**Master Thesis**

Master Business Administration – Digital Business – University of Twente

# Get the most out of a Process Mining project -

*Conceptual model of the added value of Process Mining and how to advance the added value of Process Mining projects in practice*



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## Abstract

Process Mining identifies inefficiencies and helps improving the process. However, there has been no literature or study available about the added value of Process Mining, that takes into account both the theoretical side plus enrichments from practice. This research aims to define all those indicators of the added value of Process Mining, as well as the variables that influence it. Within this research, knowledge and data will be collected by a combination of a literature study and a practical study. The practical study consists of ten interviews with both consultants and clients of Process Mining projects in the housing, education, healthcare and manufacturing industries.

Literature and practice were compared and the combination of both resulted in a final model with twenty-one input variables, seventeen contingency factors, and sixteen indicators of added value. This model shows all indicators of added value of Process Mining, how this added value can be achieved, and how it is possible that the added value can be different for each case. All too often, the focus remains solely on creating process insights, whereas it should increasingly be on process optimisation and the structural application of Process Mining, with which you will see the real added value. At the front end of the project, more attention must be paid to this structural application and the creation of commitment from the organization. The model serves as a guide getting the most out of a Process Mining project.

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# 1. Introduction

Nowadays, a digital strategy is for companies more crucial than ever. Research company Gartner (2020) indicated that 69 percent of the board of directors say the pandemic crisis and the ensuing economic and social crisis are positively impacting digital business (Goasduff, 2020). Before the pandemic, there was a gradual growth in digitization, but the pandemic has increased the urgency to invest in digitization. Gartner (2020) writes that within this digital transformation, data and the use of analytics are seen as competitive weapons, operational accelerators, and innovation catalysts. Data is used as a resource to arrive at new insights, predictions, and recommendations, and analytics as a reporting and decision-making tool (Pettey, 2019). Here, Business Intelligence refers to computer-based techniques that aim to support better business decision-making by giving you various insights into business data (Cebotarean, 2011). Process Mining is such a business intelligence technique that can give you insights. It is seen as the connecting link between data science and classical process-oriented methods. It is important to have a clear image of the actual process because there is a difference between how people think the process goes and how it actually goes (Reinkemeyer, 2020). Reinkemeyer (2020) argues that, by gaining insight into the process, Process Mining helps to identify inefficiencies and ultimately improve the process.

Until now, there have been some studies about Process Mining in general. It was about what Process Mining is, its techniques and applications, and not about the success of a project. Regarding Process Mining, no model or framework with concepts of added value is yet developed. Van der Aalst (2012) and Reinkemeyer (2020) give in their books and articles an outlook of Process Mining describing the various techniques and how to apply Process Mining. Regarding the added value of Process Mining, Rozinat et al. (2014) describe the added value of Process Mining in a very general point of view, as also the success criteria of Process Mining (Rozinat & van Geffen, 2015), and Dilmegani (2019) describes the benefits of Process Mining in a practical point of view (Dilmegani, 2019). Last year there was a thesis that dealt with the input of Process Mining projects (Hilhorst, 2020). Hilhorst (2020) found the variables that contributed significantly to an efficient and effective Process Mining project. Besides the added value of Process Mining, there is a lot of literature available on practical examples of the application of Process Mining, such as van der Aalst et al. (2015) and Rojas et al. (2016) who explain the value of Process Mining in Healthcare (Rojas et al., 2016), and Jans et al. (2013) who does this in the auditing sector (Jans et al., 2013). These are only very specific to certain industries and/or organizations, and are difficult or not applicable to other industries.

As we can conclude, there is no literature or study available about the added value, or output, of Process Mining, which takes into account both the theoretical side and the enrichments from the

practical side. Both practically and academically it is important to fill this research gap. As said, last year, Hilhorst (2020) build a conceptual model and framework of the input side of the Process Mining projects. It is valuable to extend this to the output side of Process Mining projects. Academically, it is important as it contributes to the literature on business intelligence techniques; people doing research on the possibilities of different business intelligence techniques will benefit from a model on the added value of process mining. This is also where the practical relevance comes in from two perspectives. On the one hand, organizations that are doing research on the possibilities of business intelligence techniques would benefit from a practice-tested model including concepts of added value and ways to improve this value. On the other hand, it also helps consultants to encourage organizations to start a Process Mining project and/or to expand the Process Mining project.

As said my research focuses mainly on the output side. The research goal is to determine what the added value of Process Mining projects is and how you can improve both the added value. By saying 'improve' the added value instead of 'increasing' it, you ensure that it not only relates to added value as a result, but you can also start looking at the process towards this result. It may be the case that the result cannot be increased, but the process towards this result can be improved. To achieve this research goal, the following research question needs to be answered:

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*'What is the added value of Process Mining projects for organizations and how can we improve both the outcome and the process towards the outcome of added value for organizations?'*

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A developed model that answers the question contributes to both literature and practice. From a literature point of view, it gives an overall picture of indicators of added value found and tested in practice and within these, the interrelationships as well as the relationships with the variables that are supposed to achieve this added value. From a practical point of view, this model can be used as a kind of guide to get the most out of a Process Mining project. To develop this model and answer the research question, data will be collected in two ways: a literature study and practical research. In chapter 2 a literature study is conducted that is used to gain knowledge about the different forms of process mining, the facilitators and inhibitors of process mining, and the added value of process mining from both a practical and theoretical perspective. At the end of this chapter, a final theoretical model will be given. Then, there is the practical research for which chapter 3 describes the research method, chosen sampling, data collection, and data analysis. Chapter 4 then presents all the results of the practical research. In chapter 5 the final model is presented, that provides a combination of the findings from literature and those from practice. Finally, in chapter 6 there is a discussion, that includes the theoretical and practical implication, and in which there is also room for

limitations and potential future research. In the final chapter, a conclusion is given in which the research question is answered.

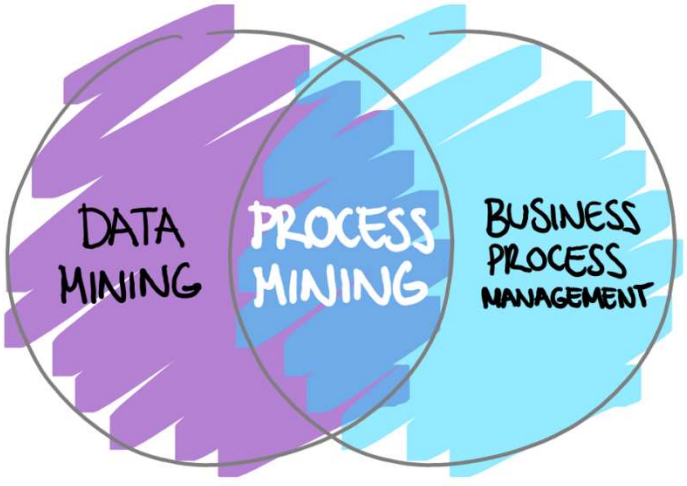
# 2. Literature study

This theoretical framework consists of 3 parts. The first two parts are about Process Mining and added value, the main components of the research, and the research question. The first section is mainly about what Process Mining is, what different types there are, the facilitators and inhibitors of a Process Mining project, and the future of Process Mining. The second section describes the added value in general, the added value of Process Mining from a theoretical point of view, and the added value of Process Mining from a practical point of view. The final section presents and describes the theoretical model that can be established.

## 2.1. Process Mining

### 2.1.1. Process Mining fills the gap between Big Data and Business Process Management

Over the years, data volume and storage capacity have grown spectacularly. This makes it possible to manage and support a business based on this data instead of subjectivity. Where data mining looks at patterns in large data sets and makes it easier to make choices, Process Mining is there to close the gap between analyzing big data and Business Process Management. Process Mining uses the event data from various information systems to map a process, then analyze it, and finally help improve it. Since it can be seen that more and more managers are applying Process Mining, you can verify that they overestimate their knowledge of the processes (van der Aalst, 2012a).




(Nogueira, 2020)

*Figure 1 - Relating Process Mining to different terms*

It is important to have a clear picture of the process, as there is a difference between how people assume the processes are performed and how the process actually is performed. Process Mining

does not tell you what process is right but shows how the process is running in reality, so you can come up with a comparison. Process Mining results in insights into what is going on in a process and whether problems arise. Reinkemeyer (2020) adds that Process Mining provides companies with insights into processes and complexities, that help them identify inefficiencies or non-compliances, and come up with actions like process redesign, workflow optimization, batch processing, and automation. All actions that help increase the efficiency and effectiveness of business processes. Improvements in business processes can lead to savings of millions of dollars and value that cannot be quantified (Reinkemeyer, 2020). The benefit of Process Mining is that you can analyze the actual process much faster because you do not have to ask managers about how the process works. Instead, you can show them how the process works and ask for reasons why things happen in a certain (*What Is Process Mining?*, 2020). According to Fluxicon, there are four main outcomes of Process Mining. First, the outcome is just an answer. Here for example you just want to know how a process goes and the answer to this is the goal of the analysis. Secondly, the outcome is a process change. Based on the analysis some controls or other process changes are implemented to make the process more effective or efficient. Thirdly, the outcome can be to better monitor some steps in the process. Due to the analysis, you find some new KPIs that are not known before but are very important. Finally, more model-based analyses may be needed to analyze one very specific problem.

Process Mining is based on so-called event logs. According to Reinkemeyer (2020), each event refers to a specific activity that has a certain timestamp and that can be assigned to a specific case. This data is stored in a digital log file. Within these processes, you have different variants. These variants differ from each other because each of them has some deviations and complexities that also occur in real-life processes. Process Mining drills down in all those variants until it has a complete picture of the total process that includes all complexities.

As long as processes are supported by an IT system, they can be analyzed with Process Mining techniques. The processes in which it can be applied vary (Rozinat & Günther, 2014). First of all, it is applied in primary processes. Think of processes that can be found in every sector, but also processes that are specific to a certain company. In addition to this, you have to think of supporting processes, usage processes, supplier processes, and outsourced processes. Compared to manually analyzing the IST-process, Process Mining is much faster and the insights and models are of higher quality.

### 2.1.2. Discovery, conformance, and enhancement as the main types of Process Mining

Reinkemeyer (2020) mentions that events are used for three types of Process Mining. First of all, there is Process Discovery where the goal is to learn a process based on event logs. It is mostly dedicated to a posteriori view of event logs (De Weerdt et al., 2012). It mainly provides insight into the process, which helps to redesign or improve the process. De Weerdt et al. (2012) add that process discovery easily answers questions about how the process is executed or what are the most frequent paths. Process Discovery is usually the starting point for further analysis such as Conformance Checking. In this conformance checking, you try to confront the model with the reality (van der Aalst, 2012a). Van der Aalst (2012) adds that in other words, you verify the accuracy of the documented process and point out the differences. Therefore, two aspects are possible. It is possible that the model does not capture real behavior, or that reality deviates from the desired model. Finally, you have Model Enhancement, where you try to extend the existing process with relevant information (Aalst, 2016). The idea is to improve an existing process model using information gathered from the actual process event logs. Once there is no alignment between the event log and model, the non-fitting process model can be corrected. In addition, the model can also be improved after analyzing the existing model; there may be bottlenecks identified in the process that need to be further analyzed and fixed. Van der Aalst (2016) concludes that an extended process is very useful to provide operational support as it delivers high aggregated business value, so it is the most ambitious type of Process Mining. The model on the right illustrates the three types of Process Mining in terms of input and output.

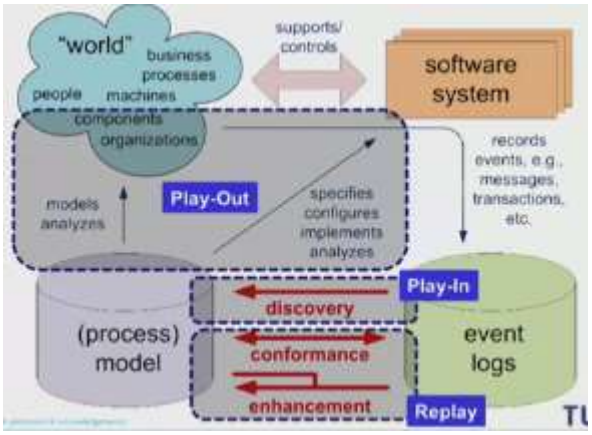



*Figure 2 - Positioning of three main types of Process Mining*

In the online course 'Process Mining: Data science in Action' van der Aalst points out that three types of relationships between model and event data can be distinguished (see figure 2): Play-out, Play-in, and Replay (van der Aalst, n.d.). Van der Aalst says 'Play-out' refers to the classic use of process models in which you try to generate a behavior based on this model. He adds that it is used for analyzing and initiating business processes. 'Play-in' is the way from event data to process model, where you want to discover the process. Lastly, there is 'Replay' of reality on top of the model. Here you can check deviations from the model and investigate conformance problems.

The following table has been prepared to provide an overview of all the above information.

*Table 1 - Types of Process Mining*

| Relationship | Types | Definition | Coherence |
|---|---|---|---|
| *Play-in* | *Discovery* | Showing how the actual process is executed. Up forehand no idea how the process goes | You have no idea how the process goes |
| *Replay* | *Conformance* | You test if the process goes as expected. You compare the process as it proceeds according to interviews and documentation about the process next to the process as it proceeds in reality according to data. | **Efficiency- and compliance check -** You do a compliance check in which you check to what extent the process complies with principles, procedures, and/or regulations from both internal and external. In addition, you also perform an efficiency check where you see to what extent the process is running efficiently. |
| | *Enhancement* | The process is improved, which can lead to more insights and better control of processes. | **Efficiency- and compliance check -** After you have done a compliance and efficiency check, you look at where the process can be improved to achieve the most efficient process in combination with compliance. |

Now that it is clear exactly what Process Mining is and what types of Process Mining there are, the next section looks at which facilitators and inhibitors influence the efficiency and effectiveness of the Process Mining project.

### 2.1.3. Different factors should complement each other for a successful project

Already before Process Mining projects start, the so-called 3Ps are crucial (Reinkemeyer, 2020). All these factors have to complement each other to make the project successful (Niks, 2018). Per P there are some facilitators and inhibitors that respectively positively and negatively impact the added value of Process Mining. Both facilitators and inhibitors are explained below and summarized in table 2.

First of all, there is the 'Purpose' for the usage of the digital tool, which differs for every project. According to Reinkemeyer (2020), at forehand, the purpose should be clearly defined and

communicated. The purpose should be defined with use cases that show the value of Process Mining for different functions in the process in which Process Mining is applied. Here, organizations should be aware of the fact that the resolving power of Process Mining can be overestimated so that an overambitious scope is chosen as the first project (Rozinat & van Geffen, 2015). Rozinat & van Geffen (2015) add that it is important to not only focus on Process Mining but also to see to what extent other technologies can help. Visual analytics can help with patterns in unstructured data (van der Aalst, 2012b). Van der Aalst (2012) suggests that if you take the challenge of combining these analytics with Process Mining, you can gain even more insights. Secondly, they describe the importance of linking the business driver to a specific business domain. This should be a process with a clear start and endpoint and where there is clear workflow support. Try not to focus directly on the process with the most business value; an effective and efficient support process adds a lot of value to the primary process. Thirdly, Rozinat & van Geffen (2015) explain that organizations should try to divide the business driver into sub-hypotheses that you can confirm or disprove through Process Mining. You have to stimulate asking questions, you have to explore, undertake and innovate.

Secondly, there are the 'People' that should have a digital mindset for change (Reinkemeyer, 2020). According to Reinkemeyer (2020), when starting a project it is best to have process owners that are passionate about change and support the use of Process Mining. In addition to this, the project team should include people with deep process know-how and people with IT competencies. It is important that there are people available and dedicated that bridge the gap with this IT world (Ash et al., 2008). Rozinat partly refutes this by stating that you have to take into account the fact that the people who work with Process Mining have too much fascination with technology, which makes it difficult to visualize the business value of the application (Rozinat & van Geffen, 2015). Ash et al. (2008) add that training and support is another key strategy for the success of implementation. Here only a small number of people critical to a research task are selected. Besides, Ash et al. (2008) suggest that the projects that are related to the implementation should require certain management expertise. The most important is that this management depends on careful planning for each cornerstone. Besides, other more ethical issues may arise in the 'people' aspect. First, the responsible handling of data is very important (Rozinat, 2016). Ash et al. (2008) agrees and says that there are certain limits to data sharing; organizations would be fearful that privacy-related violations could happen. Rozinat (2016) describes that for example, third parties must sign a non-disclosure agreement to handle data in a confidential manner. You should always check what is in the dataset before it is shared with employees and the Process Mining tool must be properly secured. Secondly, you can choose to anonymize certain data. This keeps the process intact, but, for example, the names of employees obscured. Thirdly, Rozinat (2016) describes that organizations can choose to build a common culture

around the Process Mining project. The purpose of this is that people are not constantly reminded of their mistakes, but that their perspective is included so that the process analysis is a joint effort. For example, it is good to have the data checked first by the relevant domain expert. It is also good to discuss the findings of the analysis and to give people the opportunity to ask questions and explain why things happen. Rozinat (2016) adds that Process Mining can detect inefficiencies in the process, so organizations should be aware that people see the use of it as a threat. That is why organizations should clarify the purpose of Process Mining to their employees so they can understand.

