IMPROVEMENT OF INFORMATION SHARING WITHIN THE MAINTENANCE REPORTING PROCESS

REBEKA ZANECHALOVÁ
UNIVERSITY OF TWENTE
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University of Twente
Drienerlolaan 5
7522 NB Enschede
The Netherlands

University supervisors
J.P.S. Piest (Sebastian)
M. Koot (Martijn)

EMONS Group B.V.
Rijksweg 4
6569 AB Milsbeek
The Netherlands

Company supervisors
Marcel Wouterse
Thomas Massop
Marcel van der Werf

Preface

Dear reader,

This report contains a bachelor thesis 'Improvement of information sharing within the maintenance reporting process'. This thesis was performed at the EMONS Group B.V. and is a final assignment for the bachelor study of Industrial Engineering and Management at the University of Twente. The objective of the assignment is to improve the information sharing process with regard to the maintenance reporting process.

I would like to thank EMONS Group B.V. for the opportunity to carry my assignment at their company. Also, I would like to thank the employees for their collaboration during the assignment. I have had an opportunity to meet a lot of people in the organization also outside of the main office in Milsbeek. Moreover, I would like to thank my university supervisor, Sebastian Piest, who arranged the opportunity for this assignment and guided me during the whole process. In addition, I would like to thank the other students that partly took part in the assignment. Our shared visits to the company made the whole experience more enjoyable.

Rebeka Zanechalova

Management summary

EMONS Group B.V. is a transportation company in the Netherlands. Their technical fleet support department is facing issues when it comes to the maintenance reporting process. The process is currently based around a reporting tool that is used for submitting maintenance requests. Currently, there is 4% of regular requests and 6-7% of incident requests being submitted for over a half an hour. For efficient reporting process at EMONS Group B.V., there should not be more than 1% of either requests being submitted for over a half an hour. Moreover, the information sharing via this tool causes difficulties for the actors involved in the process. The information that is received by technical fleet support department through the requests is not always correct or complete. There are 22 inputs in the tool for regular and 23 for incident requests that need to be filled in when submitting a request. Already stored information needs to be looked up in other programs and manually input in the requests for submitting a complete request. For efficient reporting process there should be fewer input values required for both types of requests. Therefore, a solution to improve this maintenance reporting process is needed. In order to do so, the main research question is defined.

How can EMONS Group B.V. make the information sharing
between different actors more efficient within the maintenance reporting process?

The research of the current situation and literature review form a basis for improving the reporting tool used in the reporting process. Collaboration assessment theory leads to an evaluation of the division of responsibilities. The responsibility to plan the schedule for the incident maintenance is shifted to the planning department, which is the department that is actually qualified to do so. This reduces the number of input values for initial submission of incident requests and reduces the opportunity to submit incorrect information by the driver support. Moreover, the actor analysis checklist provides the basis for creating the information flow within the improved reporting tool. It visualizes which actors need to inform which actors about certain information.

Action design approach is used for designing the improved reporting tool by the use of two building, intervention, evaluation cycles. The initial design is based on the implemented theory. The improved and final design is based on the feedback of actors on the initial design. The requirements for the reporting tool are to reduce the time of request submission and to reduce the number of input values for the request submission.

Relation database theory is applied for efficient information sharing. A database schema is designed and leads to reduction of input values to be filled in for both types of requests. All additional necessary information is automatically linked to a request. This reduces the opportunity to provide incorrect information and removes the possibility of submitting an incomplete request. Moreover, database tables reduce the effort needed for manually filling in some of the input values. This also reduces the effort needed for the request submission and the opportunity to provide incorrect information.

The design validation is based on evaluation of the initial requirements and user feedback. The initial requirement for the design is to have less than 22 input values for regular and less than 23 for incident requests. Using collaboration assessment with actor analysis, and relation database, these values are reduced. For the regular maintenance the number of input values went from 22 to 14. For incident request the number of input values went from 23 to 8 for initial submission of the request and to 15 for the overall submission of the request. The user feedback on the design is positive and the tool is defined as promising for the technical fleet support department and the other involved actors.

For further validation a validation timeline for the developed reporting tool is defined. For the validations by users survey forms are provided. First, within a month since the start of the use of the tool, the effectiveness of the tool is evaluated by the users. In the next month, the adequacy of the effort needed for the use of the tool is evaluated by the users. In the next month, the efficiency of the tool is evaluated by the analysis of the KPIs. The selected KPIs to analyse are the length of time for request submission as this is one of the initial requirements for the improved tool. Moreover, a KPI of time taken to schedule a maintenance from when the maintenance request is fully submitted is analysed. Lastly, within 6 months from the start of use of the tool, a user evaluation focused on lessons learned is carried out. The first validation stage focuses on evaluating whether the reporting process has indeed improved. The other validation stages focus on the quality of the improved reporting tool.

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List of abbreviations

ADR – Action design research
BIE – Building, intervention, evaluation
BPM – Business Process Model
ETA – Estimated time of arrival
ETR – Estimated time ready
KPI – Key Performance Indicator
PPI – Process Performance Indicator
SQL – Structure Query Language
TFS – Technical fleet support

1 | Introduction

The following assignment focuses on improving tasks and processes within a technical fleet support department at Emons Group B.V.. It is also important for the assignment that the relations with other departments are efficient and effective. The specific focus of the assignment is to improve the reporting tool used for maintenance requests. Section 1.1 introduces the company where the research is carried out and the assignment itself. In section 1.2 the research problem is introduced. Section 1.3 provides information about the research design.

1.1 | Company and assignment introduction

The following subsection 1.1.1 provides introduction about the company and the subsection 1.1.2 introduction about the assignment. Moreover, the subsection 1.1.3 introduces the TFS (technical fleet support) department, which is of the main focus for the assignment.

1.1.1 | Company introduction

Emons Group B.V. is a transport company from the Netherlands. Operating in the Netherlands, Germany, Poland, and Czech Republic. It is a privately owned company with an innovative vision. Three main brands at EMONS Group B.V. are 2WIN – cargo logistic, Van Huët – glass logistics, and Hofmans – logistics in champost. There are eight main actors involved with a transport of an order. The Figure 1.1 shows the flow of an order process. The actors depicted by grey color are local actors in the specific countries. The other actors are departments located at the main office in Milsbeek. The company would like to gain insight and improve the actual processes and relations between different departments and actors. In order to do so, four of the Milsbeek departments will be looked into in detail by five students. These selected departments are depicted by the yellow color in the departments overview figure.

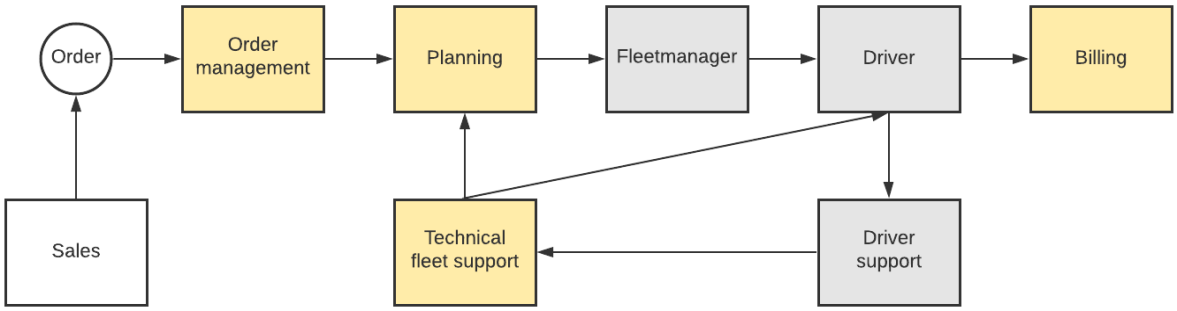

Figure 1.1_Departments overview

1.1.2 | Assignment introduction

This assignment focuses on the TFS department. It is performed in several stages based on individual and group research. The Figure 1.2 shows the different stages of the assignment.

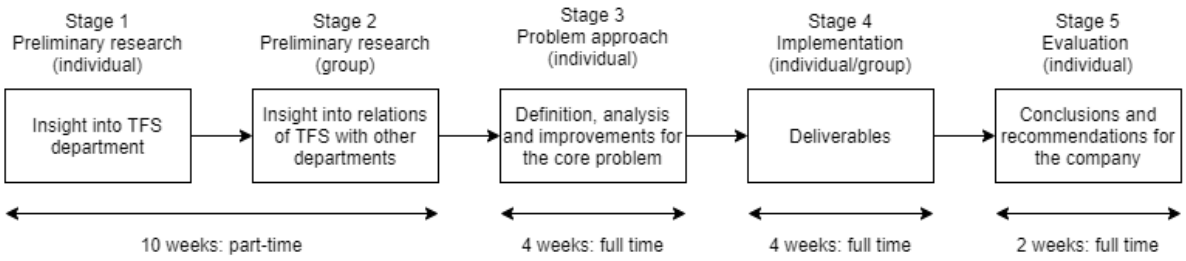

Figure 1.2_Assignment stages

In stage 1 the preliminary research for getting insights into the TFS department is performed. This is done through observations and interviews with the employees (Appendix A1). Following, in stage 2, a group research is done to gain insights into the relations between the different departments. This is done by performing a task and process analysis which depicts the relations in a PowerBI dashboard. Once the outcomes are shown in the dashboard the individual work on core problem in the specific department is done during the stage 3. The stage 3 is focused on research, including the definition, analysis, and improvement of the core problem. The 4th stage is then focused on working out the deliverables and report for the research which is an individual aspect. However, this stage also has a group aspect as the relations between the departments also need to be taken into consideration. Lastly, in stage 5, the evaluation of the research and deliverables is performed and recommendations for the company are provided.

1.1.3 | Technical Fleet Support department

The TFS department consists of two full time and one half time employees. The purpose of the department is to ensure that the vehicles used for transport are well maintained and everything is well functioning on the technical side. There are three main processes that are performed by the department. Scheduling of regular maintenance, scheduling of incident maintenance and checking the status of a scheduled maintenance. The BPMs (Business Process Models) created during the preliminary research depicting the current situation of performing of these tasks can be found in Appendix B1.1. Regular maintenance is requested by the planning department and is considered as planned maintenance. It comes from technical and statutory requirements. Incident maintenance is reported by driver support and results from incidents, such as damage, malfunction, or breakdown.

1.2 | Problem introduction

Stage 1 and 2 of the assignment are performed prior to defining of the core problem. Stage 1 findings are discussed in the subsection 1.2.1. The assignment relevant findings of stage 2 are described in subsection 1.2.2. The outcomes from these preliminary research stages lead to the problem identification in subsection 1.2.3 and moreover to the formulation of core problem in subsection 1.2.4.

1.2.1 | Main tasks TFS

Findings from the interviews and observations (Appendix A1) imply inefficiencies in communication. This can also be seen in the BPMs of the three main processes of TFS department (Appendix B1.1). When it comes to scheduling of regular and incident maintenance, the first task after receiving the request is verifying whether the information received is correct. Moreover, in some cases it occurs that needed information is missing. The requests are in a form of mails that are generated from the current reporting tool. Each relevant actor then receives information relevant to their role in the overall process. In order to determine why incorrect and incomplete data receiving occurs, interviews regarding the reporting tool are held (Appendix A2). The outcomes of the interviews show that there was a missing communication when setting up the current tool and some fields that are required to be filled in by given actors cannot be efficiently filled in by them. Moreover, the information is being looked up in several databases and is input manually, which leads to possible typing / looking up error. Figure 1.3 shows different databases that are used for filling in the requests and the actors who receive information from the submitted requests.

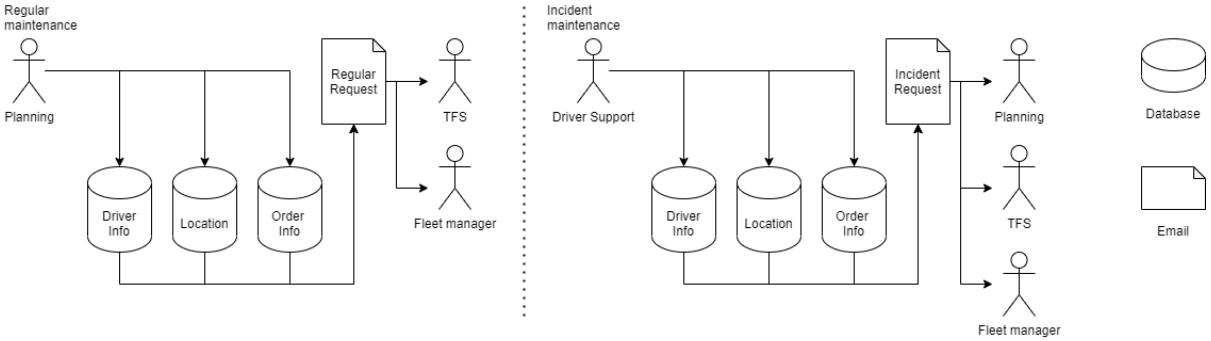

Figure 1.3_Request submission flow

1.2.2 | Task and process analysis

In stage 2, parts of the findings from stage 1 of all students were combined and put together for performing a task and process analysis. This analysis was not only for getting initial insights for the assignment, but it also is a first deliverable required by the company. The task and process analysis consists of developing a PowerBI dashboard to visualise the tasks within each department and their characteristics. (PowerBI dashboard is chosen due to the previous use of the tool within the company and their desire to be consistent with use of certain tools/programs). Each main process has their (sub)tasks, trigger starts, and trigger ends defined. Moreover, each process is labelled to show which departments and tools / programs are used when carrying out its tasks. Lastly, several general attributes are defined to depict the characteristics of the tasks. The results relevant to this specific assignment and its problem identification can be found in Appendix B1.2. From these results it is found that two out of the three main processes at TFS receive incorrect and / or incomplete information. These are received through mail which is generated from the submitted maintenance request received from the reporting tool.

1.2.3 | Problem identification

Following the findings from the preliminary research stages, the following problem cluster (Heerkens et al., 2017) is constructed (Figure 1.4). The lowest level as defined consists of potential core problems, problems that are not affected by anything. However, the TFS department is a department that performs tasks that are set by certain triggers, as they are all reaction tasks. Therefore, for this specific problem cluster, in the lowest level, we visualize triggers that lead to potential core problems at TFS.

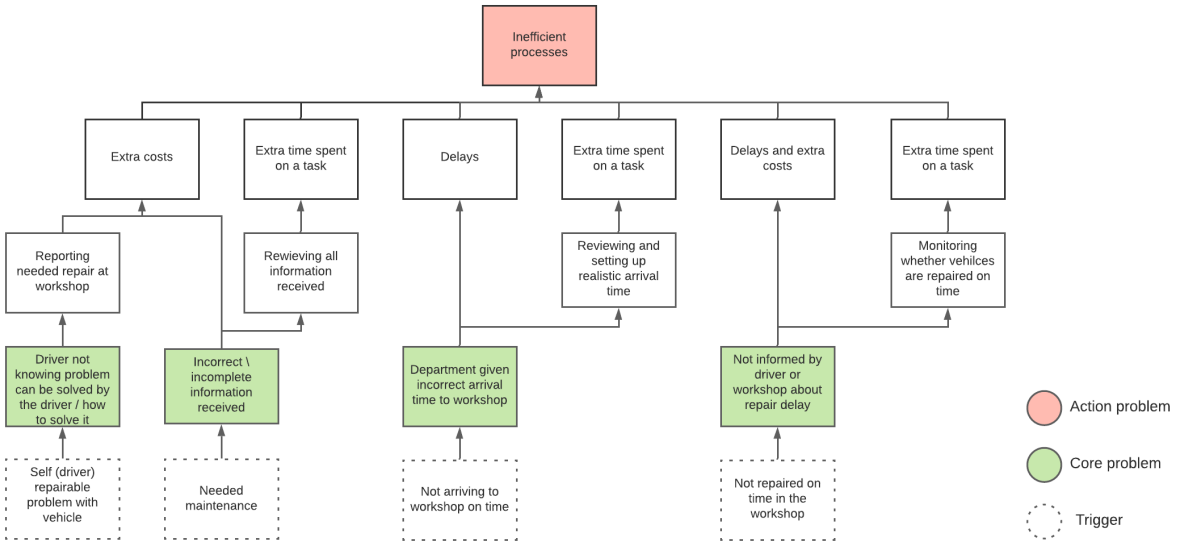

Figure 1.4_Problem cluster TFS

There are four triggers triggering the main tasks of TFS. All these triggers however also lead to a potential core problem to be looked into.

Self (driver) repairable problem with vehicle: The scheduling of maintenance (both regular and incident) is triggered by a maintenance request. For the incident requests, the request might be necessary or unnecessary. Unnecessary request that is scheduled for maintenance leads to spending of extra costs. Whereas, if the driver were aware that this problem can easily be solved and knew how to solve it there would be no need to report the incident for maintenance and maintenance costs as well as money lost due to not using the vehicle would be saved.

Needed maintenance: For the necessary maintenance, the biggest problem is that the information received is sometimes incorrect and/or incomplete. Incorrect information is either used or reviewed. Using of incorrect information leads to extra costs, for example for sending a repair man to an incorrect location costs a lot of money since the company is also charged for the km travelled to/from the vehicle. In the other case, the information is treated as unreliable and is always checked for correctness. This leads to looking up of all the information that was already looked up and therefore redoing a work that was already performed, spending extra time on the task.

Not arriving to workshop on time: The trigger is related to already scheduled maintenance and monitoring that the ETA (estimated time of arrival) of the vehicle to the workshop is met. There are two possibilities when incorrect ETA is received. This either leads to delays as the workshop is waiting on the vehicle and might be busy later when the vehicle actually arrives. Or to extra time spent on the task as the department monitors where the vehicle is located one hour prior to its ETA and whether it actually will be on time.

Not repaired on time in the workshop: The trigger is related to monitoring if the ETR (estimated time of ready) of vehicle is met, meaning that the vehicle is repaired and out of workshop by its ETR. For ETR, not being informed about the delay in ETR, this leads to unexpected delays as the vehicle is still at the workshop when it should have already been on the move. On the other hand, to prevent the unexpected delay, the department can spend extra time on the task and monitor whether vehicles are on the move again at their given ETR time and if not contact the workshop or the driver to receive a new accurate ETR.

To select one core problem, it is necessary to consult some data. To evaluate the impact of the (core) problems, we consult the data regarding measures that are taken in order to avoid them from happening. For the driver not knowing problem can be solved by the driver there are workshops performed for the drivers, but we do not have data into the efficiency of the workshops. Therefore, this is not the core problem as we cannot evaluate the impact of the workshops. For receiving incorrect or incomplete data, the employees report that they always check the information for correctness, therefore, with every request the information that was looked up when submitting a request is looked up again when the request is received. On average there are 10 requests received per day (Appendix B2.1). 6-7% of the incident and 4% of the regular requests take over half an hour to be submitted (Figure 1.5) and 3 databases are consulted (Figure 1.3). Therefore, the TFS employees also spend time looking up information in 3 databases to confirm the data or spend time on looking up for information that was not submitted in the request. For having insight into whether the arrival to workshop is on time, the employees monitor the ETAs for every scheduled maintenance prior to the ETA. Similarly, for vehicle being repaired on time, TFS monitors ETRs of all scheduled maintenance. Since there are 10 maintenance requests received per day we can say that there are on average 10 scheduled maintenances to be checked for ETA and ETR per day. Resulting in 20+ needed checks per day, as when ETA or ETR is not met, it is updated and then checked again at the updated time.

Therefore, we can see that quite some resources are spent related to the (core) problems. We could estimate based on observations (Appendix A1.2) how much time it takes to check information for correctness (3-5 min) and calculate how much time is spent on it per day (30-50 min). Then we estimate the time it takes to check status of ETA and ETR (1 min for each) and how much this adds up to during a day (at least 20 min) and compare the two values (More time is spent on the reviewing than on the monitoring). However, unrelated to the result of the comparison, the company requests that the relation to other departments is also considered. Improving the submission of maintenance requests could result in receiving of more reliable information. Moreover, looking at the time needed for submitting a request (Figure 1.5) improving the submission of maintenance request would also be beneficial for the actors that are responsible for the requests submission. Therefore, the selected core problem is improving the information sharing in the maintenance reporting process.

1.2.4 | Core problem

The selected core problem is the inefficient information sharing in maintenance reporting process. In order to prevent receiving incorrect and incomplete information from the maintenance requests, we aim to improve the request submission process. A reporting tool is used for the submission of maintenance requests. The data from the tool since the start of its use is analysed. Figure 1.5 shows the lengths of time taken to fill in a request, from the start to submission of the request. At first look it might seem that the reporting process performs quite well. For one category, in only 1% of the cases it takes over an hour to fill in a request. However, it is a category related to vehicle not being able to drive. In this case it is most urgent to report the need for repair immediately (Appendix A2.3). It is not acceptable that the request is being filled in for over an hour, nor that 5% of the cases take over half an hour to an hour.

Type of request	Over 1 h	0.5 to 1 h	Less than 0.5 h	Less than 1 min
Incident maintenance				
Vehicle cannot drive	1%	5%	94%	0,94%
Maintenance at nearest workshop	3%	4%	93%	0,52%
Maintenance by end of trip	3%	3%	94%	0,84%
Maintenance within 1 week	3%	3%	94%	2,59%
Maintenance with next maintenance	3%	3%	94%	8,51%
Regular maintenance				
Regular maintenance	2%	2%	97%	12,79%
APK	3%	1%	95%	13,93%

Figure 1.5_Reporting tool: Reporting time analysis

For efficient maintenance scheduling the maintenance requests should be submitted as soon as possible. This would allow for cost efficiency analysis to take place and more optimal scheduling of the orders can be performed (Appendix A1.1). In order to improve this process, we consider two variables to measure the reality and norm of the situation (Heerkens et al., 2017).

Variable 1 – Request submission time. The reality of the request submission time is that 6-7% of incident and 4% of the regular requests take over half an hour to be submitted. The norm is to reduce the number of requests that take this long to be submitted. The norm is to have on average a maximum of 1% of the requests to be filled in for over a half an hour.

Variable 2 – Reporting tool input values. The reality is that there are 23 input values required to be filled in for incident and 22 for regular maintenance request. An overview of the input values can be found in Appendix B2.2. The norm is to reduce this number, therefore, to have less than 23 reporting

tool input value for incident and less than 22 for regular maintenance requests. Having less input values also means less opportunity to provide incorrect and / or incomplete information and less time spent on filling in the request.

1.3 | Research design

The research design section discusses the research design through several subsections. Subsection 1.3.1 introduces the motivation for the research. In subsection 1.3.2 the research approach is explained. Subsection 1.3.3 provides overview of the research methodology and subsection 1.3.4 provides overview of the assignment structure. Subsection 1.3.5 describes the deliverables of the assignment. Subsection 1.3.6 discusses the limitations of the research, and 1.3.7 discusses the validity and reliability of the research.

1.3.1 | Research motivation

The reporting process for maintenance requests at Emons Group B.V. has several inefficiencies. The main problem is the current reporting tool (Appendix A2). The objective of this research is to **improve the reporting process by evaluating the actors and their roles with relation to the information sharing**. The motivation for carrying out the research is to make the reporting process more efficient. The contribution of designing the improved reporting tool can be used for its actual development and use. The improved reporting tool has potential to improve the way the information is shared within the reporting process and resolve the communication problem connected to it.

1.3.2 | Research approach

For the assignment, an ADR (Action Design Research) is selected. 'ADR reflects the premise that IT artifacts are ensembles shaped by the organizational context during development and use. The method conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artifact, intervening in the organization, and evaluating it concurrently' (Sein et al., 2011). This method supports the design making process for the development of an improved reporting tool. This proposed method, as stated in the source, deals with two main challenges. First is 'addressing a problem situation encountered in a specific organizational setting by intervening and evaluating'. Second, 'constructing and evaluating an IT artifact that addresses the class of problems typified by the encountered situation'. The Figure 1.6 shows the stages and principles of applying the ADR.

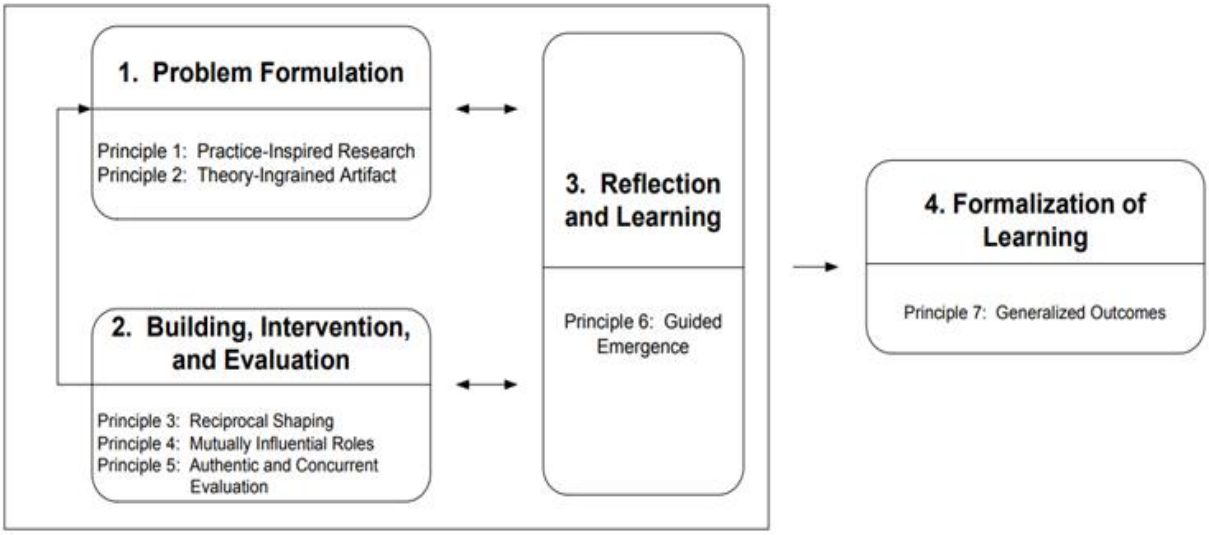

Figure 1.6_ADR Method: Stages and Principles (Sein et al., 2011)

Stage 1: Problem formulation

Principle 1: Practice-Inspired Research

The core problem of the research is the inefficient way of sharing information within the reporting process. The preliminary research shows inefficient aspects when it comes to the current reporting tool. This research looks into designing of an improved reporting tool that would improve the maintenance reporting processes for TFS as well as the other involved departments. The IT-artefact that is designed is an application design within Microsoft Power Apps environment. The Power Apps environment is chosen based on the preference of the company, which uses this environment for the current reporting tool as well.

