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PRODUCTIVITY PERFORMER

ExplainiT

LINKING APPLICATION AND BUSINESS PROCESSES USING THE PRODUCTIVITYPERFORMER

BACHELOR THESIS

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LINKING APPLICATION AND BUSINESS PROCESSES USING THE PRODUCTIVITYPERFORMER

Creating a method of implementation

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Preface

I would like to present to you my thesis, which is the final assignment before I finish the educational program Industrial Engineering & Management (BSc) at the University of Twente. The thesis is called "Linking application and business processes using the ProductivityPerformer" and is conducted at ExplainiT from February until July 2020. This preface is meant to thank the people that were involved in the research and helped me finish this thesis.

First of all, I want to thank my primary supervisor from the University of Twente, Martijn Koot. Thanks to his feedback, guidance and insights I was able to conduct my research. I would also like to thank my second supervisor, Rogier Harmelink, for his feedback and help.

Secondly, I want to thank my colleagues from ExplainiT, who helped me identify the problem and solve it. In particular, Luuk Ijland, who was my supervisor at ExplainiT. The guidance and feedback are much appreciated.

I hope you enjoy reading my Bachelor Thesis.

Jethro Kiers

Table of Contents

MANAGEMENT SUMMARY **1**

1. INTRODUCTION **3**

1.1. Introduction about ExplainiT 3
1.2. Problem identification 4
1.3. Problem-solving approach 6

2. THEORETICAL PERSPECTIVE **11**

2.1. Enterprise Architecture 11
2.2. Business Process Modelling 12

3. PROBLEM ANALYSIS **14**

3.1. The extent of business and application process modelling at organisations 14
3.2. Process modelling tool 26
3.3. Linking applications with business processes 26

4. IMPLEMENTATION THEORY **30**

4.1. Alternatives 30
4.2. Choosing the best theory 33
4.3. Conclusion 34

5. IMPLEMENTING AT EXPLAINIT **35**

5.1. Execute the technical implementation of the PP 35
5.2. Identify a scope of implementation (department, team, etc.) 35
5.3. Identify the application and business processes within the scope 35
5.4. Create the Table of Contents for user guides/courses 36
5.5. Make AWIs for the user guides/courses 37
5.6. Implement the solution 37
5.7. Conclusion 38

6. EVALUATION AND IMPROVEMENT **39**

6.1. Advises from the interviews 39
6.2. Feedback functionality 39
6.3. Reading of EA-BPMo models 39
6.4. Too short user guides 39

7. MAKING A METHOD OF IMPLEMENTATION **41**

7.1. Execute the technical implementation of the PP 41
7.2. Identify a scope of implementation (department, team, etc.) 41
7.3. Identify the application and business processes within the scope (**A**DKAR) 42
7.4. Create the Table of Contents for user guides/courses (A**D**KAR) 42
7.5. Make AWIs for the user guides/courses (AD**K**AR) 43
7.6. Implement the solution (ADK**AR**) 44
7.7. Implement the solution further into the organization (**ADKAR**) 44
7.8. Overview 45

8. CONCLUSIONS AND RECOMMENDATIONS **47**

8.1. Conclusion 47
8.2. Recommendations 49
8.3. Limitations and further research 49

9. BIBLIOGRAPHY **51**

APPENDIX A: COMPARISON MPSM-PROBLEM-SOLVING APPROACH **B-1**

APPENDIX B: TIME PLAN M12 ..... **B-1**

APPENDIX C: PROBLEM CLUSTER C-1
APPENDIX D: VARIABLES AND RELATIONSHIPS D-1
APPENDIX E: PROTOCOL SYSTEMATIC LITERATURE REVIEW E-1
APPENDIX F: ARCHIMATE 3.0 NOTATION OVERVIEW F-1
APPENDIX G: SURVEY G-1
APPENDIX H: PRODUCTIVITYPERFORMER H-1
APPENDIX I: RESULTS SURVEY I-1
APPENDIX J: INTERVIEWS J-1
APPENDIX K: MODELLED PROCESSES EXPLAINIT K-2
APPENDIX L: EXAMPLE SCREENSHOTS IMPLEMENTATION EXPLAINIT L-1
APPENDIX M: REFLECTION ON PROFESSIONAL FUNCTIONING M-1

Management summary

Research has been conducted for ExplainiT, which is a training agency for mainly IT-related programs, and for sister company PolderValley, which is the organization behind the ProductivityPerformer, about the problem that software applications and business processes are unclearly intertwined. Because the problem is mainly present at end-users, the focus lies on the processes that are in a low abstraction level. The problem has a causal relationship towards the general problem that digital performance regarding business applications is low. This problem has been operationalized into an action problem that the loss of time due to low digital skills Is 3.6%, while this should be a maximum of 2.5%.

The hypothesis is that the problem can be solved by first creating a proper way to make the unclear intertwining of business and application processes clear and second integrating that way into the ProductivityPerformer (PP). The PP is a cloud-based software application that helps organizations to easily make, maintain and centrally store (organisation specific) application work instructions (AWI). The PP is already there as a software product, but it lacks a proper implementation method. This means that the goal of this thesis is to firstly to create a proper way to make the intertwining of business and application processes clear. After that, the goal is to find a proper implementation method for the ProductivityPerformer, combined with the found way of clearing the intertwining of business and application processes. By reaching these goals, it is expected that the loss of time due to digital skills will decrease by at least 30% to 2.5%.

The research is conducted by first formulating a problem-solving approach, which is based on the Managerial Problem Solving Method (MPSM) by Heerkens & van Winden (2017). In the fourth phase it is researched how the intertwining of application and business processes can be made clear, by first researching to what extent customer organizations of ExplainiT already describe application and business processes and the link between those. After that, different theories and models for implementing software will be discussed. By combining the information gained in these phases, the ProductivityPerformer can be implemented at ExplainiT as case material. After that step, the implementation is evaluated and improved, and an implementation method can be made.

To know how to properly clear the intertwining of application and business processes, it is researched how and to what extent organizations describe their application and business processes by conducting a survey and three interviews. The main results are that the majority of the organizations does not model links between applications and processes and does not model processes at the lowest abstraction level (which is the level of tasks, procedures, etc.). Another important result is that the organizations that do model links, do this by using Enterprise Architecture (EA).

The next step is to find out how the intertwining of application and business processes can be made clear. With the help of the survey and interview results and an extensive literature review, it is found that EA itself is not enough. This is because EA is mainly meant to model processes at a high abstraction level, where this research is focusing on the lowest abstraction level. Therefore, a model is determined which combines EA with Business Process Modelling (BPMo). Archimate, which is an EA standard, is used to model two layers: the Business and

the Application layer. The Business layer consists of business processes, modelled in a BPMo language, BPMN. The application layer consists of application services and components, modelled with the Archimate standard. The relationships between the layers are also modelled with Archimate. The model is called the EA-BPMo model.

After it is clear how to make the intertwining of application and business processes clear, the problem still exists that end-users do not know how to execute an application process and still do not know for which process a certain application is used. This can be solved by integrating the EA-BPMo model into the ProductivityPerformer. By integrating the model into the PP, AWIs can be linked to the business processes, which makes sure that end-users know how and when to execute an application process. To be able to do so, an implementation method has to be determined for the PP with the EA-BPMo integration.

To find a proper implementation method, research is conducted for which implementation methods are present in literature. Because results from the research are that it is very important to focus on user adoption when implementing software applications, change management is chosen as perspective. After researching alternatives and using a decision method, the most fitting one is chosen: the Prosci ADKAR model. The main aim of this model is to combine a business and a people dimension and use that combination to properly implement change.

With the Prosci ADKAR model as a base, the PP is implemented at ExplainiT as case material. During this implementation, the processes of ExplainiT are modelled according to the EA-BPMo model. After this implementation, evaluations are done to gain knowledge on how to improve the implementation at ExplainiT. This knowledge is used in determining a method of implementation for the PP. The implementation method is a step-by-step approach divided in two dimensions: the business and the people dimension. The business dimension gives a step-by-step approach on how to implement the PP with EA-BPMo integration. The people dimension gives an approach on how to make sure that the end-users accept/use the solution.