And lastly, there should be availability and reliability of event logs, so-called 'Processtraces' (Reinkemeyer, 2020). First, you have data ingestion, where you discover and extract all relevant processtraces from any source system into one data storage environment. Here, having consistent data management can facilitate as this results in less data customization. Besides, it is important to look at data availability and process awareness (Niks, 2018). Data availability refers to whether an IT system collects all the data within all the process steps. Here, finding, merging, and cleaning event data is a challenge for many companies (van der Aalst, 2012b). Van der Aalst (2012) adds that event logs can be complex and contain diverse characteristics. Process awareness refers to the degree to which people know about the process and follow it. Niks (2018) concludes that Process Mining works best when there is a high availability of data and high awareness that helps to define new goals and improvements (see figure 3). Rozinat & van Geffen (2015) add that the unrealistic picture of the available data is a pitfall that can arise and should be taken into account (Rozinat & van Geffen, 2015). In addition to the consistency, availability, and awareness there is the importance of the usability and understandability of Process Mining outcomes (van der Aalst, 2012b). Van der Aalst (2012) considers this to be a major challenge for companies. The goal of Process Mining is actually that it can be used daily instead of ending up in the archive. To avoid the latter, you will have to hide the sophisticated Process Mining algorithms and show user-friendly interfaces to improve usability. It is also possible that the user-friendliness is in order, but that the results are difficult to understand. To avoid this and to understand, the results must be given a suitable representation.

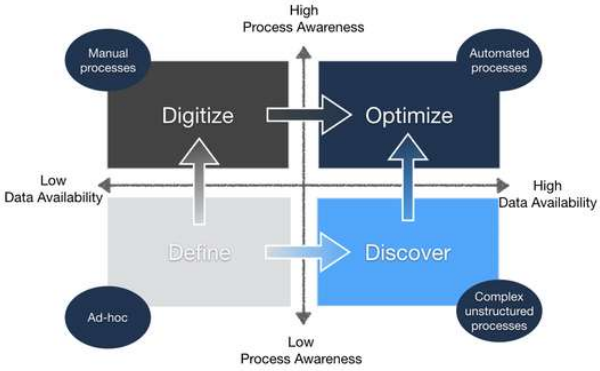



*Figure 3 - Data availability versus Process awareness*

Some challenges have already been mentioned, but there are still two important challenges that are mentioned by van der Aalst (2012), to be taken into account in the processtraces and the final analysis of these processes. First, the creation of representative benchmarks (van der Aalst, 2012b). There are big differences in the functionality and performance of Process Mining techniques. That's

why for good benchmarking you should consist of example data sets and representative quality criteria. Although there are measures for the quality of Process Mining results, benchmarks are very important. The next and last challenge is about dealing with concept drift, which refers to the situation of a changing process. This happens due to seasonal changes or changing conditions while the process is analyzed.

*Table 2 - Success factors Process Mining*

| 3Ps | Success factors | *Explanation* | References |
|---|---|---|---|
| Purpose | Show use cases | *The purpose should be defined with use cases. These cases show the value of Process Mining for different functions in the process* | (Reinkemeyer, 2020) |
| | Linking to business domain | *Linking the business driver to a specific business domain. This should be a process with a clear begin- and endpoint and clear workflow* | (Rozinat & van Geffen, 2015) |
| | Usage of sub-hypotheses | *Divide the business driver into sub-hypotheses. These can be confirmed or disproven by Process Mining* | (Rozinat & van Geffen, 2015) |
| People | Digital mindset | *You should have people that have a digital mindset for change. These process owners are passionate about change, and support the use of Process Mining* | (Reinkemeyer, 2020) |
| | Dedicated people | *There should be a high availability of dedicated people. Project team should include people with deep process know-how, IT competencies and a certain management expertise* | (Reinkemeyer, 2020) (Ash et al., 2008) |
| | Training and support | *Training and support of people is very important. Here only the small number of people critical to a research task are selected* | (Ash et al., 2008) |

| | | | |
|---|---|---|---|
| | Data responsibility | *Data should be handled responsibly. There are certain limits to data sharing. Always check data before sharing.* | (Rozinat, 2016)<br>(Ash et al., 2008) |
| | Anonymize data | *By anonymizing data you keep the process intact but names of employees obscured.* | (Rozinat, 2016) |
| | Common culture | *A common culture should be build around the project. People are not constantly reminded of their mistakes, but that their perspective is included so that the process analysis is a joint effort. The purpose of the project should be explained.* | (Rozinat, 2016) |
| Processtraces | Data reliability | *Reliability refers to whether there is a consistent data management.* | (Reinkemeyer, 2020) |
| | Data availability and process awareness | *Data availability refers to whether an IT system collects all the data within all the process steps. Process awareness refers to the degree to which people know about the process and follow it. Helps defining new goals and improvements* | (Niks, 2018) |

*Table 3 - Pitfalls Process Mining*

| **3Ps** | **Pitfalls** | ***Explanation*** | **References** |
|---|---|---|---|
| Purpose | Overestimate | *Overestimating the power of Process Mining can lead to choosing an overambitious scope* | (Rozinat & van Geffen, 2015)<br>(van der Aalst, 2012b) |
| | Only Process Mining | *Only focus on Process Mining technology is mostly not ideal. Try to look also for other technologies* | (Rozinat & van Geffen, 2015) |
| | Only main processes | *Do not always focus directly on the process with the most business value. Effective and efficient support processes also add value* | (Rozinat & van Geffen, 2015) |
| People | Too much fascination | *When people have too much fascination with technology it is difficult to visualize the business value of the application.* | (Rozinat & van Geffen, 2015) |

| | | | |
|---|---|---|---|
| Processtraces | Unrealistic picture | *People within the organization do not know about which data is actually available for Process Mining.* | (Rozinat & van Geffen, 2015) |

The 3Ps are important to make the Process Mining project as successful as possible. All the 3Ps have to be in sync, as the project will fail if one of them is missing (Reinkemeyer, 2020). This is therefore important to pay attention to on the input side, but not only the input side. You can also pay attention to this input side to evaluate and monitor the project after its completion. This will also be included in the interview questions, in appendix 2. Besides these facilitators and inhibitors found in the literature, a thesis was written last year focusing on the input side of process mining (Hilhorst, 2020). Hilhorst (2020) looked at the factors that influence the effectiveness and efficiency of a process mining project. He has developed a model that includes all these factors. These factors were found by means of literature research and by conducting interviews. In the theoretical model I am developing (see section 2.3), I combine the factors found by Hilhorst with the factors I found in the literature.

Now we have explained the facilitators and inhibitors influencing the Process Mining project outcome, we can take a look at the value of a Process Mining project, as the ultimate success of a project lies in the value it adds (De Implementatiedokter, n.d.). On the one hand, this may be the value for the user such as customer friendliness, usability, or low cost, or the value for the business such as efficiency, cost reduction, or higher customer satisfaction, which will be further clarified in section 2.2. On the other hand, this may eventually lead to complete automation of processes, which will be explained in the following section.

### 2.1.4. A successful RPA initiative depends on whether you use insights created by Process Mining

Process Mining continues to grow because there is also a continuous growth in data volume. According to McKinsey Global Institute, companies store more than 7 exabytes of new data in their systems, while consumers store more than 6 exabytes on their devices (Manyika et al., 2011). In addition to this, in response to the pandemic, a rise in technology investment has taken place which accelerated the already high demand for Process Mining tools (Lawton & Angell, 2021). Gartner estimated that the market of Process Mining grew from $110 million in 2018 to $320 million in 2019 (Kerremans et al., 2020). Applying process automation technologies to bad processes is not the most efficient and effective way.

Robotic process automation (RPA) is a technique for process automation (Geyer-Klingeberg et al., 2018). RPA can be successfully applied through the following three steps. First of all, you have to discover the potential of process automation. With non-standardized processes, automation requires more precaution. It is crucial to determine which processes are standardized enough to benefit from RPA and which processes will ultimately benefit from being standardized prior to the adoption of RPA. Here, Process Mining can be very helpful. Results of a Process Mining Sector Scan from January 2020 showed that 78% of people who automate say Process Mining is key to enabling their RPA efforts. Process Mining tools are capable of identifying automatable routines from logs (Leno et al., 2021). Variants of these routines are collected, standardized, and streamlined. Leno et al. (2021) describe that in this way Process Mining tools help analysts with making a systematic inventory of routines that can be automated. Then the candidates can be analyzed even more in terms of potential benefit and automation costs. Here, Geyer-Klingeberg et al. (2018) agree, mentioning that from the moment processes are standardized, you should look for the process with the highest potential for automation.

The next step is to develop an RPA application. The robot's activities should be tracked and eventually, the process instances can be evaluated. You can benchmark the performance of different robots to achieve the most effective implementation possible. The last step is to continue monitoring. You have to safeguard RPA benefits, by tracking the impact of RPA and its return on investment. Through Process Mining you can continue to follow the process and changes in the process are therefore quickly found. Based on this, you can determine whether you need to adjust your robots. All combined, you can conclude that a successful RPA initiative depends on whether you use insights created by Process Mining. These insights, as well as other kinds of added values created by Process Mining projects, are explained in the following section.

## 2.2. Added value

To clarify the added value of Process Mining, we will first look at the practical perspective in which we look at the different use cases and the forms of added value that have been delivered in these projects. Secondly, we will look at the more theoretical perspective of the added value, so that both perspectives can be compared. Finally, based on the forms of added value found, a conclusion is drawn whereby the link is also made to added value in general for companies.

### 2.2.1. Added value from a practical perspective

This section looks at various practical use cases of Process Mining from the literature and then examines the added value of Process Mining there. The use cases concern different organizations in different sectors. The concepts found from the literature are presented clearly, after which they are enriched from practice.

In the book 'Process Mining in Action' (Reinkemeyer, 2020), Reinkemeyer (2020) shows various use cases in which it becomes clear how Process Mining can create value for different companies and value chains. The main findings are summarized in the tables under appendix 1. Because the use cases are described in great detail, only the most important findings of the added value of Process Mining are described in the tables. Based on these tables, a self-made overview of the concepts is shown below. On the left are the concepts found in ten use cases, which represent the way Process Mining has created value, and are explained further in the third column. The percentages indicate in how many of the ten cases described in the book, the mentioned added value occurs.

*Table 4 - Added value best practice use cases (based on (Reinkemeyer, 2020))*

| Category | Added value | Explanation | Percentage * |
|---|---|---|---|
| A | Transparency | Clear vision, clean process insights, comparing As-Is process with planned | 50% |
| B | Identify inefficiencies | Bottlenecks, waste, other inefficiencies | 80% |
| C | Standardization | Minimizing the process variation | 30% |
| D | Enabling innovation | Sustainability, RPA, Active alerting systems | 70% |
| E | Increasing analytical speed | Faster decision making, modify KPIs and analyze their relevance | 40% |
| F | Better communication & collaboration | Reduce communication so employee satisfaction is increased | 20% |

| | | | |
|---|---|---|---|
| G | Compliance | Comply with procedures, regulations, strengthening internal control | 10% |

*Notes: * self-calculated percentage indicating how often the described concept of added value occurs looking at the ten described use cases.*

The use cases also indicate how the added value of Process Mining can be increased, in other words how a Process Mining project can be more successful. The following table lists the improvements found, along with a percentage of the number of use cases where the improvements appear.

*Table 5 - Improvements best practice use cases*

| Category | Improvement | Explanation | Percentage |
|---|---|---|---|
| 1 | Benchmarking | Try to compare with others | 40% |
| 2 | Artificial Intelligence | Use AI to dive deeper into data to find more detailed information: Root Cause Analysis, Swirl Analysis | 30% |
| 3 | Dashboards | Dashboards with meaningful KPIs where you can thrive down costs | 10% |
| 4 | People | Knowledge of the processes, accessibility of data, the role of process owner clearly defined, training/workshops, etc. | 40% |
| 5 | Enrichment of data | Enrich Process Mining analysis with other relevant data | 20% |
| 6 | Processtraces | Major process design, process management restructuring, one central data source | 20% |
| 7 | Other purpose | Try to analyze other processes, or try to improve instead of monitoring / visualizing | 10% |

Among the findings are also two points that show what is important in the future regarding the application of Process Mining. In the use case about BMW, Patrick Lechner, Head of Process Mining and Robotic Process Automation of BMW, indicates that it is important to stay informed about tools and technologies. He says that new tools and technologies emerge every month that need to be closely monitored. You then have to ask yourself which ones you might want to apply and which

ones you want to ignore. Lastly, in the part about Siemens where Process Mining is applied in the Order2Cash process, Gia-Thi Nguyen, Head of Operational Excellence of Siemens AG, explains that at the moment Process Mining is mainly about visualizing and improving the process. Ultimately, this should go towards predicting future processes and outcomes. Here you should not only recommend but also execute the next best action.

### 2.2.2. Process Mining is a very objective tool to quickly find causes of problems in the process

Having an eye for every value chain activity in the organization is the key to successfully creating value(Dess & Lumpkin, 2005). Dess and Lumpkin (2005) explain this is a source of competitive advantage. As can be concluded from the previous section, Process Mining can be used for several things and serve as a solution, being of real value.

First, it helps to know what is really going on in the company (de Hosson, 2020). De Hosson (2020) explains that when talking to individuals within the company it often happens that there are some deviations in the described process. With Process Mining, no activity will be forgotten. For this reason, Process Mining is a suitable tool for auditors to analyze the processes with all their variations to find out whether all internal controls are working (Rozinat & Günther, 2014). Next to that, Rozinat & Günther (2014) explain that this helps with understanding legacy systems (Rozinat & Günther, 2014). Because the developers of the old systems often no longer work at the company, Process Mining offers a solution by understanding the actual system behavior. Second, you act based on facts (de Hosson, 2020). De Hosson (2020) describes that Process Mining delivers you the right insights to come up with the right decisions. A big advantage of Process Mining is that it replaces the traditional way in a good way (Rozinat & Günther, 2014). The traditional way is to conduct interviews or give workshops to employees to map out the process. This is really time-consuming, subjective, incomplete and the analysis cannot be easily repeated. Therefore, Rozinat & Gunther (2014) explain that Process Mining is very objective in the first place and quickly finds causes of problems in the process. Because Process Mining generates the process from the data, people can focus on answering the question of why the process is happening this way. Third, according to de Hosson (2020), Process Mining gives you continuous monitoring and improvement. You can compare the performances over time and check the effectiveness of changes. To strengthen this, Preben Ormen (2014) says the following about Process Mining (Preben Ormen, 2014): *'For the first time, we now have efficient tools that allow us to repeat process analysis without significant effort because once set-up for the first round of analysis, the mechanisms are in place for reuse anytime in the future.'* Rozinat & Gunther (2014) agrees by saying to test the effectiveness of the changes in the process, Process Mining can also be performed repeatedly or periodically. This can be of value to managers who like to have control over their process. Fourth, Process Mining helps increase efficiency and

reduces risk (de Hosson, 2020). You get full transparency in the process which helps identify bottlenecks. Rozinat (2016) agrees and explains that Process Mining allows you to quickly see where on average the greatest delays occur in the process (Rozinat, 2016). Once the bottleneck has been discovered, you can make adjustments that will resolve this bottleneck. Also, Rozinat (2016) describes that Process Mining helps to detect waste in the process, which can be, for example, repeating certain process steps. Once these wastes are known, they can be reduced which can lead to cost savings. Here, for example, Rozinat & Günther (2014) explain that it is possible that some adjustments in the process have hardly been used. This helps reduce maintenance costs. To conclude, by having such an optimized process, results are achieved earlier and, according to Dilmegani (2019), the customer experience will be higher (Dilmegani, 2019). Think, for example, of faster processing of orders, or faster payment of invoices. This creates value for the company as it also keeps the awed customers happy (Heathfield, 2021). Fifth, de Hosson (2020) indicates that Process Mining unravels complexity, which is about simplifying complex database structures. Rozinat & Günther (2014) suggest that it happens quite often that the same processes run differently in different parts of the organization. By harmonizing these processes as much as possible, you can reduce overhead costs and deliver consistent quality. Sixth, Rozinat (2016) extends de Hosson's (2020) points by saying that Process Mining can be used to see to what extent the current process complies with the guidelines and prescribed procedures. Deviations from the prescribed process can be made visible and quantified. And last, Rozinat (2016) explains that it happens quite often that Process Mining helps determine important KPIs. By going through the process in detail, you know what the most important KPIs are and where in the process these KPIs should be measured for monitoring in the long term.

If we compare these seven variables with the ones found and practically explained in the use cases and highlighted in table 4, we can draw up the following table.

*Table 6 - Added value found in literature*

| Practice | Theory | Combination | Explanation |
|---|---|---|---|
| Transparency | Transparency | Transparency | Clean process insights, finding deviations from the prescribed process, understanding legacy systems |

| | | | |
|---|---|---|---|
| Identify inefficiencies | Identify efficiency | Identify inefficiency | Identify bottlenecks and waste |
| Standardization | Harmonizing | Standardizing processes | Minimizing process variation, leading to reduced overhead and maintenance costs |
| Increasing analytical speed | Determine and analyze KPIs | Increasing analytical speed | Faster decision making, modify KPIs and analyze their relevance |
| Compliance | Compliance | Compliance | Comply with guidelines and/or prescribed procedures |
| Enabling innovation | - | Enabling innovation | Sustainability, RPA, active alerting systems |
| Better communication & collaboration | | Better communication | Better communication leads to better collaboration, which also leads to higher employee satisfaction |
| | Objectivity | Objectivity | Process Mining replaces the traditional method; interviews |
| | Continuous monitoring | Continuous monitoring | Performing Process Mining repeatedly and periodically |

Now that we have covered all the relevant literature on Process Mining, the next section is devoted to creating a theoretical model.