Principle 2: Theory-Ingrained Artifact

In order to achieve the objective of the research - improve the reporting process by evaluating the actors and their roles with relation to the information sharing, the main research question is defined

How can EMONS Group B.V. make the information sharing between different actors more efficient within the maintenance reporting process?

This however covers a complex area. Therefore, we define sub-questions for answering the main research question (Figure 1.7). These are related to the context analysis and theoretical framework chapter and provide the basis for the integration of theory. The integration of theory chapter is used as basis for the initial design of the IT-artifact.

Research question	How can EMONS Group BV make the information sharing between different actors more efficient within the maintenance reporting process?
Context analysis	1. Which actors are involved in the maintenance reporting process?
	2. What are the skills required by the actors within the reporting process?
	3. Which information needs to be reported to a given actor?
	4. Which new information is provided and by which actor?
	5. When is the information shared?
	6. What is the overall end goal of the reporting process?
Theoretical framework	7. How to assess collaboration between different actors within a process?
	8. How to visualize the responsibilities and actions of actors within a process?
	9. How can already stored information be used in an efficient way?

Figure 1.7_Research questions

Stage 2: Building, Intervention, and Evaluation

Principle 3: Reciprocal shaping

The target result of the design is to have a functional design for an application for the reporting process. The end users of the application are employees of Emons Group B.V. involved in the reporting process. Namely, fleet managers, driver support, planning and TFS department. For the development of the IT-artifact an organisational BIE (building, intervention, evaluation) is used as the primary source of innovation is organizational intervention (Sein et al., 2011). The BIE for the current research consists

of two cycles and an evaluation (Figure 1.8). Following the feedback on the initial design in cycle 1, the final design is already made due to the time limit of the assignment.

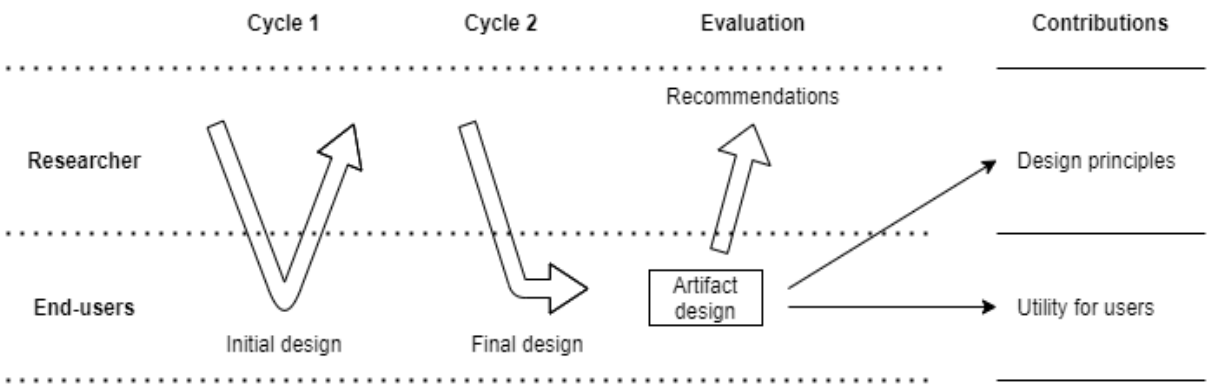

Figure 1.8_Organisation dominant BIE (Sein et al., 2011)

The reciprocal shaping focuses on the researcher's design at the beginning of each cycle. Initial part of cycle 1 is answering the research questions which lead to the integration of theory. The integration of theory is then used for the initial design of the artifact. Cycle 2 artifact design is based on the feedback received by the end users of the artifact. The feedback for the design is gathered through presenting the design to fleet manager and driver support. For the planning and technical fleet support department an interview is held. This is due to planning and technical fleet support being involved at later stages in the reporting process. The fleet manager and driver support are involved at the initial stage and only input new information. Therefore, their needs in the application are straightforward and need less functionality compared to the other actors who work with already input information.

Principle 4: Mutually influential roles

It is important that each of the actors in the reporting process provides feedback on the design of the artifact. As mentioned in principle 3, some actors are needed for more detailed feedback due to larger required use of the artifact. However, all actors need to provide feedback for an efficient and valuable design. Having a design approved by all involved actors provides a substantial basis for a future development of the artifact.

Principle 5: Authentic and concurrent evaluation

It is important that the proposed changes in the design are made alongside the designing of the artifact design. In cycle 2, the design is reshaped based on the feedback from cycle 1 by the end users. However, due to the time limit of the assignment there is no opportunity for additional cycle(s) if needed. Therefore, after cycle 2 there is a final evaluation, where the feedback from the cycle 2 is evaluated. This is then discussed and presented to the company for further research.

Stage 3: Reflection and Learning

Principle 6: Guided emergence

Once the application design is finalized, the design process of the application is evaluated. This is done by evaluating the changes in the design made in each cycle. Namely, the changes made in cycle 2 and discussion of changes that are recommended for the future with regard to the artifact design made. First, we reflect on the variables as set in the problem introduction (Section 1.2.4). Secondly, validation of the application design is performed by interviews and presenting of the design to the involved

actors (Feedback from last cycle). Lastly, the guideline for evaluating of the reporting process and the developed reporting tool is provided.

Stage 4: Formalization of Learning

Principle 7: Generalized outcomes

The last research stage focuses on the evaluation of the overall outcome of the research. The improvements for the problem are discussed. This is for presenting the value of the application to the company. It needs to be shown that the solution actually improves the reporting process. Moreover, the theory discusses how teamwork of different actors can be structured for an efficient collaboration and how a proper tool can improve the effectiveness of information sharing.

ADR Assignment structure

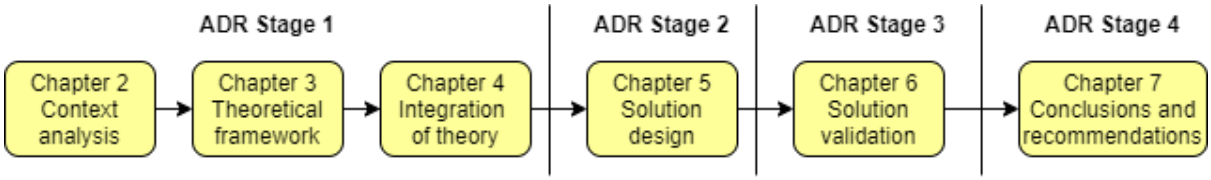

Figure 1.9_ADR Assignment structure

1.3.3 | Research methodology

The section 1.3.3 discusses the selection of research methods (Goundar, 2013). Figure 1.6 shows an overview of research objectives and relevant research aspects related to them.

Research Objectives	Type of Research	Research Strategy	Research Population	Research Method	Thesis Chapter
Preliminary research	Exploratory	Qualitative	Employees	Interview, observation	Chapter 1 Introduction
ADR	Descriptive	Qualitative	Not applicable	Literature study	Chapter 1 Introduction
Actors involved in the reporting process	Exploratory	Qualitative	Employees	Interview	Chapter 2 Context analysis
Input values in the reporting process	Descriptive	Qualitative	Reporting tool	Observation	Chapter 2 Context analysis
Reporting process	Exploratory	Qualitative	Employees	Interview	Chapter 2 Context analysis
Value of collaboration	Descriptive	Qualitative	Not applicable	Literature study	Chapter 3 Theoretical framework
Collaboration assessment	Descriptive	Qualitative	Not applicable	Literature study	Chapter 3 Theoretical framework
Actor analysis	Descriptive	Qualitative	Not applicable	Literature study	Chapter 3 Theoretical framework
Tables and databases	Descriptive	Qualitative	Not applicable	Literature study	Chapter 3 Theoretical framework
BIE user feedback	Exploratory	Qualitative	Employees	Interview	Chapter 5 Solution design
Key performance indicators	Descriptive	Qualitative	Not applicable	Literature study	Chapter 6 Solution validation
Validation	Exploratory	Qualitative	Employees	Interview	Chapter 6 Solution validation

Figure 1.10 _Research methodology

During the preliminary research, introduction chapter, the interviews held are unstructured. Also, all interviews are qualitative, firstly due to the aim to obtain detailed understanding of the department. Secondly, due to the small number of employees within the departments. The aim of the interviews is to gain insight into the tasks and processes within the department. There is no prior knowledge about what the department does therefore the employees explained themselves what the tasks they perform are. Sometimes additional questions are asked to gain detailed understanding of the task attributes. The interviews also contain an observation part where performance of the tasks is shown. During the context analysis chapter, the findings from preliminary research are used, as well as findings from new interviews related to the reporting tool. The reporting tool interviews are structured. The questions are aimed at the use and interaction of the actors with the tool. The structured method helps to get views on same aspects from different actors. During the solution design and solution validation chapter, the goal is to receive feedback about the application design. This is not performed in a structured way, to allow the respondents to focus on the design from their own perspective. If certain questions are asked they might draw the focus on specific aspects. In addition to the interviews and observation, literature study is performed. This is to gain theoretical background for certain research objectives that are applied in the research process. This is done during the research design, theoretical framework, and solution validation chapter.

1.3.4 | Research structure

Chapter 1 aims to introduce the research to the reader. Following the Chapter 1, the ADR begins, and the Figure 1.9 shows the research structure. Chapter 2 looks into the current situation in the company relevant to the defined core problem. Chapter 3 focuses on establishing theoretical background for the research and in chapter 4 the theory is integrated into the research. The solution design is presented and explained in Chapter 5. Chapter 6 focuses on the validation of the proposed solution. Lastly, Chapter 7 discusses the conclusions and recommendations resulting from the research.

1.3.5 | Deliverables

There are several deliverables provided by the assignment. The first deliverable is performing the task and process analysis which is part of the group preliminary research. Moreover, an actor analysis is performed and serves as a guide for the main deliverable. The main deliverable to be delivered is the artifact design for the improved reporting tool, together with the database schema supporting the tool. The application design is delivered as an action flow between the views within the application. The flows are made for each actor involved in the reporting process. Lastly, validation timeline for when the tool is developed is provided. Together with a selection of KPIs and survey forms, and their goal values set for future validation of the reporting process and reporting tool.

1.3.6 | Limitations

There are several limitations when it comes to the research. First limitation is the time period of the assignment. The assignment needs to be fulfilled within a 10 week period. Therefore, this also limits the number of cycles possible during the second stage of ADR. It is not expected there will be more than two cycles (improvement after first feedback and evaluation after second feedback). Moreover, the programming skills are a limitation. During this time period the application is designed but it is not developed due to no prior knowledge with the development platform. However, a person with a knowledge of the platform should be able to develop the application within a short period of time (several days) by consulting the deliverables of this assignment. The research contains the problem identification and investigation, solution in form of a design for an improved reporting tool, database schema supporting the improved reporting tool, and evaluation of the improved reporting tool together with further recommendations.

Moreover, there is a limitation as to reliability issue of the interview findings. The information is provided by different actors in the reporting process. However, no data for analysis is available. The data that would be valuable in the research is for example, how often typing mistakes occur or how often / how long actors search for already stored information in other databases. However, these are not data which can be accessed in the existing databases. Therefore, if it is stated that incorrect information is received, it is difficult to prove that this indeed is the case as we cannot actually determine if and how often does this occur.

Furthermore, there are limitations when it comes to the actual implementation of the deliverables. The actor analysis provides guidelines for when information needs to be shared and received. However, due to the human factor involved in the process it cannot be certain that the information will actually be shared when it is supposed to be shared.

1.3.7 | Validity and reliability

'Validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the inferences a researcher makes', Fraenkel et al. (2011). During the problem identification (Section 1.2.3) it was already established that there is no data to support the claims by the employees and therefore it is not possible to consider the findings reliable. However, in order to bring some objectivity and reliability to the findings, other actors in the process are interviewed. This provided input from different sources and the findings are not subjective to the TFS department anymore (Appendix A2).

Reliability refers to the replicability and repeatability of the outcomes of the research. In qualitative research, reliability is also referred to as dependability (Golafshani, 2003). For a research to be dependable the outcomes need to be trustworthy and consistent. The research itself focuses on these aspects and draws conclusions based on the received findings. However, it is difficult to conclude that the research as a whole is reliable. There is limited data available as a basis for the problem identification. Therefore, the research is based on interviews of the employees. As mentioned, the TFS department consists of only 2-3 employees. Therefore, even though the complete view is obtained by interviewing all employees in TFS departments, the sample size is also not large enough to ensure reliability of the research. To conclude, the reliability of this research depends on the reliability of the information provided by the company during the preliminary research.

1.4 | Summary

The identified core problem of the research is the inefficient information sharing in maintenance reporting process. There are two variables that are used for measuring the core problem. Namely, time for request submission and reporting tool input values. The objective of the research is to improve the reporting process by evaluating the actors and their roles with relation to the information sharing. ADR is performed to carry out the research with BIE of 2 cycles. The main research question that is defined is 'How can EMONS Group B.V. make the information sharing between different actors more efficient within the maintenance reporting process?'. The IT-artifact that is designed during ADR is a design for an improved reporting tool. During the research, interviews, observations, and literature study are performed. The research then provides the research deliverables: the assessment of tasks and processes, the guideline of the roles and responsibilities of the actors, the design for the improved reporting tool, the database schema, and the validation timeline.

2 | Context analysis

The context analysis chapter looks into the current situation relevant to the research objective. It is part of the stage 1 of ADR. First, in subsection 2.1 the current reporting tool is analysed. In subsection 2.2 the research questions are answered. In subsection 2.3 the important findings of the context analysis are summarized.

2.1 | Current reporting tool

The current reporting tool is a form in Microsoft environment (Figure 2.1). There are two forms, one for regular and one for incident maintenance. The only differences between the two forms are the questions present in the forms.

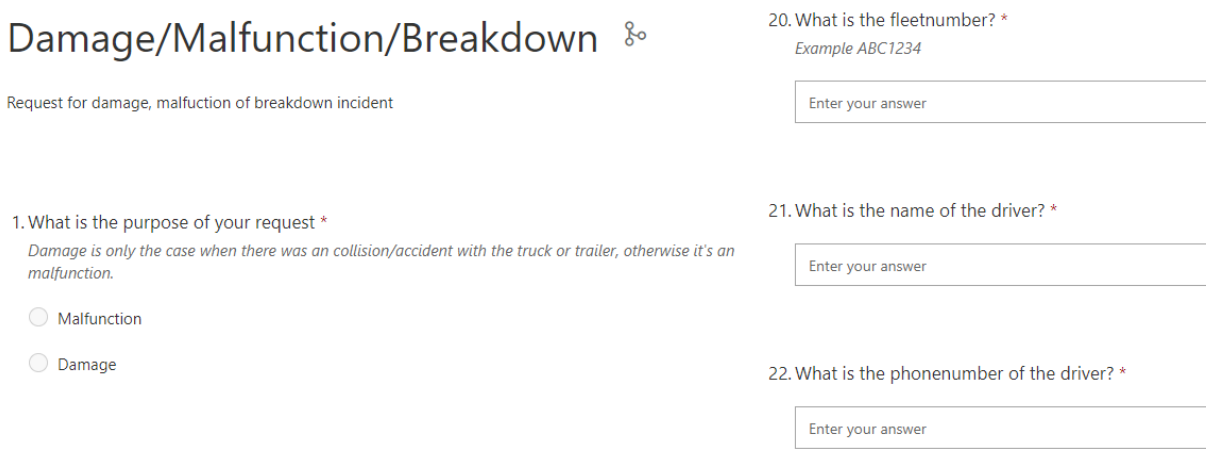

Figure 2.1_Current reporting tool: Incident maintenance

Questions that are in a form of a checkbox (these are present at the beginning of the form) guide the relevant question flow. The data containing the previously submitted requests can be analysed, in section 1.2.4 the times of submitting the requests are shown. Moreover, the input values for reporting a given maintenance are depicted from the reporting tool (Figure 2.2) and are explained in more detail in Appendix C1.

Incident Maintenance input values

- Purpose
- RepairTime
- TruckORTrailer
- PreferredLocationTruck
- PreferredLocationTrailer
- ETADate
- ETATime
- YesOrNoETR
- ETRDate
- ETRTime
- Location
- HighwayPerkingName
- HighwayNameAndExits
- CustomerSite
- EmonsSiteLocation
- Division
- Zone
- LoadStatus
- FleetNumberVehicle
- DriverName
- DriverPhone
- FleetManagerName
- Description

Regular Maintenance input values

- Purpose
- ModificationDescription
- ReparationDescription
- MaintenanceType
- Division
- Zone
- FleetNumberVehicle
- TruckORTrailer
- FleetNumberTruck
- PreferredLocationTruck
- PreferredLocationTrailer
- DriverName
- FleetManagerName
- ExpectedETADate
- ExpectedETATime
- YesOrNoETR
- ETRDate
- ETRTime
- AdditionalDamagesFailures
- DescriptionAdditionalDamagesFailures
- YesORNoComments
- Comments

Figure 2.2_Current reporting tool: Input values

As question flow is determined based on the request situation, all input values are mandatory to be filled in and cannot be skipped. However, each maintenance request situation is different. In some cases, it might be needed to provide the phone number of a driver. In some cases, it is not necessary. Therefore, some of the actors filling in the request evaluate it is not needed and input for example, 123 instead of the actual phone number. It is then important that the actors filling in the request are capable of evaluating correctly whether it is necessary to search for this information (Appendix A2.1). Moreover, the inability to proceed without providing an answer for some questions results into inefficiencies. Actors need to select ETA, ETR or workshop location for the maintenance when they do not have insights into relevant information for making this decision (Appendix A2.2). In addition, some questions require the information to be typed in (highlighted by yellow in Figure 2.2), which provides an opportunity for typing mistakes.

2.2 | Research questions

The main research question 'How can the information sharing be improved in the reporting process with relation to the roles of the actors involved in the process?' is answered by researching the sub-questions defined. Subsection 2.2.1 looks at the research questions with regards to actors, subsection 2.2.2 at research questions related to input values, and subsection 2.2.3 at research questions related to the overall reporting process. The sub-questions are answered through interviews and observations with the employees (Appendix A1 and A2) and by analysis of the current reporting tool.

2.2.1 | Actors

For researching the roles of actors, we first need to establish what actors are involved in the process. Moreover, some of the roles require specific skills. Fulfilling these skill requirements can improve the smoothness of the reporting process.

1. *Which actors are involved in the reporting process?*

There are three actors involved in the reporting process of regular maintenance request and five actors involved in incident maintenance request. Figure 2.3 shows the actors and the order of their involvement in the reporting process.

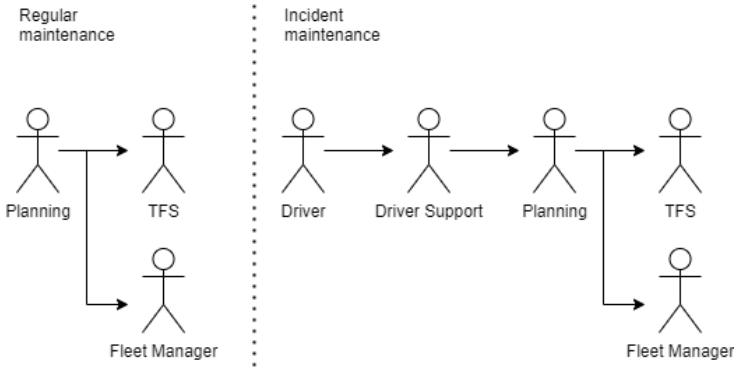

Figure 2.3_Actors: Reporting process flow

2. *What are the skills required by the actors within the reporting process?*

In addition to basic skills that are required for the employees in order to qualify for their position, there are some specific skills related to the reporting process that need to be present for different actors (Figure 2.4). These skills are defined based on how the process actors should be performing (Appendix A1 and Appendix A2).

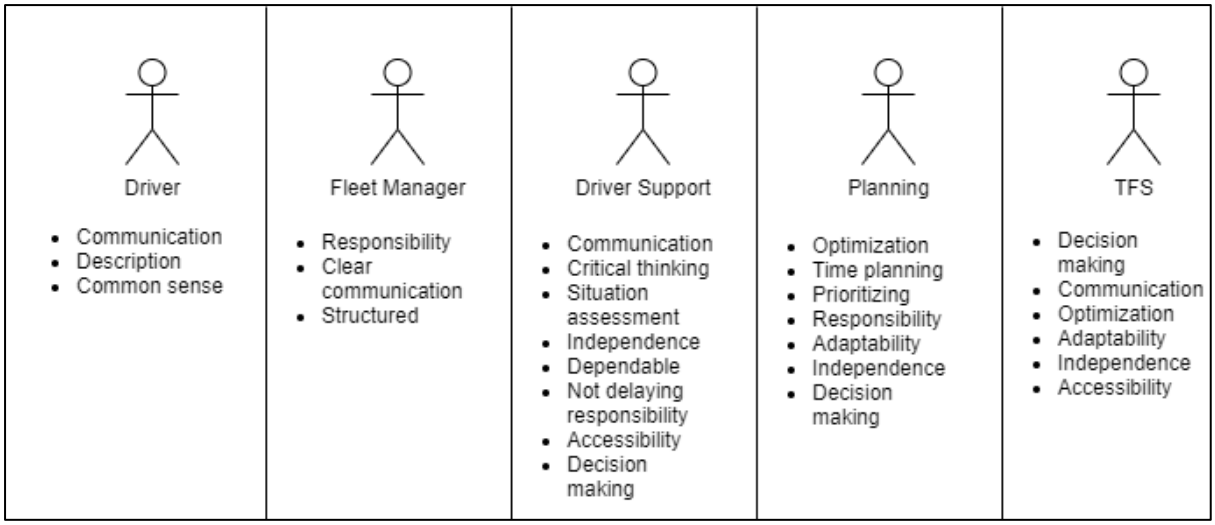

Figure 2.4_Actors: Required skills

2.2.2 | Input values

For the information sharing part, we look at the reporting tool input values. We look at the information that needs to be reported to a given actor and we look at which of the information is new (not yet stored in another program). Figure 2.5 shows the combined results.

3. Which information needs to be reported to a given actor?

There are several input values that need to be reported to a given actor within the reporting process. For regular maintenance, the planning department reports everything to TFS. For incident maintenance, driver support receives the initial information from a driver, then the driver support reports the information to the planning and TFS department (Figure 2.3).

4. Which new information is provided and by which actor?

Some of the input values are already stored in other programs in the company. We look at which of these input values that need to be reported to given actors are new (highlighted by yellow).

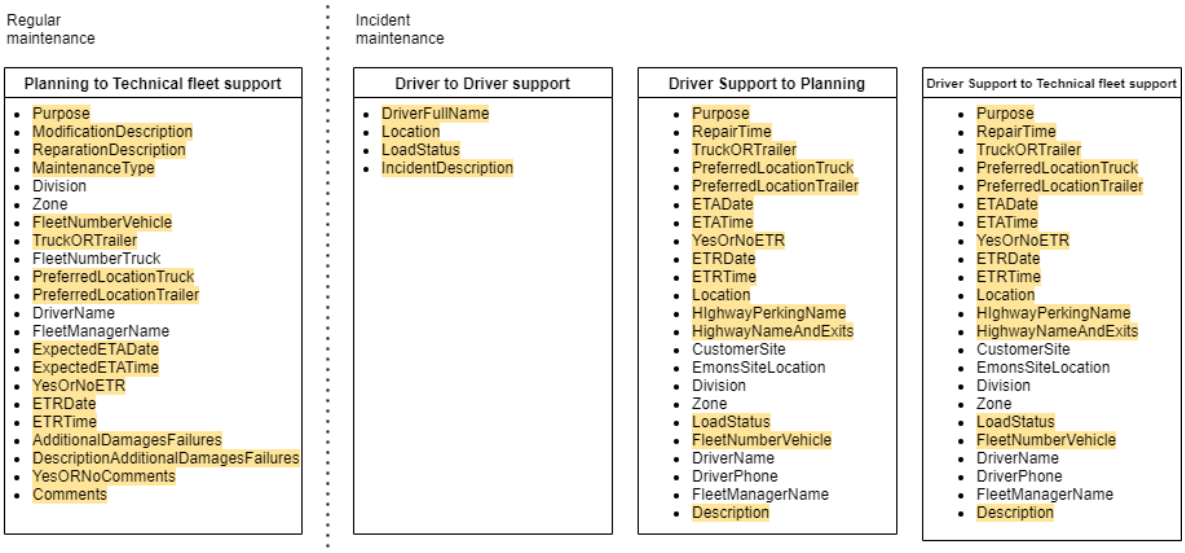

Figure 2.5_(New) input values for given actors

The findings from Figure 2.5 show which input values do indeed need to be input. The other input values do not actually need to be input, instead they need to be accessed from within the other programs where they are already stored.

2.2.3 | Reporting process

For the reporting process to run efficiently it is also important that the information is shared on time. Sharing of some information has priority over sharing of other information.

5. When is the information shared?

The Figure 2.6 shows the BPM for sharing regular maintenance information. The initial action, to submit a regular maintenance request is based on an indicator within Spits. Spits is a program where in addition to other functionalities, the tracking of approaching regular maintenance deadline takes place. There are three categories for approaching maintenance based on the closeness to the deadline. Depending on the indicators and order planning for a given truck or trailer, the planning department submits a regular request. TFS then schedules the maintenance job sometime during the day. Once the job is scheduled the time and location of the maintenance is input in Spits, for informing the planning department.