To conclude, by implementing the ProductivityPerformer according to the implementation method, process models are modelled according to the EA-BPMo model. This means that the intertwining of application and business processes are made clear. By integrating these processes into the ProductivityPerformer, AWIs can be linked to the process. Due to this, the end-user knows how and when to execute a certain application process. Furthermore, if problems are occurring due to low digital skills, the solution can be found in a central place: the PP.

Although it is not measured (see 8.3.1), it is highly expected that, due to the focus on the end-user, there will be a significant decrease in loss of time. This means that digital performance regarding business applications will be improved by the solution as given in this thesis.

1. Introduction

This chapter gives information about the commissioning company ExplainiT and information about the product that is developed by sister company PolderValley. After that, the problem will be introduced with the use of a problem cluster. Then, the problem-solving approach and the research design are given.

1.1. Introduction about ExplainiT

This bachelor assignment is written for ExplainiT. ExplainiT is a training agency, which sells courses in IT. Their mission is to make a viable organization of every organization, by coaching and training in the domain of digital performance. The company focusses mainly on Microsoft related software and are also supplying full Office/Microsoft (365) migrations.

ExplainiT is a subsidiary of INVINITIV, which is an organization that focusses on Digital Performance. INVINITIV has another subsidiary, namely PolderValley. PolderValley is a software developing organization. They have been developing a new product, the ProductivityPerformer (PP).

1.1.1. Information about the ProductivityPerformer

The ProductivityPerformer (PP) is a cloud-based software application that helps organizations to easily make, maintain and store (organisation specific) application work instructions (AWI). An AWI is a step-by-step (imaged) description of actions within applications. AWIs are made for end-users of a specific application. The tool also helps to keep application work instructions up to date. The PP makes it possible to save AWIs on a central place, which makes sure that employees do not have to search thoroughly for information. These AWIs can help employees to work faster with applications[1] or to integrate into a company easier. The PP is mainly helpful for organisation specific applications[2], which are often hard to use due to the lack of instructions, but is also very helpful for standard applications, because the entire application process can be recorded. The goal of the ProductivityPerformer is to push towards a uniform way of working with applications within the entire organization and to increase digital performance.

Figure 1 gives a screenshot of one of the main features, namely the User Guides. A user guide is a collection of AWIs which can be made as e.g. a process description. This section is elaborated in Appendix H: ProductivityPerformer.

[1] When an application is mentioned, a random software application within an organisation is meant.

[2] Organisation specific applications are the applications that are either only used by or specifically made for that organisation or adapted from a standard application for that organisation.

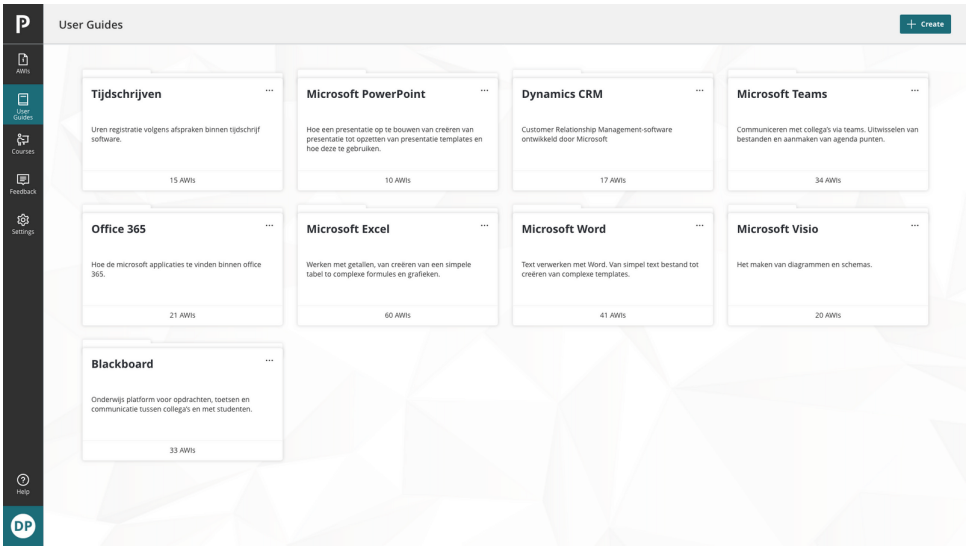


Figure 1: ProductivityPerformer User Guide functionality

1.2. Problem identification

Organisations depend more and more on digital performance. Digital performance can be defined as generic performance, but with extra elements regarding computer technologies or information technology, which is a broad concept. This report defines digital performance regarding business applications as the performance of the business applications itself and the performance of the user using that business applications. Digital performance regarding business applications is low, due to the increasing dependency of business processes on software applications (PolderValley, 2020) and due to low digital skills (van Deursen & van Dijk, 2012). According to The Workforce View (2018), inefficient systems, processes and technology are one of the top three productivity killers, which means that next to knowing how to use an application, it is important to know when to execute a certain application process efficiently.

The problem identification above shows that digital performance regarding business applications can be improved by improving the user's performance. As is explained in the previous section, the ProductivityPerformer (PP) is a software product that is developed to increase the digital performance of the user, by giving clear application work instructions and user guides. Using the PP enables the end-user to know how to use applications, because clear instructions are available. But, the problem of when to use which application process and therefore which AWI is still present, which means that application and business processes are unclearly intertwined.

1.2.1. Core problem

The selection of the core problem is based on the theory of Heerkens & van Winden (2017). In Figure 2 the problem cluster is given (Appendix C: Problem cluster gives more information on how the problems are identified). The blue problems are already solved by standard use of the PP; therefore, the problem that is not solved is that business and application processes are unclearly intertwined. The general problem is that digital performance regarding business applications is low at most of the potential customer organisations of PolderValley.

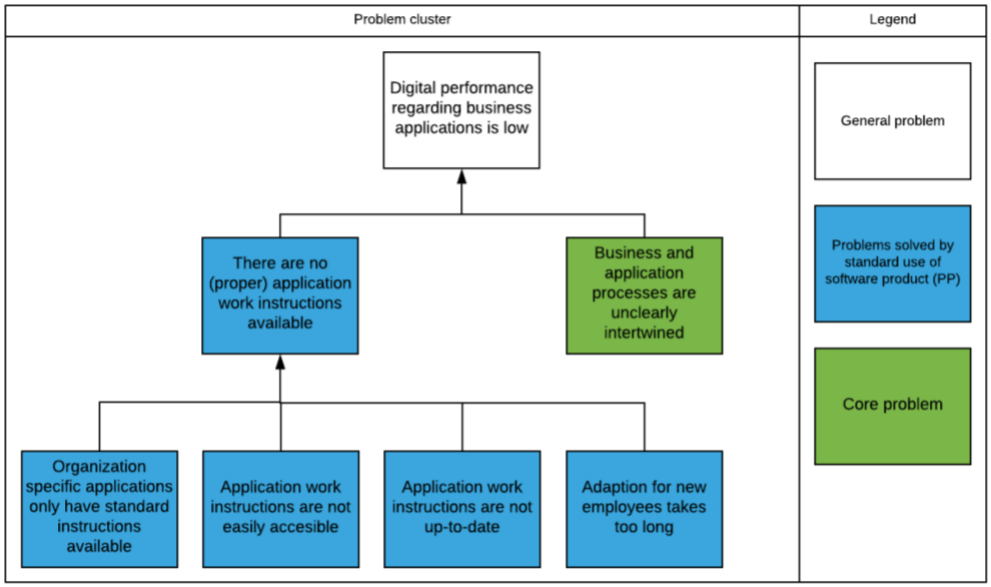


Figure 2: Problem cluster

Therefore, the core problem is:

> *Business and application processes are unclearly intertwined.*

In this thesis, business processes will be arranged in three abstraction levels:

- Low abstraction level – these are the processes that can also be written as procedures, tasks or step-by-step plans;
- Mediocre abstraction level – these are the processes that are subprocesses of the business processes.
- High abstraction level – these are the business processes, which represent the business model.

The focus of this thesis is mainly on low abstraction level processes. This is because the focus lies on improving digital performance regarding business applications, which is mainly done by focusing on the end-user. The end-user executes processes as tasks, procedures, etc., therefore, the low abstraction level processes are the most important.