## 2.3. Theoretical model

Several studies were found during the literature review and the results of these studies have been included in this research. Ultimately, these results are also reflected in the theoretical model as shown below. In this model, the new indicators and variables are marked by green. A judgement needs to be made to what extent this model can be enriched from practice.

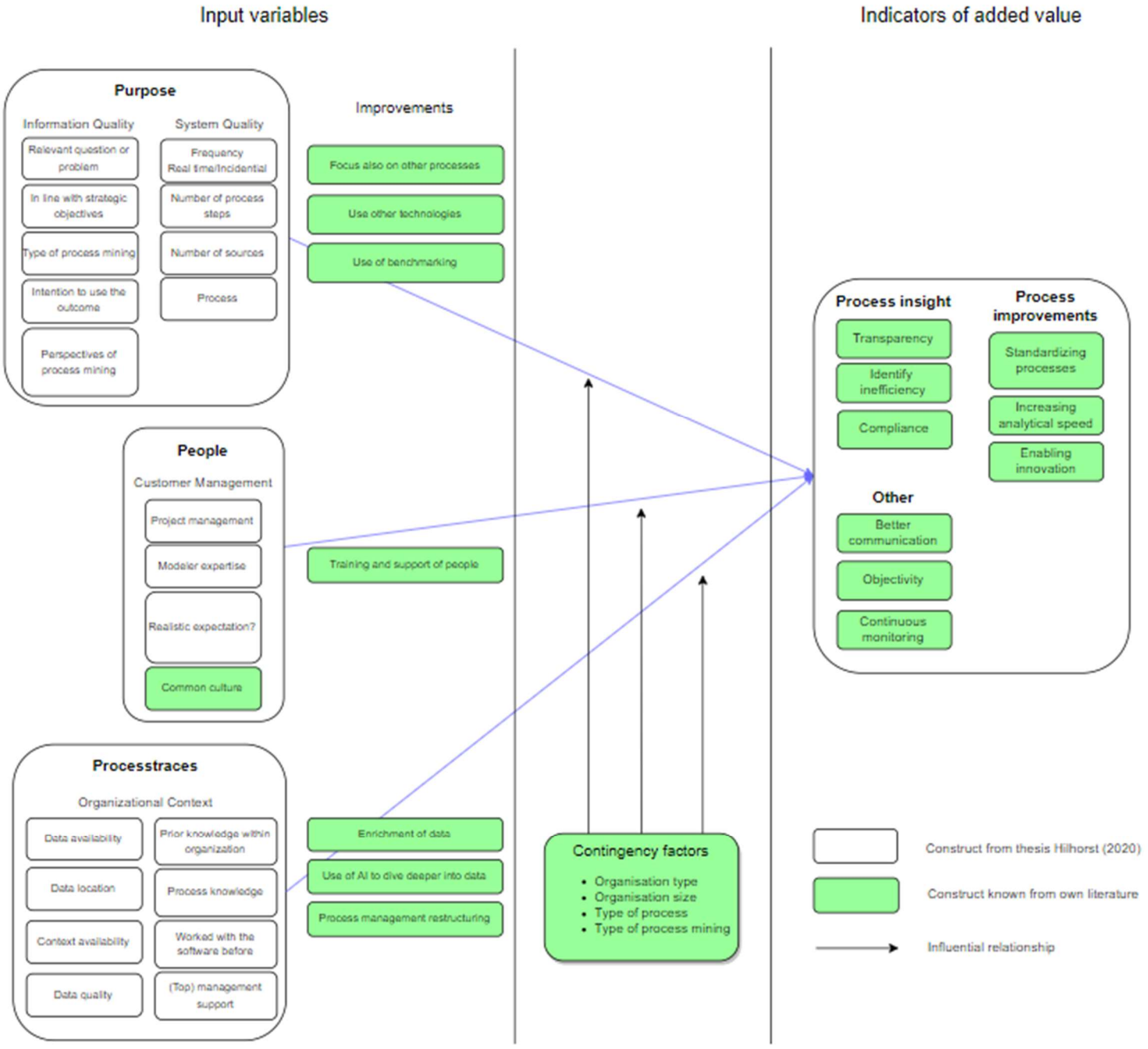



*Figure 4 - Theoretical model*

Looking at the output side of the model, you see all indicators of added value that can be found in the literature. It is based on table 6, which ensures a good balance between on the one hand the concepts found in theory as described by de Hosson (2020), Rozinat & Gunther (2014), and Rozinat (2016). On the other hand, this includes the indicators found in the use cases as described by Reinkemeyer (2020). Some indicators can be grouped, as it has been found in the literature that in general Process Mining helps to map a Process and to improve it (van der Aalst, 2012a). As said, it should be considered whether these indicators can be supplemented from the context of my practical research. Therefore, the following proposition is formulated:

P1: The groups 'process insight', 'process improvements', and 'other', with their underlying indicators of added value of Process Mining, are also reflected in the results of the practical research.

On the left, the input variables are shown. They consists on the one hand of a combination of success factors and improvements found by Reinkemeyer (2020), Rozinat (2016), and Niks (2018), as also shown in tables 2 and 5. On the other hand, there are white marked variables that are found in the research done by Hilhorst (2020). It can be concluded that many variables found in this literature review are underlying the variables of Hilhorst's (2020) model. In order to see to what extent the groups and their underlying input variables and improvements can be supplemented from practice, the following proposition has been formulated:

P2: The groups 'Purpose' (information quality, system quality), 'People' (customer management), and 'Processtraces (organizational context), with their underlying input variables and improvements, are also reflected in the results of the practical research.

Because I expect the relationship between input variables and the indicators of added value to be different in every organization, there are so-called contingency factors. These are unexpected variables that are beyond your control (Lazzari, 2018). Already some expected contingency factors are shown in the model. In order to see whether these contingency factors are evident in practice, the following proposition should be judged:

P3: 'Organization type', 'organization size', 'type of process', and 'type of process mining' are in the practical research seen as contingency factors that have a significant impact on the relationship between input variables and the indicators of added value of Process Mining.

Based on the results of the practical research, the above propositions should be judged. The next chapter explains how this practical research is set up and what the methods are regarding data collection and data analysis.

# 3. Method

## 3.1. Research design

Within practical research, of which there are two main types: qualitative and quantitative. Whereas in quantitative research you try to focus on confirming or rejecting hypotheses, in qualitative research, you focus on understanding concepts and gaining insight into subjects about which there is little knowledge (Streefkerk, 2021). As said in the research gap there is not yet a model showing the added value of Process Mining and ways to improve this. Therefore, this research commits a qualitative strategy. Figure 5 shows the methodology that will be applied.

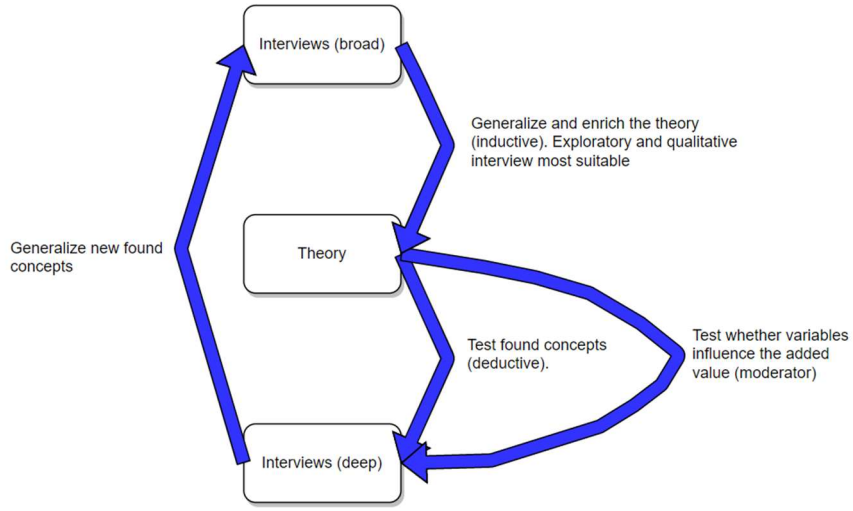



*Figure 5 - Methodology*

Research has shown that conducting interviews is the most commonly used data collection method (Benbasat et al., 1987), so this is preferable within this qualitative research. One kind of interview is for the broad view. This involves looking at multiple cases in multiple sectors to enrich and generalize the theoretical model (see figure 4). This is an inductive method of research in which I try to generalize and enrich a theory based on observations from interviews. In this inductive way of research, exploratory and qualitative interviews are most suitable (Saunders et al., 2019). Another type of interview is for the deeper view, which focuses more on one particular sector. Here it is more about testing the concepts found and looking at whether the found concepts are also reflected here. Eisenhardt (1989) mentions that the theories are empirically valid and testable because the constructs are already tested during the theory-building process (Eisenhardt, 1989).

The propositions formulated in section 2.3, are empirically testable using data. This qualitative research can therefore be used to judge these propositions. On the basis of these judgements, the final conceptual model can then be drawn up.

The following sections clarify the chosen sampling, the method of data collection, and the method of data analysis.

## 3.2. Sampling

This qualitative research is conducted in association with the consultancy company. It is operating mainly for organizations in the central, northern, and eastern Netherlands. This concerns Interim Finance assignments. In the beginning, the assignments were more about accountancy projects, like preparing the annual reports. Now, their focus is increasingly on business controller tasks and the use of new techniques to create new insights, including the use of Process Mining.

The interviews with consultants of the consultancy company are about getting a broad perspective. Here, eight consultants are interviewed who have conducted Process Mining projects, in this study defined as 'cases', at various sectors. These project leaders were responsible for the implementation of Process Mining within an organization. For the deep perspective contact persons of these organizations are interviewed, who can be seen as the project sponsors. Initially, two cases in the housing market are concerned. Each case is a different organization, in which an interview is conducted with a function that was present within the Process Mining project group of the organization.

Below is an overview of the interviews including the associated sector and the process in which process mining was applied.

*Table 7 - Overview interviews*

| Perspective | Interview nr. | Type of organization | Process |
|---|---|---|---|
| **Broad Perspective** | 1 | Housing corporation | Repair and maintenance process |
| | 2 | Housing corporation | Approval process & maintenance invoice |
| | 3 | Car dealer | Telephony process |
| | 4 | Education | The invoice handling process and personnel process |
| | 5 | Care institution | Invoice handling process |
| | 6 | Grid company | Purchase-to-pay |

| | | | |
|---|---|---|---|
| | 7 | Care institution | Critical workflows |
| | 8 | Manufacturing | Purchase-to-Pay process |
| **Deep Perspectives** | 9 | Housing corporation | Repair and maintenance process |
| | 10 | Housing corporation | Approval process and maintenance invoice |

As said, the broad perspective concerns the consultants of the consultancy company, and the deep perspective concerns the client looking back at the Process Mining project. Here, cases are also dealt with that have also been dealt with the consultants, only now it is highlighted from a different perspective. So you go deeper into it. The next section describes how these interviews are conducted.

## 3.3. Data collection

There is a certain protocol for conducting interviews. The interviews will be conducted physically whenever possible. After all, due to the coronavirus, there may be no other option than to meet online. Then there are a number of steps.

1. Consultants or representatives of firms are contacted via e-mail or telephone
2. Sending appointment confirmation via e-mail including date and time
3. Questions are sent in advance
4. Interview will be conducted
5. Interview will be recorded, with the permission of the interviewee
6. Introduce yourself and the study
7. Rest of the interview ask the questions and take notes of the most important things
8. Evaluate the interview in order to ensure high quality for the upcoming interviews
9. Transcribing the interview, with changes regarding privacy
10. Code the transcriptions with Atlas.TI

The questions asked in the interviews are semi-structured, as in appendix 2 there is a format with questions that will be asked. However, it is possible to deviate as new topics may occur which are interesting to dig in deeper. I want to discuss with the consultants at the consultancy company the cases they handled. I try to let the consultants and representatives of organizations tell their own stories as much as possible and not ask specific questions based on the theoretical model. This is to avoid putting words in their mouths. However it did happen that standardized questions are asked in the end. Once the interviewee does not answer the question, the question is modified or a follow-up question is asked, as also seen as important by Saunders et al. (2019).

At the beginning of the interview, there is an introduction of both the interviewer and interviewee. Then some general questions are asked about the organization where process mining has been applied, the process where it is applied, the type of process mining, and what the reason for applying process mining was. The following questions are structured based on the outline of the theoretical model (see figure 4). First the 'What did you achieve?' side will be treated. Here, most 'indicators of added value' will be found. After that, the 'What did you do?' and the 'Reflection' side will be treated. Here, the interviewee should think about what they did in the project and take a critical look at it. Here most 'input variables' and 'contingency factors' will be found. At the end of the interview, there is room for additional remarks from the interviewee. After the interview, the interview is transcribed and coded.

In addition to both the interviews, a survey is sent afterward, to ask both consultants and representatives of organizations to fill it in. On the one hand, this is done for generalization purposes. This is because there are some codings that only come up in one or at most two interviews, or of newfound codings in the deep interviews. These will first have to be generalized before they are included in a model. On the other hand, this is done to validate the answers given in the interviews. In the survey, all codings are included as well as some additional items from the notes. This is because it may also be that there are some cases not coded, or that codings are sometimes rather general and may cover several underlying variables, which are not separately coded. The survey is included in appendix 4 and consists of four parts. The first part asks to what extent the respondent sees the importance of the mentioned input variables of a process mining project. The second part is about the contingency factors, where the respondent has to indicate what in his/her opinion is the impact of the variables mentioned. Thirdly, the respondent is asked to what extent he/she agrees with the found forms of the added value of Process Mining. Finally, the respondent is asked to indicate on a scale of 1 to 10 what he or she believes to be the added value of Process Mining for the company and to explain this.

All the data that is collected from both the interviews and survey should be analyzed. How this is done, is explained in the following section.

## 3.4. Data analysis

Before working with the codings, a grouping has already been made. For each coding made, it is written directly in the comment what form it is: 'indicator of added value, 'input variable', or 'contingency factor'. The results of the codings are shown in the code table, included in appendix 3. From a combination of the variables tested in the survey, and the coded variables, cross-case comparison matrices are drawn up for both 'output' and 'input' and 'contingency factors', which are included in the next chapter. Here the variables are grouped and, on the basis of the codings and

notes, it is indicated in which and how many interviews these variables are mentioned. The tables also show for each variable the mean answer in the survey.

To get some additional information about what interviewees say about variables, but also to find relationships between variables, the taken notes will have to be analyzed as well as some specific parts of the transcription where the coding was done. In appendices 6, 7, and 8 this is shown in tables. For each variable, there will be shown what certain interviewees have to say about it.

A combination of these analyses should determine which 'indicators of added value', 'input variables', and 'contingency factors' emerge from practice. This is subject to certain conditions:

1. >5 number of interviews mentioned
2. IF underlying (not coded) variable mentioned, THEN mean survey result >3
3. IF 4 OR 5 number of interviews mentioned, THEN mean survey result ≥3
4. IF <4 number of interviews mentioned, THEN mean survey result ≥4
5. IF <4 number of interviews mentioned, BUT mentioned in both interviews with clients, THEN mean survey results ≥3

On this basis, the propositions can be judged and the conceptual model can be drawn up. Besides, in order to answer the research question, an indication of the added value of Process Mining for organizations should be made. This is done based on the answers to the survey question: *"Please indicate on a scale of 1 to 10 what you consider to be the added value of your process mining project that we have covered in the interview"*, plus the subsequent written explanation, plus the codings from the "What did you achieve?" section of the questionnaire.

The results of all these analyses are presented in the next chapter.

# 4. Results

In this chapter, the results of the analysis of the interviews, as well as the survey, are combined and presented. Tables are included in which some types of variables that are related, are grouped. These tables show in how many of the ten interviews the variables are mentioned. Finally, the mean answer from the survey is included. Based on this, it is determined which from practice are included in the final model. Under each table, the groupings and the underlying variables that will be included in the final model, are explained. The comments are mainly quite general. Because it is important to name different perspectives in a small sample, exceptional comments are also highlighted. In the table, an asterisk indicates the interview in which this is mentioned. For more background information, please refer to in which all comments are included.

## 4.1. Indicators of added value

Regarding the indicators of added value, the following groupings are made and will be explained: 'general', 'integral insight', 'communication and cooperation', 'awareness', 'component of reporting', and 'process optimization'. After this section, the measured added value of Process Mining in the cases will be explained, and an overall conclusion is written.