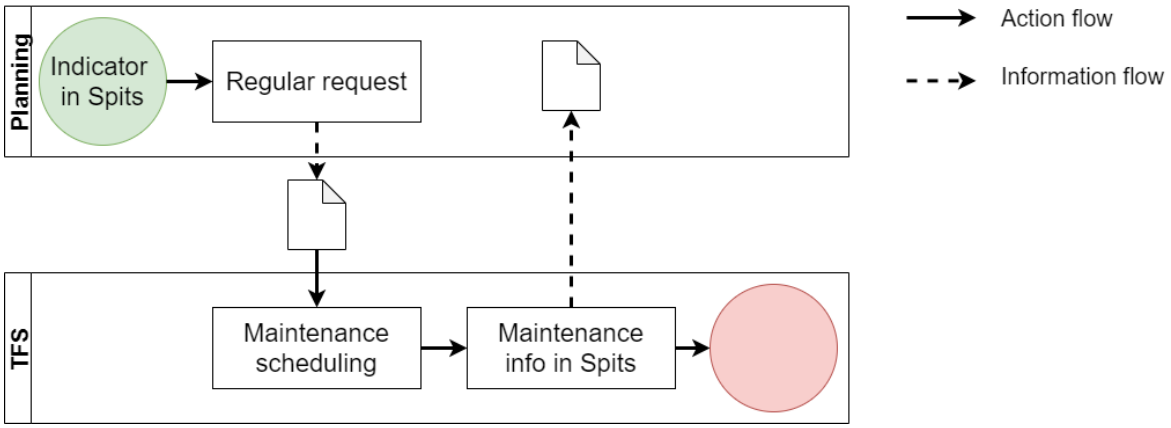

Figure 2.6_BPM: Information sharing regular request

Figure 2.8 shows the BPM for information sharing for incident maintenance. The initial action to report the need for maintenance should be taken immediately by the driver. It is however not monitored if all trucks are on the move or if the driver is waiting and taking time to report a need for maintenance. When the driver is to report the need for maintenance, the driver support should be accessible on the phone. The request then should immediately be submitted, no matter the repair time. There are five different categories for repair time of incident maintenance, that also set the urgency for the maintenance scheduling action (Figure 2.7). However, for an optimal overall schedule, the incident maintenance should be reported right away. Once the request is submitted, the planning and TFS department prioritizes the requests based on the repair time urgency.

Urgency	Repair time
1	Immediately
2	To the nearest workshop
3	Within 1 week
4	At the end of the trip
5	With the next maintenance

1 - most urgent
5 - least urgent

Figure 2.7_Incident request: Urgency

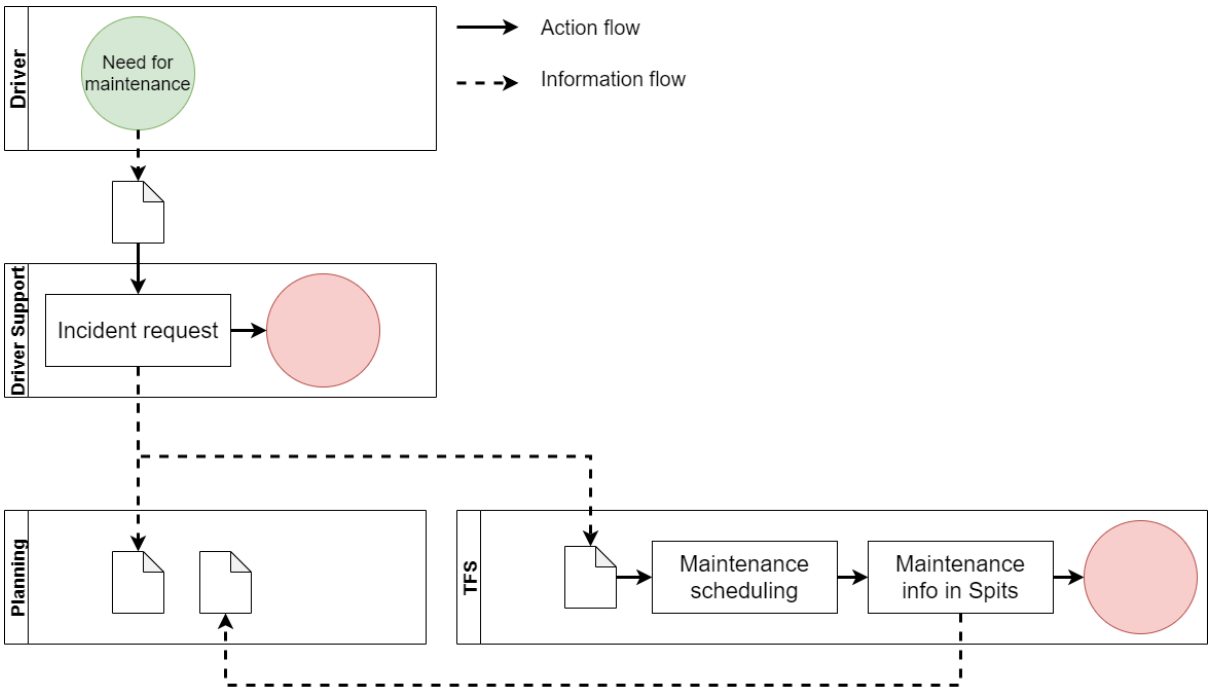

Figure 2.8_BPM: Information sharing incident request

6. What is the overall end goal of the reporting process?

The goal of the maintenance reporting process is to have well maintained trucks and trailers. Firstly, so that they are able to drive and transport the orders. Secondly, so that they conform to the statutory and technical requirements. In addition, it is important to do this reporting process efficiently, as then it is possible to plan and schedule the maintenance in an optimal way. Therefore, for the least amount of time lost and for the least amount of costs spent.

2.3 | Summary

The actors and their needed skills within the reporting process are established. The input values needed for a given actor are depicted. Moreover, the input values that are not yet stored in other programs are listed. The information sharing and action taking within the process is discussed and the overall goal of the reporting process is presented. Combining the findings from these research questions the information flow within the improved reporting tool can be set up. It is known which actors need to be informed about which information and who provides that information so that the process goal is met.

3 | Theoretical framework

This chapter looks at theoretical background for the research. It is part of the ADR stage 1. There are two main parts to research. First part looks into the collaboration of actors and the second part looks into information sharing. Subsection 3.1 specifically looks into values and ways for setting up a successful collaboration team. Subsection 3.2 looks into key aspects of collaboration of actors within processes, and into ways to assess them. In section 3.3, guides for defining the respective roles, and responsibilities of actors within processes are researched. In subsection 3.3, ways of efficient information sharing using different programs / databases are presented. Subsection 3.4 provides a summary of the discussed theoretical framework.

3.1 | Value of collaboration

Collaboration within a company brings new structure to organization and leads employees to commit to working for a common goal. It requires a well-defined planning and communication between all the actors (Cano-Hays et al. 2015). The collaboration reporting process within EMONS Group B.V. is already defined and operational. However, by implementing the designed improved reporting tool into the already existing process, the collaboration might be affected as well. Therefore, it is important to evaluate the collaboration process once the improved reporting tool is being used. There are four collaborative indicators to use for reflecting on assessment of process success.

- Effective effort: "Are we complying with our objectives to benefit the community and achieving our own interests at the same time?"
- Adequate effort: "Are we using sufficient resources to achieve the results?"
- Efficient effort: "Are we using our time, money and energy in the best way possible within the collaboration and in the community?"
- Lessons learned: "What have we learned about the relationships that we have built and the work we have done, and what still needs to be done?"
  (Cano-Hays et al. 2015)

Collaboration indicator 1: Effective effort

'Effective effort involves reflecting on our approaches to work smarter, which is needed to achieve better outcomes' (Brown, 2016). It is important for an efficient process that the actors show effective effort when carrying out their tasks. It allows for development and learning from the experience. Moreover, it is important that the objective and interests are being met by the process performance.

Collaboration indicator 2: Adequate effort

An adequate effort is defined as effort that is acceptable in quality or quantity (Lexico, 2021). The quantitative aspect does not apply to our evaluation of the reporting process, as the amount of work is solely dependent on the number of maintenance requests needed, not on the effort. The quality of the effort can be evaluated. The resources needed for achieving the overall goal of the process are assessed.

Collaboration indicator 3: Efficient effort

An efficient effort is effort that is not wasteful (Dictionary, 2021). It is important that resources within the process, such as time, money, energy are not being wasted.

Collaboration indicator 4: Lessons learned

For evaluating the lessons learned it is important to assess what has been done when performing the process. What was going well and what was not going well? Are there some aspects that still need to be improved? It is important to assess the reality of the process rather than to assess the process as it should be. The reality is different than the set norm and even though certain processes are planned in a certain way they might not work in practise.

ADR relation (Stage 4, Principle 6: Guided emergence)

It is important to address these indicators during validation of the process that uses the improved reporting tool. The improved reporting tool is designed due to inefficiencies with the current reporting process. However, it is important to evaluate whether the new process is more effective, adequate, and efficient. If the improved reporting tool does not actually improve the reporting process than

there is no value for the tool. Therefore, we evaluate the current reporting process for value using the collaboration indicators.

3.2 | Collaboration assessment

7. How to assess collaboration between different actors within a process?

Innovative assessment of collaboration (Davier et al., 2017) refers to team competencies for understanding how teams work and perform. Team competencies consist of understanding how much a team knows, what are the skills of the team and the overall value that is brought by the team. Furthermore, they define key issues relevant for collaborative assessment. Figure 4.1 shows these key issues grouped in four assessment groups.

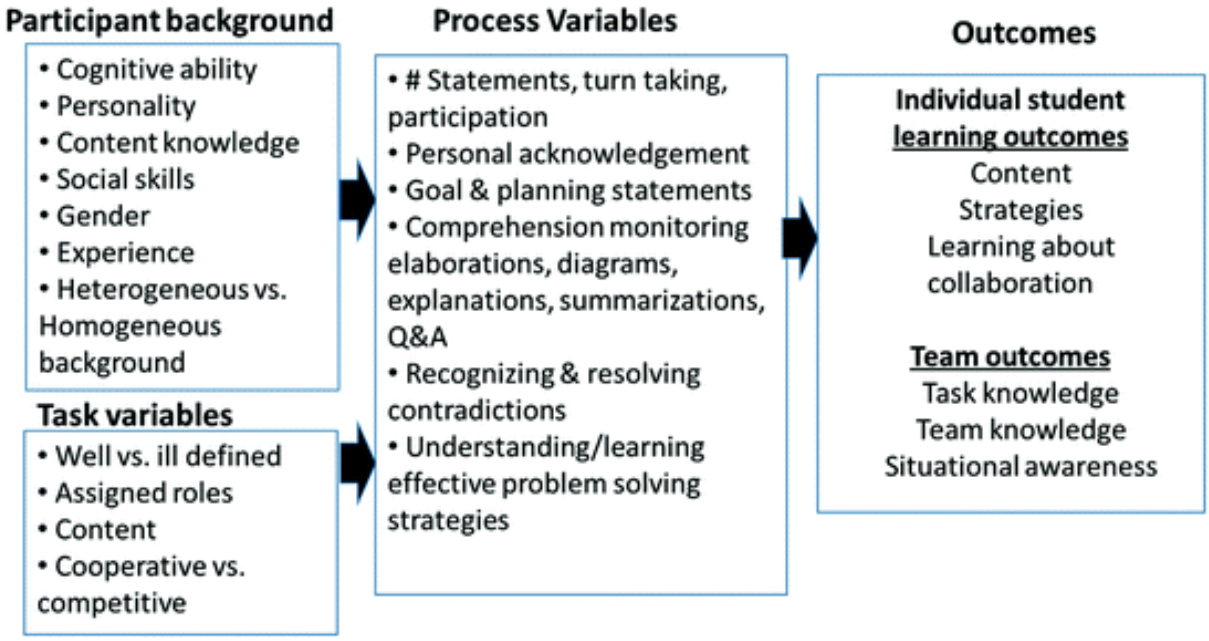

Figure 3.1_Taxonomy of collaborative assessment factors (Davier et al., 2017)

For the integration of theory, the collaborative assessment is divided into two parts. First part is related to the theoretical basis for the initial design of the reporting tool. The participant background depicts what is required from actors with regard to the task variables in the current reporting process. This is compared with the actual participant background to assess whether the responsibilities are divided efficiently. If characteristics are required but are not actually present they are depicted in red color. The second part is related to the validation of the improved reporting process. The process variables and outcomes that are aimed for in the improved reporting process are defined and will be used for the validation in the future when the reporting tool is developed.

Assessment group 1: Participant background

The participant background looks at the actors themselves. Cognitive ability is an ability to perform information reasoning, such as reasoning, problem solving or decision making (Gottfredson, 1997). These are more difficult to be learned than for example content knowledge, which can easily be learned by receiving information. Another important aspect in this group is the personality and social skills of the actor. The experience and heterogenous / homogenous background are also very important aspects. Experience provides already present knowledge about the area. Heterogenous background consist of having background of different types, whereas homogenous means that the

background is of the same type (Cambridge Dictionary, 2012). Therefore, this also provides insight into the knowledge of the actor within the area of the task.

Assessment group 2: Task variables

The task variables group focuses on the tasks that are performed by the actors. Well-defined tasks have clear goals and can be performed in a set way. Whereas ill-defined tasks cannot be performed in a routine way (Durling & Shackleton, 2002). It is also important that the roles of the actors are defined and that the content of the task is known. Moreover, the tasks are defined with regard to cooperative versus competitive aspects.

ADR relation (Stage 2, Principle 3: Reciprocal shaping)

Performing an assessment of the collaboration helps understand the skills and task performances required from the actors. It also helps look into the roles division within the process. The main value of performing the collaborative assessment is to set up the application so that it matches task characteristics. For example, if a certain aspect of a task is repetitive it can be standardized. Such insight is used as a basis for the initial application design.

Assessment group 3: Process variables

Process variables are used to measure the whole process. Aspects such as turn taking and personal acknowledgements are evaluated. It is also important that the goals and the planning of the process is made. Moreover, the actor understanding of the process is needed. For the process to run efficiently it is crucial that when problems arise they are recognized and solved. This leads to effective process and actor development by understanding and learning about the overall process.

Assessment group 4: Outcomes

There are two categories to consider when assessing the outcomes of the process. Individual and team outcomes. For the individual aspect, the actors should learn about the content and strategies related to the process. Moreover, they learn about the collaboration needed for the process to run. For the team outcomes, the actors should be aware of all the tasks that are necessary for the process to function. Also, it is needed that the actors are aware of the resources and experience available to them. All the actors need to be aware of what is happening during the whole process.

ADR relation (Stage 4, Principle 6: Guided emergence)

The collaboration assessment of process variables and outcomes is used for the validation of the improved reporting process. The validation goals for the collaboration assessment are then defined and evaluated once the improved reporting tool is developed and used.

3.3 | Actor analysis

8. How to visualize the responsibilities and actions of actors within a process?

Actor analysis methods describe specific activities designed to achieve a defined purpose (Hermans et al., 2009). In the analysis of the actor analysis methods, Hermans proposes three dimensions to help explain actor behaviour. Perception dimension focuses on beliefs of the actors, Values perception focuses on motivation, and Resource dimension focuses on objectives of actors. For the development of the tool, we will focus on the resource dimension as we are interested in what the actors need to do, therefore, in what are the objectives for the actors. ‘Resources enable actors to influence the world around them, including other actors, relations and rules in a network’, Hermans (2009). In the current case the resources are the information shared between the actors during the reporting

process. To visualise the resource dimension influence along the process we will look into a visualisation options for actor analysis.

An actor analysis checklist can be among other things used for mobilizing stakeholders' objectives. In general, the tool increases the awareness of influence of stakeholders during the process (Managing for Sustainable Development Impact, 2012). The article also provides an example for actor analysis checklist with the following inputs: stakeholders, primary activity, purpose, and impact. Using the example, we will adjust the checklist to be applicable for the visualisation of the resource dimension.

Combining the two theoretical frameworks, an actor analysis checklist table is proposed with input values relevant to the resources with which actors influence the reporting process. In Figure 4.2 we can see on the left side the example checklist and on the right side, the adjusted checklist to fit the resource dimension applicable for our case. In the left checklist the primary activity is interpreted as an action to be taken by the stakeholder and the impact as how does their activity affect the process. However, we are not interested in different actions of the actors, but instead we are interested in the way they share information in the reporting process. Therefore, we adjust the primary activity to be relevant to the information sharing. The main idea of primary activity 'what is performed by the stakeholder' is maintained. Moreover, to assess the impact on the process, we adjust how the information provided by the stakeholder is further used in the process.

Example of Actor analysis checklist (RAAKS)

Stakeholders	Pimary Activities	Position (Influence on decision-making)	Impact Contribution to successful outcomes of you programme
Policy makers			
Sales manager			
Farmer			
Researcher			
Etc.			
TOTAL			

Stakeholders	Primary activity			Impact		
Actor	Information to receive	From whom	When	Information to share	To whom	When
Driver						
Driver support						
Planning						
TFS						
Fleet manager						

Figure 3.2_Actor analysis checklist (Managing for Sustainable Development Impact, 2012)

Research relation (Stage 2, Principle 4: Mutually influential roles)

The actor analysis checklist provides visualisation of the primary activities that need to be performed by given actors. Moreover, impact of their activities on the process is visualised. The checklist is used for the initial design of the reporting tool as it provides understanding of how the information is shared within the process.

3.4 | Tables and databases

9. How can already stored information be used in an efficient way?

Database is a collection of information that can be stored within a computer program. Moreover, a relational database allows to relate data points to each other. It allows for easy access of relevant information based on the main object, known as the key. This is possible by applying SQL (Structured Query Language) (Hughes, 2019). It allows for an effective data searches for the selected key object.

In order for the application to run efficiently, a relation database with table connections needs to be designed. Having more tables in a database helps to 'reduce repeated input of the same content, prevent spelling errors due to repeated input, and improve filtering of data in the displayed tables', Großkopf et al. (2013). Therefore, we look into how to create tables and how to define the

relationships between them. When creating a table, the table is given a name. Then we define the variables for the table with the following aspects: Field name, Field type, Entry requirements (Großkopf et al., 2013). Field name is the name of the variable, for example, DriverFullName. The field type then depends on the variable, whether it is a text, number, time, etcetera. The entry requirements relevant for us are the primary key, not null, and foreign key. Primary key is a unique value and cannot be null, not null means that the variable has to have a value and cannot be left empty, lastly, the foreign key is a variable that is linked to a primary key in another table (Großkopf et al., 2013). Use of this three basic definitions allow us to create an efficient database schema for the application. One other aspect to consider is the relationship type between the tables. There are three main types, namely, one to one, one to many and many to many relationship (Großkopf et al., 2013). The first two relationships are the ones we will use. Figure 4.3 gives an example of this two relationships.

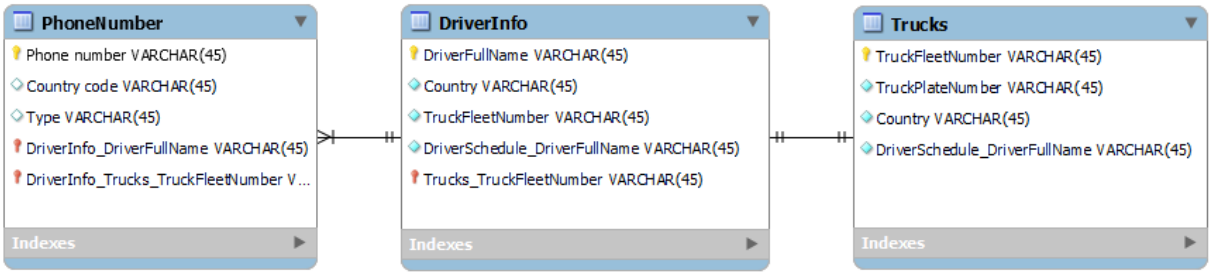

Figure 3.3_Database relationships

One to one relationship is between the DriverInfo and Trucks table. In general, many drivers can drive many trucks, but for the purpose of the reporting process this relationship is one to one. This is due to the relationship purpose which is to be able to contact a driver driving a given truck. Each time a truck is exchanged between drivers, the driver – truck relation is rewritten. Therefore, since one truck is driven by only one driver at a given time, and a driver drives only one truck at a given time, this is a one to one relationship.

One to many relationship is present between DriverInfo and PhoneNumber table. This is due to the fact that driver can have more phone numbers (for example work and personal). However, one phone number cannot belong to more than one driver. Therefore, the driver to phone number relationship is a one to many relationship.

Research relation (ADR Stage 2, Principle 3: Reciprocal shaping)

The relation database is used to set up the backend of the improved reporting tool. It links the necessary information together. This allows to search for certain attributes of a specific object. The related information is automatically linked to a certain object. The additional, already stored, information does not have to be manually looked up anymore. At the beginning of each cycle a relevant database schema is created.

3.5 | Summary

It is important to evaluate the new reporting process compared to the current reporting process to establish whether there is a value in the use of the improved reporting tool. This is done by assessing the four collaborative indicators. Moreover, the collaboration within the process needs to be assessed. This is done by collaboration assessment of four assessment groups. In order to provide a guide and understanding of the new reporting process an actor analysis checklist is made. Furthermore, to

provide an efficient information sharing within the process, a relation database schema is provided for supporting the improved reporting tool.

4 | Integration of theory

In this chapter the theoretical framework and the context analysis are combined. This chapter is part of stage 1 of the ADR. In subsection 4.1 the collaboration assessment of actors is made. In subsection 4.2 an actor analysis is performed. Lastly, subsection 4.3 provide a summary of the integration of theory.

4.1 | Collaboration assessment

For performing the collaborative assessment of the actors, we look at the main actors involved in the reporting process. We look at all the variables for both regular and incident maintenance at the same time. Fleet managers serve as a link between the order schedule and the reporting tool. They are not part of the analysis as their involvement in the process is not directly related to the maintenance reporting aspect. Therefore, their background and task variables are not of interest. The actors of interest for collaboration assessment are driver support, planning, and technical fleet support. These are the actors that are actively involved in the reporting process. For each of these actors we first define the participant background and task variables (Figure 4.1).

Participants and tasks

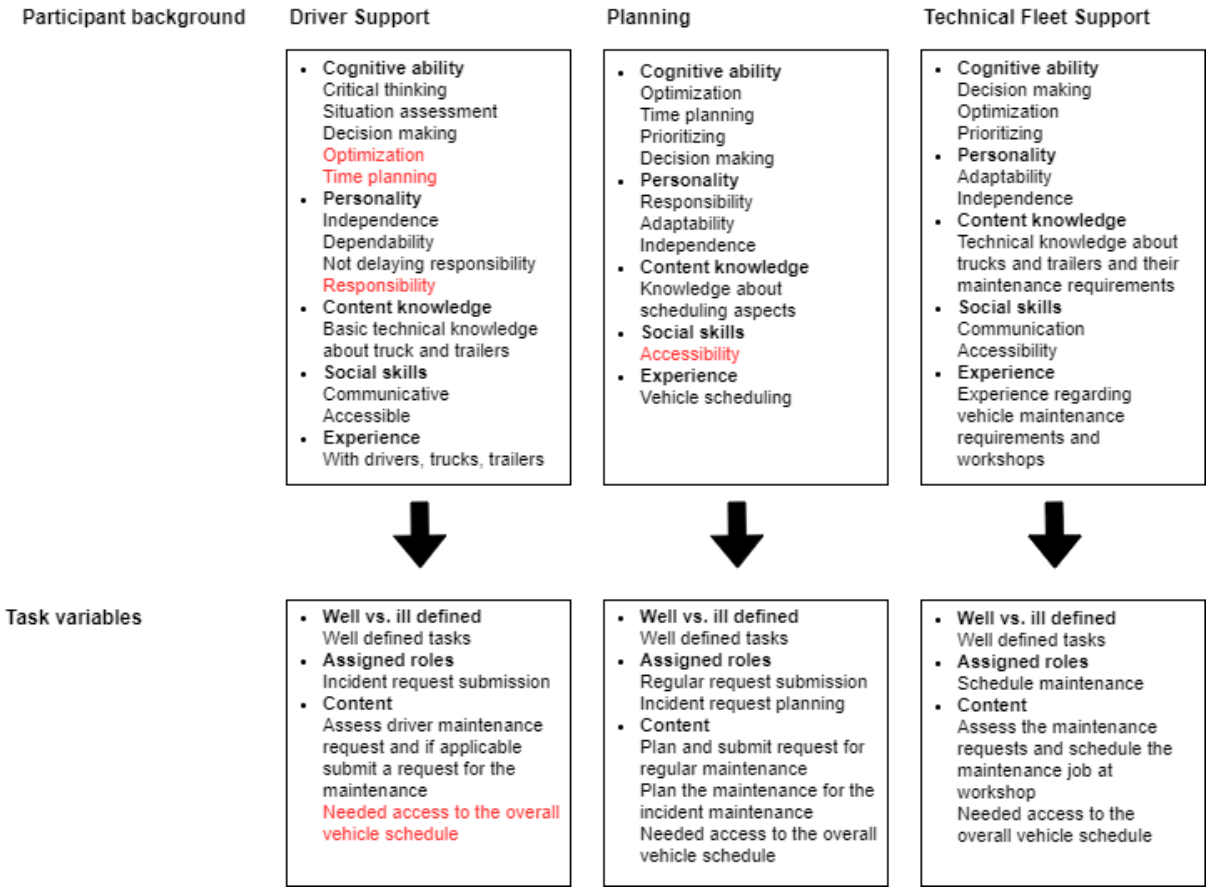

Figure 4.1_Collaborative assessment: Participants and tasks

The collaborative assessment of the participants and the tasks provides an overview of which characteristics are required for carrying out the tasks using the current reporting tool. However, the characteristics depicted in red color are characteristics that are not in line with the reality of

characteristics of the actors (Figure 2.4). Specifically, it is requested from driver support to provide requested ETA, ETR and workshop location. However, in order to do so it is required to have optimization and time planning abilities. Moreover, it is required that the actors take responsibility for the selected ETA, ETR and workshop location. As shown in the task variable assessment for driver support, they do not have access to the overall vehicle schedule, nor any of the participant background characteristics (Figure 4.1). Therefore, it cannot be required from them to do so. That is why for the improved reporting process in which the improved reporting tool is used, the driver support will no longer be required to submit ETA, ETR or workshop location for the maintenance. This will be left to the planning department, which is responsible for the scheduling.

Moreover, is it not required from the planning department to be accessible at all times when it comes to the reporting process (Figure 2.4). For regular maintenance it is required that they submit a request, and for the incident maintenance it is required that they plan the maintenance. However, the scheduling of the maintenance is performed by TFS department. Therefore, if adjustments need to be made, for example, due to unavailability of the workshop, the planning department needs to be contacted. The proposal is to have the TFS department schedule the maintenance themselves. They do have the basic necessary skills to do so, decision making and optimization. However, in the reality of the current situation, even though planning department is not required to be accessible they share the office with TFS department. This makes it easy to simply communicate within the office to make needed adjustments. Therefore, in the current state of the shared office, the planning of the maintenance will be left as it is. However, in case of future research the benefits of shifting the maintenance scheduling to TFS department should be looked into.