1.2.2. Operationalization

A core problem is defined. The next step is to formulate an action problem. According to Heerkens & van Winden (2017) an action problem is “a discrepancy between the norm and reality, as perceived by the problem owner”. Therefore, an action problem needs a reality, a norm and a problem owner. To create an action problem, digital performance regarding business applications needs to be operationalized. This can be done by measuring the loss of time. In this case, only the loss of time on application usage due to lack of digital skills needs to be measured, due to the focus on the end-user. With digital skills, the skills of how and when to properly execute a certain application process is meant. The loss of time can be measured by measuring the total time that is spent on IT and by measuring the time that is spent on problems (due to lack of digital skills) regarding the IT. By dividing the time that is spent on problems by the total time, a percentage of loss of time can be calculated. The lower this percentage is, the better.

Reality

The loss of time on the use of applications is high. According to Deursen & van Dijk (2012) the average Dutch employee loses 3.6% of its time due to low digital skills.

Norm

The norm is that the loss of time should be lower. By realizing a clear view on the intertwining of business and application processes (solving the core problem), and combining this with the ProductivityPerformer, the hypothesis is that the digital skills of end-users improve. This means that the hypothesis is that the loss of time will be decreased by an estimated 30% to 2.5%. Therefore, the norm will be set on 2.5% loss of time due to low digital skills.

Problem owner

The problem owners are the potential customers of PolderValley (who sells the ProductivityPerformer). In the research from van Deursen & van Dijk (2012), eighteen different sectors are involved, with in total 2004 respondents. Due to a large and wide sample, it can be assumed that the results from that study can be reflected onto potential customers of PolderValley.

1.2.3. Action problem

Now that the norm, reality and the problem owner are clear, the action problem can be formulated:

The loss of time due to low digital skills is on average 3.6% at the potential customers of PolderValley, while this should be a maximum of 2.5%.

1.3. Problem-solving approach

This section gives the methodology that is used to solve the problem. Furthermore, this section gives the knowledge problems and the research design. The hypothesis is that the problem can be solved with the use of the ProductivityPerformer and by creating a proper way to make the intertwining of business and application process clear. The ProductivityPerformer is already there as a software product, but the product lacks an implementation method. This means that the goal of this thesis is to firstly to create a proper way to make the intertwining of business and application processes clear. After that, the goal is to find a proper implementation method for the ProductivityPerformer, combined with the found way of clearing the intertwining of business and application processes. By reaching this goal, it is expected that the loss of time will decrease. To reach this goal, a problem-solving approach has to be made.

1.3.1. Methodology

The used approach is a spin-off of the Managerial Problem-Solving Method (MPSM) by Heerkens & van Winden (2017), where phase 1 and 2 are already done in this chapter and where the other phases are rewritten to this particular project. The different phases (except phase 1 and 2) will be further explained in the next sections. A visualization of the problem-solving approach is given in Figure 3. Appendix A: Comparison MPSM-Problem-solving approach gives a comparison between this problem-solving approach and the MPSM.

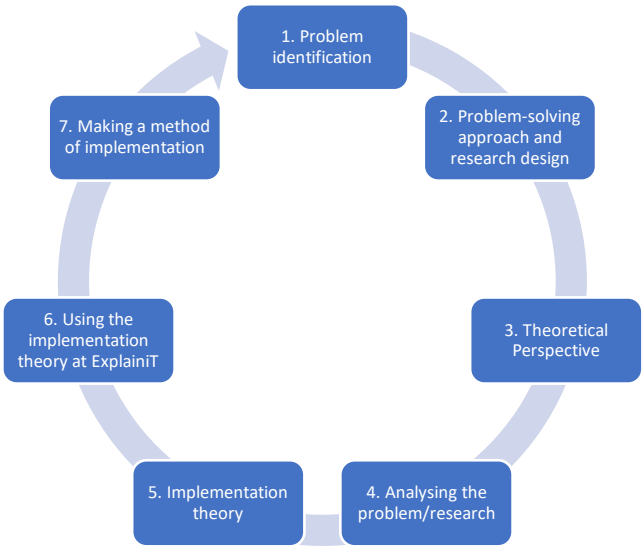


Figure 3: Problem-solving approach

Phase 3: Theoretical perspective

To gain knowledge about the theoretical side of the research, a (systematic) literature review is conducted. It is found that to make the intertwining of application and business processes clear, Enterprise Architecture (EA) is important. Therefore, EA is the starting point. Business Process Modelling (BPMo) is also researched in this part. This research has led to a theoretical perspective, where the following knowledge problem is answered: There is a lack of knowledge on what Enterprise Architecture and Business Process Modelling (BPMo) is.

Phase 4: Analyzing the problem (research)

In this phase the problem will be further analyzed and defined. This will be done by conducting research and solving knowledge problems. The knowledge problems in this phase are:

1. It is unknown whether or not the potential customer organisations of PolderValley describe their business and application processes and to what extent they do so. This knowledge is needed for finding out how to make the intertwining of application and business processes clear.
2. There is a lack of knowledge on which tooling can be used best for modelling processes in combination with the ProductivityPerformer. This knowledge problem has to be solved because it is found that processes will have to be modelled to solve the main problem.
3. There is a need for knowledge on how to make the intertwining of application and business processes clear. This is the main knowledge problem.

It is expected that after this phase a theoretical solution for the core problem is present.

Phase 5: Implementation theory

The solution that is determined in the previous phase needs to be put to practice. This will be done by using the ProductivityPerformer. However, the PP lacks an implementation method. Therefore, in this phase, literature research will be done on how to implement software applications. After giving alternatives, a decision method is used to determine the best implementation theory/model. There is one knowledge problem in this phase: there is a lack of knowledge on what the best type of model/theory is for implementing the ProductivityPerformer.

Phase 6: Using the implementation theory at ExplainiT (Case material)

This phase combines the results of phases 4 and 5. The model/theory that is determined in the previous phase will be the base for the implementation of the ProductivityPerformer at ExplainiT as case material. This is done to gather data about the quality of the solution. ExplainiT is the sister company of PolderValley. Due to this, using ExplainiT is not a completely fair case, however it is expected that valuable data can be gathered.

The implementation uses a way of making the intertwining of application and business processes clear, as determined in phase 4. It is found that processes need to be modelled to make the intertwining clear. Because ExplainiT does not yet have modelled processes, all the processes of ExplainiT have to be modelled. The processes will be modelled in the different levels, starting at the highest abstraction level and ending at the lowest abstraction level. The lowest abstraction level has to be reached to make the intertwining of business and application processes clear. That level is also the limitation, due to time constraints. The processes that are between the highest and the lowest level are indicated as "…" in the visualization of Figure 4.

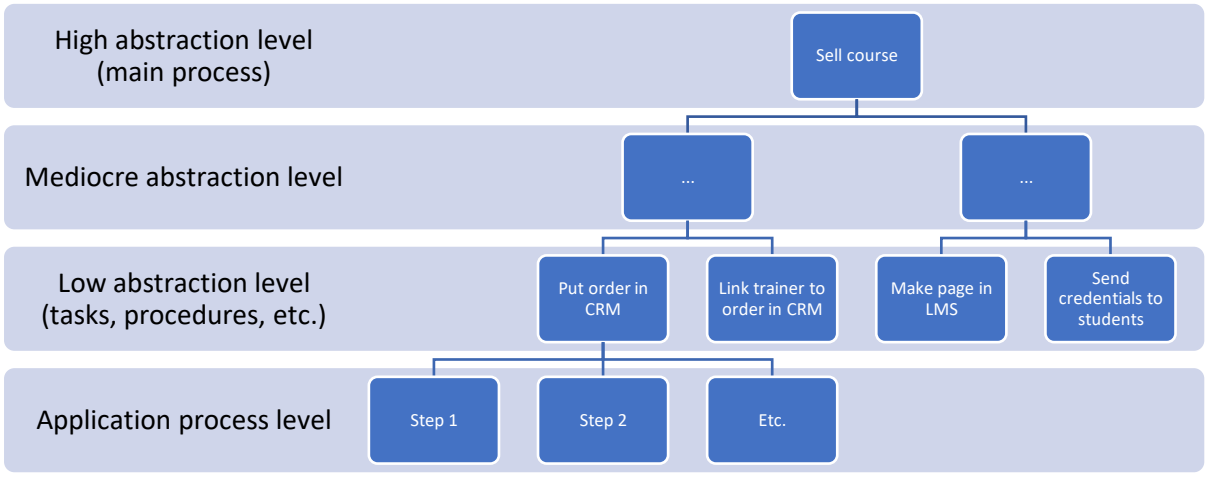


Figure 4: Example of levels in process modelling

The following two knowledge problems have to be addressed:

1. For the case material there is a lack of knowledge about the processes and applications within ExplainiT. There is a need to understand these processes and applications before they can be modelled. During the implementation of the PP, the processes will be modelled.
2. After the implementation is done at ExplainiT, there will be evaluations. The knowledge problem is that there is a need of knowledge on improving the implementation. The results will be used for the next phase.

