | 7 | 8 | 9 | 7 | 10 |
| Weet niet/geen opgave | 1 | 1 | | | 1 | | | | | | |
| **Grand Total** | **134** | **111** | **64** | **57** | **56** | **54** | **50** | **48** | **44** | **43** | **40** |

| Company size | Systems used Total |
|---|---|
| **<10** | 32 |
| **100-250** | 133 |
| **10-49** | 170 |
| **250+** | 237 |
| **50-99** | 164 |

| Total respondents | 206 | Percentage |
|---|---|---|
| Excel | 134 | 65% |
| ERP | 111 | 54% |
| Warehouse management | 64 | 31% |
| System developed for us | 57 | 28% |
| Inventory management | 56 | 27% |
| Transport management | 54 | 26% |
| Document Management | 50 | 24% |
| Route planning | 48 | 23% |
| Own platform | 44 | 21% |
| DATA ANALYTHICS AND VISUALISATION | 43 | 21% |
| Connection systems | 40 | 19% |
| Forecast | 38 | 18% |
| Webshop | 36 | 17% |
| System of logistics provider | 31 | 15% |
| Business Process Management/Workflow | 21 | 10% |
| Logistics platforms (market place, bookings) | 15 | 7% |
| No answer | 14 | 7% |
| Otherwise | 13 | 6% |



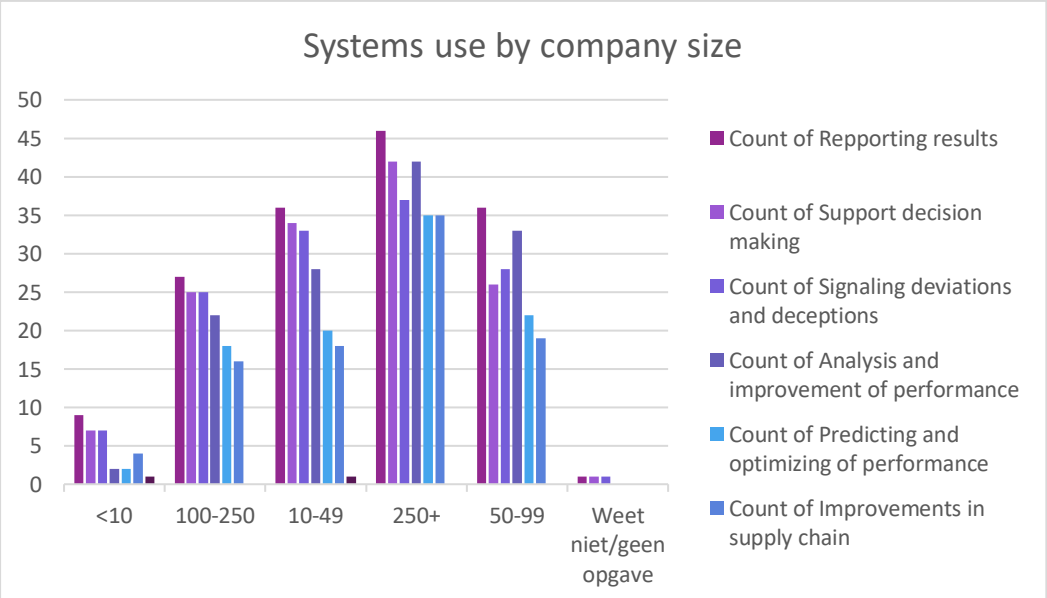

| Company size | Number of employees | Number of respondends | Count of systems in Use |
|---|---|---|---|
| Micro | <10 | 31 | 32 |
| Small | 10-49 | 57 | 170 |
| Medium | 50-99 | 40 | 164 |
| Medium large | 100-250 | 30 | 133 |
| Large | 250+ | 48 | 237 |
| Together | | 206 | |

| Company size | Number of employees | Number of respondends | Count of systems in Use | System per company |
|---|---|---|---|---|
| **Micro** | <10 | 31 | 32 | 1,0 |
| **Small** | 10-49 | 57 | 170 | 3,0 |
| **Medium** | 50-99 | 40 | 164 | 4,1 |
| **Medium large** | 100-250 | 30 | 133 | 4,4 |
| **Large** | 250+ | 48 | 237 | 4,9 |
| **Together** | | 206 | | 0,0 |

## Q17 – MULTIPLE SELECTION QUESTION – SYSTEMS USED FOR IN COMPANIES

Explores how companies use digital systems for tasks like reporting, decision support, and performance improvement, demonstrating their functional role in operations.

| Company size | Count of Repporting results | Count of Support decision making | Count of Signaling deviations and deceptions | Count of Analysis and improvement of performance | Count of Predicting and optimizing of performance | Count of Improvements in supply chain | Count of Otherwise |
|---|---|---|---|---|---|---|---|
| **<10** | 9 | 7 | 7 | 2 | 2 | 4 | 1 |
| **100-250** | 27 | 25 | 25 | 22 | 18 | 16 | |
| **10-49** | 36 | 34 | 33 | 28 | 20 | 18 | 1 |
| **250+** | 46 | 42 | 37 | 42 | 35 | 35 | |
| **50-99** | 36 | 26 | 28 | 33 | 22 | 19 | |
| **No answer** | 1 | 1 | 1 | | | | |
| **Grand Total** | **155** | **135** | **131** | **127** | **97** | **92** | **2** |



## APPENDIX C – QUESTIONAIRE QUESTIONS

Appendix C included as separate PDF document.

## APPENDIX D - QUESTIONAIRE RESULTS SUMMARY

Appendix D included as separate PDF document.

## APPENDIX E - SYSTEMTIC LITERATURE REVIEW

Appendix E included as separate PDF document.