ADR relation (Stage 2, Principle 3: Reciprocal shaping)

The findings from collaborative assessment of participant background and task variables are used for the initial design of the improved reporting tool. The findings show inefficiencies in the current division of actors' responsibilities. For designing an improved reporting process all requested responsibilities need to be in line with the abilities of the actors from whose they are requested. Therefore, the responsibility to schedule an incident maintenance is shifted to the planning department.

4.2 | Actor analysis

Using the results from the research and knowledge questions the actor analysis focused on information sharing of the reporting process is performed. Figure 4.2 shows how the information is shared in the current reporting process for regular request and Figure 4.3 for incident request. The information depicted by red color is related to situations when additional information needs to be shared. For both types of requests that is when the maintenance cannot be scheduled as planned in the submitted request. Therefore, for regular requests there are 4 or 5 mails sent per each request. For incident maintenance, in case of need for adjustments either planning or TFS or both can get back to driver support, therefore, the number of email per request is between 5 and 11.

From	What	To: Fleet Manager	Driver Support	Planning	TFS	Spits	# mails
Planning	Regular request mail	x	-	NA	x	-	2
TFS	Reply about updated info	x	-	-	NA	-	1
TFS	Scheduled maintenance info	x	-	-	NA	x	1
Planning	Order schedule	x	-	NA	-	-	1
							Total 4 or 5

Figure 4.2_Current information sharing: Regular request

From	What	To:	Fleet Manager	Driver Support	Planning	TFS	Spits	# mails
Driver Support	Incident request mail		x	NA	x	x	-	3
Planning	Reply about incorrect info		-	x	NA	-	-	1
TFS	Reply about incorrect info		x	-	-	NA	-	1
Planning	Adjusted info		x	-	NA	x	-	2
TFS	Adjusted info		x	-	x	NA	-	2
TFS	Scheduled maintenance info		x	-	-	NA	x	1
Planning	Order schedule		x	-	NA	-	-	1

Total 5 to 11

Figure 4.3_Current information sharing: Incident request

With the average number of 10 requests received per day, there are at least 40 to 50 mails sent per day during the maintenance reporting process. These are all sent separately, so they are located between other mails that the actors receive during the day. Moreover, it is not set when the information needs to be acted on. In order to improve this process, the request related information is input in the improved reporting tool. All requests are located in one place and all actors have access to the information in the reporting tool. This provides a clearer and easier to work with environment for the reporting process. In addition, a guideline for when the information should be acted on is provided. Figure 4.4 shows the actor analysis for regular maintenance and Figure 4.5 shows the actor analysis for incident maintenance.

Actor	Information to receive	From whom	When	Information to share	To whom	When
Planning	Indicator for upcoming deadline for planned maintenance	Spits	1-3 weeks or X km prior to deadline	Repair time, purpose, vehicle, maintenance type, description, other damage (+description), ETA & ETR date and time, workshop location	TFS (Reporting tool)	Depends on urgency (1 week > 3 weeks prior to deadline)
TFS	Repair time, purpose, vehicle, maintenance type, description, other damage (+description), ETA & ETR date and time, workshop location	Planning (Reporting tool)	When planning submits the request	Actual ETA & ETR date and time, workshop location	Planning Fleet Manager (Reporting tool)	As soon as possible
Fleet manager	Schedule for driver	Planning (Mail)	When schedule made by planning	Driver schedule	Driver (Board Computer)	Prior to the trip

Figure 4.4_Actor analysis: Information sharing (Regular Maintenance)

Actor	Information to receive	From whom	When	Information to share	To whom	When
Driver	Updated schedule, location and time of workshop to visit	Fleet manager (Board Computer)	Once the maintenance is scheduled	Reason for request and description of maintenance needed, load status	Driver support (call)	As soon as possible
Driver support	Reason for request and description of maintenance needed, load status	Driver (Phone call)	When called by driver	Driver, repair time, purpose, vehicle, exact location, load status, description of maintenance needed	Planning (Reporting tool)	As soon as possible
Planning	Driver, repair time, purpose, vehicle, exact location, load status, description of maintenance needed	Driver Support (Reporting tool)	When request added in reporting tool by driver support	ETA & ETR date and time, workshop location	TFS (Reporting tool)	Depends on urgency (A - Immediately, E - Within a week)
TFS	Repair time, purpose, vehicle, exact location, load status, description, ETA & ETR date and time, workshop location	Planning (Reporting tool)	When planning part of request is filled in	Actual ETA & ETR date and time, workshop location	Planning Fleet Manager Driver Support (Reporting tool)	As soon as possible
Fleet manager	Updated schedule for driver	Planning (Mail)	When schedule made by planning	Updated schedule, time and location of workshop to visit	Driver (Board Computer)	As soon as possible
	ETA & ETR and workshop location	TFS (Reporting tool)	When ETA & ETR and workshop location filled in			

Figure 4.5_Actor analysis: Information sharing (Incident Maintenance)

These figures provide a guideline of how the process flow should be performed by the actors involved in the process when using the improved reporting tool. It also provides a guideline on when the information should be reported. For the regular maintenance, the requests are submitted based on urgency, the closer approaching deadline has higher priority. The incident maintenance requests need to be submitted as soon as possible (some might have a lower priority, however based on findings in interview it is set to have all cases reported right away; Appendix A2.2). Another aspect that does not have to be dealt with right away is the planning department planning the incident maintenance. This is again done based on urgency (A urgency should be done immediately, E urgency can wait a few days but should be done within a week). This is due to no pressing deadline and therefore there is more time to schedule the most optimal maintenance job. For the other aspects, the action should be done as soon as possible.

ADR Relation (Stage 2, Principle 4: Mutually influential roles)

The actor analysis checklist is provided to the actors in the reporting process. It serves as a guide for the new reporting process. Understanding what is required from each actors allows for better understanding of the improved reporting tool. Therefore, the feedback is expected to be more critical.

4.3 | Summary

The current reporting process shows issues with some of the responsibilities required from incorrect actors. Moreover, the communication within the process is overwhelming and does not have a good overview. For the improved reporting process, the responsibilities will be shifted so that the qualified actors are asked to provide certain information. Moreover, the improved reporting tool provides one environment for the requests and their relevant information. This creates an overview which provides an easier way to access the requests information.

5 | Solution design

The solution design is part of the ADR stage 2. The artifact design for improving the reporting process is presented. The artifact is an application design for a reporting tool which will be used by four actors. Namely, fleet manager, driver support, planning, and technical fleet support department. The design is applicable for application in the Microsoft PowerApps environment. The solution design presents the initial design from BIE cycle 1 in subsection 5.1, and the final design from BIE cycle 2 in subsection 5.2. Moreover, the relevant relation database schema is provided in subsection 5.3.

5.1 | BIE Cycle 1: Application design

The initial application design can be found in Appendix D1.1. There are five main flows in the improved reporting tool: fleet manager, driver support, planning, TFS and scheduled maintenance. Moreover, there are four main purposes in the improved reporting tool: administration of drivers, input of order schedule, submission of regular and incident requests, and monitoring of scheduled maintenance. This section discusses the changes made based on the feedback on the initial design (BIE cycle 1). The unchanged aspects are presented as part of the presenting of final design in BIE cycle 2 (Section 5.2).

The summary of the feedback interviews on the initial design can be found in Appendix A3.1. The main changes within the flows that are made to the design are driver support searching by truck and trailer fleet and plate numbers. Submitting of off hours maintenance reports. An overview of actual ETA, ETR and workshop location available to the fleet managers, driver support and the planning. Moreover, a mail template for the maintenance request is provided for TFS.

For supporting the design of BIE cycle 2 the following adjustments are made to the database schema (Figure5.9). The Trucks and Trailers tables have additional attributes assigned. Namely, TruckBrand, TyreBrand, TyreCompanyContact and TyreSize for Trucks. TrailerBrand for Trailers. Moreover, an additional table is defined as FleetManagerInfo, providing contact information of the fleet managers. A given fleet manager manages several drivers, therefore, the fleet manager is assigned to several driver schedules. However, one driver schedule cannot have more fleet managers. Therefore, the FleetManagerInfo to DriverSchedule is a one to many relationship.

The initial design already shows improvement in the reporting process. Variable 2 – Reporting tool input variables (Section 1.2.4) had a set norm to have less than 23 input values for incident and less than 22 input values for regular requests. Figure 5.1 shows the input variables for incident requests (The color coding shows where the information from reality is located within the norm). The initial design has reduced the number of input values for incident maintenance to 8 for the initial submission of the request and to 15 for the overall submission. By using relations in the database schema 8 input values do not have to be input when submitting the request. Moreover, based on collaborative assessment (Section 4.1) the responsibility to input the planning of the maintenance was shifted from the driver support to the planning department. Therefore, the 7 input values related to the planning of maintenance are not input during the initial submission of request. Figure 5.2 shows the input variables for regular requests. By using relations in the database schema 5 input values do not have to be input anymore. Moreover, two input values (depicted by red color) were removed as they were used for selecting whether ETR or comments are present. Instead, if they are present they can simply be input in the request, and if not the input fields can be left empty. The number of input values for the regular requests is then 14. To conclude, the norms for variable 2 were met. The incident request has 8 / 15 input values, which is less than 23. The regular request has 14 input values, which is less than 22.

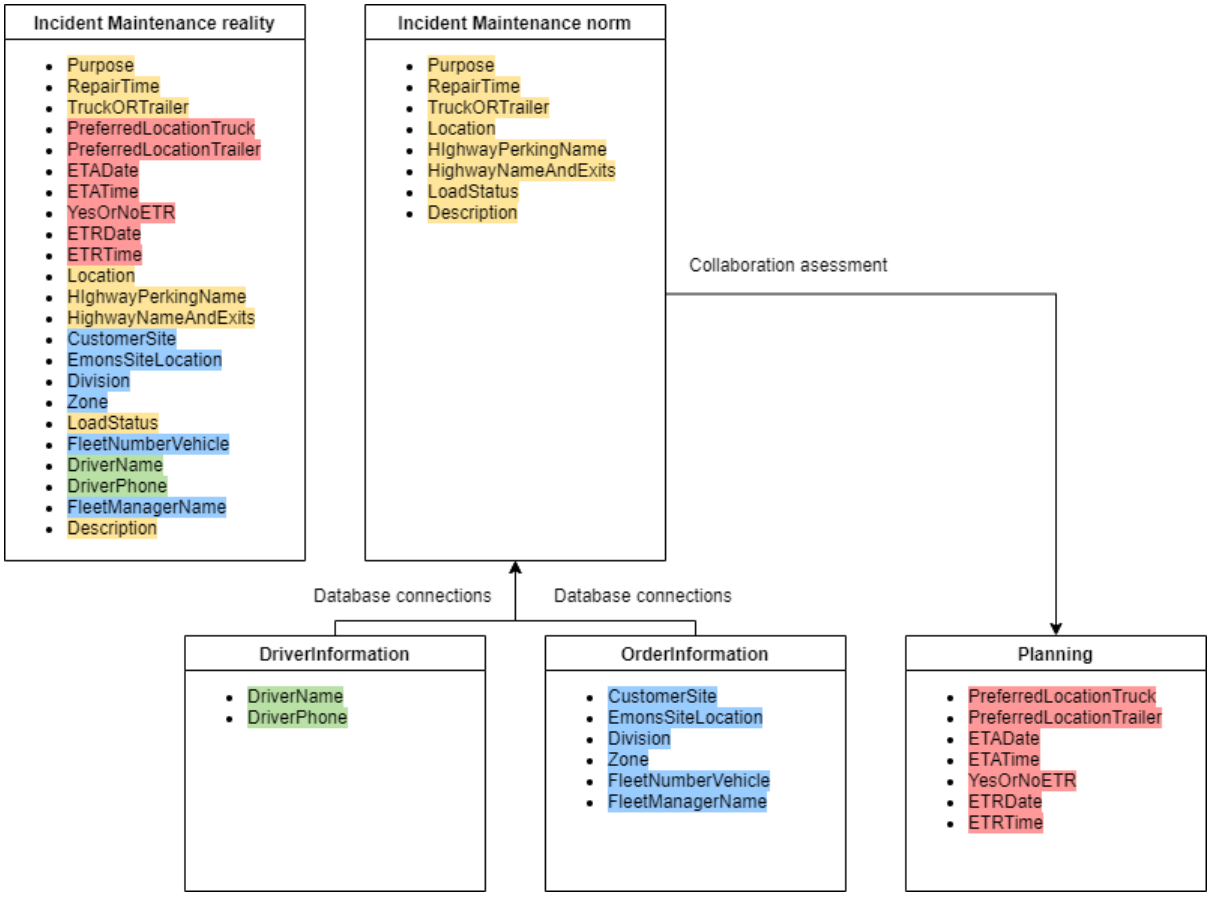

Figure 5.1_Input values: Incident request

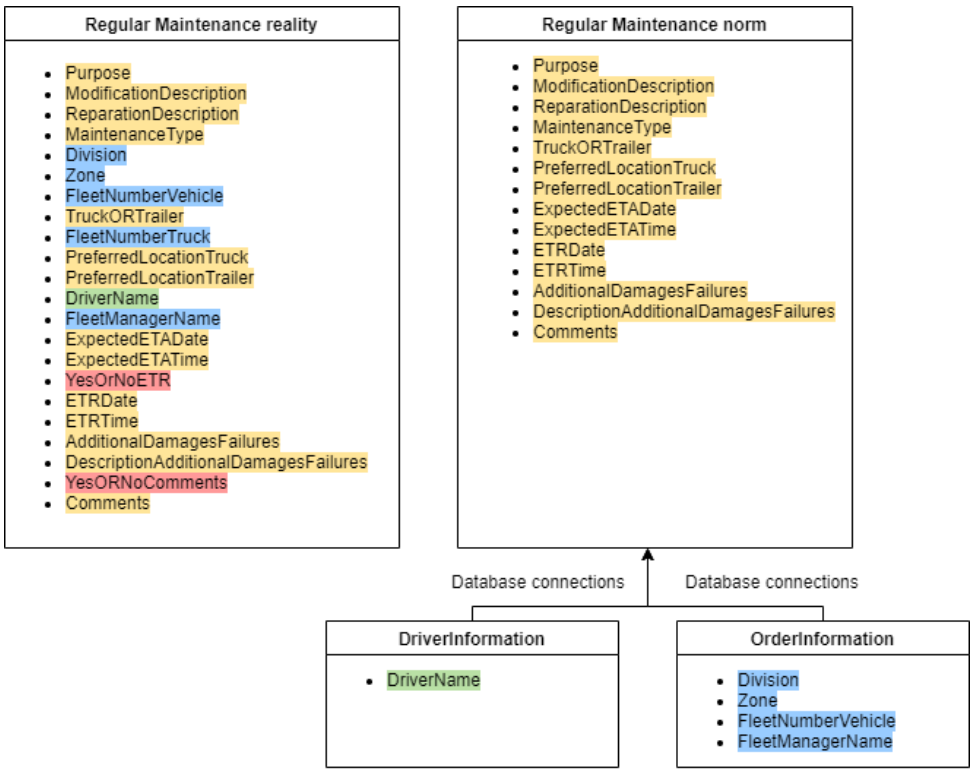

Figure 5.2_Input values: Regular request

5.2 | BIE Cycle 2: Application design

The final design for the improved reporting tool can be found in Appendix D1.2. Appendix D2 provides some additional information about the design asepcts. Figure 5.3 shows in the first screen on the left, the home screen of the tool. There are 4 main action flows, one for each of the actors: fleet manager, driver support, planning and TFS. Moreover, the main action flows that can be carried out by the given actors are shown (pressing the circled button in the tool opens up the corresponding color screen).

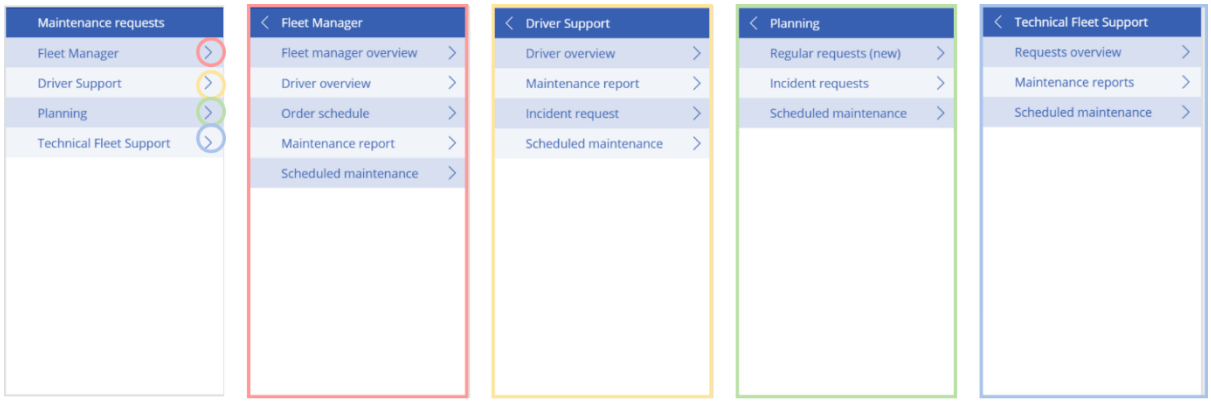

Figure 5.3_Improved reporting tool: Main action flows

Fleet Manager

The first action flows for the fleet managers are fleet manager and driver overview. These have the same design and functionality. The purpose is to have an overview of these employees. Once the fleet manager / driver overview is selected an overview of the employees is shown, sorted by the names. Furthermore, it is possible to use a search box and search for an employee by their name or by country. It is possible to add a new employee, or search for an existing one and edit their information. The information of the employees that is present is one that is needed for within the reporting process. Namely, the names and contacts (mails, phone numbers).

The next action flow is the order schedule. An order schedule is linked to a given driver, therefore, when the flow is selected an overview of the drivers (same principle as in driver overview) is shown. When the specific driver is selected order schedule can be added for the driver. The main purpose is to link the driver to a given truck and trailer. Moreover, some details regarding the order schedule are added so that they do not have to be looked up again in case of maintenance request submission.

The maintenance report flow allows to add a report for an off hours maintenance, or a maintenance related to tyre contract (drivers can contact workshop themselves to have maintenance on a tyre). This serves to inform the TFS so that they are able to contact the workshop after the maintenance.

Moreover, it is possible to lookup the status of a schedule maintenance in the scheduled maintenance flow. The overview of all scheduled maintenances is shown. It is possible to search for a specific scheduled maintenance by a truck or trailer fleet or plate number. Moreover, it is possible to search for scheduled maintenance for vehicles from a given country. This is due to fleet managers being from one of the countries, and therefore, being interested only in vehicles from the given country.

Driver Support

The driver overview, maintenance report, and scheduled maintenance flows are the same as for the fleet managers.

The incident request flow is the flow where incident maintenance requests can be submitted. Figure 5.4 shows the improved reporting tool action flow for submitting the incident requests. First, it is selected by driver support whether the maintenance is needed for a truck or trailer. Then the corresponding overview is shown. It is possible to search for the specific vehicle by fleet or plate number, or to search for vehicles from a given country. Once the vehicle in need of maintenance is selected, it is possible to input the values relevant for the incident maintenance, that are not yet stored anywhere else. Once this is done, the initial submission of the incident request is complete.

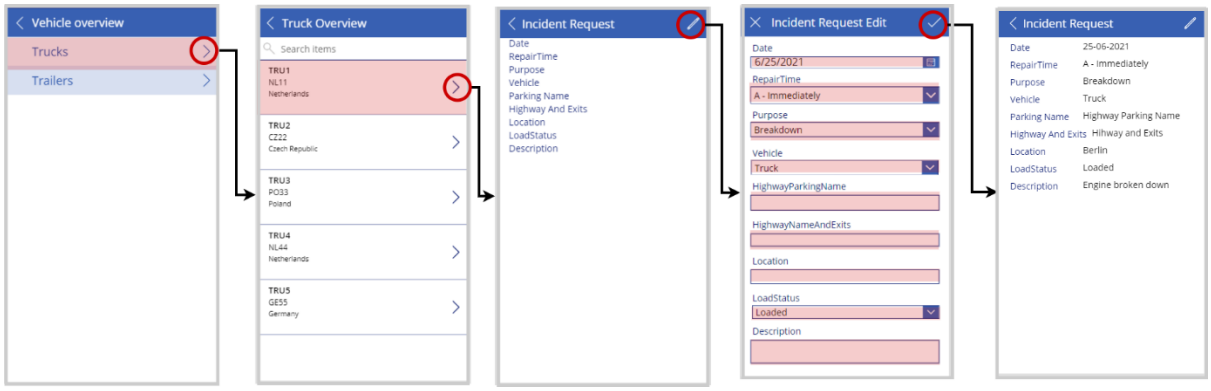

Figure 5.4_Improved reporting tool: Incident requests (Driver support)

Planning

The first flow, regular requests (new), is for submitting regular maintenance requests. Figure 5.5 shows the submission flow. Same as for initial submission of incident requests, first the vehicle type is selected. Then the overview of the vehicles is provided, and once the specific vehicle is selected, the input values relevant to the regular request are input and the request is submitted. Additionally, all the regular requests are automatically assigned urgency F – regular maintenance (Section 5.3.2).

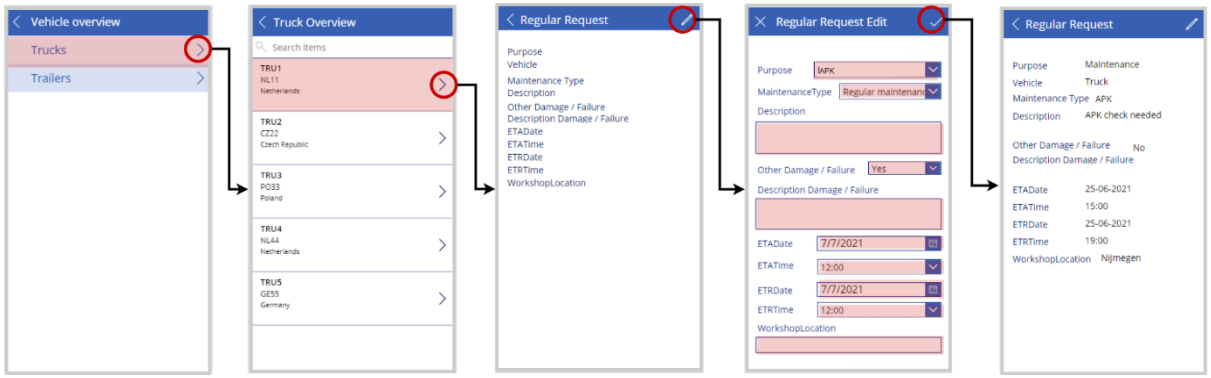

Figure 5.5_Improved reporting tool: Regular requests (Planning)

The incident requests flow is the continuation of submission of the incident request. Figure 5.6 shows the flow. First, the initial submission overview is shown (incident requests submitted by driver support). The requests are sorted by their urgency, which is based on the provided repair time needed for the maintenance. A is the most urgent and F is the least urgent (Section 5.3.2). In addition, it is also possible to search for requests based on repair time, maintenance type or date of request submission. Moreover, for finding a specific request it is possible to search by truck or trailer fleet or plate number. Once a specific request is selected, the initially submitted information about the maintenance is shown. Moreover, it is possible to look at the contact information for the request or at the information regarding the order schedule . The action that needs to be taken by planning is to plan

the maintenance schedule. Therefore, to edit the request and add the information about ETA, ETR and workshop location. Once this information is submitted, the incident request is fully submitted.

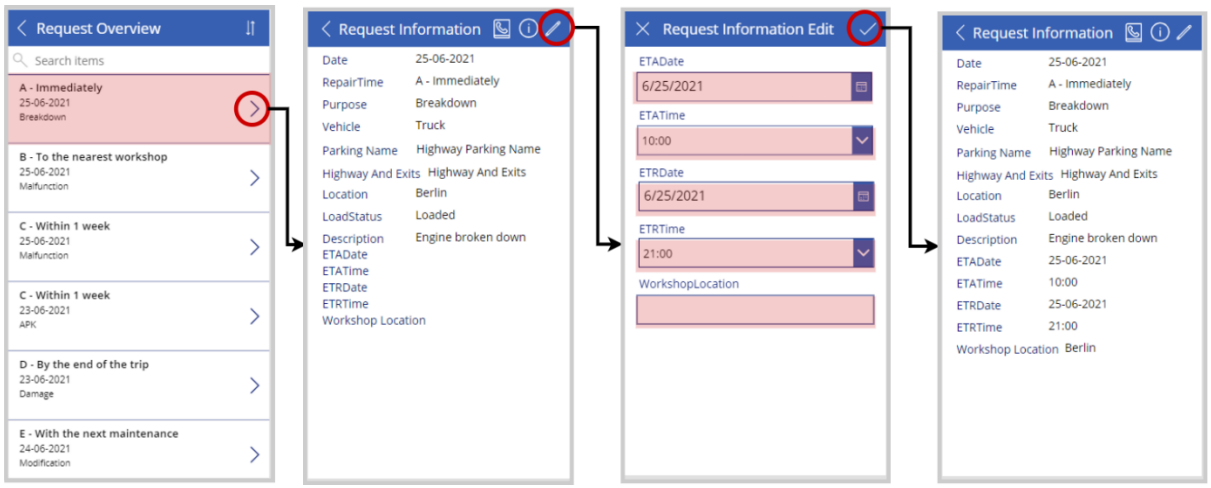

Figure 5.6_Improved reporting tool: Incident request 2 (Planning)

The last flow, scheduled maintenance, is the same as for fleet manager and driver support.