Phase 8: Making an implementation method

Now that the PP is implemented at ExplainiT and the intertwining of application and business process have been made clear, an implementation method that can be used at potential customers of PolderValley has to be determined. Therefore, the knowledge problem of this phase is: there is a need of knowledge on how the implementation at ExplainiT can be transformed into a method of implementation. The goal of this phase is to deliver a method of implementation for the ProductivityPerformer that makes the intertwining of application and business processes clear.

1.3.2. Research design

This section gives an overview on how the research will be conducted. The knowledge problems that are described in the previous sections, are rewritten into research questions.

Research method

In Table 1, the research strategy/type, the data gathering and processing method and the research population is given per research question. A time plan can be found in Appendix B: Time Plan M12.

Research question (RQ) 5 is the most important question of the research, because this is an important part of the solution. Research questions one to four lead to an answer to RQ 5. RQ 3 will be researched by a combination of qualitative and quantitative analysis. A survey will be made and send to the customer base of ExplainiT (quantitative), this customer base represents the potential customers of PolderValley. The survey should be made in a way that the answers are quantifiable. This makes the data easier to analyze and draw conclusions. The survey will be send by e-mail, which gives an average response rate of 30% (Lindemann, 2019). Also, the plan is to conduct a maximum of five interviews with process managers. The process manager can give important information on how to model processes and combine these with application work instructions. Also, (systematic) literature reviews will be conducted.

Deliverables

As case material the ProductivityPerformer is implemented at ExplainiT, which solves the problem at ExplainiT. The main deliverable is a method of implementation for the ProductivityPerformer, that makes the intertwining of application and business processes clear and decreases the loss of time and therefore improves the digital performance regarding business applications.

Table 1: Research method

#	Phase	Chapter of elaboration	Research question	Research strategy/type	Data gathering and processing	Research population
1	3	2.1	What is Enterprise Architecture?	Descriptive	Literature Review	-
2	3	2.2	What is Business Process Modelling?	Descriptive	(Systematic) Literature Review	-
3	4	3.1	How and to what extent do organisations describe their application and business processes?	Descriptive (Qualitative and quantitative)	Interviews and survey	Customer base ExplainiT
4	4	0	Which tooling can be best used for modelling (business and application) processes?	Exploratory	Literature and desk research	-
5	4	3.3	How can the intertwining of business and application processes be made clear?	Exploratory Descriptive	Desk research and interviews	Customer base ExplainiT
6	5	4	What type of model/theory can be best used for implementing the ProductivityPerformer?	Descriptive	Literature research and interviews	Managers at PolderValley and ExplainiT
7	6	5	What are the processes and (organization specific) applications within ExplainiT and how do they work?	Descriptive (Qualitative research)	Interviews and observation	Managers at PolderValley and ExplainiT
8	6	6	What are possible improvements for the implementation method?	Descriptive (Qualitative research)	Interviews and observation	Managers at PolderValley and ExplainiT
9	7	7	How can the implementation at ExplainiT be transformed into a method of implementation?	Descriptive	Interviews and desk research	Customer base ExplainiT

2. Theoretical perspective

This chapter gives the results of a (systematic) literature review. The protocol that is used for conducting the systematic part of the review is given in Appendix E: Protocol Systematic Literature Review. This literature review should answer the following research questions:

What is Enterprise Architecture?
What is Business Process Modelling?

2.1. Enterprise Architecture

When looking into linking business process with applications, business & IT alignment is an important subject. According to Kutosev (2020) Business & IT alignment is "an overall consistency between current business operations and underlying information systems (operational alignment), as well as between strategic business plans and long-term IT strategies (strategic alignment). Linking business processes with applications is therefore a part of business & IT alignment, with the focus on operational alignment. Therefore, business & IT alignment can help to answer the research question.

An existing theory for business & IT alignment is Enterprise Architecture (EA). According to Iacob et al. (2012) "Enterprise Architecture is the complete, consistent and coherent set of methods, rules, models and tools which guides the (re)design, migration, implementation and governance of business processes, organizational structures, information systems and the technical infrastructure of an organization according to a vision." An EA has multiple layers (Figure 5), among others:

1. Business Layer – gives the internal processes, roles and actors;
2. Application Layer – gives the applications that are used for a certain process within the business layer;
3. Technology Layer – gives the technological infrastructure within an organisation.

An EA does not only give the different layers, but also gives the relationships between the layers. An EA model visualizes for example the relationship between a process and what server is used to execute that process.

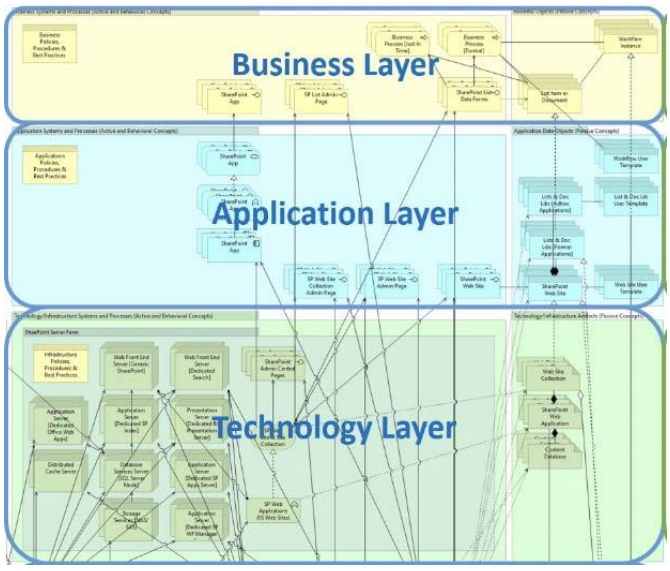


Figure 5: Layered view of EA (Iacob, 2019)

EA is a model that is modelled with a certain standard. One of the existing standards is ArchiMate 3.0. This standard will be used in this research, because this is a known language from a course.

The Archimate standard consists of six components (Lankhorst et al., 2009):

1. A framework – A conceptual framework consisting which allows classification of architectural phenomena.
2. An abstract syntax – This component contains the formal definition of the language in terms of a meta-model, providing the characteristics of each language construct, and its relationships to other language constructs.
3. Modelling concepts – A set of modelling concepts allowing for the description of relevant aspects of enterprises at the enterprise level.
4. The language semantics - This component defines the meaning of each language construct and relation type.
5. A concrete syntax in terms of visual notation – This syntax defines how the language constructs defined in the meta-model are represented graphically.
6. A viewpoint mechanism - These mechanisms correspond to the idea of diagram types in UML, though it is much more flexible as there is not a strict partitioning of constructs into views.

Appendix F: Archimate 3.0 Notation Overview gives the notation overview of Archimate 3.0. In this figure, a distinction has been made between different elements. The notation is clearly formulated by The Open Group (2019), that can be used to model an Enterprise Architecture.

2.2. Business Process Modelling

EA has a standard way of describing processes, but the processes “do not list the flow of activities in detail” (The Open Group, 2019). This means that EA only covers high-level business processes. Therefore, deeper knowledge on other methods for modelling business processes is needed.

Business Process Modelling (BPMo) is part of Business Process Management (BPM). Business Process Management can be defined as “an integrated set of principles, methods and tools for improvement of organizational performance, based on the principle that all work in an organization is part of a “process”” (La Rosa, 2015). In this project, the focus does not lie on Business Process Management, but on Modelling. Business Process Modelling means describing business processes by the use of a certain language (e.g. BPMN, UML, etc.).