*Table 8 - Cross-case indicators of added value*

| | | Housing corporation | | | | Care institution | | Education | Car dealer | Grid company | Manufacturing | Score survey |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | 1 - 5 |
| General | Objective | | ✓ | ✓ | | ✓ | ✓* | ✓ | ✓ | ✓ | ✓ | 4.44 |
| | Visualize | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓* | 4.56 |
| | Broadly applicable | ✓ | | | | | | ✓* | ✓ | | | 4.22 |
| | Knowledge Process Mining | | | | | | | | ✓* | ✓ | ✓ | 3.86 |
| Integral insight | Judgement on data | | | | ✓ | | ✓* | | | | | 3.78 |
| | Degree of automation | | | | | ✓* | | | | | | 4.11 |
| | Financial insight | | | | ✓ | | | | | | | 3.56 |
| | Compliance check | | ✓ | | | | ✓* | ✓ | ✓ | ✓ | ✓ | 4.00 |
| | Bottleneck analysis | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓* | ✓ | 3.67 |
| Communication & Cooperation | Higher-level conversations | | ✓ | | ✓ | | | | | | ✓* | 3.89 |
| | Addressing and directing people | ✓ | | ✓* | | | | | ✓ | | | 4.22 |
| | Benchmarking | | ✓ | ✓* | ✓ | | | | | | | 4.22 |
| Awareness | Awareness towards actions | | | ✓ | ✓* | ✓ | | ✓ | ✓ | ✓ | ✓ | 3.44 |
| | Awareness towards targets | | ✓ | ✓ | ✓* | | ✓ | | | ✓ | | 4.22 |
| Component of reporting | Continuous monitoring | ✓ | ✓ | | ✓ | | ✓ | | ✓* | ✓ | ✓ | 4.00 |
| | Opens way to PowerBI | ✓ | ✓ | | ✓ | | ✓ | | ✓ | | | 3.78 |
| Process optimisation | More efficient process flow | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | 4.56 |
| | Automate process | | | | | ✓ | ✓ | | | | | 4.11 |
| | Improved data capture | | | | | | ✓* | | | | | 4.22 |

*Notes: [1] * Special insight that is also addressed in the explanation below. All comments can be found in Appendix 5. [2] 1 = Strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree*

**General -** First, the value-added indicators that occur in every Process Mining case, and are therefore very 'general'. It consists of the indicators 'objective', 'visualize', 'broadly applicable'. Objectivity takes away the discussion about how well or badly process steps are going. Therefore it is related to 'communication & collaboration', which is another indicator of added value. Interview 7 also indicates that objectivity is only there if the data is also sufficient. This in turn shows that there is a relationship with the quality of data. In terms of visualisation and the insights you gain so quickly, this is seen as the added value of Process Mining. Finally, interview 3 and 4 explain that when there is sufficient data available, Process Mining can be applied within any organization and any process, thus broadly applicable.

**Integral insight -** In the interviews, 'integral insight' into the process was most often seen as the added value of Process Mining. This is after all a broad concept consisting of several indicators. First of all, process mining gives a bottleneck analysis, that shows the efficiency of the process, thus an improvement potential. Here, interview 6 mentioned that it is not only good to look at the bad points, but that insight into the good points in the process is also of added value. Secondly, it checks compliance, meaning whether everything goes according to procedures and regulations. Interview 7 adds that by making this visual, it can help the auditor. Thirdly, process mining gives a judgment on data about how it is going through the process, and whether the data capture is in order. Fourthly, there is an insight into the degree of automation, giving an indication of where automation and computerization are currently in order and where they can be improved. Finally, because the bottleneck analysis indirectly shows where the greatest costs are in the process, it was decided not to mention the indicator 'financial insight' separately.

**Communication and cooperation -** As you have insight into the process and you have an objective view of the process, it helps in the 'communication and cooperation' in the whole organization. Because you are talking about facts together, you can address and direct people in their work, which makes conversations take place at a higher level. That is why it has been decided that these indicators actually follow on from each other and therefore belong together. Then, because Process Mining is good at benchmarking, it also leads to better cooperation with, for example, chain partners. Interview 10 adds that for this reason, better decisions can be made.

**Awareness -** Because Process Mining provides certain insights, it also creates 'awareness' among employees. On the one hand, this awareness is towards administrative actions, as the consequences of these actions are made clear. On the other hand, it is awareness of the objectives. Interview 10 explains that it makes you think about whether the objectives are realistic. Interview 9 explains that

it also makes you think about whether you should not set new objectives that show when you are satisfied with the process.

**Process optimisation -** Ultimately, the insight gained must lead to 'process optimisation', which can take several forms. Firstly, it can lead to a more efficient process, where you focus on solving inefficiencies and standardizing the process. The next step may be to automate the process or some process steps. Finally, interview 7 explains that Process Mining can also lead to the need to go back to the data to improve the data capture.

**Component of reporting -** To measure the added value of Process Mining, it is important to include it in your PDCA and see it as a 'component of reporting'. Interview 3 concludes that by letting it sink in structurally, it will help you get the most out of your Process Mining project. First, once you have optimized the process, it is important to monitor it continuously. Second, Process Mining also opens the way to PowerBI, as KPIs found in a dashboard are easy to monitor. Because both points are easy to implement, it is seen as an added value of Process Mining.

Now that the six different groups with their underlying indicators have been described, a conclusion is written in the next section concerning the actual measured added values of the Process Mining projects discussed.

## 4.2. Measured added value

Based on the answers to the survey question: ‘Please indicate on a scale of 1 to 10 what you consider to be the added value of your process mining project that we have covered in the interview’, plus the subsequent written explanation, plus the codings from the ‘What did you achieve?’ section of the questionnaire, a judgement can be made about the measured added value of Process Mining in the studied cases. In the end, a conclusion is written.

The mean answer of the scale measurement regarding the added value of the Process Mining project is '7'. The written explanations are somewhat different from each other, but they all boil down to the same thing. For example, one respondent indicated that there was definitely added value in terms of concrete points where improvements could be made in the process. On the other hand, another respondent indicated that the follow-up of these points was lacking, which meant that, as a result, it had less impact than it had in potential. Another indicates that Process Mining does create a certain awareness within the organisation, which is also of great added value. Finally, it is mentioned that a project was done too independently, which ultimately led to it not being taken up, even though the insights were good.

Based on these explanations and answers from the "What did you achieve?" section of the questionnaire, a conclusion can be written regarding the added value. First of all, Process Mining creates a certain awareness among employees in the organization. It also provides 'insight' into the process, on the basis of which improvement actions are drawn up. However, the follow-up of these actions and the structural application of Process Mining is often lacking. Among the eight interviews, there was also only one interview in which there was a follow-up case. In the interviews, it is often mentioned that to achieve the follow-up and structural application, it is important to create commitment within the organization. People in the organization must be willing to apply Process Mining and see its usefulness, which encourages them to follow up actions and apply Process Mining structurally. Once something is done with the process insights, process mining has real added value.

Contingency factors and input variables influence this. As a consultant, you have to pay attention to these factors and variables at the front end. This is to ensure the follow-up and structural application of Process Mining and thus maximize the added value. The following sections discuss these contingency factors and input variables that have the most impact on the added value of a Process Mining project.

## 4.3. Contingency factors

Regarding the contingency factors, the following groupings are made and will be explained: 'organization', 'tool', 'consultant', 'process', 'software and data', and 'situation organization/sector'.

*Table 9 - Cross-case contingency factors*

| | | Housing corporation | | | | Care institution | | Education | Car dealer | Grid company | Manufacturing | Score survey |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | 1-5 |
| Organization | Profit or non-profit | ✓* | | ✓ | | | ✓ | | ✓ | | | 2.11 |
| | Startup or established | | | | ✓ | | ✓* | | | | ✓ | 3.11 |
| | Size | | | | | | ✓* | | | ✓* | ✓ | 3.22 |
| | Chain partner or not | | | | ✓ | | | | | | | 2.67 |
| | Separate BI department | | | | | | ✓ | | | | | 3.11 |
| | Organzational culture | | ✓ | ✓* | | | ✓ | ✓ | | ✓ | ✓ | 4.33 |
| Tool | Tool is already at the organization | | | | | | | ✓ | ✓ | | ✓ | 3.22 |
| | Practical divisibility | | | | | | | | ✓* | | | 3.78 |
| | Technical aspects | | ✓ | | | | ✓ | ✓* | ✓ | | | 3.78 |
| Consultant | Physical presence | ✓ | ✓ | ✓* | ✓ | | | ✓ | ✓ | | ✓ | 4.11 |
| | Function/role | ✓* | ✓ | | | | | | ✓ | | | 3.56 |
| | Type of cooperation | | | | | | | ✓* | | | | 4.44 |
| Process | Type of process | | | ✓ | | | | ✓* | | | | 3.67 |
| | Complexity process | | ✓ | | | | | | ✓ | ✓ | | 4.00 |
| Software & Data | Software experience | | | | ✓* | | | | | | | 3.67 |
| | Opportunity for automation | | | | ✓* | | ✓* | | | | | 3.67 |
| | Willingness to provide data | | | | ✓ | | ✓* | | | | | 4.22 |
| | Data complexity | | | | | | ✓ | | | | ✓* | 4.00 |
| Situation organization/sector | Financial situation | | | ✓ | | | ✓ | | | | | 3.22 |
| | Degree of work on austerity | | | ✓ | | | | | | | ✓ | 3.67 |
| | Degree of improved data capture | | | ✓ | ✓ | | ✓* | | | | | 4.11 |
| | Degree of work in automation | | | ✓ | ✓* | | ✓ | | | | | 3.67 |

*Notes: [1] * Special insight that is also addressed in the explanation below. All comments can be found in Appendix 6. [2] Score survey: 1 = No impact, 2 = low impact, 3 = moderate impact, 4 = significant impact, 5 = severe impact*

**Organization -** The 'organization' itself can influence the relationship between input and output. After all, this includes several forms. First of all, the organisational culture is important. Interview 9 explains that it' s about whether people are quick to accept mistakes, change, and accept Process Mining as a tool in this, even if maybe the process is going well. Secondly, in terms of startup or established, are easier to convince about the added value of Process Mining, thus showing more commitment than established organizations. Interview 7 explains that startups tend to be more creative in their thinking and have less fear of new tools and systems. Thirdly, in terms of size, interview 7 explains that it matters whether you have a parent company above you making decisions, impacting whether Process Mining is used more often or not. Size also matters in the verification of data and results, as in a larger company you will have to go to the department more often instead of asking a process owner who does not oversee everything in detail. Lastly, having a separate BI

department makes a difference because these people have a high degree of knowledge of the process and data, making verification easier. It will also be easier for Process Mining to be taken up structurally by this department. As large companies often employ information analysts, a relationship can be found between size and having such a department.

**Tool -** The Process Mining 'tool' is also seen as a contingency factor. First, the higher the practical divisibility of the tool. Interview 3 explains that the more you can bring the organization into the Process Mining, the higher the likely acceptance and commitment you get. It can be concluded from the interviews that if this divisibility is high enough, it does not matter whether the tool is already at the organization or not. Therefore, these forms can be seen together. Secondly, the technical aspects of the tool also matter. The client wants a simple, easy-to-understand tool. Also, interview 4 explains that the technical aspects often influence whether Process Mining can be easily applied structurally and whether benchmarking is possible.

**Consultant -** There are also some contingency factors related to the 'consultant'. First of all, it often makes a difference whether the consultant is physically present, which impacts the commitment you get from the organization. Interview 9 explains that by keeping the distance as small as possible, resistance among employees will be prevented. Then, the type of cooperation has an impact, meaning whether the consultant works on the project independently or in a team. Here, interview 4 indicates that if you work in a team you will have more commitment, and otherwise, it remains to be seen what happens with the outcome of the project.

**Process -** Then the 'process' in which Process Mining will be applied has an impact. In terms of process type, interview 4 explains that Process Mining is best suited to processes that are structural and repeatable. Also, the greatest added value comes when you apply process mining to the main process, and use this as a starting point for further application. As far as the process complexity is concerned, the more complex the process, the higher the improvement potential, and ultimately the higher the added value.

**Software and data -** Regarding 'software and data', there are also some contingency factors. First, according to interview 10, the opportunity for automation is about the chance that the software package the organization is currently using, can be automated to such an extent that process mining can be used optimally, and maybe even implemented in the software. Interview 7 explains that it also affects the automation of your process, as digital partners are not always able to do this. Secondly, as a consultant, you are often dependent on the willingness to provide data. According to interview 7 software suppliers often see it as part of the source code, so they do not always want to

make data available. Thirdly, the data complexity may be very high because the software contains too much information. As a result, consultants spend more time on data analysis.

**Situation organization/sector -** Finally, it also matters what the current situation is within the organization or sector. This is seen as an important contingency factor, especially by the clients themselves. On the one hand, you have the degree of improved data capture, meaning the recording of the data and therefore whether it can be fully extracted from the ICT. Interview 7 explains that this recording, and therefore availability of data, is sometimes lacking in organizations. On the other hand, you have the degree of work in automation. Interview 10 concludes that the more attention an organization pays to automation and digitalization, and the more work it already does in this area, the more progressive the client will be during the project and the more quickly it will show commitment to the application of Process Mining.

There are thus six groups of underlying contingency factors that influence the relationship between the input variables and indicators of added value. In the next section, we will further discuss which input variables these are.

## 4.4. Input variables

Regarding the input variables, the following groupings are made and will be explained: 'problem and question, 'introduce', 'agreements', 'knowledge', 'data analysis', 'customer ownership', and 'recommendation and follow-up'.

*Table 10 - Cross-case input variables*

| | | Housing corporation | | | | Care institution | | Education | Car dealer | Grid company | Manufacturing | Score survey |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | 1 - 5 |
| Problem and question | Problem and question (prioritize) | ✓ | | ✓* | ✓* | ✓ | ✓ | ✓ | ✓ | | | 4.44 |
| | Delineating assignment | | | ✓* | | ✓ | ✓ | ✓ | | | ✓ | 4.11 |
| | Assessing whether Process Mining is the right tool at all | | | | | | ✓* | | | | ✓ | 4.00 |
| | Awareness of problem client | | | | ✓* | | | | | | | 4.11 |
| Introduce | Introducing Process Mining and its importance | | | ✓* | | ✓ | ✓ | ✓ | | | ✓ | 3.89 |
| Agreements | Making it structural | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓* | ✓ | ✓* | 3.56 |
| | Small/restricted group | ✓ | ✓ | ✓ | ✓ | | | | | | | 3.44 |
| | Role consultant | | | ✓* | | | | | | | | 4.00 |
| Knowledge | Process knowledge (client) | ✓ | ✓ | ✓ | | | ✓ | | ✓ | ✓ | ✓ | 4.22 |
| | Data knowledge (client) | ✓ | ✓ | | | | ✓ | | ✓ | | ✓ | 4.33 |
| | Process knowledge (consultant) | | ✓ | | ✓ | | ✓ | | | | ✓ | 4.44 |
| | Process Mining experience (consultant) | | ✓* | | | ✓ | | ✓ | | ✓ | | 4.22 |
| Data analysis | Collecting data | ✓* | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | 4.56 |
| | Take data from multiple departments | | ✓ | | | ✓ | | | ✓ | ✓ | | 4.11 |
| | Edit data | ✓ | ✓ | ✓ | | | | ✓ | ✓* | ✓* | | 4.11 |
| | Verify data | ✓ | ✓ | ✓ | | ✓ | ✓* | ✓ | | ✓ | ✓ | 4.78 |
| | Verify results | ✓ | ✓ | ✓ | | | ✓* | ✓ | ✓ | ✓ | | 4.89 |
| Customer ownership | Customer ownership | | | ✓ | | | ✓* | ✓ | ✓* | ✓ | ✓ | 4.44 |
| Recommendation & follow-up | Presentation of findings | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓* | ✓ | 4.33 |
| | Quantify findings | | | | | | | | | ✓ | | 4.33 |
| | Making recommendations | ✓ | | ✓ | ✓ | | ✓ | | | | ✓ | 4.56 |
| | Appoint someone to ensure follow-up | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓* | ✓ | 4.67 |
| | Create awareness with client | | | ✓* | ✓ | | | | | | | 4.56 |

*Notes*: [1] * *Special insight that is also addressed in the explanation below. All comments can be found in Appendix 7.* [2] *Score survey: 1 = Strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree*

**Problem and question –** Within the problem and question it is first important to put in sharp words what is the problem and what you want to do with Process Mining. Here, interview 9 adds that it is important that you link this to formulated objectives. Interview 10 explains that everyone involved with the project must be behind the same objectives and on the same page. Secondly, delineating the case is very important, as clients tend to do too much at one time. The client in interview 9 indicates that consultants have an important role to play here, by suggesting that you can best start with the main processes and then delve deeper. Thirdly, it is important to also ask yourself whether Process Mining is the right tool to solve the problem at all. Interview 7 explains that it is often only a

very good technique when there is enough data. Process Mining should never be the goal in itself. Lastly, in interview 10 the client explains that once the problem is formulated it is important that the consultant shows awareness of the problem of the client and what its importance is.

**Introduce -** Before applying Process Mining, it is important to explain to employees, and especially the people who control and manage information, exactly what Process Mining is and what to expect from it. Interview 9 adds that you have to make people think it is not a threat.

**Agreements –** To have things clear in advance, it is important to make some agreements. First of all, there must be an agreement about making Process Mining structural, and according to interview 3, preferable include it in your PDCA cycle. Interview 8 concludes that depending on the organization, you could maybe even see it as a condition before starting the project. By doing Process Mining more often, you see what went well and where things were left out. Only then the real added value can be measured. Secondly, there should be agreements about working in a small/restricted group. By agreeing on the size of the group beforehand, you know who belongs to the project group and will therefore be present at presentations. Lastly, In other variables mentioned, it is sometimes indicated what the consultant should do. This is the reason that agreements should be made about the role of the consultant. In interview 9, the client considers it important that the consultant takes an active role in guiding and taking along the organization.

**Knowledge -** During a Process Mining project it is important that the client knows the process and data. People in the organization should know how the process works, which administrative actions are carried out, and what the data stands for. This will reduce the time spent on data analysis, as it is easy to verify results and outcomes. The fact that the consultant has process knowledge can also be very helpful, as it helps in analysing the process. Lastly, as a consultant, you need to have a certain Process Mining experience, as this gives a better understanding of what Process Mining can and cannot do. Having an experience can even increase the added value, but according to interview 2, this can also be a downside as you are trying to repeat the same trick.