Technical fleet support

The request overview flow is used for the scheduling of the maintenances. Figure 5.7 shows the action flow. First, the overview containing both incident and regular requests is shown. The requests are sorted by the closest approaching ETA. This is due to the vehicle being the first to be able to get to a workshop, therefore, it should be scheduled first, even if the urgency is lower. However, it is also possible to look for a specific request using the search box. Requests can be searched for by date of submission, ETA, ETR, truck or trailer fleet or plate number. Once a request is selected, overview of the request information is shown. Then the TFS schedules the maintenance at the workshop and inputs the actual ETA, ETR, and workshop location info (it might be scheduled by planning that ETA is 13:00, but in reality the truck cannot get there in time, so the actual ETA is later than the expected ETA, so it is updated now). Once the scheduled maintenance information is submitted, the request is removed from the requests overview and is moved to the scheduled maintenance overview sections.

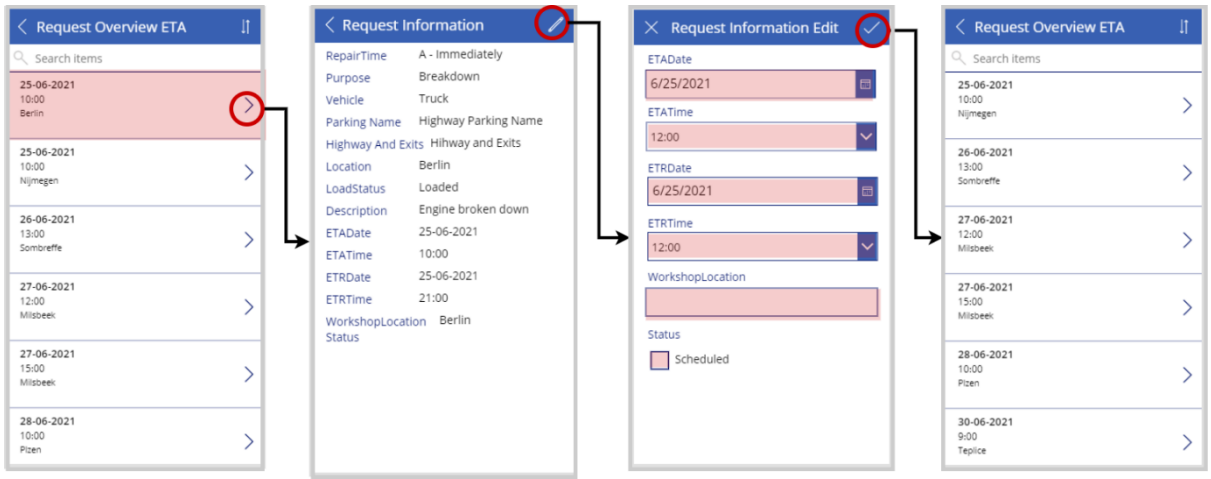

Figure 5.7_Improved reporting tool: Maintenance scheduling (TFS)

The maintenance reports section provides an overview of off hour maintenance or maintenance related to tyre contracts. The overview is sorted by the date of the maintenance. The maintenance

has already taken place, TFS only needs to contact the workshop afterwards. The contact information for the workshop is provided in the report. A draft mail can also be drafted, so that relevant maintenance information is input. Then text for the workshop can be generated and TFS only needs to copy it into the email.

The schedule maintenance flow is different for TFS, compared to the other three actors. Figure 5.7 shows the action flow. The overview of scheduled maintenance is sorted by the closest approaching ETA or ETR. Once a scheduled maintenance is selected, the scheduled maintenance info is shown. Then the ETA or ETR is checked. If the ETA or ETR is not met, the new date or time is input and the scheduled checkbox is checked. Then the ETA or ETR is updated and stays in the scheduled maintenance overview until it needs to be checked again. If the ETA is met, the complete checkbox is checked, and the ETA is removed from the schedule maintenance overview. If ETR is met, again the complete checkbox is checked and the whole scheduled maintenance is removed from the tool.

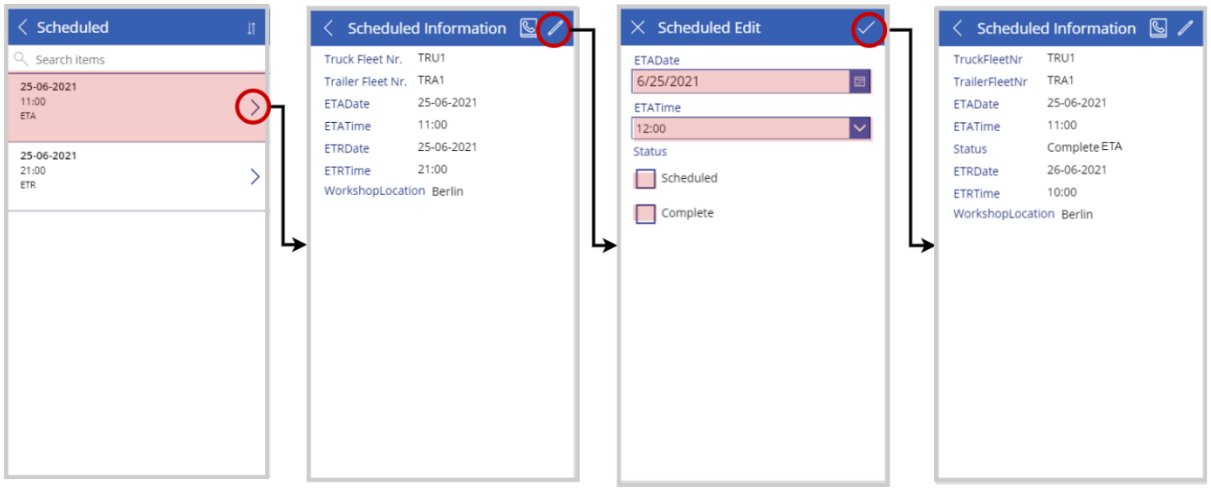

Figure 5.8_Improved reporting tool: Scheduled maintenance (TFS)

5.3 | BIE Cycle 2: Databases and tables

For the functionality of the improved reporting tool a relation database schema is made. Connections between tables are made so that information related to a certain key value are automatically connected as well. In subsection 5.3.1 the database schema is presented and in subsection 5.3.2 the database tables for drop down selection are presented.

5.3.1 | Database schema

The Figure 5.9 shows the tables within the relation database used for the submission of requests with the improved reporting tool. It is important to note right away, that the database is used for the reporting tool. Therefore, the information we are interested in is only the updated one. Therefore, even though a given truck can have multiple drivers or requests over a time, the relationship in the database is one to one. When a driver is assigned a new truck or trailer, the information is simply rewritten. Therefore, for the purpose of the maintenance reporting, there will not be other than one to one relationship between any of the tables, except for the fleet manager to driver schedule. At a given time, a fleet manager is managing multiple drivers and therefore driver schedules. The variable types are assigned based on whether the variables are text, number, or date/type variables (HostGator, 2021).

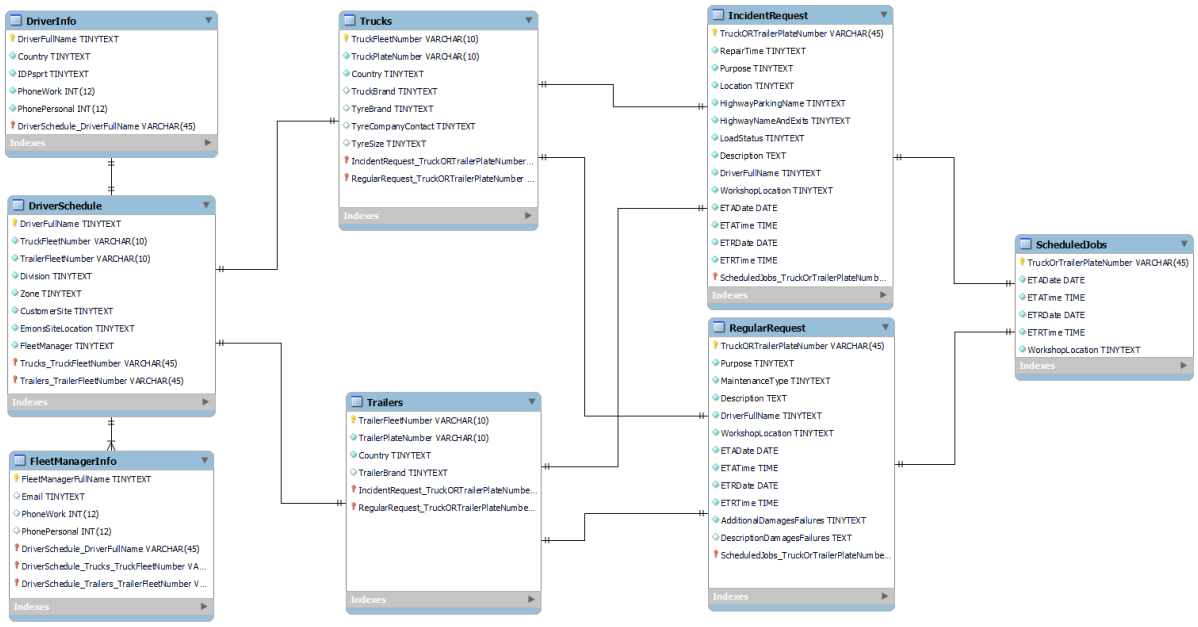

Figure 5.9_Improved reporting tool: Database schema

5.3.2 | Drop down selection tables

In addition to the relation database schema, several additional tables for drop down selection are defined (Appendix D1.1 - FigureD1.1.6). These tables contain pre-set inputs for different input variables. This is done for input variables that have a discrete list of options. For example, with regard to the IncidentRequest table (Figure 5.9) there is a set number of options to be input for RepairTime. We define an additional table RepairTime that is linked to the input field within the Microsoft PowerApps and allows for a drop down selection from the options defined in the RepairTime table (Figure 5.5).

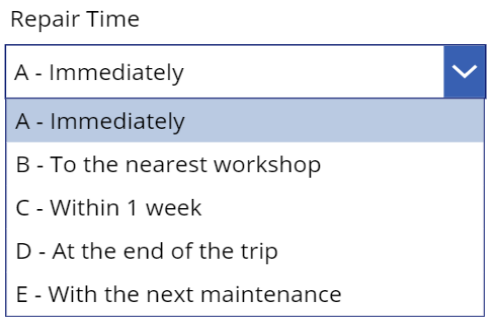

Figure 5.10_Drop down selection

6 | Solution validation

The solution validation chapter is related to the stage 3 of ADR. Subsection 6.1 focuses on validation of the main research deliverable. In subsection 6.2 the validation of other deliverables is performed. Moreover, in subsection 6.3, the future validation of the deliverables is discussed.

6.1 | Main deliverable

The main deliverable is a design for an improved reporting tool. As the tool is not yet developed, the evaluation at the current time is based on the requirements and the user feedback on the design. The requirements set for the improved reporting tool are discussed in subsection 6.1.1. In subsection 6.1.2 the user feedback for the design validation is presented.

6.1.1 | Requirements

The main requirements for the research are based on the norms of variables set for measuring the core problem. There are two variables, therefore two main requirements for the improvement of the reporting process (Section 1.2.4). Variable 1 – Request submission time, the norm is to have on average a maximum of 1% of the request be submitted for over a half an hour. This cannot yet be validated as the tool is not yet being used, therefore, it is part of the future validation (Section 6.3.1). However, the length of submission request is also related to the number of input values needed for the request submission. Variable 2 – Reporting tool input values, the norm is to reduce the number of input values from 23 and 22 for respectively incident and regular maintenance. This has been met, as currently, the number of input values required to be filled in when submitting a request is 8 / 15 and 14 respectively for incident and regular maintenance.

6.1.2 | User feedback

The user feedback on the final design is positive (Appendix A3.1 and 3.2). It is carried out partly as part of groups stage, interviewing other departments as well. It is expected by the users that the communication with regard to repairs and maintenance will improve. The effort needed for the submission of the requests is also reduced which provides a better working for the departments submitting the requests. For the TFS department all the requests are located in one place, and they do not need to search for information in different places anymore. This will provide a calmer working environment within the department. Moreover, the waste of resources of times and needed communication (mails) is removed which is another satisfactory aspects for the actors.

6.2 | Other deliverables

The task and process analysis which was based on interviews with TFS as part of the preliminary research suggests inefficiencies with regard to information sharing between TFS and other departments. This has been confirmed by interviews with the other departments as well. Actor analysis is validated when the feedback from users of the reporting tool is obtained during the BIE cycles. The actors are aware what information they need to submit and receive. However, the set time guides can only be validated when the reporting tool is actually developed and will be in use. Therefore, KPIs for future validation of the actor analysis are also set (Section 6.3). Moreover, the database schema is validated by the functionality of the designed reporting tool. There are no goals set for the future validation of the overall database schema, simply the functionality of the tool is the validation of the database schema. The validation of the drop down selection tables is validated as part of the future validation. The drop down selection is validated by user evaluation of the tool.

6.3 | Future validation

For validating the developed reporting tool there are three aspects to take into account. The subsection 6.3.1 discussed the tool validation through the use of KPIs and their set goal values. In subsection 6.3.2 the goals for validation of the reporting tool through the use of collaborative indicators (Section 3.1) and collaborative assessment of the new reporting process are set. Moreover, in subsection 6.3.3 the goals for user evaluation of the interaction with the tool are presented. Lastly, the subsection 6.3.4 provides a timeline for the future validation of the three aspects.

6.3.1 | Key Performance Indicators

Process Performance Indicators (PPIs) are Key Performance Indicators (KPIs) focused on the evaluation of processes. PPIs evaluate success of a given existing process within a company (del-R´ıo-Ortega et al., 2010). We focus on the base measurements. Specifically, the count and data measurements. These are obtained by measuring certain values every time a process is performed. (del-R´ıo-Ortega et al., 2010). There are several aspects we can focus on with the new reporting tool. Firstly, we look at the

reporting time of a request. Secondly, we look at the time duration between submission of a request and a scheduling of its maintenance. Thirdly we look at how the requests are submitted. Figure 6.1 shows the three KPIs, their description, and validation goal.

Request submission: During the data evaluation of the current reporting tool, we have obtained the reality of this measure (Figure 1.5). For the improved reporting tool, a PPI of time spent to submit a request is set. This is a count measure. Compared to the original tool, the aim is to not have any requests that take over a half an hour to be filled in. (The filling in of a request is relevant to the initial submission of a request. This means the driver support submission of incident and the planning submission of regular request). Therefore, we count how many times a requests takes over half an hour to be submitted. The idea is then to evaluate this request and find out why this was the case so that it can be resolved and does not occur again.

Submission to scheduling: In addition, we have a data measure, where it is looked at for both maintenance types what is the time from when a request is submitted to when the maintenance job is actually scheduled. There are no current data on this, therefore the PPI does not have a base value and is used to for creating this baseline itself. Then over some time period this can be analysed, and new goals can be set by the company. It is expected that the incident maintenance takes longer during this process as it goes through three instead of two stages. However, the incident requests are more urgent and therefore should be dealt with earlier. It is important that the analysis of these measurements is thorough and logical.

Submission type: During the original reporting process some requests were not submitted through the original reporting tool. They were received by individual mail or a phone call. With the improved reporting tool, we use the count measure to count whether / how many times does this occur. The idea is then to evaluate this request and find out why this was the case so that it can be resolved and does not occur again.

KPI	Description	Validation goal
Time taken to submit a request	The time it takes from starting to fill in a request to the time it is submitted (the initial part, by planning for regular an driver support for incident maintenance)	Count measure of over half an hour = 0
Time taken to schedule a maintenance	The time it takes from initial request being submitted to the request being scheduled by TFS	The average time of requests with urgency A is smaller than the average times of requests with lower urgencies (A<B..< F)
Submission type	The way in which the request is submitted	Count measure of request submitted without the application = 0

Figure 6.1_KPI application validation

It is also advised to set some department / company wise KPIs for the improved reporting tool performance. These should be set to monitor regularly based on the aims of the company for the improved reporting tool performance.

6.3.2 | Collaboration indicators

The validation goals for collaboration indicators are set. These represent what is expected from the improved reporting process compared to the original reporting process. For concluding that the new process with the improved reporting tool is indeed improved, the validation goals should be met.

Effective effort

The effective effort is related to reflecting on the working. It is important that the users first get experience working with the improved reporting tool. An actor analysis checklist provides a guide for the users when it comes to when and what information needs to be shared. However, when it comes to reflection on the effectiveness this can be done once the tool is developed and the users interact with it over a given period of time. The validation goal is that the actors get familiar with the tool and use it in a smart and effective way.

Adequate effort

Adequate effort is related to the quality and quantity of work. The validation goal of quality is again related to the communication aspect. If there is no need for call backs due to incomplete or incorrect information received, the previous stage of submitting a report is of a better quality then in the original reporting process. Moreover, the quantity of work performed to obtain the same results should decrease. This is due to the already stored information being automatically linked to requests and drop down selections, resulting in less amount of required work.

Efficient effort

Efficient effort is related to not wasting resources. The main focus of the improved reporting process is improved information sharing and efficient communication. The efficient effort validation goal is also related to information sharing and communication. The validation goal is to have no call backs regarding maintenance requests due to incorrect or incomplete information received. Moreover, there is a validation goal related to wasting of time. The goal is to have less time spent on searching for information regarding an active maintenance. In the improved reporting tool and therefore the whole reporting process all information is located in one place and should be easily accessible. Figure 4.2 shows the aims for the process variables and outcomes within the collaborative assessment related to better communication. For better communication it is important to have understanding of the overall process. The actors need to be aware of the other actors and their responsibilities.

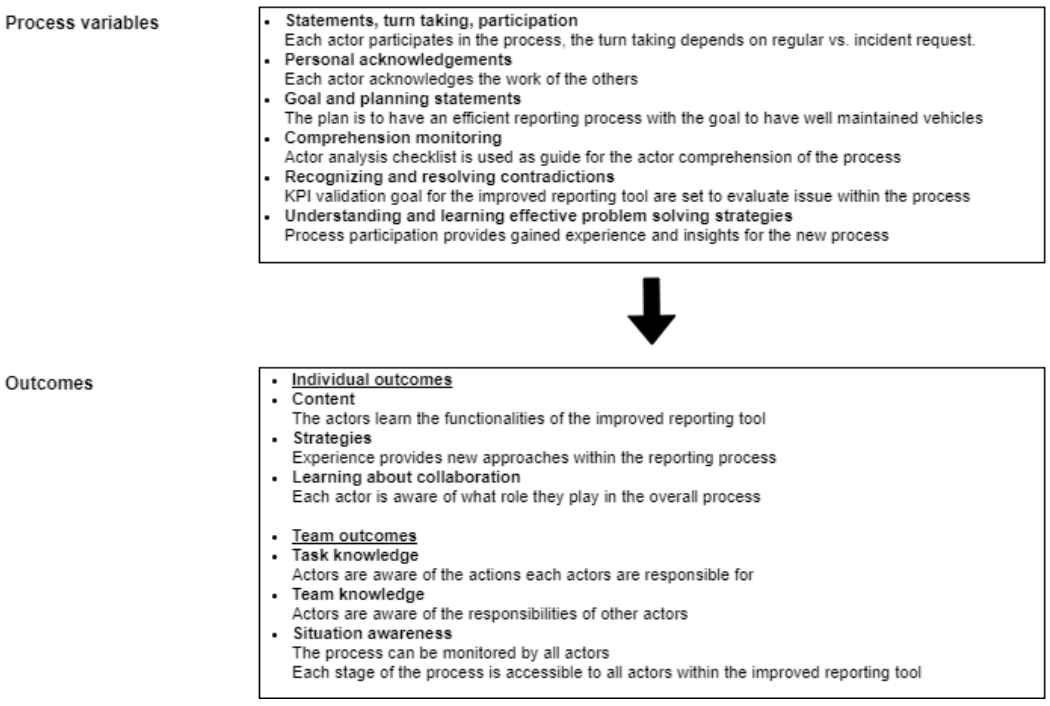

Figure 6.2_Collaboration assessment: Process and outcomes

Lessons learned

The main lesson that is aimed to be learned is the reliability of the request information. Prior to the improved reporting tool, the information received in requests was not believed to be correct and was double checked by TFS. With the use of the improved reporting tool, the validation goal is that the end receivers of the information, TFS department, trusts the information received.

6.3.3 | User satisfaction

It is also important that the users of the application are satisfied with the application. If they are not satisfied with the use of the application then it is not actually valuable for the department. The application needs to be easy and clear to interact with. The main value that we aim for with the tool is structured and effective information sharing and communication. The structured aspect is to have all the requests be reported within the application. It is more convenient if all the requests are received at one place as the employees then always know where the requests can be found instead of searching for them at different locations. The user validation is however linked to the collaborative assessment as the user evaluation assesses the collaboration. Therefore, three surveys for users are set. One is focused on the effective effort, one on adequate effort of collaboration and one on the lessons learned. The survey can be found in the Appendix E. The surveys are set so that not much time is required for their evaluation, so that the company is motivated to actually carry them out and not waste additional time on them. This is done by having simple yes / no questions. When 'other' is selected, the users are encouraged to elaborate on their answers.

6.3.4 | Timeline

Figure 6.2 shows the timeline for the future validation. The effective effort is validated through user survey 1, adequate effort through user survey 2, and lessons learned through user survey 3. The efficient effort is validated through the selected KPIs. The company is also encouraged to set their own KPIs to regularly monitor, with regard to the TFS department or the whole process.

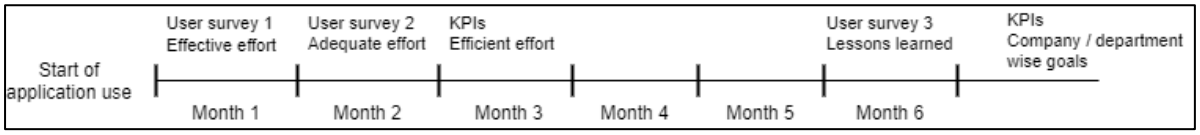

Figure 6.3_Validation timeline

7 | Conclusions and recommendations

The final chapter concludes the research and its findings and is part of ADR stage 4. Subsection 7.1 concludes the research. Subsection 7.2 provides critical reflection on the research. In subsection 7.3 the recommendations for EMONS Group B.V. are presented. Lastly, in subsection 7.4, the discussion and further research is discussed.

7.1 | Conclusion

The research is focused on the core problem identified for the TFS department at EMONS Group B.V.. The core problem defined is the inefficient information sharing in maintenance reporting process. This is due to the inefficiencies in the reporting process, related to the reporting tool which leads to receiving incorrect or incomplete information in the maintenance requests. In order to solve the core problem, the main research question is defined.

How can EMONS Group B.V. make the information sharing
between different actors more efficient within the maintenance reporting process?

For answering the research question, first, the current situation regarding the reporting process is analysed. During this stage the requirements for reporting of maintenance requests are defined. The main requirements are to lower the request submission time and to reduce the number of input values for request submission. The collaboration assessment of participants and tasks leads to better division of responsibilities when it comes to the actors qualifications. Therefore, the receiving of incorrect information should reduce and also the amount of wasteful communication due to call backs related to incorrect proposed scheduling of maintenance. Actor analysis provides insight into the information sharing flow within the maintenance process. The initial design of the tool based on these two theories provides a design with reduced number of needed input values for request submission. Moreover, designing of relation database and drop down selection tables leads to removing the submission of incomplete requests, and to reduction of the opportunity to submit incorrect information.

7.2 | Reflection

The most significant limitation is the data availability. The preliminary research leading to the core problem identification, and therefore to the main research objective, is based on the interviews of the employees. There is no data to support the claims. This affects the reliability of the whole research. That is also why some KPIs for when the application is designed are also set. This will provide basic data to work with for possible analysis of the application in the future. It is also set in the validation goals (Section 6.2.1) that when a request is submitted in other way than through the application this is investigated and therefore noted. During the research time this was an occurring event that requests were submitted in other way than the original reporting tool. However, it was not noted anywhere, therefore, it was not known how often and why this is occurring. With the new application it is expected that it will not happen or will be a rare occurrence. However, if it happens more often, it should still be investigated and a solution for standardizing this process should be made.

7.3 | Recommendations

The objective of the research is to improve the information sharing process with regard to maintenance reporting process. During the research it was decided to improve the information sharing in the reporting process by improving the reporting tool. One of the research deliverables is a design for the improved reporting tool. However, in order to actually improve the reporting process recommendations to the company are provided.

Development of improved reporting tool

The improved reporting tool for reporting maintenance process should be developed. The reporting process with the use of the improved tool removes the receiving of incomplete requests and reduces the opportunity to receive incorrect information in the requests. Moreover, the design has been validated by all the actors within the reporting process and the validation is positive. In addition, the validation specific to TFS department, the actors expect improved overall communication, and saving of time and money at the TFS department, as well as calmer working environment.

Validating of improved reporting tool

In order to validate the actual improved reporting tool, it has to be developed and used. That is also required for the validation of the reporting process improvement and user satisfaction. Therefore, it is recommended that using the validation timeline (6.3.4) the defined validation goals are assessed. These are for the application through KPIs (6.3.1), for the reporting process through collaborative indicators (6.3.2) and for the user satisfaction through user surveys (6.3.3). It is also advised to set some department or process wise KPIs for the performance of the improved tool that can be regularly checked. That would also provide data for further analysis if applicable. However, that is based on the

company's preference. The recommendation from the research is to assess the set validation goals during the validation timeline to make sure the reporting process is actually improved.

7.4 | Discussion and further research

The research has focused on defining complete requirements for the design of the improved reporting tool. However, there are still some aspects and functionalities that can be added in the future.

Currently the most critical aspect of the tool Is the need to monitor the application at all time. It is necessary to look at the overviews whether new requests have been submitted. This can cause some things not get noticed immediately, since for TFS there are two sections to monitor (requests and scheduled maintenance). It should be further looked into the options to provide alerts for newly added requests, or when an ETA or ETR time for scheduled maintenance is approaching.

Another aspect to consider with further research is reducing the number of actors in the reporting process. The reason for involving driver support in the process is that they are able to adequately assess the maintenance situation of the driver. Provided that drivers receive proper training or guidance materials they would be able to submit their requests themselves. This would also make the submission of request be done earlier compared to when they need to report it to the driver support. However, it should be properly researched whether that would actually be beneficial as the drivers are not that closely related to the company as the employees, therefore their motivation in correctly assessing and submitting the request might also be a factor.