Business Process Modelling can be done by multiple languages. According to a requirements study by Patig & Casanova-Brito (2011) BPMo languages are interchangeable. BPMN 2.0 (Business Process Modelling Notation) will be used as a modelling language, because BPMN is the most popular modelling notation (van Sinderen, 2018) and because the principle behind BPMN is rather simple to understand (Camunda, 2020). This notation is developed and maintained by Object Management Group; a report was made with all specifications. This report will be used for modelling processes (Object Management Group, 2013). The latest version, 2.0.2 (December 2013), will be used. BPMN 2.0.2 consists of the following elements (Object Management Group, 2013):

1. Flow objects – Main graphical elements to define the behavior of a process, such as events, activities and gateways.
2. Artefacts – Graphical object that provides information to support the process or elements within the process. Does not directly affect the flow. Among other things "Data" is an artefact. Data provides information about what activities require to be executed.
3. Connecting objects – objects that connect flow objects or other information with each other.
4. Swim lanes – Used for grouping elements or stakeholders (e.g. persons, organisations, departments, etc.).

Figure 6 gives a visual of the elements.

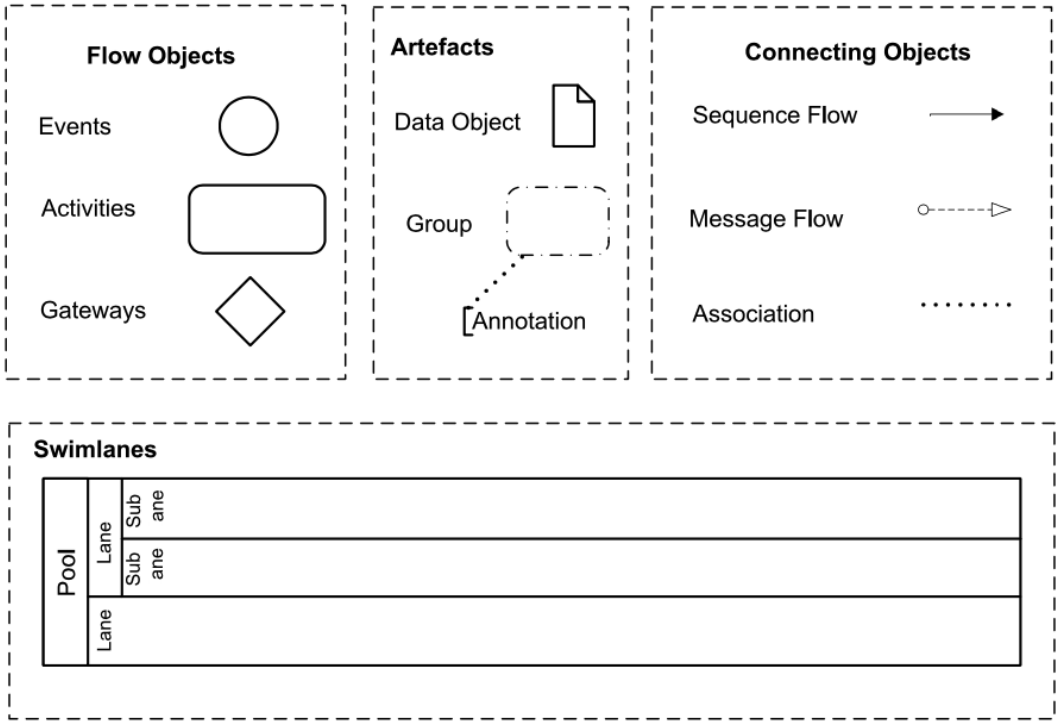


Figure 6: BPMN: categories of elements (Weske, 2012)

The modelling elements that are given in the figure will be used for this research to find a proper way of linking applications with processes, with the help of the formulated notation by Object Management Group (2013).

3. Problem analysis

In this chapter, which is phase 4 of the problem-solving approach, the problem will be further analyzed and defined. First of all, the third research question about the extent of process describing at organisations will be elaborated. Second, the right modelling tool will be determined. After that, the focus will lie on the intertwining of business and application processes.

3.1. The extent of business and application process modelling at organisations

This section will focus on answering the following research question, which will be answered with the help of a survey and interviews:

How and to what extent do organisations describe their business and application processes?

3.1.1. Theoretical framework

In this section, a research model or theoretical framework is determined, which is needed to construct the survey.

Literature review

In chapter 2, it is introduced what BPMo and EA is. This literature review will be elaborated in this section, to determine variables and indicators/dimensions for the research model. In order to gain knowledge into the link between application and business processes, first of all information about the separate subjects has to be gained. The first part of this section focusses on the business side (BPMo) of the alignment. The second part focuses on the IT side (EA).

Business process modelling at organisations

In literature, a lot of information can be found about the maturity of organisations in BPM. But Maturity Models do not only focus on whether or not processes are modelled as they mainly focus on how the Management part is integrated in the organizations. However, a paper by Janssen and Ravesteyn (2015) that studied the effect of BPM Maturity on BPM performance in the Netherlands and Portugal gives important dimensions for BPMo, namely process description and process management.

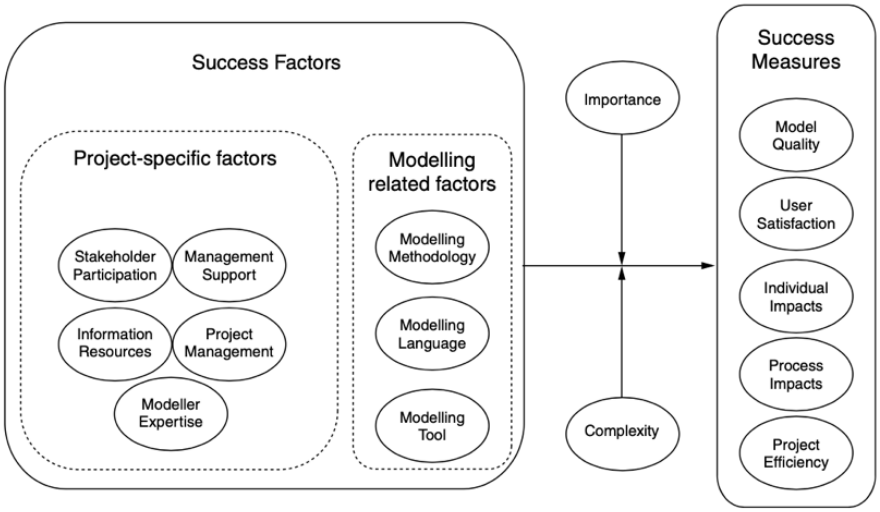


Figure 7: Process modelling success model (Bandara et al., 2005)

A paper by Bandara et al. (2005) determined a model with factors and measures that influence the success of BPMo. This information is helpful for the research model that will be determined. The model is given in Figure 7. Important factors and measures from the model are modelling methodology, modelling language and modelling tool. These are labeled "Modelling related factors" in the model.

Organizations can get certified in a certain ISO standard if they meet the requirements. ISO is "an independent, non-governmental international organization that brings together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards that support innovation and provide solutions to global challenges" (ISO, 2020). An important standard for this research is 9001. The ISO 9001 standard is focused on Quality Management principles. According to ISO's report about the Quality Management principles (2015), there are seven principles: customer focus, leadership, engagement of people, process approach (focus on a standard process), improvement, evidence-based decision-making, relationship management. The fourth one, process approach, is mainly important for this research. This principle focusses on if and to what extent processes are managed. Therefore, this is an important dimension to take into account.

To summarize, the following dimensions are important when looking into the extent of business process modelling. These dimensions will be used for the research model.

- Process description (processes are identified and captured in descriptions);
- Process management (Process owners are assigned within the organisation);
- Management methodology (is this used and are users certified users);
- Modelling language (which language is used to model the processes);
- Modelling tool (which tool is used);
- ISO 9001 certification.

Application process modelling at organisations

There is a lot of overlap in business and application processes, due to the fast growth of importance of IT. Normal business processes are often executed by using or with the help of certain applications, which makes it necessary to include the application processes into the business processes. An application process is a business process that is executed by the use of an application. This part of the review focuses on how to measure or research the extent that application processes are modelled.

According to Venkatraman et al. (1993) information technology (IT) and information systems (IS) have evolved towards a strategic and central role within organisations. Due to this, IT management plays a more important role. A part of IT management is application management. According to Jobhero (2020) an application manager is "an IT professional who is responsible for managing the software applications within a business." Also, application managers are not responsible for the development, but responsible for improving business operations, by using applications.