**Data analysis -** During the Process Mining project, the consultant is mainly occupied with data analysis. This consists of several steps. First of all, the data has to be collected. Here, interview 1 indicates that you have to look carefully at the availability of the data at the organization, as it is often held by external parties. Secondly, during this data collection, it is important that, within the chosen process, data from multiple departments are included. This makes verification easier as data can be benchmarked. As this belongs to data collection, it is put under the same input variable. After you have collected data, you may have to edit it. On the one hand, according to interview 3, you may have to convert it as the client does not know where the data stands for. On the other hand,

according to interview 6, you have to put it in a certain format before it can be put in the tool. By doing this, you can use the file again next time. Thirdly, it is important to verify the data. This means checking whether the data is in line with reality, so correct conclusions can be drawn from it. Interview 7 adds that it is important to constantly be prepared to go back to the beginning and look at the exact source of the data. Finally, the results should be verified. Here, according to interview 7, it is important to look critically towards the results. The consultant should ask to what extent the organization recognizes certain results.

**Customer ownership -** It is important to see Process Mining as a joint tool during the project. According to interview 3 it is advisable to let the organisation take it up jointly with the consultant during the first months. Interview 7 explains that findings should be repeatedly translated back to the organizations to bring people along. It is important to show that the organization will eventually have to do it themselves, thus encouraging the structural use of Process Mining.

**Recommendation and follow-up -** After Process Mining has been carried out, the findings are presented. Interview 6 explains that the findings should be presented in a way that you found something valuable that makes the organization enthusiastic to do something with it. Here, it can help to quantify the findings, as this shows the organization how urgent it is and what you can achieve. Based on the findings, recommendations should be made and people should be appointed to ensure follow-up. According to interview 6, this can be a person from within or outside the organization or a project team that realizes the improvement and ensures the continuity of Process Mining. In interview 9, the client considers it important that when making recommendations, the consultant creates awareness among them. They should be critical of where in the process it goes wrong and make employees aware that things can also be done differently.

In terms of input variables, there are thus seven groups to be created with underlying variables that can be seen more as concrete important steps to take before, during and after a Process Mining project. In the next chapter, these results as well as the results of the indicators of added value and contingency factors will be combined with the results from the literature. On this basis, the final model is prepared and presented.

# 5. The final model

Looking at the practical results the propositions can be judged. As the variables from the practice have already been dealt with in the results section, this chapter will only consider the main differences and similarities between theory and practice. Therefore, to complete the final model, some found variables are adjusted or replaced, or some variables are added. Regarding the relationships between variables, most are already mentioned in the results section, as some will briefly be mentioned in this section again.

P1: The groups 'process insight', 'process improvements', and 'other', with their underlying indicators of added value of Process Mining, are also reflected in the results of the practical research.

The indicators of added value are grouped the same as in the results section. Where the group **'Awareness'** is new from practice and directly included in the model, the other groups are not entirely new and will be explained below.

**Integral insight –** As in the theoretical model, integral insight is still a group, which among others still includes the indicator **compliance**. The indicator 'identify inefficiency' is supported in practice but will be renamed to **bottleneck analysis**. Transparency is no longer an underlying indicator but is actually the same as the entire group of integral insight.

**Communication & cooperation -** The indicator 'better communication' found in the literature is supported in practice but renamed to communication & cooperation. The main difference is that it has now become a grouping with more specific underlying indicators. In the literature, the use cases showed that **benchmarking** can increase added value, as often mentioned in the use cases in the book by Reinkemeyer (2020), but was not seen as an added value in itself.

**Process optimisation –** Where in the theory there was already a group named process improvements, this will be renamed to the group process optimisation. The variable 'standardizing processes' will be renamed to **more efficient process flow**. This is because standardization is a way of achieving a more efficient process. In the interviews, this was drawn somewhat more broadly. The indicator 'enabling innovation' is supported in practice but will be renamed to **automate process**, which is a form of innovation.

**Component of reporting -** The group component of reporting contains indicators that were described in theory as 'continuous monitoring'. This has now become a separate group with underlying indicators. From theory, the variable 'increasing analytical speed' will be renamed

to **opens way to PowerBI**. By including the found KPIs in dashboarding in PowerBI, you can continue analyzing them, which was also seen as important in the use cases described in the book by Reinkemeyer (2020).

P2: The groups 'Purpose' (information quality, system quality), 'People' (customer management), and 'Processtraces (organizational context), with their underlying input variables and improvements, are also reflected in the results of the practical research.

The input variables are grouped in the same way as in the results section. In addition, the groups are also placed under one of the 3Ps: 'Purpose', 'People', and 'Processtraces', as defined by Reinkemeyer (2020), just like in the theoretical model. This is done because you will see that it makes it clearer what are input variables and what are contingency factors. However, the underlying groupings are different. To clarify the final model a bit more, for some groupings a figure is added.

We start with **purpose. '**Information quality' and 'System quality' are transformed into the groups '**Problem and question'** and **'Agreements'**. Also some improvements are now Both groups will be explained.

**Problem and question -** The variables **'**is there a relevant problem or question from the organization?' and 'in line with strategic objectives' are supported in practice. However, these variables are merged into **problem and question (prioritize)**. This turns questions into concrete process steps. There are some newly found input variables, which were not yet seen as input variables in theory. The variable **delineating assignment** actually refutes the improvement that you should also focus on other processes, described by Rozinat & van Geffen (2015). It is mainly important to start simple. Also, Rozinat & van Geffen (2015) described that only focusing on Process Mining could be a pitfall in the Process Mining project, so the variable **assessing whether Process Mining is the right tool at all** solves this as now being an input variable.

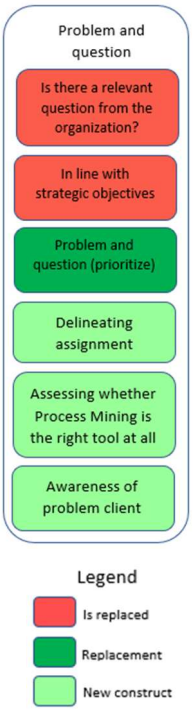



*Figure 6 - Problem and question*

**Agreements –** The variable 'frequency' will be renamed to **making it structural**, making it a concrete step instead of a question of what the frequency of Process Mining should be. It is worth noting that the variable **role consultant** has inter-relationships with other input variables. Where these relationships come from is addressed in the results section.

Then **people** and **processtraces,** where, 'Customer management' and 'Organizational context' are replaced by other groupings. Where among **people** the groups **'Introduce'**, **'Customer ownership'** and **'Recommendation & follow-up'** are entirely new from practice and directly included in the mode, the group **'Knowledge'** is explained. Among **processtraces,** the group '**Data analysis'** will be explained.

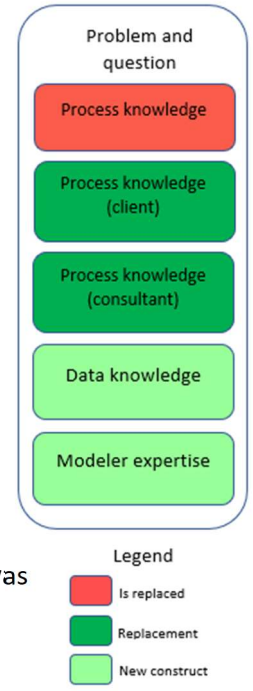



*Figure 7 - Knowledge*

**Knowledge** – In this grouping, many variables already appeared from the theory, only there are some adjustments. First, the variable 'process knowledge' is supported in practice, but will be split up into the variables **process knowledge (client)** and **process knowledge (consultant)**. Secondly, the variable 'context availability' is supported in practice. However, this variable will be renamed to **data knowledge**, as this variable is easier to understand when seeing it for the first time. Lastly, **modeler expertise** is supported in practice, but the context is slightly different. Whereas in the literature it was about the expertise of the organization, in practice it is added that the 'process mining experience of the consultant' also positively impacts the outcome of the project.

**Customer ownership -** As for the improvement to train people and to support people as defined by Ash et al. (2008), this is now done by bringing the customer along and leaving the ownership with the customer.

**Data analysis –** The variables **collect data** and **edit data** are already mentioned in the literature by Niks (2018) and Rozinat & van Geffen (2015), but were not given a place in the theoretical framework as no suitable place could be found for them. This place can be found in the current subdivision. As far as improvements found in the use cases by Reinkemeyer (2020) are concerned, they have already been dealt with in the added value of Process Mining. You may have to go back to your data because of an insight showing that it is not in order.

On this input side, the variables have really become concrete steps instead of single issues in the theoretical framework. This is also the reason why there is no place in the model for improvements, as these are no longer relevant at all or are already covered by certain input variables.

P3: 'Organization type', 'organization size', 'type of process', and 'type of process mining' are in the practical research seen as contingency factors that have a significant impact on the relationship between input variables and the indicators of added value of Process Mining.

Mostly, the contingency factors that are included in the model are not found in theory. However, the practice has shown that some concepts that are considered input variables in the theoretical model, should be characterized as contingency factors, as these concepts are often unexpected and difficult to influence. Only these factors will be discussed below, as well as their relationships with other variables.

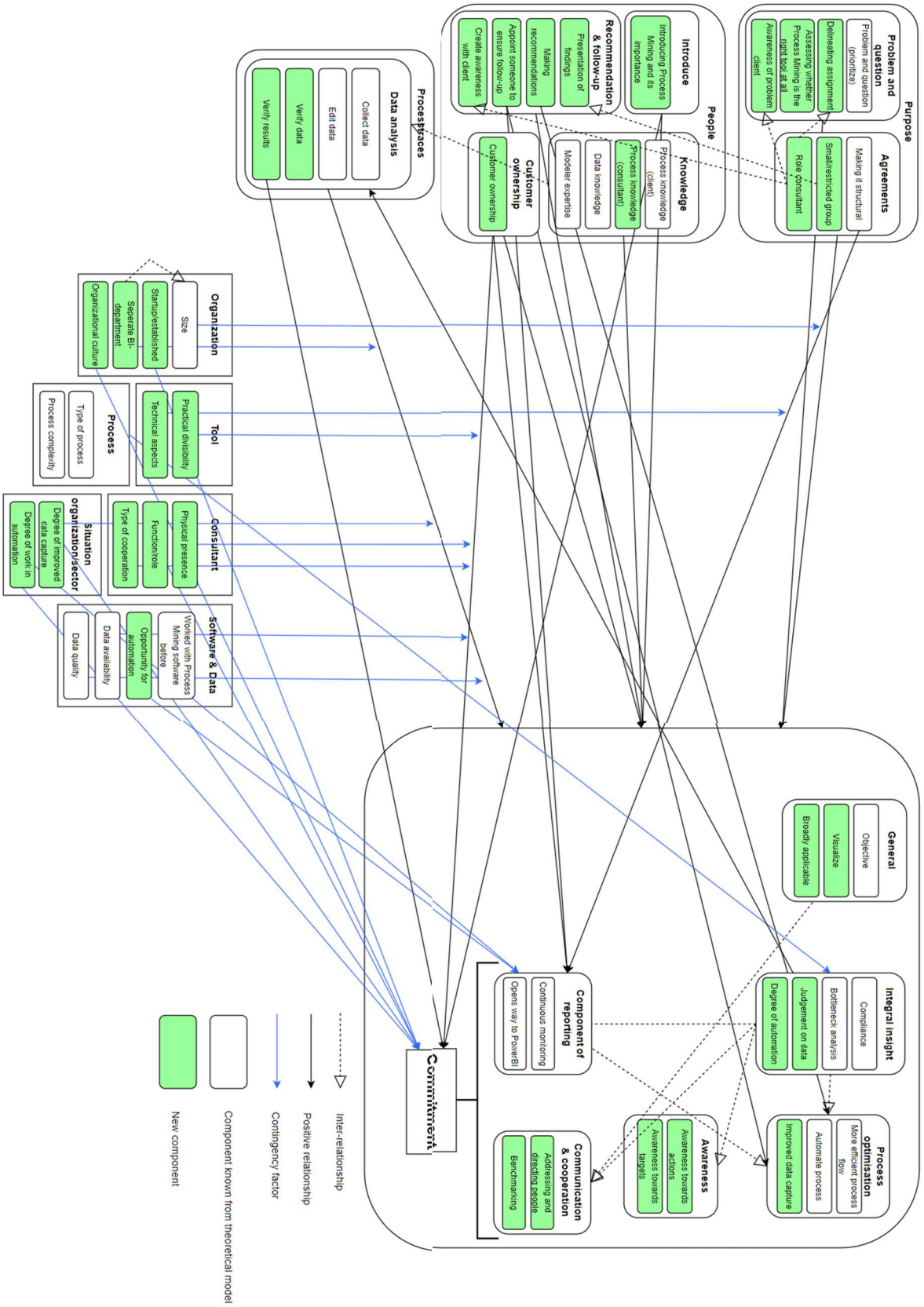
**Organization -** In practice, the **type of organisation** has proven to be a contingency factor, just as was expected. After all, this has become a grouping with underlying contingency factors. However, there was an expectation that **organization size** would also be a contingency factor, which has now also been proven in practice.

**Process – Type of process** and **process complexity** were in practice seen as contingency factors. They were already known from the literature, but there they were indicated as input variables named 'number of process steps', 'number of sources', and 'process'. The first two are now grouped as the contingency factor process complexity, and the last one can be under the variable type of process. Besides, type of process was also expected to be a contingency factor.

**Software and data –** In this grouping, there are some factors already known from theory, only there are some adjustments. First, whether software suppliers had **worked with Process Mining software before** was seen in the theory as an input variable that has an impact on the efficiency of a project. However, this is seen more as a contingency factor, on which you cannot have an impact. Secondly, **data availability** was seen as an input variable in the theory. In practice, it was found that the 'willingness to provide data' is an important contingency factor, which also influences data availability. Because data availability is a somewhat broader concept, meaning both the willingness to provide and the recording of data, it is included as a contingency factor. Willingness to provide data is therefore renamed data availability. Lastly, **data quality** was seen as an input variable in the theory. But because you have little influence on it, this concept is now characterized as a contingency factor. It is therefore processed. In practice, 'data complexity' is an important contingency factor. However, as this factor can be placed under data quality, it is replaced. The lower the data quality, the more time you spend on data analysis.

The final model, which is shown in figure 8, combines all concepts named in this chapter. In the model, a distinction between these components is made based on colours. This model helps to answer the main question. What this model adds and means for theory and practice is discussed in the next chapter.

*Figure 8 - Final model*



# 6. Discussion

## 6.1. Theoretical implications & future research

There are several points this model adds to the theory. First, the model clarifies the added value of Process Mining. It fills the research gap very well, as the model has been tested in and enriched from practice, which has not been done before. Rozinat & Günther (2014) see the added value of Process Mining mainly in the insight into bottlenecks and waste and in making adjustments to the process. Therefore, it is quite surprising that there is also already great added value in creating awareness among employees, and the judgement on data. These are not mentioned in the literature, but are still seen as important indicators, which I had not expected.

Besides the newly found indicators of added value, the interrelationship between these indicators also becomes visually apparent. There is more coherence, which is an addition to the literature of Rozinat & Günther (2014) and Reinkemeyer (2020). In the future, cases should be included, that help you enrich the model with new indicators of added value. On the one hand, this can be done by evaluating future cases of the consultancy company. On the other hand, this can be done by searching added value of Process Mining it creates for other organizations. When including other cases in this study, it is recommended to apply the same data collection and data analysis methods. It is important that you generalize everything first, as was done in this study by means of a survey.

Secondly, the input variables as they appear in the theoretical model have been given a better place in the model. There is now a good distinction in what you as a consultant in a Process Mining project have influence on and what you do not or to a lesser extent. The input variables contain concrete steps that act as a guide for a consultant in a Process Mining project. This was also supposed to be the contribution for the practice at the beginning of the project and this has been achieved. Looking at the differences between the theoretical model and the final model, this has some examples. First, instead of having an input variable discussing whether the expectations are realistic, there is now an input variable about ‘delineating the assignment’, which ensures that the expectations are realistic. Secondly, instead of asking whether the organization has intentions to use the outcome, there are concrete steps, such as ‘appointing someone to follow up’ and making agreements to ‘apply it structurally’. Thirdly, for the variable 'frequency'. It should not be a question of how often you want to use Process Mining, but you should strive for this structural use. Fourthly, ‘top management support’ is no longer an input variable, but something that needs to be addressed in the problem and question section. All noses must be in the right direction. And lastly, ‘prior knowledge within the organization’ is changed into a concrete improvement step, namely introducing Process Mining and its importance. Apart from this, there are also variables from the theory that do not change in a concrete step but have to be created through the coherence of steps. For instance, ‘common culture’

is no longer an input variable, but is now seen more as ‘commitment’ that is created by certain input variables. The same applies to ‘project management’, which must be created through concrete steps such as working in a small/limited group and appointing someone to follow up. The literature speaks of success factors, which can be compared to these concrete input variables that have now been formulated. What is now added to the literature is that they have now also been demonstrated in practice and specific relationships have been established with the indicators of added value of the project.

Besides the input variables that you can influence, there are also factors that you cannot or hardly influence but have an impact on the variables on the input and output side, and thus on the relationship between them; contingency factors. Some are totally new from practice, and some input variables. Regarding these contingency factors, there is no literature available, but, just as my expectation, I have shown they do exist. My expectation was that there would be contingency factors that could actually have an impact in any context, and therefore not necessarily Process Mining related, such as the organisation and the situation in the organisation. I was not surprised that practice turned out that they are present. Nevertheless, I was surprised that practice has shown that there are factors that really fit Process Mining, such as factors concerning the consultant, tooling, and software and data. It will be interesting to conduct further research into contingency factors, especially those Process-Mining-related factors The impact of the contingency factors was mentioned in a majority of interviews but is still somewhat speculative. Therefore, it is difficult to judge whether it can be seen as a contingency factor. By looking at them in future research, it will be easier to assess their actual impact on input variables and indicators of added value.