Moreover, the possibility of automatization can be researched. With the improved reporting tool, the planning department provides ETA, ETR and workshop selection for a maintenance. That is then moved on to TFS to actually schedule the job. In this aspect it is simple to implement automatization. Once the planning provides the ETA, ETR and workshop selection, an automatically generated mail containing maintenance information (all present in the tool) is automatically sent to the selected workshop. This would then remove the need for an actor for the actual scheduling of maintenance.

There are other possibilities for automatization as well, however they would be more difficult to implement. Such as, automatically evaluating the scheduled maintenance ETA and ETR. The application with the information on when a truck is supposed to be at certain workshop and when a truck is supposed to leave a certain workshop can be checked by the system. The location of the selected workshop and the actual location of the truck can be compared. Only in the case of ETA or ETR not met the application would alert a TFS employee so they can take further action.

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9 | Appendices

9.1 Appendix A – Research methods

*Some parts are blurred out due to confidentiality

Appendix A1 – Preliminary research

Appendix A1.1 – Technical fleet support interview

There are two main problems as stated by the employees in the technical fleet support department. One is the outdated systems / programs that are being used. For example, for the scheduling of the job it is necessary to input the same information three times, each time into a different program. This is due to the scheduling program (Ultimo) not supporting a function of showing overview of previously scheduled jobs. Therefore, for being able to check whether the ETAs and ETRs of jobs are met, the employees use an additional Excel file for monitoring the ETAs and ETRs. In addition, this information needs to be known to the planning department as well. So, the same information is also input into Spits, where it is visible to the planning department. [redacted]

The other problem is the communication between the departments and actors. The problem aspect of communication with planning department is that the department share an office are and sometimes the communication consists of shouting at each other across the room. This leads to people not clearly understanding and making typing mistakes when looking up a certain element. Moreover, the communication with driver support is not efficient. The information in requests received from the reporting tool do have incorrect data from time to time. Therefore, some employees always assume the data received is incorrect and therefore recheck all the information received. Meaning they need to look up the information in multiple databases. Same as originally the driver support had to. This is not very efficient. Moreover, the current reporting tool is not always being used by the employees who report the maintenance request so sometimes the requests come by mail form the reporting tool but sometimes the driver support just calls the technical fleet support. Moreover, the driver support when submitting a request fill in ETA and ETR for the maintenance, however the ETA is usually not met, so the technical fleet support employees often look up the location of the vehicle and add half an hour to the set ETA by driver support. Then they inform them back that the ETA is not correct and inform them about new ETA.

It is important that the maintenance jobs are scheduled with cost efficiency analysis. Therefore, by having the most optimal cost but also distance / time to the workshop. The driver support does not have access to the full schedule of a given vehicle therefore their scheduling proposal of the ETA, ETR and preferred location is not usually optimal. It is an idea to have driver support have access to the scheduling system, so they see the planning for a given vehicle.

Appendix A1.2 – Technical fleet support observation

The process of scheduling maintenance in Ultimo was observed. First the request (via mail) is received, then the truck or trailer is looked up in Spits. Indicators for approaching regular maintenance are looked at. Then the truck or trailer is searched un Ultimo. Information about the required maintenance is filled in (depends on country of workshop some information is provided in different language). Afterwards a mail request for workshop is generated in the Ultimo program (the standard template generates mail in three languages). Then the mail is sent to the workshop. Afterwards, the scheduled maintenance information is input into Excel file. Where one hour prior to ETA or ETR the cells change background color and indicate that the ETA and ETR times are approaching. Afterwards, the

information that was input in Excel is copies to Spits. This is how the process is performed as should be, however, in reality the information received is double checked for correctness. The estimation of checking information for correctness is 3-5 minutes.

Moreover, the process of monitoring the scheduled maintenance was observed. Once the cell color indicates the ETA or ETR is approaching the vehicle is searched for in Spits. There the location of the vehicle can be looked up. If the ETA will be met, nothing is done. If ETA will not be met, it is decided, based on other scheduled jobs (whether the workshop is working on other vehicles currently) and the experience with the workshop, whether the workshop needs to be contacted about the delayed ETA. In case it needs to be contacted it is contacted, otherwise it is just rewritten in the Excel file to the ETA calculated based on the current location of the vehicle. Then it is checked again when the new ETA is indicated to be looked at by Excel. For ETR, the vehicle is again looked up in Spits and the location is checked. Mainly, it is checked whether the vehicle is on a move once the ETR has been reached. If that is not the case the workshop (or driver) is contacted for explanation and new ETR is set. This is then rewritten in Excel and also in Spits so that the planning sees the new ETR as well. If the ETR is met then the vehicle is looked up in Spits and the information about the maintenance is removed for the vehicle. Moreover, the vehicle is looked up in Ultimo and the status of the maintenance job is changed from active to not active. It was observed how ETA and ETR is checked, the estimation is that it takes up to 1 minute to check the status of ETA or ETR.

Appendix A2 – Reporting tool

Appendix A2.1 – Technical fleet support interview

Incorrect information received sometimes. ETA, ETR and preferred location for workshop are not optimal and therefore driver support needs to be contacted that the information they provide is not good. Moreover, some requests do have, and some do not have filled in information such as driver phone number. Then TFS needs to search for it themselves if it is needed. It is important that the person filling in the request is able to critically assess whether the information is needed in the given situation or not. The tool does not allow them to continue without filling in the number, but if the person thinks it is not necessary they just input values as 123 instead of the actual number.

Appendix A2.2 – Driver support interview

First issue with the reporting tool is that it was just sent out and told to be worked with. There was no communication or guide on how to work with the tool. For the tool there is a need to search for information in different databases and input everything manually. It is possible to make typos. In some cases, some information is not relevant for the case, but the tool does not allow to continue with the request unless it is filled in. Also, there are questions that the driver support does not have ability to answer in an optimal way. They do not have access to the overall schedule so cannot properly set ETA, ETR or workshop location leading to call backs to the department. Due to call backs from planning / technical fleet support some employees chose repair time option so that the requests do not ask to provide ETA and ETR when submitted. It is better for some employees to submit the request right away instead of during a certain time every day, since the information is fresh in their mind, and they feel they might forget some detail / information if it was to be filled in later.

Appendix A2.3 – Fleet manager interview

Too many emails received (along other mails that are received by mail). Difficult to keep overview. When asked about Figure 1.5, it is not known why a request that is related to breakdown would take over half an hour. With the other repair times, it is known that the employees filling in the requests

do start the submission but then leave the request open in a background tab and that results in longer submission time. However, for breakdown situation this should not ever happen as the maintenance needs to take place right away.

Appendix A3 – Research design feedback

Appendix A3.1 – BIE Cycle 1

Appendix A3.1.1 – BIE Cycle 1: Driver support feedback

- 'For me very good option would be to be able to search not only by drivers name/surname but also by fleet number and registration number of a truck and a trailer. Depending which information will be typed into the search field, missing info will be filled up automatically.'
- 'Also, current reporting tool does not have an option to inform [redacted] (we have to send an email)[redacted] (also email need to be sent). Good option would be to have access to history of reports so that we could easily bring the case when someone else reported problem/breakdown. It would be enough to add extra drop section where we could choose who else should be informed.'
- 'I am only little bit afraid about personal data and GDPR. I do not understand why the ID or passport Nr needs to be set in the app. Is not necessary.'
- 'And if I understand well on first time report we have to write all data of drivers and second time there has been data saved. Is it not possible to initially transfer all the existing data ? And only add new drivers in the future?'
- Overall, the tool seems very helpful. Mostly that the additional information does not have to be looked up and is automatically linked to the request. It is also nice that for some of the input values there is a selection of answers, and it does not have to be typed in.

Appendix A3.1.2 – BIE Cycle 1: Technical fleet support feedback

- Some requests are not scheduled by us. [redacted] Therefore, the fleet managers and driver support need some area where they can send a summary of that maintenance so it can be sent to TFS so they can contact the workshop about the maintenance job they performed.
- Moreover, there is a contract with a tyre company, therefore the drivers are able to take care of the maintenance themselves. This also needs to be reported by driver support to TFS. There is a selected number of the tyre companies. For each of them different company needs to be contacted by TFS about the maintenance job performed. With this communication goes directly, to save direct money and time and we create calmness at TFS department.
- It is also an idea to have the ability to schedule the maintenance from the tool already. This means sending the maintenance request mail to a given workshop with information about the maintenance.
- Overall, the tool looks promising. It is nice that it is in English and can be used both on a phone and on computer. It also suggests better communication, all information is in one place and accessible to everyone.
- It is helpful that the monitoring of the scheduled maintenance was implemented in the tool as well. This removes the need to input this information in 3 different programs as it is the case currently.

Appendix A3.1.3 – BIE Cycle 1: Fleet manager

- It would be nice to include an option to see the scheduled maintenance of given truck or trailer. When it has already been scheduled by TFS. Moreover, for fleet managers it is useful to be able to filter on country, as they are interested only in their country trucks.

Appendix A3.1.4 – BIE Cycle 1: Planning

- Repair time of maintenance by the end of the trip is more urgent than within 1 week.
- Someone needs to maintain the fleet manager and driver information.
- The tool design looks very good and will be a good improvement of the maintenance reporting process.

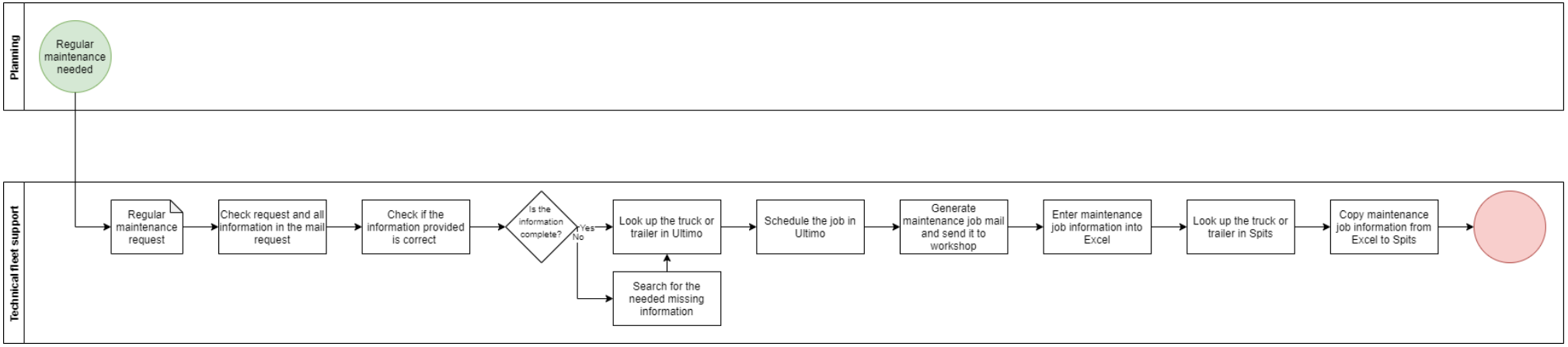
Appendix A3.2 – BIE Cycle 2

- New APP design for workflow repair & maintenance looks good! With this communication goes directly to save direct money and time and we create calmness at TFS department!
- If there are additional requirements these can be discussed when developing the application.

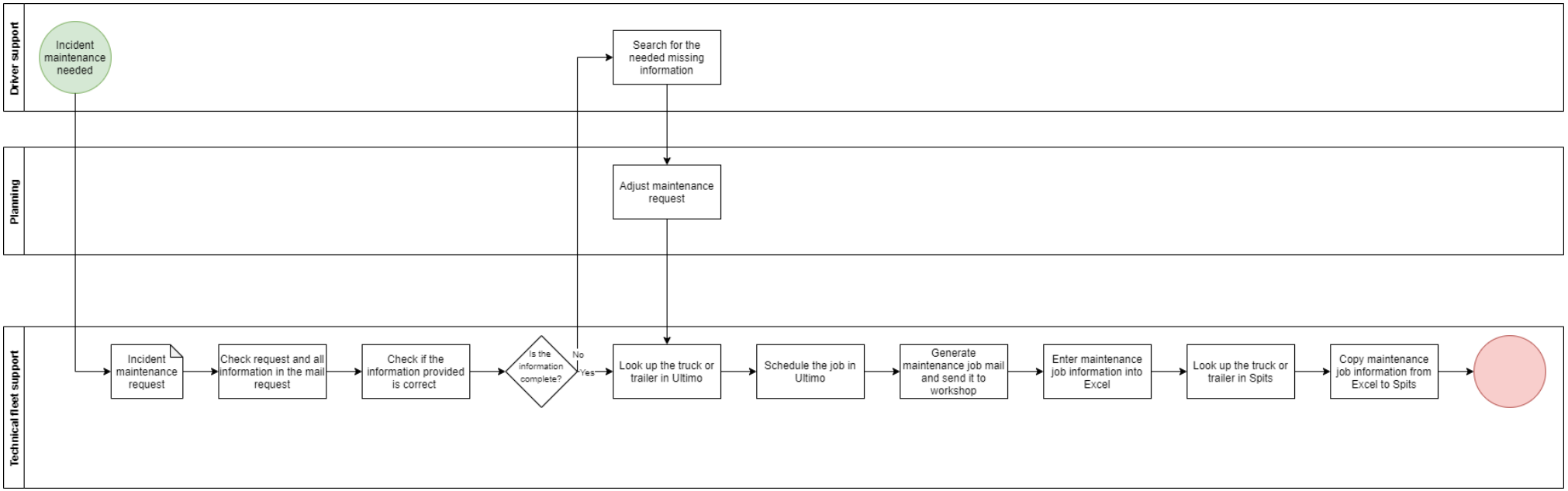
9.2 Appendix B – Problem introduction

Appendix B1 – Business process models TFS

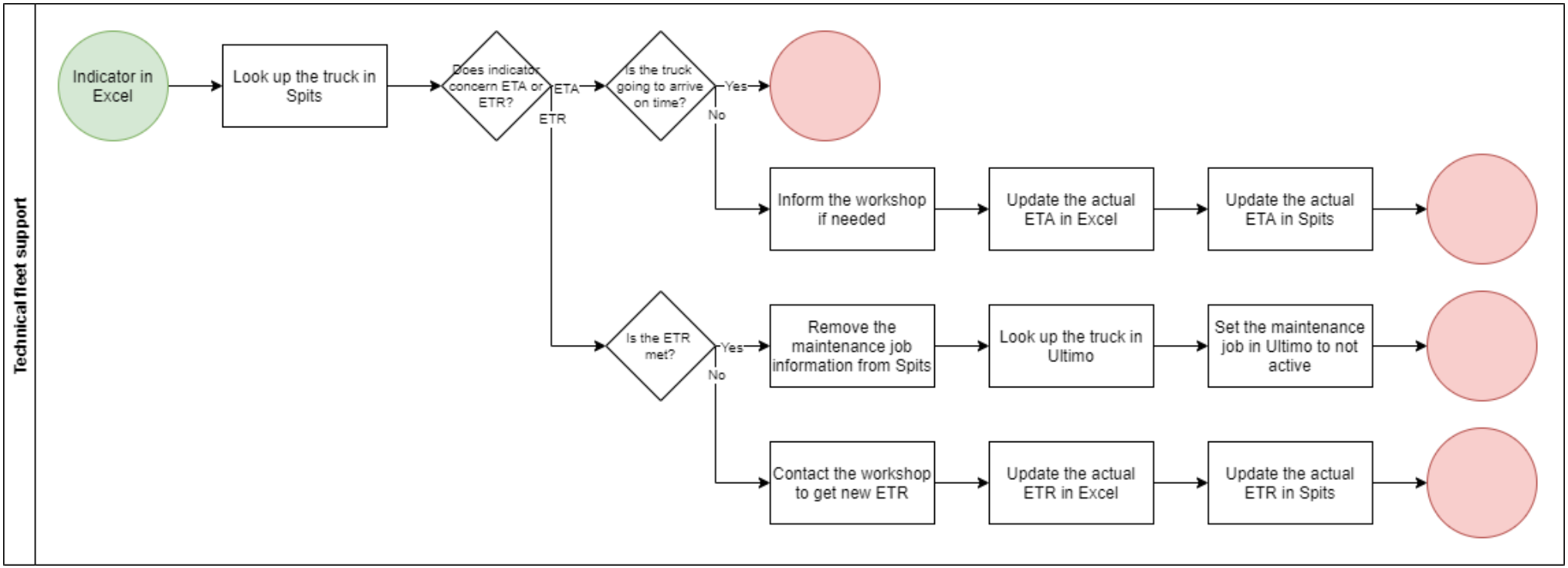
AppendixB1.1 – Main tasks TFS



FigureB1.1.1_Scheduling regular maintenance

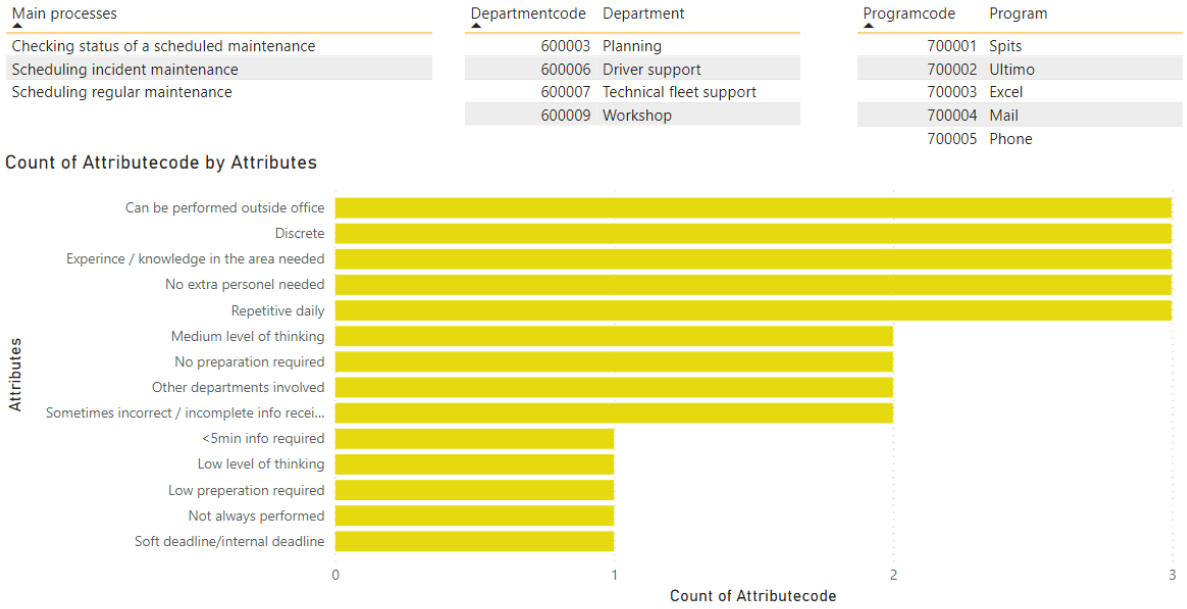


FigureB1.1.2_Scheduling incident maintenance

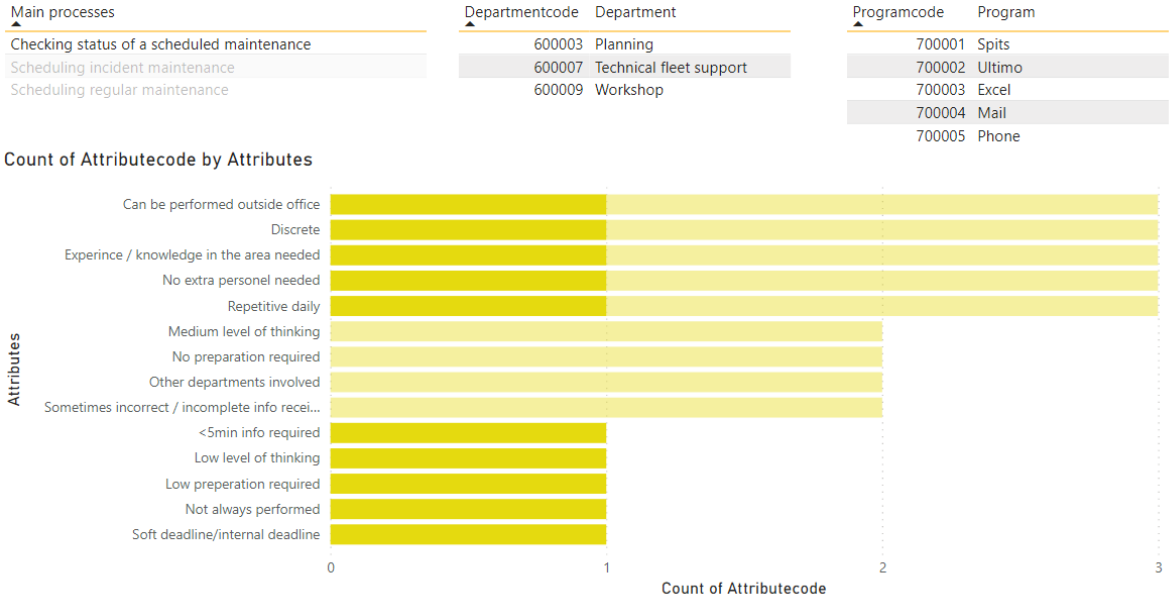


FigureB1.1.3_Checking statues of scheduled maintenance

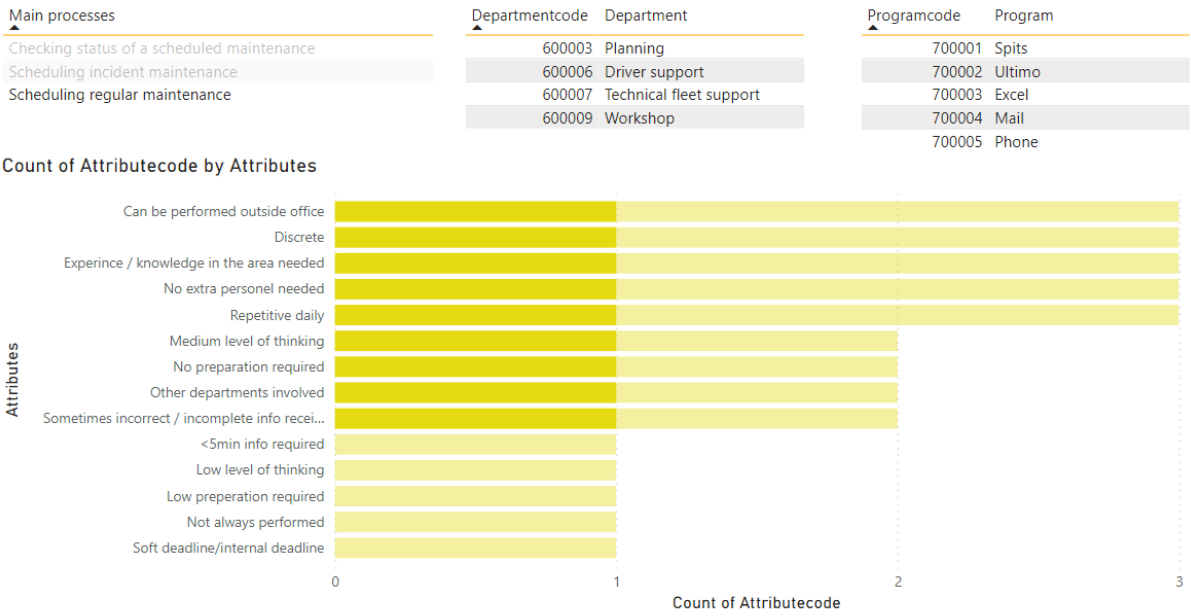
Appendix B1.2 – Task and process analysis



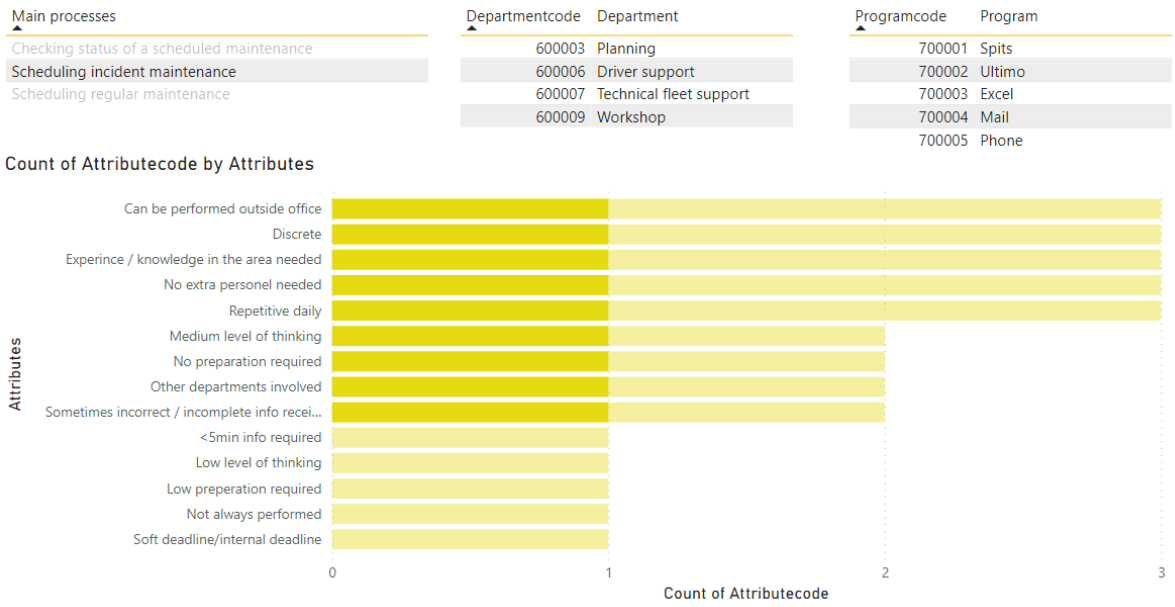
FigureB1.2.1_Main Processes Dashboard



FigureB1.2.2_Process 1 Dashboard: Checking status of a scheduled maintenance



FigureB1.2.3_Process 2 Dashboard: Scheduling regular maintenance



FigureB1.2.4_Process 3 Dashboard: Scheduling incident maintenance

Appendix B2– Core problem

Appendix B2.1 – Requests frequency

For evaluating the frequency of request received by the department an analysis of the data in the current reporting tool was performed. This was done for the most recent data inputs for a period of 2 months. It has occurred that a request was submitted on a Saturday or Sunday, however that happened only once, therefore the average is still approaching a zero. That is why it is left out from the calculation of average number of requests received per day/week.