The follow-up dimension is the use of a methodology by these managers. There are lots of different methodologies that can be used in application management. One of these methodologies is the ISO 20000 standard (ISO, 2018). This standard is closely related to ISO 9001 standard but focuses on IT service management. Therefore, this standard is interesting

for the (extent of) application management. Furthermore, the type of application is important for the research. This means that it is important to know which percentage of the applications is organisation specific.

Some dimensions can be taken from the business process modelling part. Therefore, to conclude, the most important dimensions for the extent of application modelling are:

- Application management (application managers/owners are assigned within the company);
- Management methodology;
- Application process description;
- Type of application.

Research model

Now that the dimensions have been found, a research model can be determined. First of all, variables (or dimensions) that influence the research goal have been determined by the literature review. Also, indicators to make to variables measurable have been determined. These are given in Table 2.

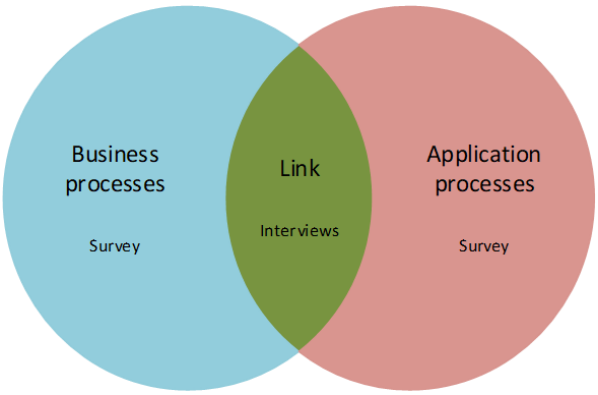


Figure 8: Venn-diagram about research model

The research model is designed to find out the dependent variable: the extent of business and application processes modelled. This variable can be measured by abstraction levels within an organization:

- Low abstraction level – these are the processes that can also be written as procedures, tasks or step-by-step plans;
- Mediocre abstraction level – these are the processes that are subprocesses of the business processes.
- High abstraction level – these are the business processes.

By researching the intermediate and moderate variables, the two subjects are researched separately. The linkage between the two subjects (Business & IT) will be research by using these results and conducting interviews with respondents that are willing to (Figure 8). Interviews generally give more detailed results and the interviewer can ask follow-up questions. In order to categorize the responses into sectors and sizes, the first two variables are included. The variables and the relationships between the variables result in a research model, which is given in Figure 9.

Table 2: Variables and indicators

Variables	Indicator	Reason of inclusion
Type of organisation	Sector of organisation	The type of organisation is important, to separate potential customers into groups.
Size of organisation	# FTE Revenue Balance sheet total	The size of an organisation is measured, to group the respondents. This is interesting for the company, to make an estimation for an implementation method determined by the size of organisation.
Process management	# FTE Process managers Level of process management Use of methodology in process management Methodology certification ISO 9001 certification	The extent of process management is interesting for answering the research question, because this has significant impact on the goal of the research.
Process description	Describing of processes Method of describing Modelling tool Modelling language	This variable actually answers the research question partly.
Application process description	Application process modelling Enterprise Architecture	EA is measured by whether or not the organization has an EA modelled.
Application management	# FTE Application managers Use of methodology in application management Methodology certification ISO 20000 certification # organisation specific applications # total applications	The extent of application management is interesting for answering the research question, because this has significant impact on the goal of the research. Organisation specific application processes need more managing, because there are no standard instructions or helpdesks available.

An explanation of the variables and their relationships can be found in Appendix D: Variables and relationships.

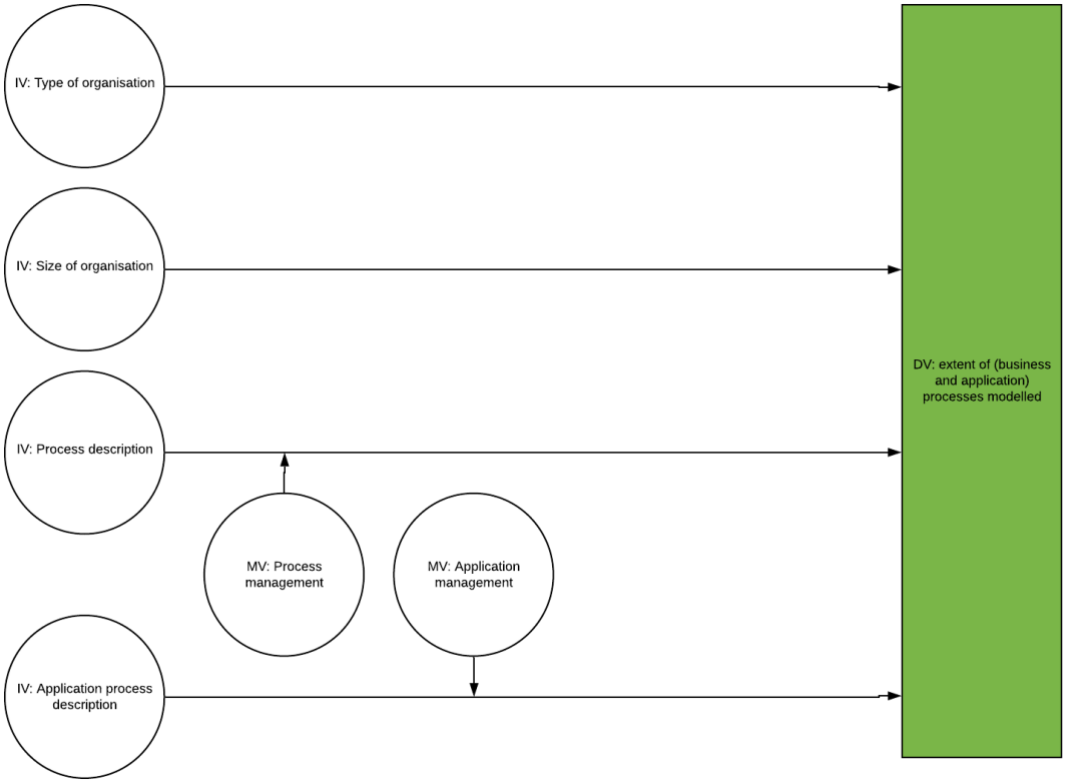


Figure 9: Research model

3.1.2. Survey

To answer the research question, a survey is conducted. This sub-chapter explains how the survey is constructed. The questions are based on the research model and based on a literature review. In Appendix G: Survey the structure, questions and answering possibilities are given.

To draw a conclusion about the dependent variable, hypothesis have been formulated. The first hypothesis is that most organizations in the sample do not model links between applications and processes. The assumption has been made that this means that application and business processes are unclearly intertwined, therefore it will be tested whether or not the problem at hand exists. The second hypothesis is that most of the organizations in the sample does not model the processes in the lowest abstraction level. The focus of this thesis is on low abstraction level processes; therefore, this should give a conclusion about the variable process description. The third hypothesis focusses on application process description. The hypothesis is that more organizations use instructions than that they use application process models. These hypotheses should help answering the dependent variable.

Data collection instrument and sample selection

The tool that is used to collect the data is Microsoft Forms Pro. This tool makes it possible to get the data directly in Excel. Via Excel, the data was exported to PowerBI to be analyzed.

The sample is based on a database that includes 'info'-mailboxes. The database includes the name of the organization, the sector and a central mail address. Organisations often use info@<organisation's name>.nl/com as a central place for questions from outsiders. The database consisted of 2117 information mailboxes, to which the survey was send. In the email that was send, was asked to forward the mail to the responsible persons within that organisation, with the following examples of functions:

1. Application managers;
2. Process managers;
3. Operational directors;
4. Managing directors;
5. IT team leaders, managers or directors.

The mail that was send can be found in Appendix G: Survey.

Validation of the survey

Because the survey is based on a research model (which is based on a literature review), the content of the survey is valid. The survey was reviewed and filled in by my supervisors. ExplainiT and The Backbone[3] have filled in the survey, to test if the gathered data was sufficient to draw a conclusion. After the test, improvements have been done by adapting the answering possibilities from intervals to choices, to improve the validity.

3.1.3. Results survey

This section gives the results of the survey. First of all, a table with the number of respondents and the response rate is given. After proving the action problem and treating the variables from the research model, a general conclusion is drawn. With the help of PowerBI the results are transformed into a visualized report. This report and tables with the results per question are added in Appendix I: Results Survey.