Thirdly, as already indicated the relationships between the concepts are much more specific, making it easier to see which variables influence what, and which ones may be more important than others. This also allows for more specific steering towards input variables to increase added value. The relationships between input and output, as well as the inter-relationships, are not yet mentioned in the literature, so this research certainly adds something. By evaluating future cases and gaining experience, you can enrich the model and perhaps establish more specified relationships, thus increasing the added value of Process Mining.

To conclude, what this model adds to the theory is that it not only indicates what exactly the added value of Process Mining is but that it also indicates more precisely on what some input variables and contingency factors have an influence.

## 6.2. Practical implications

Theory shows that Process Mining can be of great added value to an organization. However, practice shows that this added value is not always achieved (see section 4.2). Organizations often gain integral insight into the process, but its follow-up is lagging. As already indicated in section 4.2., of the eight interviews, there was also only one interview in which there was a follow-up case. As said in the theoretical implications, the model contains concrete steps, which can serve as a handle for a consultant to get the most out of Process Mining. Because different types of organizations have been included in this research and this has also been generalized, the model can be applied to many cases in different organizations.

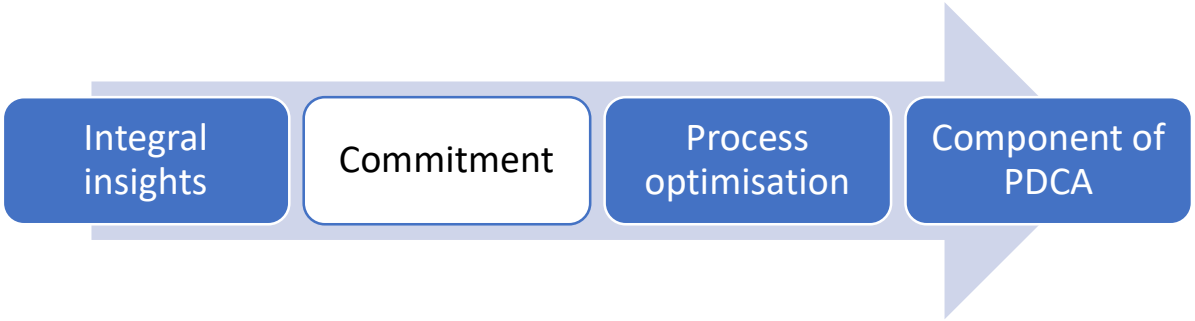



*Figure 9 - Commitment as important factor*

Practice shows that there is often a lack of commitment and structural use of Process Mining. Therefore some recommendations can be made regarding future Process Mining projects.

- I would recommend the consultancy company to insist more on the structural application of Process Mining at the front-end and perhaps see this as a condition before starting a case.
- At the end of the case, a team will have to be appointed to ensure the structural application, by applying Process Mining again six months later and incorporating it into the existing reporting structure.

During the case, the focus should mainly be on creating commitment, as then the other forms of added value are much easier to realize. How this commitment can be created can be seen from the relationships in the model.

- At first, this should be done by giving a presentation explaining what is Process Mining and its relevance, which creates a kind of urgency among employees. Present at this presentation are the process owners, the finance and control manager, and, if possible, information analysts. Here you can share the resulting client experiences with potential new clients. For this, cases conducted by the consultancy company itself should be evaluated, and it is also useful to hear and learn from the customer experiences of other organizations offering Process Mining. Think of an organization like Celonis. Besides gaining experience, you should

stay up to date with the developments around Process Mining. For instance developments around other tooling of Process Mining. For instance, through the so-called PAFnow, Process Mining can nowadays also be implemented in PowerBI. Because this makes the link with reporting and monitoring, the step to the structural application is less for some organizations. As this is very new, more future research can be done regarding the application and implementation of this software.

- Second, the Process Mining assignment should especially be done jointly during the first months and not separately by the customer, creating customer ownership.

To conclude, creating commitment and structural use is very important as well as clear agreements on this between the client and the consultancy company. The role of the consultant should be widened to a kind of change management, in which they try to change the organization in certain respects.

In general, as can be seen from the model in figure 8, all input variables need to be addressed to create added value. Contingency factors determine the impact of the input variables on some relationships. If, in the end, the final added value still falls short, there are some potential causes. On the one hand, this may be due to some contingency factors over which little or no influence can be exercised. On the other hand, this may be due to input variables that should have received more attention. To maximize the added value, you should take another critical look at this.

## 6.3. Limitations

This research provides some interesting insights for both theory and practice. But it also has some limitations. First of all, the practical part contains only the cases from the consultancy company. The consultancy company also only uses Disco as Process Mining software. It makes sense to increase the sample size in the future to further increase the validity of the results.

Another limitation of the study is the lack of extensive discussion of the model and framework of Hilhorst (2020), which this study builds on. I have chosen to only mention the function of the model and framework. Because he also built up the input side from both theoretical and practical research, I did not pay too much attention to this, but tried to enrich the model here and there, and perhaps bend it to my own will. Because I had molded the theoretical model to my own will, it was easier to compare it with the results from practice. As I was critical towards the results of Hilhorst (2020), I also came to the expectation that there were contingency factors.

Also, Process Mining is still relatively new and emerging. Due to this, the experience and knowledge of the consultants in some areas are often still somewhat limited, which impacts the results of the

research. Therefore, future research is certainly of value in the form of looking at the developments around Process Mining.

Finally, there is a limitation regarding the type of research. Since this study did not quantify the results, there is always room for interpretation for future users of the model.

# 7. Conclusion

This research answers the research question: '*What is the added value of Process Mining projects for organizations and how can we improve both the outcome and the process towards the outcome of added value for organizations?'.* The final model shows that the added value of Process Mining consists of sixteen indicators. However, in most of the cases of the consultancy company, the added value was often limited to creating awareness among employees and gaining insight into the process, and not doing something with that insight. From the theory, we know what you can achieve with Process Mining. It can be concluded that the added value can be improved, and for that, the created model can be used. To create more value than just integral insight, the consultant should ensure that Process Mining is accepted by the client and that the client is open to follow-up the recommendations and applying Process Mining more structurally and preferably see it as a component of the client's cycle for continuous improvement (such as PDCA). To achieve this, commitment from the client should be created.

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# Appendix

## A1 – Table of concepts use cases

Below is a table per use case with the most important findings from that use case. At the top of each table are the ways of improving the added value of Process Mining. Below, there are the types of added value.

Siemens: Drive Global Change with the Digital Fit Rate in Order2Cash

| Siemens | category |
|---|---|
| rising business models around reduction of waste and other inefficiencies | B |
| standardization | C |
| increase in automation | D |
| need to go to predicting future processes and outcomes | |

(Nguyen, 2020)

Uber: Process Mining to Optimize Customer Experience and Business Performance

| Uber | category |
|---|---|
| compare processes between agents, sites, cities; benchmarking | 1 |
| identify inefficiencies | B |
| improve customer satisfaction and track impact in metrics such as Average Handling time | D |
| changing analytical teams from ad hoc to powerful insights | E |

(Rowlson, 2020)

BMW: Process Mining Production

| BMW | category |
|---|---|
| Benchmarking to achieve better results | 1 |
| data-based root cause analysis to improve PM | 2 |
| use of AI to dive deeper into data | 2 |
| when using PM for first time exchange between users is very important | 4 |
| build up relevant skills; further scaling | 4 |
| adding data to look at steps that costed more as planned | 5 |
| stronger focus on support processes | 7 |
| try to use it for improvements and not only for monitoring / visualizing | 7 |
| compare as-is with originally planned process | A |
| complexity of process understood + interdepartmental cross overs | A |
| improve agility, identify issues faster | B |
| identify bottlenecks; reduce throughput times | B |
| RPA | D |
| implementation of transformation programs is more succesfull | D |
| monitoring-tool; fast decisions | E |
| modify KPIs and also analyze quality and relevance of KPIs | I |
| stay informed about tools and technologies | |

(Lechner, 2020)

Siemens: Process Mining for Operational Efficiency in Purchase2Pay

| Siemens: Purchase2Pay | category |
|---|---|
| recommend one central data source | 6 |
| increase operational efficiency | B |
| reduce throughput time | B |
| optimize working capital | B |
| increase digitalization | D |

(El-Wafi, 2020)

Athenahealth: Process Mining for Service Integrity in Healthcare

| Athenahealth | category |
|---|---|
| Benchmarking to improve PM | 1 |
| improve PM with Root Cause Analysis | 2 |
| Swirl Analysis to improve PM | 2 |
| Making up dashboards to identify areas that can drive down costs | 3 |
| clean process insights | A |
| full transparency | A |
| detailed workflows | A |
| identifying bottlenecks | B |
| identify inefficiencies "administrative Swirl" | B |
| break down definable subsystem | C |
| minimizing process variation | C |
| improve customer experience | D |
| enables automation | D |
| Building active alerting systems | D |
| Robotic process automation to remove repetitive work | D |

(Balint et al., 2020)

EDP Comercial: Sales and Service Digitization

| EDP Comercial | category |
|---|---|
| develop benchmarks to increase understanding | 1 |
| right people on the project to improve PM; knowledge of processes and accessing relevant data, capacity to learn and unlearn, agile mindset | 4 |
| Upskilling PM knowledge by on-job training, workshops, webcasts, etc | 4 |
| clear vision about processes | A |
| transparency | A |
| Increased analytical speed | E |
| reduced time to deal with business changes | E |
| anticipate problems with operational alarms | E |
| sharper decision making | E |
| less effort with operational support | F |
| meaningfull KPI's | I |

(Henriques, 2020)

ABB: From Mining Processes Towards Driving Processes

| ABB | category |
|---|---|
| PM supports continuous improvement programs; less effort, more focus, better results | D |
| focus on making right decisions instead of thinking about what happened | E |
| better communication and collaboration, more timely response | F |
| reduce communication effort, increase employee satisfaction | F |

(Jansen, 2020)

Schukat: Process Mining Enables Schukat Electronic to Reinvent Itself

| Schukat | category |
|---|---|
| Role of process owner should be clearly defined | 4 |
| enrich PM with customer experience for future improvements | 5 |
| major process design and process management restructuring to maximize PM effects | 6 |
| avoid unnecessary inefficiencies | B |
| PM can help with reliable cost calculations | G |

(Schukat, 2020)

Siemens Healthineers: Process Mining as an Innovation Driver in Product Management

| Siemens Healthineers | category |
|---|---|
| showing comparison between automated and manual workflows | A |
| identifying issues | B |
| visualize clients clinical routine by filtering workflow variants | C |
| standardization | C |
| PM in terms of innovation management | D |

(Reindler, 2020)

Bayer: Process Mining Supports Digital Transformation in Internal Audit

| Bayer | category |
|---|---|
| supports Root Cause Analysis | 2 |
| for understanding PM you should have knowledge about SAP process and SAP table | 4 |
| providing transparency | A |
| detection of inefficiencies | B |
| identify patterns, approval procedures, that don't comply with regulations of Bayer | H |
| internal control system is strengthened | H |

(Boenner, 2020)

## A2 – Questions interview

| | **Interview consultants (broad)** | **Interviews companies (deep)** |
|---|---|---|
| **Intro** | *First of all, I would like to thank you for taking part in my research. These interviews are very important for my research, so thank you for making time for them. Please give your permission for this interview to be recorded and transcribed. During transcription, names will be omitted and the interview will be completely anonymous.* | |
| | 1. *Can you introduce yourself?* | |
| | 2. *Can you tell me something about the organization where you applied Process Mining?* | |
| | 3. *In which type of process was Process Mining applied?* | |
| | 4. *What was the type of Process Mining?* | |
| | 5. *Why did you apply Process Mining? Why was it relevant for the organization?* | |
| | 6. *Why did you think Process Mining was relevant?* | |
| | 7. *What was the objective of Process Mining?* | |
| **'What did you achieve?'** | 8. *Can you tell me what you achieved with Process Mining? What were the added values for the company?* | |
| | 9. *Was it insight, or was it more than that? After all, you want people to do more after that insight? What will be the added value after you have commitment?* | |
| | ➔ If no new input is obtained, use concepts in theoretical model, by asking for instance:<br>• *Did it lead to detecting inefficiencies?*<br>• *Did it help comply with procedures?*<br>• *Did it help to standardize/harmonize the process?*<br>• *Did it lead to better communication between employees in the organization?*<br>• *Etc.* | |
| | | 10. *Is the added value structural or one-off for you?* |
| | 11. *What was planned to achieve? Were there any problems up forehand that you wanted to solve?* | |
| | 12. *Why was this achieved or not achieved?* | |

| | | |
|---|---|---|
| | 13. *Can you think of some variables that influence the relation between input and result/added value of Process Mining for this organization?* | |
| | 14. *Can you maybe think of more concepts of added value, or variables influencing the relation between input and added value/result outside of this case?* | |
| | 15. *Could you perhaps compile a top 3 of added values of the Process Mining project?* | |
| | 16. *How can an organization maximize the added value of process mining?* | 16. *How can you maximize the added value of process mining?* |
| | 17. *Outside of the case, do you see the following concepts of added value recurring more often? (generalize variables found in interviews deep perspective)* | |
| **'What did you do?'** | 18. *What did you do before the Process Mining project started and/or what did you pay attention to?* | 18. *What did you, as an organisation, pay attention to before the project started?* |
| | ➔ If you notice that some parts have not been explained, ask, for example:<br>• *How was Process Mining applied?* | |
| | • *What was done regarding the people in the organization?* | |
| | ➔ If you notice that some parts regarding people have not been explained, ask, for example:<br>○ *Was staff made aware that Process Mining would be used and what the value of Process Mining might be?*<br>○ *Can't you better do bottom-up first; first ask people on the shop floor what they could do better in their work.*<br>○ *Was there any expertise in ICT in the project group?*<br>○ *Was there any training of employees to enhance the implementation of Process Mining?* | |
| | • *What was done regarding processtraces in the organization?* | |
| | ➔ If you notice that some parts have not been explained, ask, for example:<br>○ *To what extent was it necessary to merge, find and clear the data?* | |

| | | |
|---|---|---|
| | ○ *How was the process awareness of the people in the organization?* | |
| | 19. *What did you do during the Process Mining project and/or what did you pay attention to?* | |
| | 20. *What did you do after the Process Mining project and/or what did you pay attention to?* | |
| | | 21. *What do you think of the role of consultants?* |
| | | 22. *How can they improve their role?* |
| | 23. *How much were the things you achieved with the project related to activities/circumstances done before, during, or after the project? How where they related?* | |
| | 24. *Could you compile a top 3 of most influential factors on the outcome of the Process Mining project?* | |
| | 25. *Could you compile a top 3 with least influential factors on the outcome of the Process Mining project?* | |
| **Reflection** | 26. *Did you change your view towards Process Mining after completing the project? Do you think it can add value to organization? In what way?* | |
| | 27. *What pitfalls did you occur during the project? How did you manage these pitfalls or risks? What would be ideal solutions or improvements?* | |
| | 28. *What were the downsides of applying Process Mining? Did you resolve them, how?* | |
| | | 29. *What do you think could be a reason why the organisation decides not to use process mining after all?* |
| | | ➔ If you notice that some parts have not been explained, ask, for example:<br>• How do you look at different tools? Why one tool over another? What do you think is the most important when it comes to a tool?<br>• How do you look at costs? |

| | |
|---|---|
| | 30. *Is Process Mining something you apply once, or on adhoc basis, or continuously? In other processes, other organizations?* |
| | 31. *What are you going to do to follow the consultants' advice?* |
| | 32. *What do you think determines whether Process Mining has been valuable? What aspects influence this?*<br>a. *Organizational culture*<br>b. *Time intensity* |
| | 33. *Which aspects of the project should be improved if you would apply Process Mining again, on adhoc basis or on a continuous basis?* |
| | 34. *Was Process Mining unique in the way it added value? Where there any alternative methods or tools for the objective?* |
| **Outro** | 35. *Do you have any additional remarks?*<br>36. *Are you prepared to fill in a survey for me for validity?*<br>37. *Would you like me to share the results of my research with you?*<br>*Thank the interviewee for his/her time* |