Date	Frequency
26/05/2021	2
25/05/2021	19
24/05/2021	4
21/05/2021	13
20/05/2021	14
19/05/2021	12
18/05/2021	11
17/05/2021	5
14/05/2021	8
13/05/2021	4
12/05/2021	14
11/05/2021	11
10/05/2021	11
07/05/2021	8
06/05/2021	9
05/05/2021	7
04/05/2021	9
03/05/2021	8
30/04/2021	13
29/04/2021	10
28/04/2021	13
27/04/2021	4
26/04/2021	7
25/04/2021	1
23/04/2021	10
22/04/2021	14
21/04/2021	10
20/04/2021	14
19/04/2021	15
18/04/2021	1
17/04/2021	2
16/04/2021	13
15/04/2021	17
14/04/2021	4
13/04/2021	13
12/04/2021	13
09/04/2021	19
08/04/2021	11
07/04/2021	14
06/04/2021	12
05/04/2021	2
02/04/2021	5
01/04/2021	13

Day	Average#
Monday	8
Tuesday	12
Wednesday	10
Thursday	12
Friday	11
Week	**52**
Average/day	**10**

Appendix B2.2 – Reality and norm

Regular Maintenance reality

- Purpose
- ModificationDescription
- ReparationDescription
- MaintenanceType
- Division
- Zone
- FleetNumberVehicle
- TruckORTrailer
- FleetNumberTruck
- PreferredLocationTruck
- PreferredLocationTrailer
- DriverName
- FleetManagerName
- ExpectedETADate
- ExpectedETATime
- YesOrNoETR
- ETRDate
- ETRTime
- AdditionalDamagesFailures
- DescriptionAdditionalDamagesFailures
- YesORNoComments
- Comments

Incident Maintenance reality

- Purpose
- RepairTime
- TruckORTrailer
- PreferredLocationTruck
- PreferredLocationTrailer
- ETADate
- ETATime
- YesOrNoETR
- ETRDate
- ETRTime
- Location
- HighwayPerkingName
- HighwayNameAndExits
- CustomerSite
- EmonsSiteLocation
- Division
- Zone
- LoadStatus
- FleetNumberVehicle
- DriverName
- DriverPhone
- FleetManagerName
- Description

FigureB1.2.2.1_Variable 1: Regular and incident maintenance request input values

9.3 Appendix C – Context analysis

Appendix C1 – Reporting tool input values

Incident Maintenance input values
• Purpose • RepairTime • TruckORTrailer • PreferredLocationTruck • PreferredLocationTrailer • ETADate • ETATime • YesOrNoETR • ETRDate • ETRTime • Location • HIghwayPerkingName • HighwayNameAndExits • CustomerSite • EmonsSiteLocation • Division • Zone • LoadStatus • FleetNumberVehicle • DriverName • DriverPhone • FleetManagerName • Description

Regular Maintenance input values
• Purpose • ModificationDescription • ReparationDescription • MaintenanceType • Division • Zone • FleetNumberVehicle • TruckORTrailer • FleetNumberTruck • PreferredLocationTruck • PreferredLocationTrailer • DriverName • FleetManagerName • ExpectedETADate • ExpectedETATime • YesOrNoETR • ETRDate • ETRTime • AdditionalDamagesFailures • DescriptionAdditionalDamagesFailures • YesORNoComments • Comments

FigureC1.1_Reporting tool input values

Input variable	Description	Checkbox	Typing in	Always relevant
Purpose	Purpose for the maintenance: Breakdown, damage, malfunction	Yes	No	Yes
RepairTime	Can the truck still drive? When does it need to be repaired?	Yes	No	Yes
TruckORTrailer	Does the truck or trailer need to be repaired?	Yes	No	Yes
PrefferedLocationTruck	Preferred location for the maintenance in case the truck needs to be repaired	Yes	Yes	No
PrefferedLocationTrailer	Preferred location for the maintenance in case the trailer needs to be repaired	Yes	Yes	No
ETADate	ETA date for the maintenance	No	Yes	Yes
ETATime	ETA time for the maintenance	No	Yes	Yes
YesOrNoETR	Is there an ETR for the maintenance?	Yes	No	No
ETRDate	ETR date for the maintenance	No	Yes	No
ETRTime	ETR time for the maintenance	No	Yes	No
Location	What is the location of the combination?	No	Yes	Yes
HighwayParkingName	What is the name of the highway parking?	No	Yes	Yes
HighwayNameAndExits	The name of the highway and the highway exits	No	Yes	Yes
CustomerSite	The location of the customer site of the order	Yes	Yes	Yes
EmonsSiteLocation	The location of the Emons site of the order	Yes	No	Yes
Division	Which division is the combination driving for?	Yes	No	Yes
Zone	Which zone is the combination driving in?	Yes	No	Yes
LoadStatus	Is the combination loaded?	Yes	No	Yes
FleetNumberVehicle	What is the fleet number of the vehicle needing maintenance?	No	Yes	Yes
DriverName	What is the name of the driver of the combination?	No	Yes	No
DriverPhone	What is the phone number of the driver?	No	Yes	No
FleetManagerName	What is the name of the fleet manager?	Yes	No	No
Description	Space for providing description of the needed maintenance	No	Yes	Yes

FigureC1.2_Incident maintenance input values

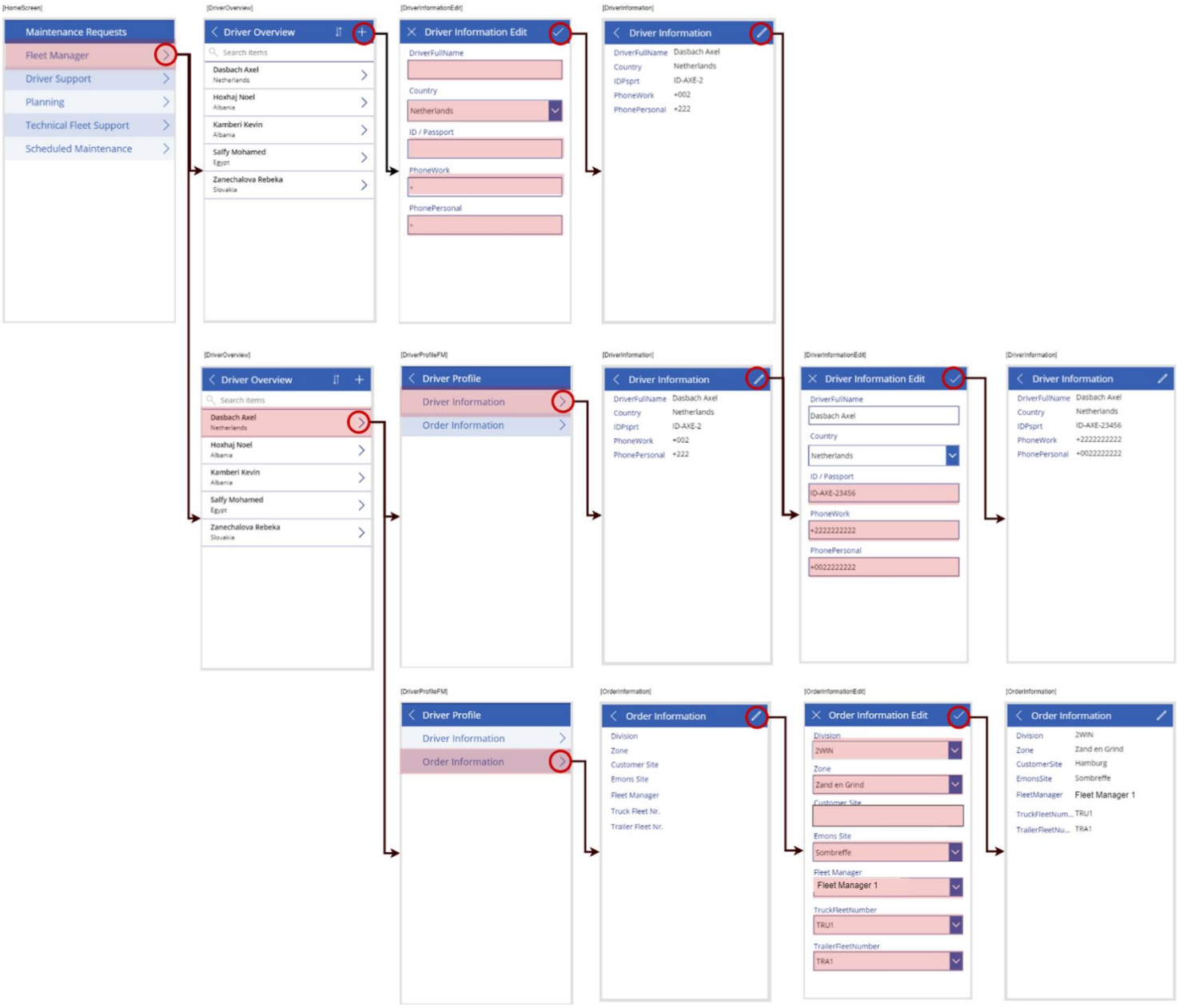
Input variable	Description	Checkbox	Typing in	Always relevant
Purpose	Purpose for the maintenance: Reparation, Modification, Maintenance	Yes	No	Yes
ModificationDescription	Description of the requested modification	No	Yes	Yes
ReparationDescription	Description of the requested reparation	No	Yes	Yes
MaintenanceType	What kind of maintenance is requested?	Yes	No	Yes
Division	What division is the combination driving for?	Yes	No	Yes
Zone	What zone is the combination driving in?	Yes	No	Yes
FleetNumberVehicle	What is the fleet number of the vehicle needing maintenance?	No	Yes	Yes
TruckORTrailer	Does the truck or trailer need maintenance?	Yes	No	Yes
FleetNumberTruck	What is the fleet number of the truck of the combination?	No	Yes	Yes
PreferredLocationTruck	What is the preferred location for maintenance if the truck needs maintenance?	Yes	Yes	Yes
PreferredLocationTrailer	What is the preferred location for maintenance if the trailer needs maintenance?	Yes	Yes	Yes
DiverName	What is the name of the driver of the combination?	No	Yes	No
FleetManagerName	What is the name of the fleet manager?	Yes	No	No
ExpectedETADate	What is the expected ETA date for the maintenance?	No	Yes	Yes
ExpectedETATime	What is the expected ETA time for the maintenance?	No	Yes	Yes
YesOrNoETR	Is there an ETR for the maintenance?	Yes	No	No
ETRDate	What is the ETR date for the maintenance?	No	Yes	No
ETRTime	What is the ETR time for the maintenance?	No	Yes	No
AdditionalDamagesFailures	Are there any additional damages or failures?	Yes	No	No
DescriptionAdditional DamagesFailures	Description of present additional damages or failures	No	Yes	No
YesORNoComments	Are there any comments about the maintenance request?	No	Yes	No
Comments	Space for providing comments regarding the maintenace request	No	Yes	No