Table 3: Number of responses survey

Sent	2117
Bounce	-256
Arrived	1861
Response	**147**
Response rate	**7.9%**

Proving the core problem

The goal of this section is to prove that the core problem exists in the sample. The problem of unclearly intertwining of business and application processes can be caused by the lack of modelled links between applications and processes. Therefore, the hypothesis is that most organisations do not have modelled links between applications and processes This hypothesis will be tested using a statistical test with a level of significance of $\alpha = 5\%$. The test will be executed with the help of eight steps, as described by Meijer (2018). An assumption has to be made that organisations that model their links, do so with the help of an Enterprise Architecture. The number of organizations that have an EA is measured with the survey.

[3] The Backbone is another sister company of ExplainiT, active in IT monitoring solutions.

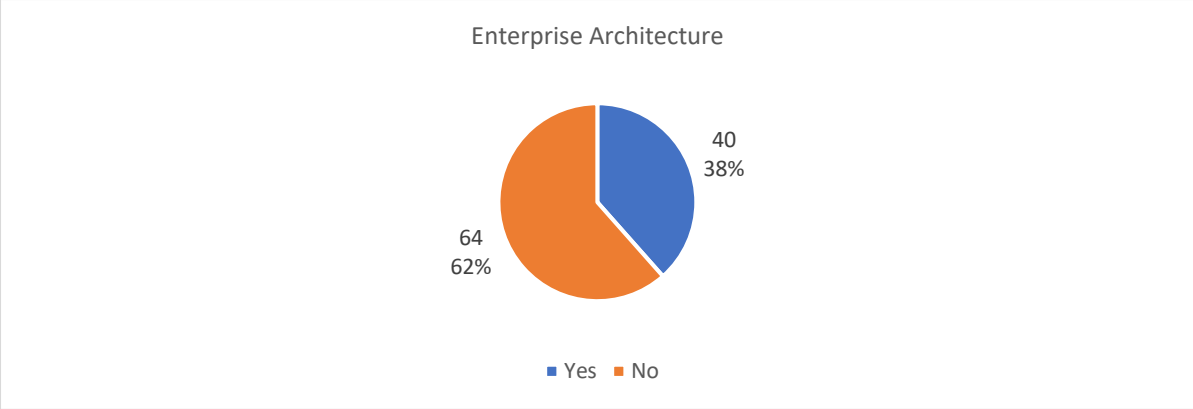


Figure 10: Response survey Enterprise Architecture

Step 1 – Probability model: X = "number of organisations in the sample that do not model links between applications and processes"
The answering possibilities of the question in the survey were "Yes" and "No", which can also be seen as a success or a failure. This means that it can be assumed that X is B(104,p)-distributed with unknown *p* = "the proportion of the population that does *not* model links between applications and processes".
Step 2 – H_0 and H_1: The H_1 hypothesis is that a majority of the population does not model links between applications and processes, which means that a majority should be a failure or "No". This is against the H_0 hypothesis that a majority does model links between applications and processes. Therefore, a binomial test with a null hypothesis of p = ½ and an alternative hypothesis of p > ½ (majority) is tested. The test is H_0: $p = \frac{1}{2}$ against H_1: $p > \frac{1}{2}$ with $\alpha = 5\%$.
Step 3 – Test statistic: X
Step 4 - Distribution if H_0 is true: $X \sim B(104, \frac{1}{2})$. This can be approximated with the Normal distribution with $\mu = np = 52$ and $\sigma^2 = np(1-p) = 26$. So approximately $N(52,26)$.
Step 5 – Observed value: x = 64 (Figure 10)
Step 6 – p-value: Reject H_0 if the p-value $\leq \alpha = 5\%$. Computation of the upper-tailed p-value (with continuity correction):

$$P(X \geq 64|H_0) = (c.c.)P(X \geq 63.5|H_0) \approx P\left(Z \geq \frac{63.5 - 52}{\sqrt{26}}\right) = 1 - \Phi(2.26) = 1.21\%$$

Step 7 – Statistical conclusion: The p-value $1.21\% < 5\%$, so reject H_0.
Step 8 – Conclusion: At a 5% level of significance it is showed that most organisations do not model links between applications and processes. Therefore, the action problem, as described in chapter 1, exists.

Type of organization

The responses of the survey are categorized by sector. As can be seen in Figure 11, the most response came from governmental organisations (36.1%).

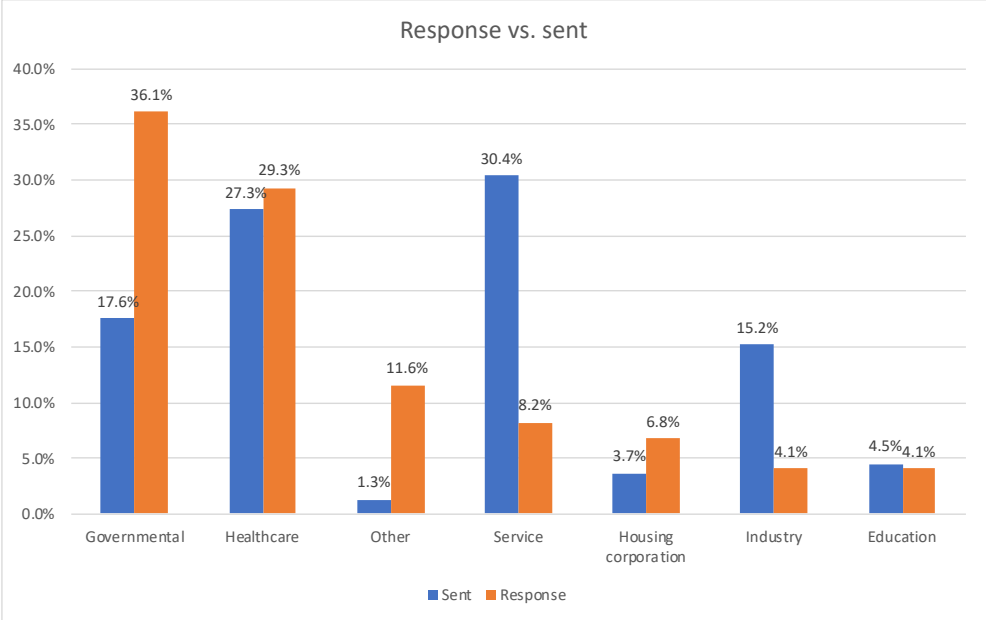


Figure 11: Response vs. sent

Size of organization

The information given in the following table is to categorize the organisations in size, by looking into the total number of FTE that works for the company, the yearly revenue (in millions of euros) and, if the revenue is unknown, the yearly balance sheet total (in millions of euros).

Table 4: Overall Organisation information

Total FTE		Revenue		Balance sheet	
x ≤ 10	2.7%	**x ≤ 1**	4.1%	**x ≤ 1**	25.0%
10 < x ≤ 50	10.2%	**1 < x ≤ 10**	11.6%	**1 < x ≤ 10**	6.3%
50 < x ≤ 250	24.5%	**10 < x ≤ 50**	21.1%	**10 < x ≤ 20**	12.5%
250 < x ≤ 500	22.5%	**50 < x ≤ 100**	17.7%	**20 < x ≤ 50**	12.5%
500 < x ≤ 1000	15.0%	**100 < x ≤ 200**	14.3%	**50 < x ≤ 100**	12.5%
1000 < x ≤ 2000	11.6%	**x > 200**	9.5%	**100 < x ≤ 200**	6.3%
x > 2000	13.6%	**I do not know**	21.8%	**x > 200**	25.0%

The conclusion that can be drawn from this information is that most of the organizations of the respondents are small-medium sized (SME).

Process description

Figure 12 gives the type of process description per abstraction level. What can be concluded is that the higher the abstraction level, the more process models are used, and the less step-by-step plans are used. The high abstraction level processes are mainly modelled, just like the mediocre abstraction level processes. The low abstraction level processes are mainly described by text or by step-by-step plans.