## A3 – Code table

| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (deep) | 10 (deep) | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Structureel maken (doel opzich) | 2 | 0 | 5 | 8 | 0 | 1 | 3 | 2 | 3 | 3 | 27 |
| Kleine groep | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 8 |
| Introduceren PM en belang ervan | 0 | 0 | 0 | 2 | 1 | 0 | 2 | 4 | 3 | 0 | 12 |
| Kennis proces | 2 | 9 | 1 | 0 | 0 | 2 | 7 | 3 | 1 | 0 | 25 |
| Kennis data | 1 | 6 | 2 | 0 | 0 | 0 | 6 | 2 | 0 | 0 | 17 |
| Kennis proces (consultants) | 0 | 2 | 0 | 0 | 0 | 0 | 7 | 4 | 0 | 1 | 14 |
| Ervaring (consultants) | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| Probleem- en vraagstelling | 1 | 0 | 1 | 4 | 2 | 0 | 5 | 0 | 6 | 4 | 23 |
| Afbakenen opdracht | 0 | 0 | 0 | 2 | 1 | 0 | 5 | 4 | 4 | 0 | 16 |
| Afwegen of Process Mining de juiste techniek is | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 5 |
| Bewust zijn van probleem opdrachtgever | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| Eigenaarschap bij klant | 0 | 0 | 5 | 5 | 0 | 1 | 6 | 1 | 10 | 0 | 28 |
| Commitment creëeren | 0 | 0 | 5 | 6 | 1 | 0 | 1 | 6 | 7 | 1 | 27 |
| Verificatie data | 5 | 3 | 0 | 4 | 1 | 2 | 6 | 2 | 1 | 0 | 24 |
| Verificatie uitkomsten | 2 | 5 | 3 | 1 | 0 | 2 | 5 | 0 | 1 | 0 | 19 |
| Data bewerken | 1 | 3 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 0 | 9 |
| Data verzameling | 2 | 0 | 0 | 2 | 0 | 2 | 3 | 0 | 1 | 1 | 11 |
| Meerdere afdelingen meenemen (benchmarken) | 0 | 3 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 7 |
| Iemand aanwijzen die de opvolging borgt | 0 | 0 | 5 | 0 | 1 | 2 | 1 | 2 | 10 | 1 | 22 |
| Presentatie bevindingen | 6 | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 20 |
| Aanbevelingen | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 3 | 11 |
| Bewust maken van opdrachtgever | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 |
| Kwantificeren van bevindingen | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Fysieke aanwezigheid | 1 | 4 | 4 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 14 |
| Rol/Functie uitvoerder | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Type samenwerking | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Type organisatie | 1 | 0 | 1 | 0 | 0 | 1 | 7 | 1 | 1 | 5 | 17 |
| Organisatiecultuur | 0 | 2 | 0 | 3 | 0 | 1 | 1 | 1 | 2 | 0 | 10 |
| Proces | 0 | 2 | 1 | 4 | 0 | 1 | 0 | 0 | 2 | 0 | 10 |
| Complexiteit data | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| Werkzaamheden bedrijf (automatisering) | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 3 | 0 | 17 |
| Financiële situatie bedrijf/sector | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 4 |
| Werkzaamheden bedrijf (vastlegging) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 1 | 5 |
| Werkzaamheden bedrijf (verbeteren) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 4 |
| Werkzaamheden bedrijf (financieel) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 3 |
| Software | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 2 | 3 | 10 |
| Ervaring systeem | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Type tool | 0 | 1 | 3 | 4 | 0 | 0 | 2 | 0 | 0 | 0 | 10 |
| Tool op bedrijf | 0 | 0 | 7 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 11 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Objectiveren** | 0 | 6 | 5 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | **17** |
| **Visualiseren** | 1 | 4 | 4 | 1 | 0 | 1 | 3 | 1 | 0 | 0 | **15** |
| **Breed toepasbaar** | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **Kennis process mining** | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | **3** |
| **Bewustzijn** | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 1 | 2 | 2 | **11** |
| **Overige communicatie & samenwerking** | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | **10** |
| **Benchmarken (output)** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | **6** |
| **Bepalen nieuwe doelstellingen** | 0 | 3 | 0 | 0 | 0 | 1 | 2 | 0 | 3 | 1 | **10** |
| **Overig inzicht** | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | **4** |
| **Compliance** | 0 | 1 | 1 | 1 | 0 | 3 | 3 | 2 | 0 | 0 | **11** |
| **Knelpunten analyse** | 4 | 6 | 5 | 6 | 0 | 2 | 2 | 4 | 3 | 2 | **34** |
| **Continuous monitoring** | 4 | 10 | 2 | 0 | 0 | 2 | 3 | 1 | 0 | 2 | **24** |
| **Opent weg naar PowerBI** | 2 | 5 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | **11** |
| **Verhogen efficiëntie proces (standardisatie)** | 2 | 2 | 1 | 0 | 1 | 1 | 3 | 3 | 1 | 1 | **15** |
| **Betere vastlegging data** | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | **4** |
| **Automatiseren proces** | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | **3** |
| **Totals** | **46** | **89** | **73** | **66** | **15** | **37** | **121** | **56** | **94** | **47** | **644** |

A4 – Survey

# Process Mining

Start of Block: Inleiding

Hallo

De enquête bestaat uit drie onderdelen. In het eerste onderdeel worden jullie gevraagd in hoeverre jullie het belang zien van de genoemde input variabelen van een process mining project. Het tweede onderdeel gaat over de contingency factoren die we ook tijdens het interview behandeld hebben. Dit zijn de variabelen die impact hebben op de relatie tussen input en output. Jullie moeten hier aangeven wat in jullie ogen de impact is van de genoemde variabelen. Als laatste ben ik benieuwd in hoeverre jullie het eens zijn met de gevonden vormen van toegevoegde waarde van Process Mining.

End of Block: Inleiding

Start of Block: Belang van input variabelen

Geef bij de volgende genoemde input variabelen, op basis van de Likert-scale, aan in hoeverre u denkt dat ze invloed hebben op de toegevoegde waarde van Process Mining.

Q1 Probleem- en vraagstelling

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Duidelijke probleem- en vraagstelling (prioriteren) | ○ | ○ | ○ | ○ | ○ |
| Afbakenen opdracht (simpel beginnen) | ○ | ○ | ○ | ○ | ○ |
| Afwegen of Process Mining überhaupt juiste tool is | ○ | ○ | ○ | ○ | ○ |
| Bewustzijn tonen van probleem opdrachtgever | ○ | ○ | ○ | ○ | ○ |

Q2 Introduceren

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Mensen vertellen wat belang van Process Mining is | ○ | ○ | ○ | ○ | ○ |

Q7 Afspraken

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Structureel maken van process mining (mits dit haalbaar is) moet doel opzich zijn | ○ | ○ | ○ | ○ | ○ |
| Organisatie vertegenwoordigd in kleine / beperkte groep | ○ | ○ | ○ | ○ | ○ |
| Afspraken over rol van consultant | ○ | ○ | ○ | ○ | ○ |

Q4 Kennis

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Kennis proces (opdrachtgever) | ○ | ○ | ○ | ○ | ○ |
| Kennis data (opdrachtgever) | ○ | ○ | ○ | ○ | ○ |
| Kennis proces (consultant) | ○ | ○ | ○ | ○ | ○ |
| Ervaring Process Mining (consultant) | ○ | ○ | ○ | ○ | ○ |

Q5 Data-analyse

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Data verzamelen | ○ | ○ | ○ | ○ | ○ |
| Het meenemen van data van meerdere afdelingen / ketenpartners (benchmarken) | ○ | ○ | ○ | ○ | ○ |
| Data bewerken | ○ | ○ | ○ | ○ | ○ |
| Verificatie data | ○ | ○ | ○ | ○ | ○ |
| Verificatie uitkomsten Process Mining | ○ | ○ | ○ | ○ | ○ |

Q6 Eigenaarschap bij klant

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Mensen meenemen in het process minen, niet apart doen | ○ | ○ | ○ | ○ | ○ |

Q8 Aanbeveling & Opvolging

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Presentatie bevindingen | ○ | ○ | ○ | ○ | ○ |
| Kwantificeren van bevindingen | ○ | ○ | ○ | ○ | ○ |
| Aanbevelingen doen | ○ | ○ | ○ | ○ | ○ |
| Iemand of meerdere aanwijzen die opvolging borgt | ○ | ○ | ○ | ○ | ○ |
| Bewustzijn creëren bij opdrachtgever (kritische blik richting werkzaamheden bedrijf) | ○ | ○ | ○ | ○ | ○ |

End of Block: Belang van input variabelen

Start of Block: Impact van Contingency factoren

Geef voor de volgende contingency factoren, op basis van een Impact-scale, aan in hoeverre ze impact hebben op de relatie tussen input en output van een Process Mining project. Zoals we tijdens de interviews hebben besproken.

Q9 Organisatie

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Profit of non-profit | ○ | ○ | ○ | ○ | ○ |
| Startup of established | ○ | ○ | ○ | ○ | ○ |
| Grootte | ○ | ○ | ○ | ○ | ○ |
| Ketenpartners of niet | ○ | ○ | ○ | ○ | ○ |
| Aparte BI afdeling | ○ | ○ | ○ | ○ | ○ |
| Organisatiecultuur (verbeterbereidheid) | ○ | ○ | ○ | ○ | ○ |

Q10 Tool

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Tool al op bedrijf of niet (licentie) | ○ | ○ | ○ | ○ | ○ |
| Praktische deelbaarheid tool | ○ | ○ | ○ | ○ | ○ |
| Technische aspecten (makkelijk te begrijpen / toe te passen) | ○ | ○ | ○ | ○ | ○ |

Q11 Consultant

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Fysieke aanwezigheid bij opdrachtgever | ○ | ○ | ○ | ○ | ○ |
| Functie / rol (ook gekeken naar verleden: eerdere functie bij opdrachtgever) | ○ | ○ | ○ | ○ | ○ |
| Type samenwerking; in team / individueel | ○ | ○ | ○ | ○ | ○ |

Q12 Proces

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Type proces | ○ | ○ | ○ | ○ | ○ |
| Complexheid proces | ○ | ○ | ○ | ○ | ○ |

Q13 Software & Data

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Ervaring bedrijf met systeemsoftware | ○ | ○ | ○ | ○ | ○ |
| Kans op automatisering | ○ | ○ | ○ | ○ | ○ |
| Bereidwilligheid aanleveren data (ICT) | ○ | ○ | ○ | ○ | ○ |
| Complexheid data | ○ | ○ | ○ | ○ | ○ |

Q14 Situatie organisatie / sector

| | Geen impact | Lage impact | Gematigde impact | Grote impact | Ernstige impact |
|---|---|---|---|---|---|
| Financiële situatie organisatie/sector | ○ | ○ | ○ | ○ | ○ |
| Mate van werkzaamheden betere administratieve vastlegging | ○ | ○ | ○ | ○ | ○ |
| Mate van werkzaamheden rondom bezuinigen (financieel) | ○ | ○ | ○ | ○ | ○ |
| Mate van werkzaamheden rondom automatisering | ○ | ○ | ○ | ○ | ○ |

End of Block: Impact van Contingency factoren

Start of Block: Toegevoegde waarde Process Mining

Geef voor de volgende variabelen, op basis van een Likert-scale, aan in hoeverre u denkt dat het een indicator van toegevoegde waarde is van Process Mining.

Q15 Algemeen

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Objectiveren | ○ | ○ | ○ | ○ | ○ |
| Visualiseren | ○ | ○ | ○ | ○ | ○ |
| Breed toepasbaar | ○ | ○ | ○ | ○ | ○ |
| Meer kennis Process mining consultant (ervaring) | ○ | ○ | ○ | ○ | ○ |

Q16 Integraal inzicht

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Geeft oordeel over data; volledigheid en juistheid | ○ | ○ | ○ | ○ | ○ |
| Knelpuntenanalyse | ○ | ○ | ○ | ○ | ○ |
| Financieel inzicht; waar komen meeste kosten vandaan | ○ | ○ | ○ | ○ | ○ |
| Vaststellen compliance | ○ | ○ | ○ | ○ | ○ |
| Mate van automatisering vaststellen | ○ | ○ | ○ | ○ | ○ |

Q17 Communicatie & Samenwerking

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Gesprekken vinden op hoger niveau plaats | ○ | ○ | ○ | ○ | ○ |
| Je kunt mensen ergens op aanspreken / sturen | ○ | ○ | ○ | ○ | ○ |
| Benchmarking: je leert van andere organisaties / ketenpartners | ○ | ○ | ○ | ○ | ○ |

Q18 Bewustzijn

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Een process mining project creëert automatisch bewustzijn bij medewerkers | ○ | ○ | ○ | ○ | ○ |
| Creëert bewustzijn bij opgestelde doelstellingen | ○ | ○ | ○ | ○ | ○ |

Q19 Onderdeel rapportagecultuur / PDCA

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Continuous monitoring (resultaat project bekijken) | ○ | ○ | ○ | ○ | ○ |
| Opent weg naar PowerBI (vastgestelde KPIs analyseren) | ○ | ○ | ○ | ○ | ○ |

Q20 Procesoptimalisatie

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Betere vastlegging data; volledig, juist, tijdig | ○ | ○ | ○ | ○ | ○ |
| Standardiseren proces; efficiënter procesverloop | ○ | ○ | ○ | ○ | ○ |
| Automatiseren proces | ○ | ○ | ○ | ○ | ○ |

Q21 Geef op een schaal van 1 tot 10 aan wat volgens u de toegevoegde waarde was van uw process mining project die we in het interview hebben behandeld

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Toegevoegde waarde | | | | | | | | | | | |

Q22 Geef een korte toelichting op uw antwoord hierboven

_____

End of Block: Toegevoegde waarde Process Mining

## A5 – Cross-case comparison matrices: Indicators of added value

### Notes 'General'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective | | ✓ Objectifying gut feelings | ✓ | | ✓ It takes away all discussion | ✓ Is only objective if data is also adequate | ✓ | ✓ No discussion possible | ✓ | ✓ | **4.44** |
| Visualize | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ You give people quick insights | **4.56** |
| Broadly applicable | ✓ | | | | | | ✓ You can apply it in any organisation and within any process, as long as you have good data | ✓ It is broadly applicable, when the data is available | | | **4.22** |
| Knowledge Process Mining | | | | | | | | ✓ For consultants always added value, you gain a lot of experience | ✓ | ✓ | **3.86** |

### Notes 'Integral insight'

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Other insights** | Judgement on data | | | | ✓ Gaining insight into how data flows through the process | | ✓ You see whether the data capture is in order or not | | | | | **3.78** |
| | Financial insight | | | | ✓ Insight into the financial course of the process, insight in where are the greatest costs | | | | | | | **3.67** |
| | Degree of automation | | | | | ✓ Where is computerisation currently in order and where is it not? | | | | | | **3.56** |
| Compliance check | | | ✓ Does everything go according to procedures (+ external regulations) | | | | ✓ You can play a sort of film for accountants, compliance | ✓ Does the process operate according to agreements? Separation of functions and authorisation of employees | ✓ | ✓ Ensuring that processing times meet the standard | ✓ | **4.00** |
| Bottleneck analysis | | ✓ Identifying improvement potential | ✓ Determine where you want to focus on | ✓ | ✓ | | ✓ Demonstrating improvement potential | ✓ Determining how efficient the process is, throughput time and waiting time<br><br>Insight in improvement potential | ✓ See where most of the bottlenecks are | ✓ You can really get to the bottom of what's behind trends<br><br>Good to look at the good points | ✓ | **4.11** |

### Notes 'Communication and cooperation

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Other communication & cooperation** | Higher-level conversations | | ✓ Conversations between chain partners are at a higher level. You are talking about facts | | ✓ Because it is transparent, the conversation is much easier and shorter | | | | | | ✓ Can lead to better cooperation. People know better what people in other departments are doing | **3.89** |
| | Addressing and directing people | ✓ You can walk up to an employee and say whether his work could be done a bit faster | | ✓ Sit together and discuss things. Steering why things do not happen | | | | | ✓ Addressing people | | | **4.22** |
| Benchmarking | | | ✓ Benchmarking of results | ✓ Benchmarking with other organisations; seeing what they have found with process mining | ✓ Discuss with chain partners whether or not to stop this part of the process. This is what you can do with data from process mining | | | | | | | **4.22** |

## Notes 'Awareness'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Awareness towards actions | | | ✓ | ✓ Awareness towards process and urgency of administrative actions. You see that by entering data incorrectly this and that happens (consequences) | ✓ | | ✓ Urgency; you show how often something goes wrong. Without adjusting things, people are already doing better | ✓ You create urgency among the employees | ✓ | ✓ | 3.44 |
| Awareness towards targets | | ✓ | ✓ Can lead to setting new targets; you have to set a standard when you are satisfied with processes | ✓ Awareness towards targets; realistic or not | | ✓ | | | ✓ | | 4.22 |

## Notes 'Component of reporting'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Continuous monitoring | ✓ | ✓ | | ✓ First done 2 years in a row; to monitor points of improvement | | ✓ | | ✓ Once you have invested in process mining, you should keep it up for longer; let it sink in structurally | ✓ | ✓ | 4.00 |
| Opens way to PowerBI | ✓ | ✓ Determination of KPIs; baseline measurement for the application of PowerBI | | ✓ This has resulted in a dashboard with several chain partners; make it structural in the reporting culture, this is done monthly | | ✓ | | ✓ | | | 3.78 |

## Notes 'Process optimisation'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| More efficient process flow | ✓ | ✓ More efficient process flow | ✓ You want to solve inefficiencies | ✓ | ✓ More efficient and effective organisation of the invoicing process. Fewer processors in the department, leaving more room for organisational improvement | ✓ | | ✓ | ✓ Ultimately, the structural improvement of the effectiveness and efficiency of process | ✓ | 4.56 |
| Automate process | | | | | ✓ | ✓ Process Mining is an important tool for eventually automating your process | | | | | 4.11 |
| Improved data capture | | | | | | ✓ The outcome of process mining can also be to go back to data analysis; that you conclude that your data is not up to standard and that you need to pay attention to this | | | | | 4.22 |