FigureC1.3_Regular maintenance input values

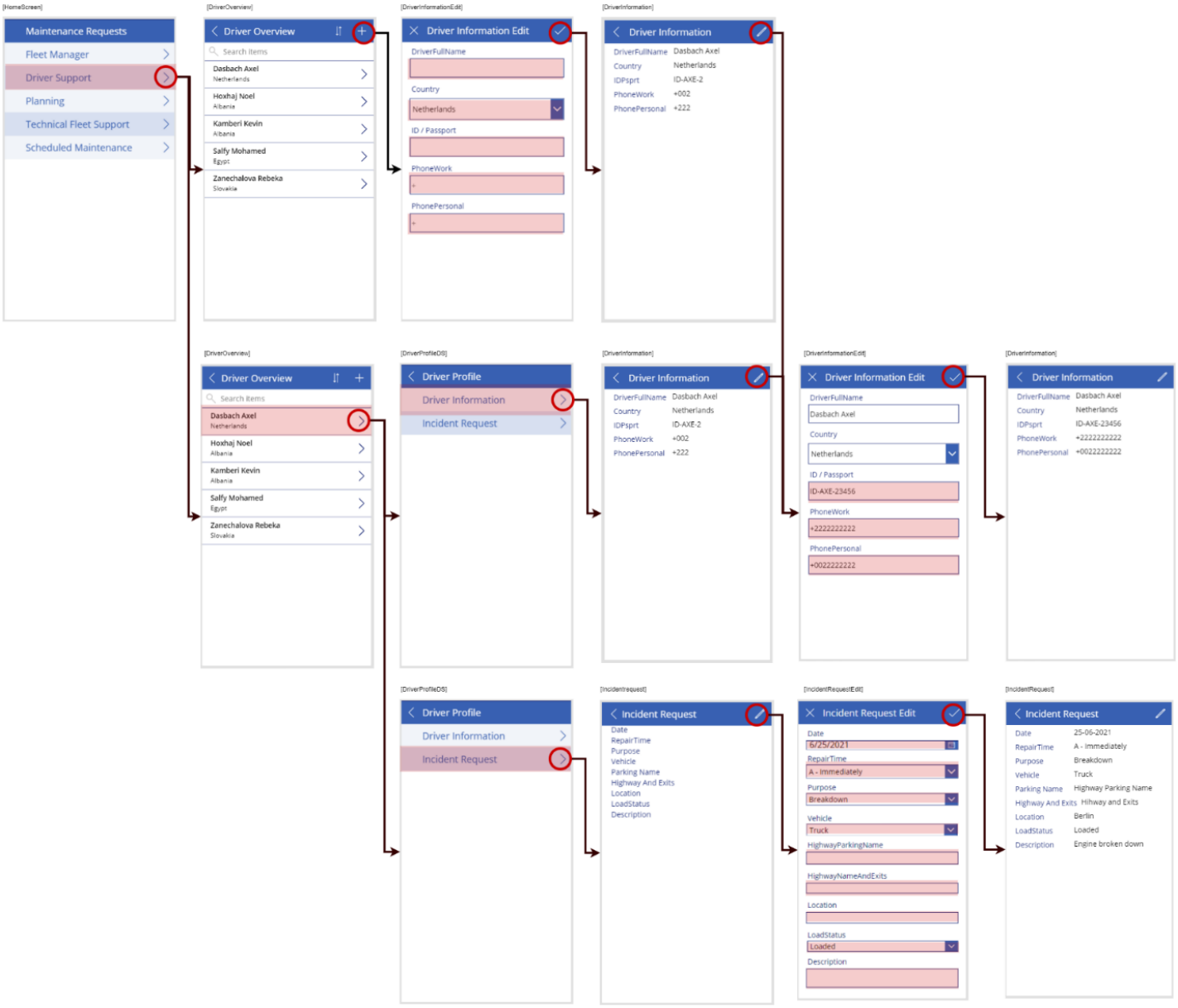
9.4 Appendix D - Deliverables

Appendix D1 – Application design

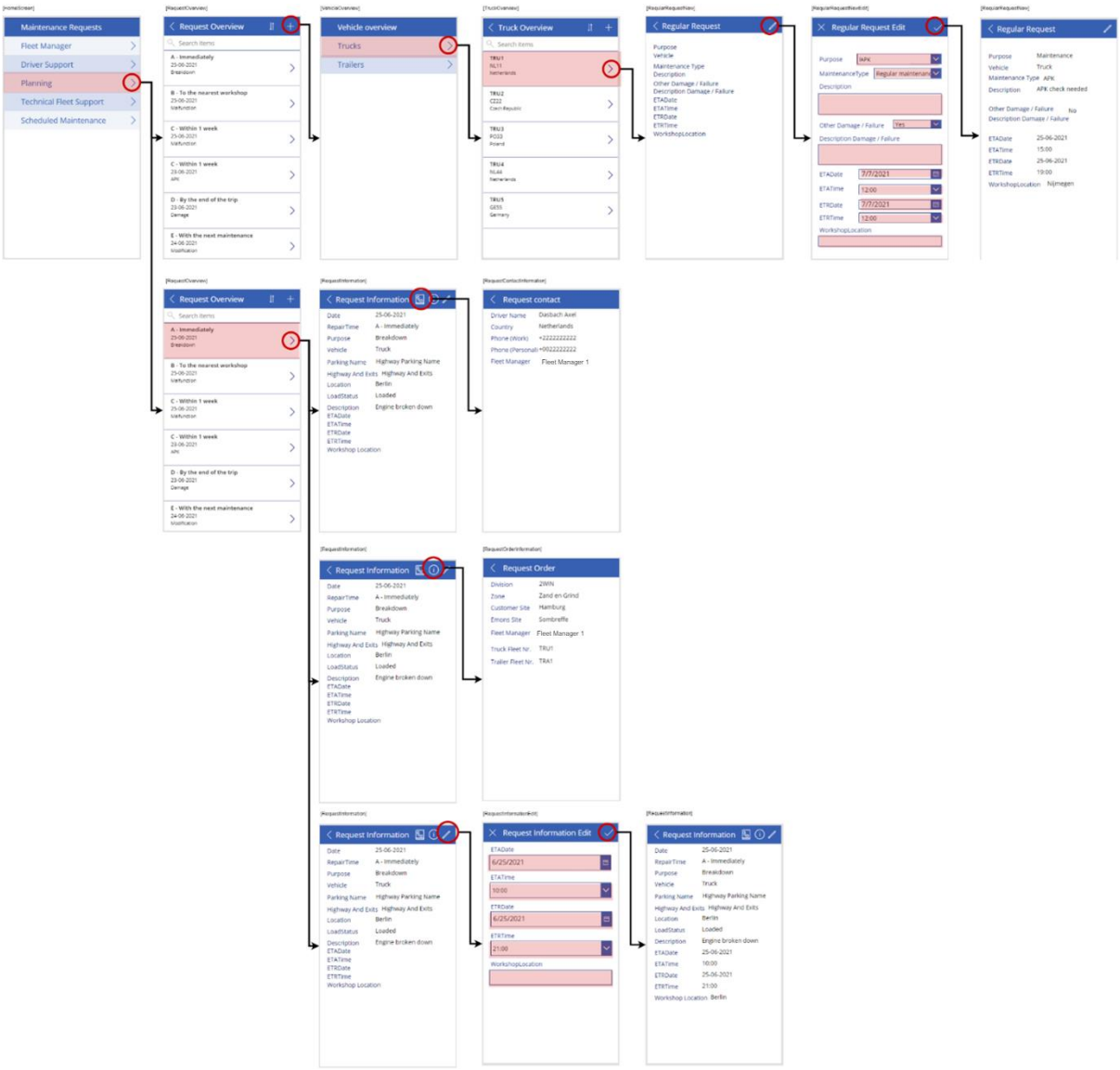
Appendix D1.1 – BIE Cycle 1



FigureD1.1.1_Reporting app: Fleet Manager flow

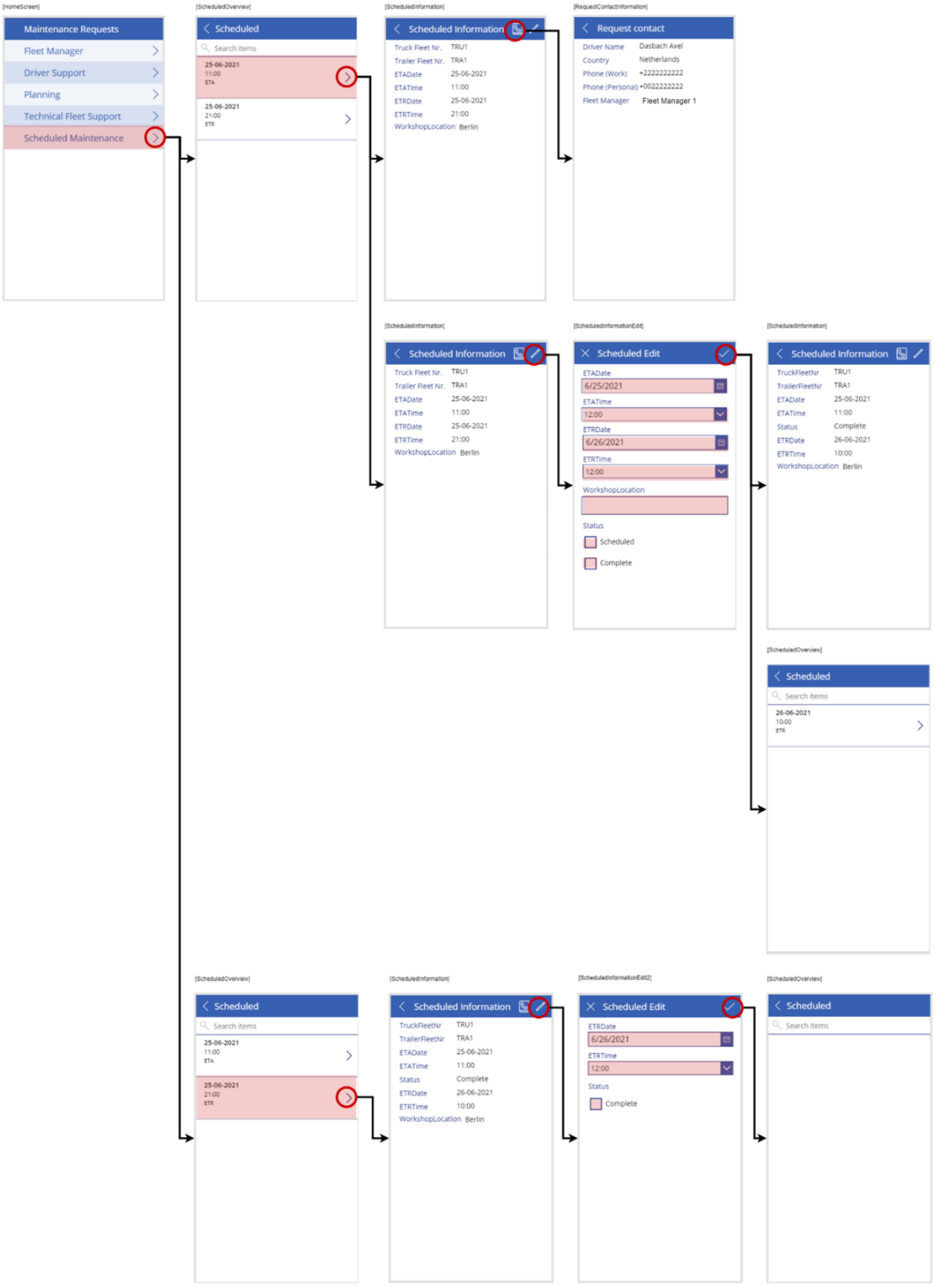


FigureD1.1.2_Reporting app: Driver Support flow

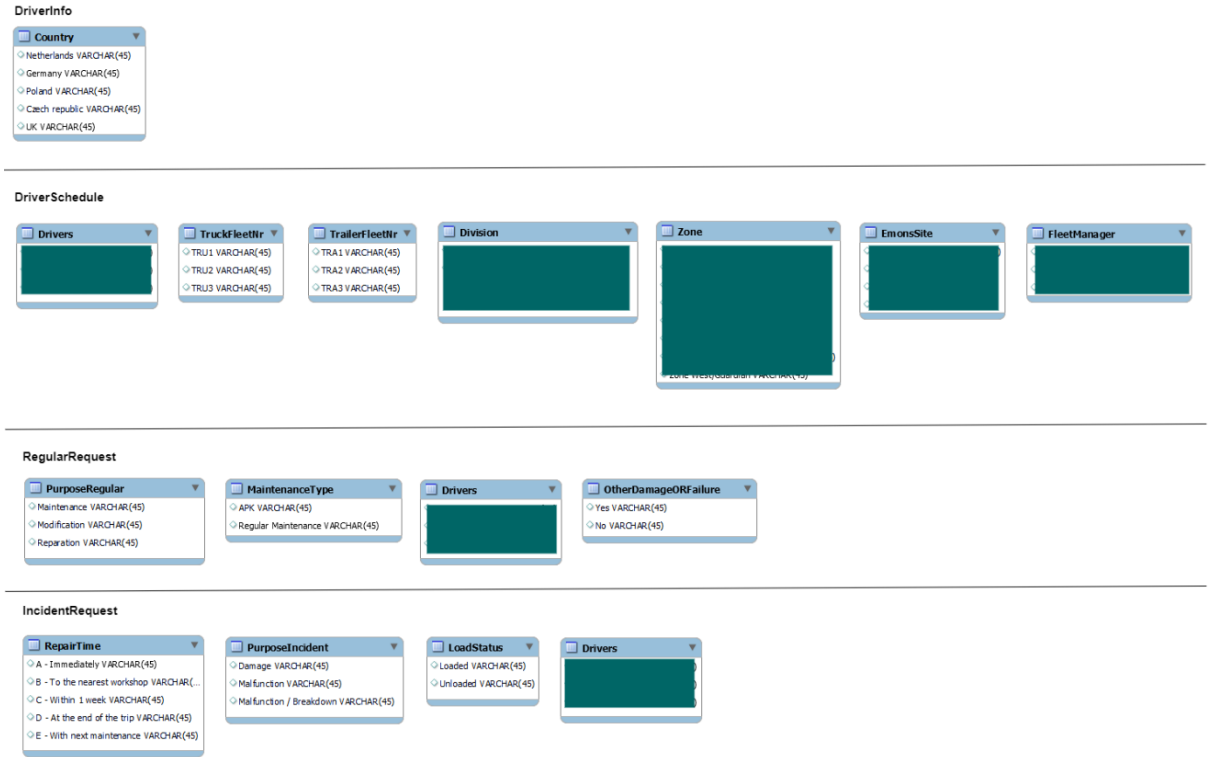


FigureD1.1.3_Reporting app: Planning flow

FigureD1.1.4_Reporting app: Technical Fleet Support flow

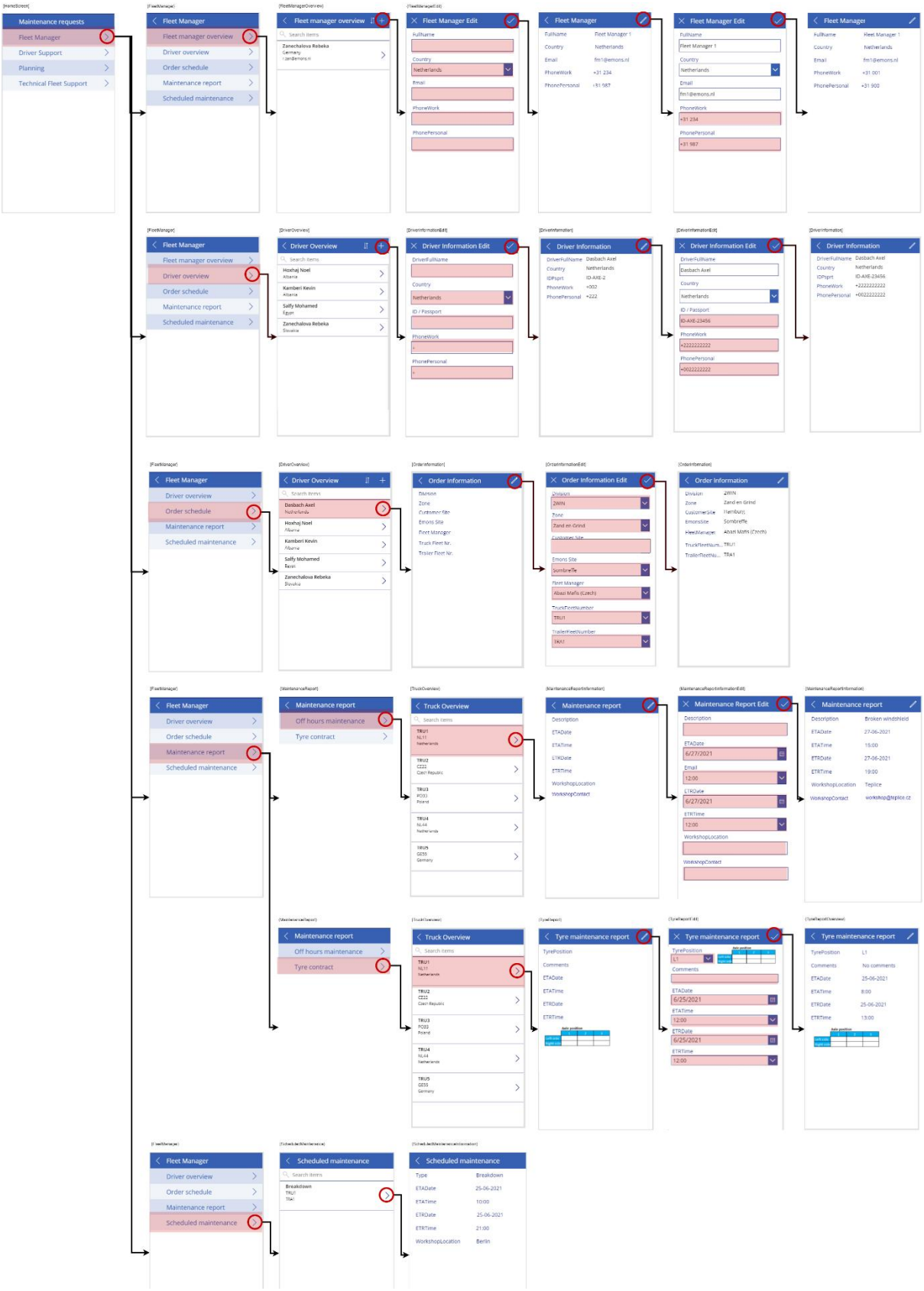


FigureD1.1.5_Reporting app: Scheduled Maintenance flow

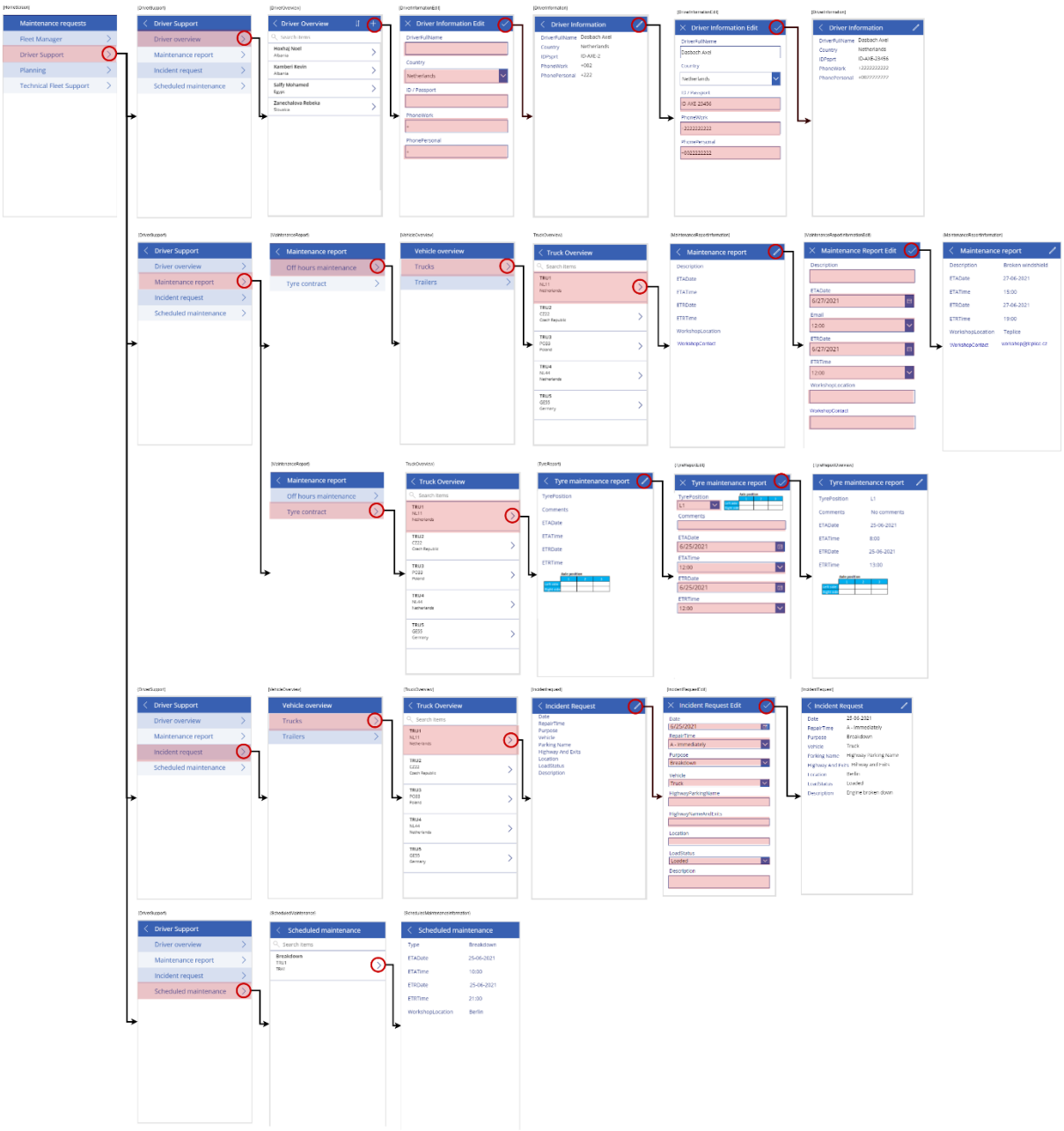


*FigureD1.1.6_Dropdown selection tables**

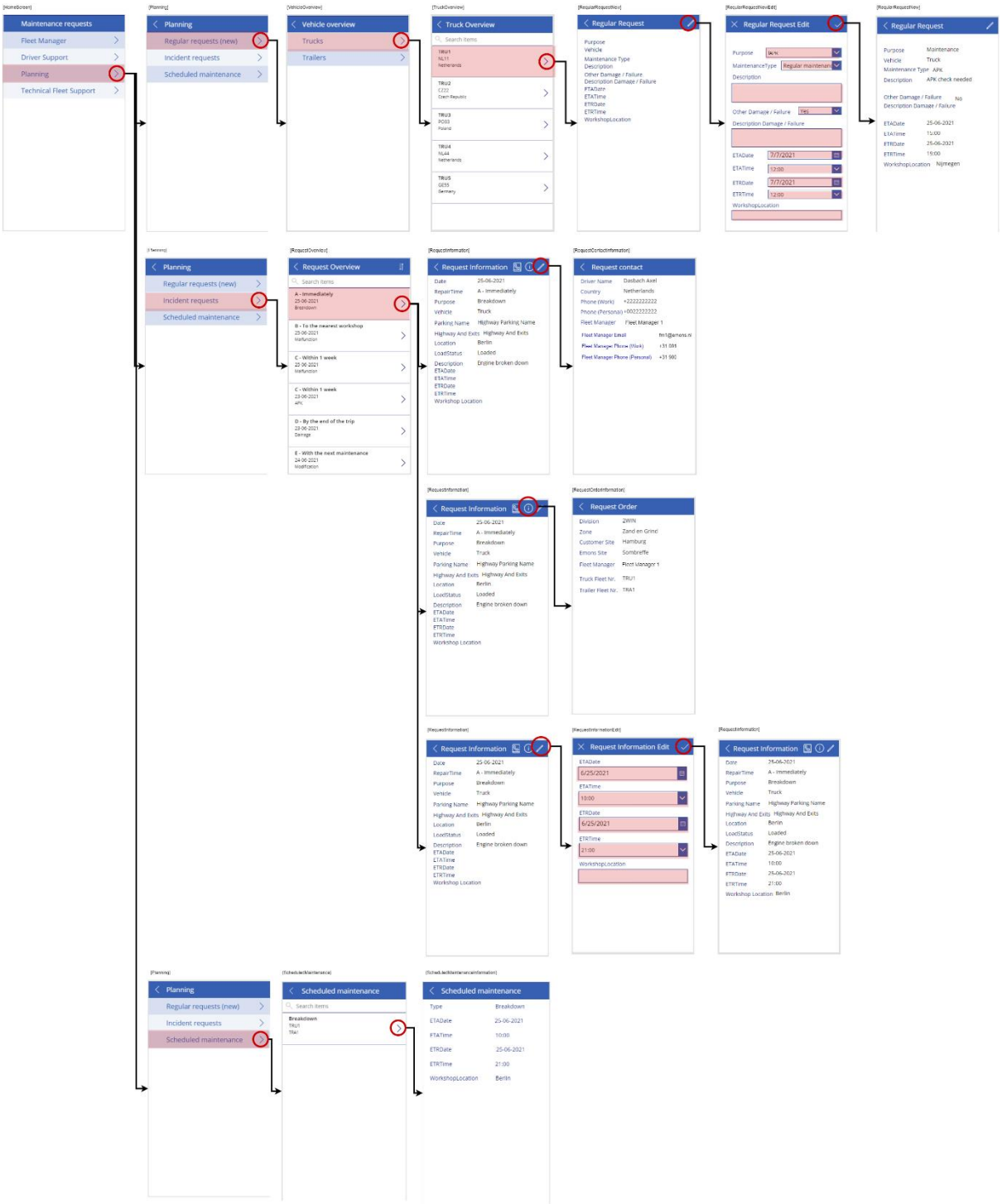
*Some of the values are blurred out due to confidentiality



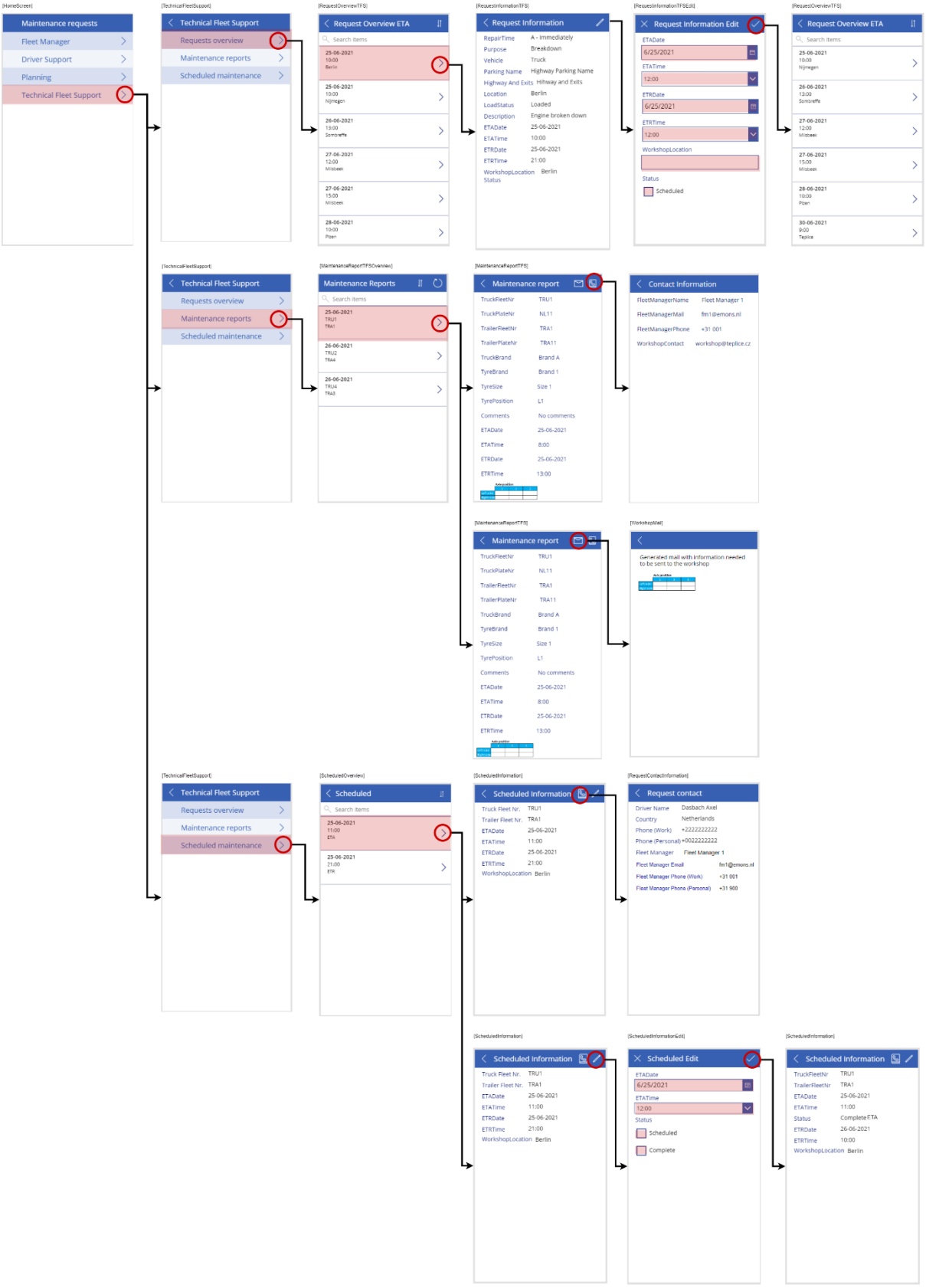
FigureD1.2.1_Reporting app: Fleet Manager flow



FigureD1.2.2_Reporting app: Driver Support flow



FigureD1.2.3_Reporting app: Planning flow



FigureD1.2.4_Reporting app: Technical Fleet Support flow

Appendix D2 – Additional information

Fleet Manager

[FleetManagerOverview] and [DriverOverview}
sort by full name
search by full name, country

[TruckOverview]
search by truck fleet number, truck plate number and country

[TrailerOverview]
search by trailer fleet number, trailer plate number and country

[ScheduledMaintenance]
search by trailer fleet number, trailer plate number, truck fleet number, truck plate number, country

Driver Support

[TruckOverview]
search by truck fleet number, truck plate number and country

[TrailerOverview]
search by trailer fleet number, trailer plate number and country

[ScheduledMaintenance]
search by trailer fleet number, trailer plate number, truck fleet number, truck plate number, country

Planning

[TruckOverview]
search by truck fleet number, truck plate number and country

[TrailerOverview]
search by trailer fleet number, trailer plate number and country

[RequestOverview]
sort by repair time (/ urgency)
search by repair time, purpose, date, truck fleet number, truck plate number, trailer fleet number, trailer plate number, country

[RequestInformationEdit]
each request is automatically assigned urgency / repair time: F – Regular request

[ScheduledMaintenance]
search by trailer fleet number, trailer plate number, truck fleet number, truck plate number, country

Technical Fleet Support

[RequestOverviewTFS]
sort by ETA time, the closest ETA time is the first
search by trailer fleet number, trailer plate number, truck fleet number, truck plate number

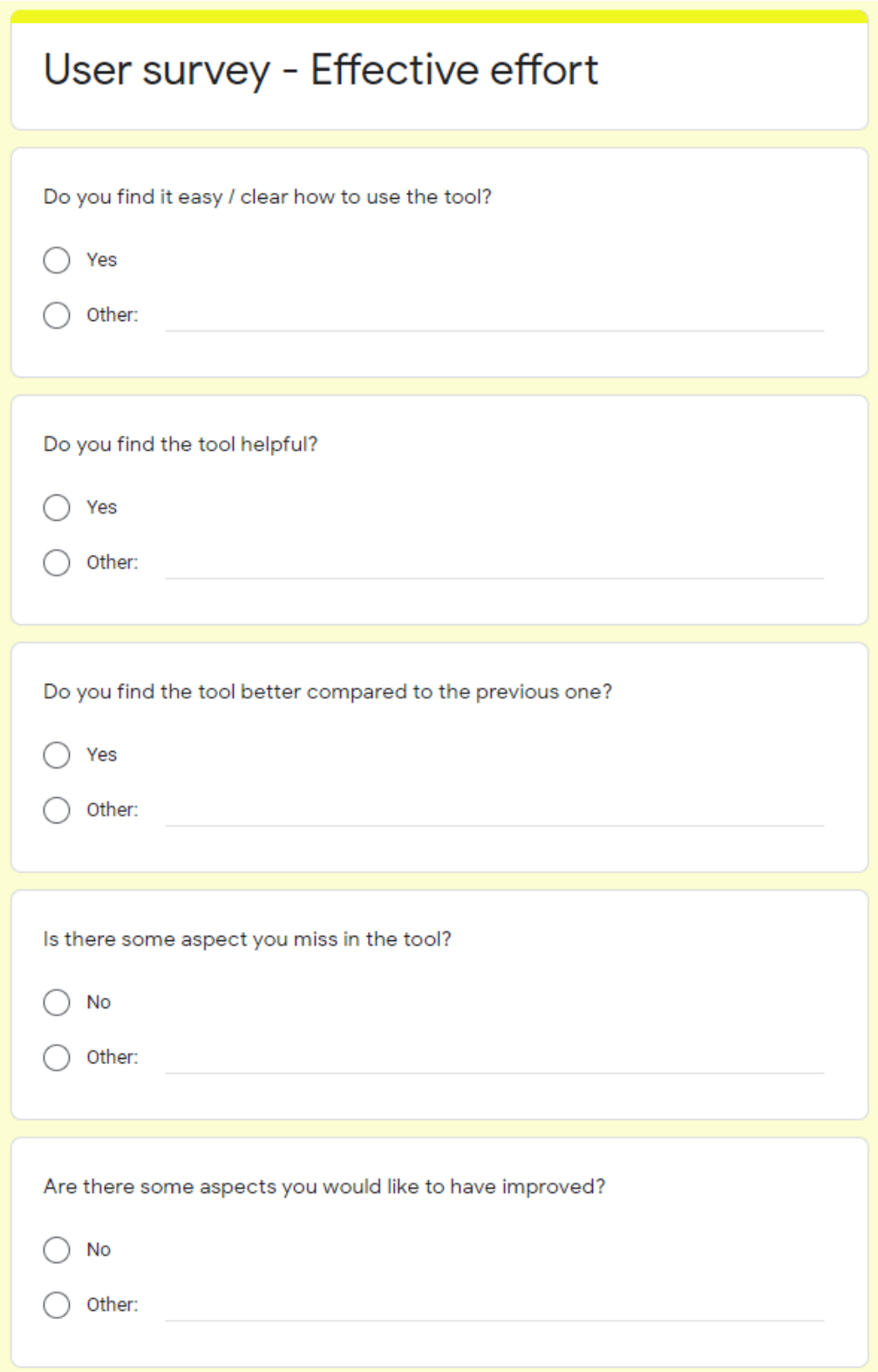
[RequestInformationTFSEdit]
When the ‘scheduled’ checkbox is checked on the request by TFS, the request is removed from all other request overviews and is moved to the scheduled maintenance overviews

[MaintenanceReportTFSOverview]
sort by date
search by date, trailer fleet number, trailer plate number, truck fleet number, truck plate number, country

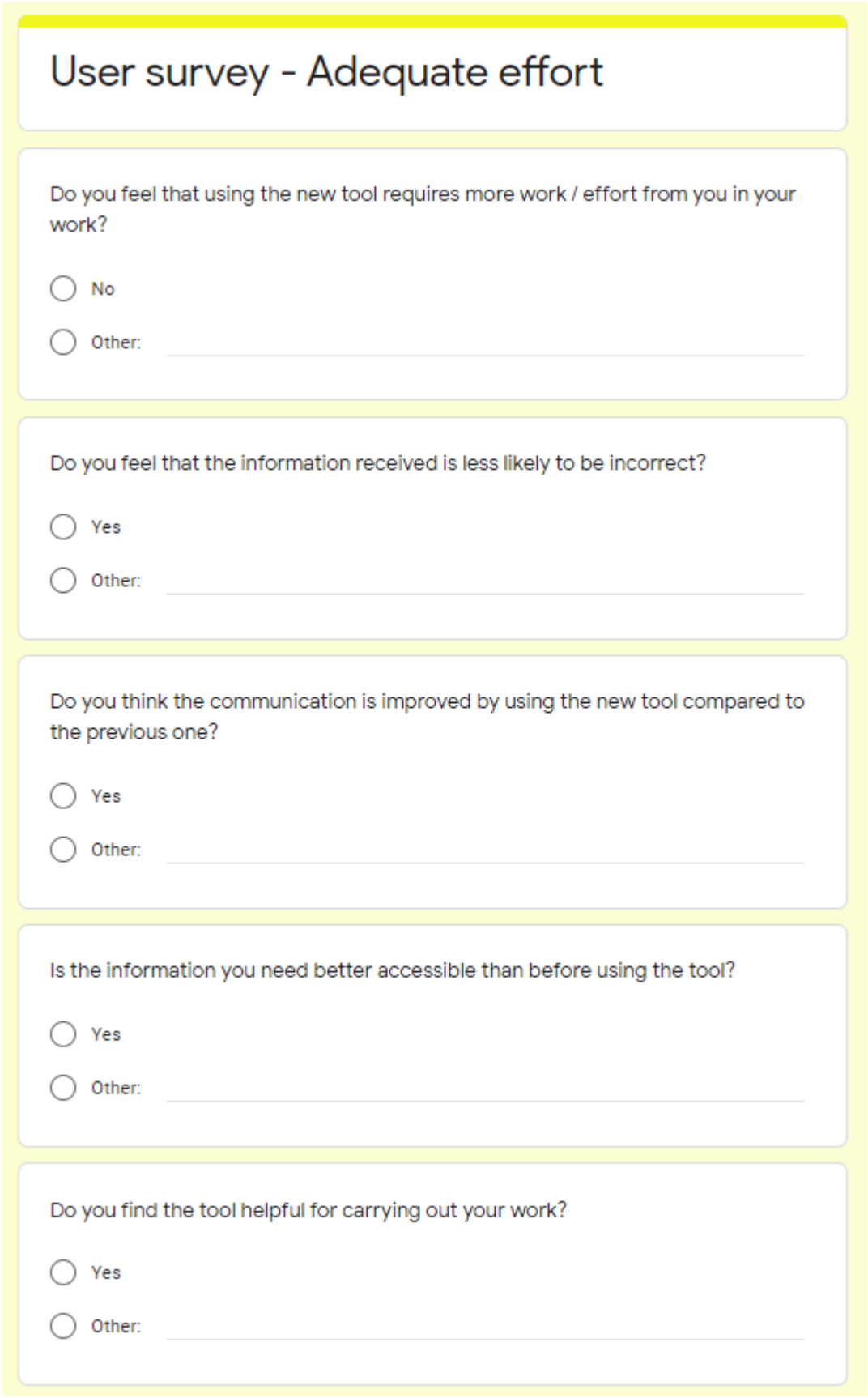
[ScheduledOverview]
sort by ETA and ETR time, earliest first

[ScheduledInformationEdit}
if ‘scheduled’ checkbox is checked, the information is updated and the request stays in the scheduled maintenance overview
if ‘completed’ checkbox is checked for ETA, ETA is removed from scheduled maintenance overview
if ‘completed’ checkbox is checked for ETR, the whole request is removed from the application

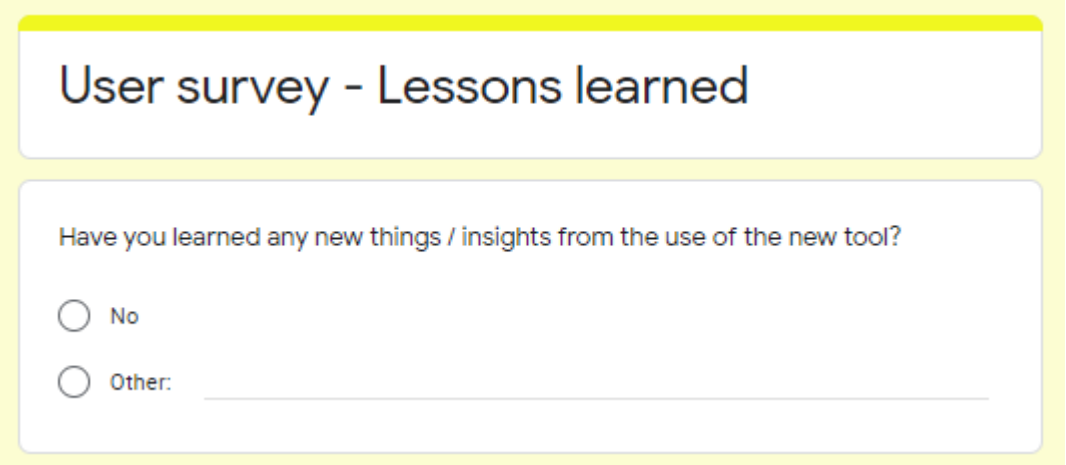
9.5 Appendix E – User surveys



FigureE.1 – User survey: Effective effort



FigureE.2_User survey: Adequate effort



FigureE.3_User survey: Lessons learned