## A6 – Cross-case comparison matrices: Contingency factors

### Notes 'Organization'

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Organization type** | Profit or non-profit | ✓ Commercial is more profit-oriented and will therefore have a higher or earlier commitment than a government institution. | | ✓ Government agency makes less of a fuss about costs. Public interest organisation: they have to. | | | ✓ The drive of an unprofitable business can certainly be less. | | ✓ Profit company tends to continue with the project | | | **2.11** |
| | Startup or established | | | | ✓ Startup; are more creative at the front, have fewer interests, are less afraid of new things | | ✓ Startup easier. They have a more creative way of thinking and working with new systems. Have things digitised faster too. | | | | ✓ Young organisation are easier to convince than older organisation | **3.11** |
| | Size | | | | | | ✓ It can have an impact when you have a parent company above you making decisions. You may not be able to switch quickly because you are forced to by the parent company. Large companies also have more information analysts | | | ✓ Size of organisation determines whether process owner is enough for verification, or whether you really need to go to departments for verification. | ✓ Largest gains can be made with larger organisations | **3.22** |
| | Chain partner or not | | | | ✓ Chain partners or not, you have to have your nose to the grindstone, same goals | | | | | | | **2.67** |
| | Separate BI department | | | | | | ✓ Do you have a separate department, or do you employ people who safeguard the data and analyse the processes (BI departments, and information analysts). Here, you must ensure that you have knowledge of the process yourself, and not just BI partner from outside. | | | | | **3.11** |
| Organzational culture | | | ✓ Looking at people's willingness to improve, a so-called discussion culture | ✓ You have to dare to make mistakes and face them. You also have to want to see the results of process mining. | | | ✓ Willingness to discard old systems | ✓ Organisational culture is not an all-determining variable; it can be greatly influenced by creating commitment. But it can influence the degree of commitment. | | ✓ If there is no willingness to improve in the organisation, it becomes difficult to achieve real improvement. | ✓ It is also true that if you have a good company that is in good financial shape, but where everything is open on the table, then it can be a drive to still apply process mining in order to do everything more efficiently. | **4.33** |

### Notes 'Tool'

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tool is already at the organization | | | | | | | | ✓ Whether that tool is present in the company or not. If not, whether that tool is expensive. This can be a barrier for some organisations. | ✓ The practical shareability of the software - when the company does not have the software itself. When the shareability is higher, this ensures more acceptance of the company. Also easier from an AVG point of view; when the company has its own software, there is no need for anonymisation. Sharing data in the office is much more difficult. | | ✓ | **3.22** |
| **Type tool** | Practical divisibility | | | | | | | | | | | **3.78** |
| | Technical aspects | | ✓ The comparison over several periods of time is difficult within Disco | | | | ✓ Some are so technical that it is difficult for the organisation to understand. Client wants it simple | ✓ Look at which tools cooperate to apply process mining structurally and not adhoc. With some tools, you have to create new filters over and over again instead of writing a script that you can apply again and again. | ✓ The software was not set up for benchmarking between departments. | | | **3.78** |

## Notes 'Consultant'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Physical presence | ✓ Internally, there is more commitment. Also, things can be fine-tuned more quickly if you are at the office. | ✓ You get most of the information when you are on the farm, which helps to fine-tune issues and outcomes in the interim. Also ensures more commitment | ✓ A physical presence helps to gain commitment, and to remove resistance among employees towards process mining. | ✓ The physical presence of a consultant is important in order to get some commitment from the organisation. | | | ✓ Whether you are in the office or not, you can quickly speak to people, you create a culture of reflection and improvement | ✓ It makes a difference whether you work from the office or at the organisation. It is good to work with clients together | | ✓ I think if you're more visible, it's easier anyway. You can do some work in the office, but you have to make sure you keep the people together and preferably physically on site. | **4.11** |
| Function/role | ✓ If you come from internally, then you have more of a feeling for the data you have. If you are internal, it also helps with how quickly the organisation picks up the project. | ✓ The extent to which you can influence recommendations. A business controller can go after his own recommendations, whereas a consultant has almost no ownership. | | | | | | ✓ Suppose you are more intertwined in the organisation, that the people of the organisation are more involved. If someone is involved from within, it is much easier. | | | **3.56** |
| Type of cooperation | | | | | | | ✓ Working in a team gives you more commitment. The moment you have no commitment, the ball is always in your court. Then you have to wait and see what happens with the outcome. | | | | **4.44** |

## Notes 'Process'

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process** | Type of process | | | ✓ Process mining in the main process often has the greatest added value. Process mining is easier to carry out in a streamlined process. | | | | ✓ These are processes that are structural, repeatable, and where data is recorded. Also preferably with large processes, not with small or creative ones. | | | | **3.67** |
| | Process complexity | | ✓ The more clutter, the greater the added value. Best process is to pick up what is not going well. | | | | | | ✓ This process had so much potential for improvement | ✓ The more complex the process, the higher the added value | | **4.00** |

Notes 'Software and data'

| | | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Software experience | | | | | ✓ Difficulty in getting third parties to work in the system. Are still new to the system, experience with the system plays into the commitment you get. | | | | | | | 3.67 |
| Software | Opportunity for automation | | | | ✓ The next drawback is that we don't want to work with an intermediate tool. We actually want to be able to work with the main system that would be able to do this process mining or at least feed that data. To what extent are you then able to get your system fit for purpose? | | ✓ Some suppliers are absolutely not fast enough in developing their own package. So their digital support is very poor and that means that even though you see things that can be improved, it doesn't mean that your suppliers and digital partners are able to do it fast enough. | | | | | 3.67 |
| | Willingness to provide data | | | | ✓ We outsourced our entire ICT to an external party, and there was also a bit of willingness there, like, how do they want to deliver the data? Um, that has, that has had an influence on this project. | | ✓ A lot of packages don't want to make that available to the customer, consider them part of a source code. Whereas actually you have to share that kind of thing to have and get insight into your processes, and to be able to do analyses | | | | | 4.22 |
| Data complexity | | | | | | | ✓ The design of your package often determines the complexity of the data you have to work with. | | | | ✓ We got a bit stuck on the complexity in the end. Where you normally have certain flows that are quite logical and clear, now, even at the most summarised level, there was not really a clear process. It contained too much information. | 4.00 |

Notes 'Situation organization/sector'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Financial situation | | | ✓ When there is a need, people start working with it. People suddenly come up with creative ideas. | | | ✓ The healthcare is so compromised that they have to | | | | | 3.22 |
| Degree of work on austerity | | | | | | | | | | ✓ Are you already working to make the business profitable when it is not going well financially? | 3.67 |
| Degree of improved data capture | | | ✓ Is everything properly recorded so that it is easy to pull everything out of ICT? | ✓ It matters whether the files/paths can be pulled from the ICT or not | | ✓ If you have recorded things well, the data analysis is quite another story. Too little attention is paid in organisations to record things properly | | | | | 4.11 |
| Degree of work in automation | | | ✓ The larger your organisation is with automation packages, the sooner you will be able to do process mining. | ✓ One chain partner was very much engaged in digitalisation, was progressive and showed more commitment. | | ✓ Whether the organisation is already working on automation and digitalisation, because you spend most of your time in the preliminary stages. This also determines whether an information analyst may be present. | | | | | 3.67 |

# A7 – Cross-case comparison matrices: Input variables

## Notes 'Problem and question

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Problem and question (prioritize) | ✓ Setting objectives in advance; correct problem and question definition | | ✓ Link a good objective to which you must constantly think and to which the follow-up assignments must be linked | ✓ Everyone must be behind the same objective | ✓ Putting into sharper words what we are going to do with process mining. Improvement plan must be in the mind | ✓ What is the process, what do we want to achieve, what are the systems (set-up), what is the available data. This has to be described well. | ✓ | ✓ | | | **4.44** |
| Delineating assignment | | | ✓ Start with primary processes; so that there is a foundation. So it's about starting simple. Here is an important role for consultants. They must ensure that the organisation does not want too much, so that it can adjust. | | ✓ | ✓ In process mining, you have to start small and then make it bigger (delineate). It is also important to delineate in order not to have to answer too many questions afterwards | ✓ | | | ✓ It is important to start simple, try to delineate. Start in the big process and then go deeper into it | **4.11** |
| Assessing whether Process Mining is the right tool at all | | | | | | ✓ Process mining is only a good way to go if there is a lot of data involved. But you can also get very far with existing information. Process mining should never be a goal in itself. | | | | ✓ Sometimes process mining is not necessary. I think there is an expectation gap. | **4.00** |
| Awareness of problem client | | | | ✓ Understanding the importance of the organisation | | | | | | | **4.11** |

## Notes 'Introduce'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Introducing Process Mining and its importance | | | ✓ Take everyone by the hand at the front, what is it and what can you expect. You have to take away all fear by discussing and talking. It is not a threat | | ✓ Spoke to them at the front and explained what process mining could do for them | ✓ In particular, informing the people involved in controls and managing information. Management is too distant; it is more about results | ✓ It would have been good to sit down with the department in question and explain what process mining is, what you can do with it. So you could have taken the people with you | | | ✓ Showing at the front what it is at all, what it looks like, and what you could do with it | **3.89** |

## Notes 'Agreements'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Making it structural | ✓ | | ✓ Try to include it in the PDCA cycle | ✓ Make agreements about this. Making process mining structural ensures that you get even more out of it. Where did it go well, and where did you leave things out? | | ✓ You have to link it to good dashboarding. You have to include this in the PDCA; you get KPIs from process mining and that allows you to do continuous monitoring | ✓ Draw up a framework to be worked with every month. Draw up KPIs to be worked with. It is more than an experiment, it must be used structurally; part of your reporting culture | ✓ Wherever possible, implement it structurally; you have to apply it again because you also want to complete the PDCA circle. You have to keep monitoring it, because it is a snapshot | ✓ The objective must be to work on it structurally. By doing it more often you will see trends, development in lead times (PDCA) | ✓ You should not force people to do it more often. There was resistance from within the organisation to do it structurally. So depending on the organisation, you can see it as a condition. First show what it can deliver | **3.56** |
| Small/restricted group | ✓ I thought there were too many people involved. Then everyone starts asking questions, including people who have little feeling about it. That does not help much | ✓ We started with eight and ended with five when presented. I thought, I don't know who got the whole story. The responsibilities were very low. | ✓ Try to agree in advance that you will do it in a small group and who belongs to this group and therefore sits in on presentations. | ✓ At the beginning, you decide how big the group is that you need to involve in your research/project | | | | | | | **3.44** |
| Role consultant | | | ✓ Agreements on the role of the consultant. That the consultant supports us and pulls us along, so that we are not left behind | | | | | | | | **4.00** |

## Notes 'Knowledge''

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
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| Process knowledge (client) | ✓ It is always easy to have someone who knows all the process and knows how the big picture works. It is also easy to have someone who knows whether the data is good, for verification. | ✓ So the technical process of it all goes to the chain partner and we are going to see if it is all resolved properly, they did have that. But the administrative process of how to report an order ready was something the guys I was dealing with had, but not the others. That's why you get such | ✓ There are only two or three people who really know how the process works. But also which button to press to get the data out. Those players are crucial. | | | ✓ Knowledge of data and knowledge of processes is a MUST. Information analysts also help to obtain commitment. There is also much less work involved in the data analysis at the front end. | | ✓ No one actually has the overall picture of the process | ✓ Process awareness of employees | ✓ Availability of people with process knowledge | 4.22 |
| Data knowledge (client) | | ✓ You do need to know which data field is for what purpose, the data quality and how data is captured | | | | | | ✓ The first journey was actually of what do the codes mean at all because the customer doesn't know either. So this would have been very useful | | ✓ Knowledge of the system, knowing how things run through the package | 4.33 |
| Process knowledge (consultant) | | ✓ The better knowledge you have of the process and possible exceptions, the better you can analyse. I also did the implementation of the system myself, so I knew the system well and knew exactly what I could get out of it | | ✓ I can imagine that as a consultant you say you want to be taken through such a process. This is so that you, as a consultant, have an idea of who you should be working with on this project | | ✓ Knowledge of the organisation and consultants about the process and the data. How the system works; how things are recorded. You simply have to list things, go through them. You have to spend a lot of time understanding the dataset. | | | | ✓ First gaining knowledge of processes works for the consultants | 4.44 |
| Process Mining experience (consultant) | | ✓ Experience with the system increases added value, but can also be a downside as you are trying to repeat the same trick | | | ✓ We have also taken a number of courses ourselves. At a certain point, you get an idea of what process milling can and cannot do | | ✓ | | ✓ Expertise of consultants | | 4.22 |

## Notes 'Data analysis'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Collecting data | ✓ Before starting a project, you start thinking about what data you need, what variables should be included, can this data be provided by the organisation, etc. | | ✓ | ✓ Data collection from external party. There is also some willingness to provide data. | | ✓ | ✓ See what data is available | | ✓ | | 4.56 |
| Take data from multiple departments | | ✓ It is important not to only take the process part of one department, but to include and involve multiple departments in the process mining. The data of chain partners can also be useful | | | ✓ Keep pushing to get data from departments | | | ✓ A process often runs across several departments. It is important to involve them. | ✓ | | 4.11 |
| Edit data | ✓ | ✓ Start with raw data and then filter | ✓ Do you have the right files, do you have the right size, do you have the right times, so we had to get that done first and that was a lot of key work. And that's one of requirements once you set it up with a certain process, you can use it again next time | | | | ✓ | ✓ Often, customers do not know what codes mean. So then you have to convert them. Code 1 means this, code 2 means that. | ✓ Important to have the right format in the data to be able to enter it in Disco | | 4.11 |
| Verify data | ✓ The moment you have received data, you are going to check if the data is correct | ✓ By benchmarking with data from chain partners, you can check whether the data is correct and complete | | | ✓ Determine data reliability by means of sampling. Continuously improving why things are done the way they are. | ✓ You have to be prepared to go back to the data. What does the data mean, how is it recorded, how does the system work. Sometimes you find out that the | ✓ Do real events also show up in the data you have in front of you? | | ✓ Check with the process owner whether the data is logical, and whether you can draw good conclusions based on this data. | ✓ We often check whether the data we have corresponds to what we see in SAP. It is more a question of whether everything is still correct once you have linked things together. | 4.78 |
| Verify results | ✓ Because Disco is not a self-learning system, there is always an outcome. By tuning in between, you prevent distorting faces. Stay critical towards the results, don't jump to conclusions | ✓ Intermediate verification of people's outcomes within that process step | ✓ Discuss in detail whether you recognise things, what recommendation comes from this, and is this realistic to ask or | | | ✓ Continuous feedback in the organisation. How come, what are they, is this possible, why is this not digitised and why is this not automated? etc. | ✓ The moment we had an outcome, I went to talk to someone who was in the process, who could tell me what it meant. | ✓ Once you have the process records, it is important to feed back these findings. | ✓ Sometimes after verifying results, you go deeper into things | | 4.89 |

## Notes 'Customer ownership'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Customer ownership | | | ✓ It's about giving people instructions and getting them involved in the process mining. | | | ✓ You really have to be in the job, you don't have to do it separately, you have to do it together and bring people along. Repeatedly translating things back and making process owners aware that they have to do it. | ✓ I would say that the ownership should be there. That means the software, the execution of the analysis, the discussion of the insights. And we sit there to monitor progress, to ask the right questions, to give advice | ✓ Or we say, hey, it's a joint mirror joint tool, we'll train you. That's why you have to say the first four months together. We're going to give it our best shot together, committed, and then we'll take it ourselves. | ✓ It is important to bring people into the process of mining so that they can train you to work with it later. | ✓ Try to keep people involved; you need to see progress. | **4.44** |

## Notes 'Recommendation and follow-up'

| | 1 | 2 | 9 | 10 | 5 | 7 | 4 | 3 | 6 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Presentation of findings | ✓ Presentation of findings preferably with as few people as possible | ✓ Also presented to all chain partners and the MT | ✓ | ✓ It has become a very critical report. Where it went wrong, the finger was pointed. | ✓ At the end, you also present the findings to the company, and at that point you also leave the organisation and say: go and do something with it. | ✓ Presentation given to the MT, i.e. to the steering committee | ✓ Actually, I made a PowerPoint presentation in which I simply, well, wrote down a top ten list of points for improvement on which we should focus. I presented this to the board and to the operations manager, who was responsible for the processes. | ✓ Yes, feeding back the findings in the form of a discussion with the management and later also recorded. | ✓ Presenting and showing that you have really found something interesting and valuable, especially to enthuse them. A report has also been made | ✓ Yes, we handed over a presentation. All the data and so on is on the server there, and that was actually the last step from me, and with that they would then have to take it further themselves internally. | **4.33** |
| Quantify findings | | | | | | | | | ✓ Quantify the improvements in number of days turnaround time. This is to show what you can really achieve with it | | **4.33** |
| Making recommendations | ✓ | | ✓ Based on the recommendations, a follow-up meeting was held with all those involved, and the managers formed a team to work on the actions. Some recommendations were also prioritised. | ✓ We have assigned all recommendations to an owner and an executor, in the form of a kind of project team, and they have actually started to solve these issues. Once a month, someone also does process mining again. | | ✓ It is precisely the ability to help improve processes, to redesign organisations, to advise | | | | ✓ | **4.56** |
| Appoint someone to ensure follow-up | | | | | ✓ Strive for continuity at the front end. To this end, also appoint persons who will ensure continuity and perform analyses themselves. | ✓ We are rather of the doing type and I absolutely, you have to convert precisely those points into structural improvement plans. And sometimes the improvement plan is that you are allowed to implement things yourself and sometimes by the organization | | ✓ There must ultimately be someone who takes up those recommendations and puts them into practice in the organisation. This can also be done by employing someone for this purpose. | ✓ So in addition to that, you also need to have someone who has knowledge of it or wants to acquire it. So either you have to train someone yourself, or you have to bring in an agency or something that already has the knowledge of it. So there is just investment in time, knowledge, money. That is a disadvantage. | ✓ After that, it was indeed transferred to someone in the organisation who became its project leader in order to eventually realise improvements. | **4.67** |
| Create awareness with client | | | ✓ Yes, I call it awareness, awareness of what you can do differently. If I do a certain thing every day, but I am not aware of what could be done differently or better, I expect someone to make me aware of it. That's what the consultant has to do. | ✓ | | | | | | | **4.56** |