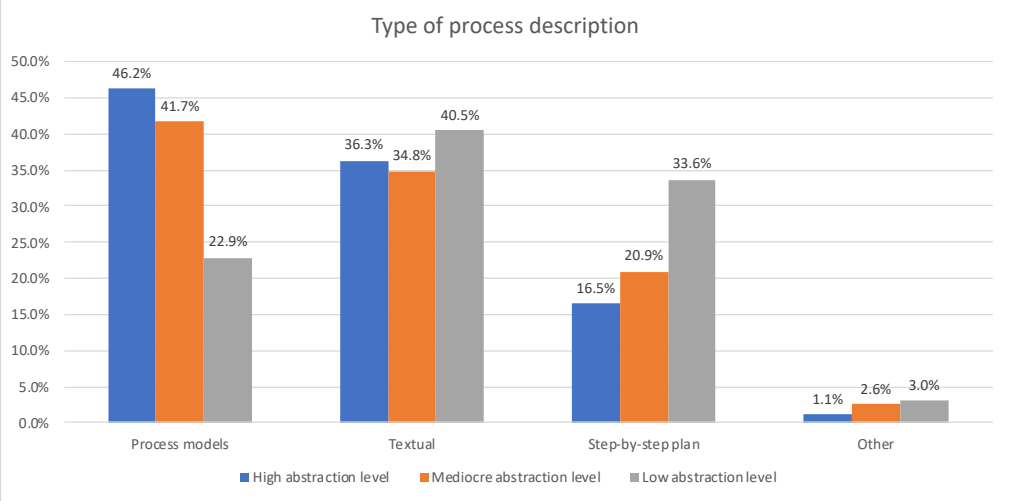


Figure 12: Type of process description per abstraction level

This thesis is mainly focused on the lowest abstraction level, because the thesis focusses on end-users. It is expected that processes at the lowest abstraction level are not modelled at most organizations. For solving the problem, these processes have to be modelled. To see if most organizations do not model processes at the lowest level, the hypothesis is that most organisations do not model processes at the lowest abstraction level with process models. The hypothesis will be tested using a statistical test. In the survey, first the question is asked whether or not processes at the lowest abstraction level are modelled/described. If the answer is yes, the question is asked how the processes are described/modelled.

Step 1 – Probability model: X = "number of organisations in the sample that models processes at the lowest abstraction level"
Because the answers to the survey can be transformed into a success if the processes are modelled at the lowest abstraction level and into a failure if the processes are not modelled at the lowest abstraction level, X is B(104,p)-distributed with unknown *p* = "the proportion of the population that models processes at the lowest abstraction level".
Step 2 – H_0 and H_1: To test if the majority of the population does not model the processes at the lowest abstraction level, the null hypothesis is p = ½ against the alternative hypothesis p < ½. The test is H_0: $p = \frac{1}{2}$ against H_1: $p < \frac{1}{2}$ with $\alpha = 5\%$.
Step 3 – Test statistic: X
Step 4 - Distribution if H_0 is true: $X \sim B(104, \frac{1}{2})$. This can be approximated with the Normal distribution with $\mu = np = 52$ and $\sigma^2 = np(1-p) = 26$. So approximately $N(52,26)$.
Step 5 – Observed value: x = 31
Step 6 – p-value: Reject H_0 if the p-value $\leq \alpha = 5\%$.
Computation of the upper-tailed p-value (with continuity correction):

$$P(X \leq 31|H_0) = (c.c.)\ P(X \leq 31.5|H_0) \approx P\left(Z \leq \frac{31.5 - 52}{\sqrt{26}}\right) = \Phi(-4.02) = 0.003\%$$

Step 7 – Statistical conclusion: The p-value $0.003\% < 5\%$, so reject H_0.
Step 8 – Conclusion: At a 5% level of significance it is showed that most organisations do not model processes at the lowest abstraction level. Therefore, the H_1 hypothesis is correct.

Application process description

The following table gives information about how organizations in the sample describe application processes.

Table 5: Description of application processes

Description application processes	
Instructions	24.8%
Process models	13.9%
Instructions and models	24.8%
No	27.7%
Other	8.8%

This thesis is using the ProductivityPerformer, which uses application work instructions. Therefore, the hypothesis that organisations use more instructions for application process descriptions than that application processes are modelled with process models is tested. The data is taken from the survey question how the application processes are being described/modelled. There were six answering possibilities, from which two answers mean that application processes are being modelled, two possibilities mean that instructions are used, one that the applications are not described and the 'other' possibility, which is not taken into account. A statistical test is conducted to test the hypothesis. This test uses a method of J. Calvin Berry (2008):

Step 1 Probability model - The model is based on two dependent probabilities, p_1 and p_2. p_1 = "the proportion of the population that models application processes" and p_2 = "the proportion of the population that uses instructions to describe application processes".

Step 2 – H_0 and H_1: The hypothesis is that more organizations use instructions than process models. Therefore, a test with a null hypothesis of $p_1 = p_2$ (equal) and an alternative hypothesis of $p_1 < p_2$ is tested. The test is H_0: $p_1 = p_2$ against H_1: $p_1 < p_2$ with $\alpha = 5\%$.

Step 3 – Test statistic: $Z = \frac{p_1 - p_2}{\sqrt{(p_1+p_2)/n}}, where\ n = 95$

Step 4 - Distribution if H_0 is true: $Z \sim N(0,1)\ (approximately)$

Step 5 – Observed value: $p_1 = 0.421\ and\ p_2 = 0.558$, so $z = \frac{0.421 - 0.558}{\sqrt{(0.421+0.558)/95}} \approx -1.348$

Step 6 – rejection region: Reject H_0 if $Z \leq -c$.

Computation of the lower-tailed c-value:

$$P(Z \leq c|H_0) = \alpha = 0.05\ if\ \Phi(c) = 0.95, so\ c = 1.6449$$
$$P(Z \leq c|H_0) = \alpha = 0.10\ if\ \Phi(c) = 0.90, so\ c = 1.2816$$

Step 7 – Statistical conclusion:

At $\alpha = 0.05$ the value $z = -1.348 > -1.6449$, so do not reject H_0.

At $\alpha = 0.10$ the value $z = -1.348 < -1.2816$, reject H_0.

Step 8 – Conclusion: At a 5% level of significance it is not showed that organisations use instructions more often than that they use models for the application processes. At a 10% level of significance it is showed that organizations use instructions more often than models. This means that the hypothesis is only correct for alphas greater than or equal to 10%, which is not low enough to draw a good conclusion. This means that the hypothesis that the organizations in the sample use instructions more often than process models for application processes cannot be proven with a significant value.

3.1.4. Interviews

As described in chapter 3.1.1, the main goal of the interviews is to gain knowledge about if and how applications are linked to the processes. This goal is extended, with also trying to gain knowledge about how to implement software applications. One of the closing questions of the survey was whether or not the respondent was willing to be interviewed. A distinction has been made between the respondents that were willing to be interviewed, by looking at different parameters, namely function, sector and background.

The first parameter was the function of the respondent. The function was obtained via the survey. The function has to be as broad as possible, to gain the most information. The second parameter was the sector. The goal was to interview people from different sectors, so that the response is not only focused on one sector. The third parameter was the background. By looking at the LinkedIn of the possible interviewees, it was determined whether or not the background was proper for answering the questions. Five people were invited to be interviewed via the mail address they left via the survey. The invited people came from the following sectors: healthcare (2), housing, governmental and service. Three people, from the healthcare, housing and governmental sectors, responded.

In Appendix J: Interviews an outline of the asked questions is added. The list is structured as following:

1. Questions about results of the survey;
2. Deeper knowledge about interviewee's function and link to processes;
3. Deeper knowledge about process managers, due to bias in survey;
4. Deeper knowledge about process description;
5. Deeper knowledge about application management, due to bias in survey;
6. Deeper knowledge about application process description;
7. Gain knowledge about linkage between (business) processes and applications;
8. Gain knowledge about software application implementation.

The interview is conducted as a semi structured interview, such that deviation from the outline is possible.

3.1.5. Results interviews

Three of the five invited people responded, so three interviews were conducted. The respondents came from the healthcare, governmental and housing sectors. A summary per conducted interview is added in Appendix J: Interviews. This section only gives the overall results.

An important conclusion that can be drawn from the interviews is that application and business processes are not always unclearly intertwined. One of the respondents said that they have a small number of applications[4], which are crucial in executing processes. Due to this, there is no unclear intertwining of applications and processes. However, other respondents do have the issue of unclear intertwining processes and applications. Another conclusion that can be drawn from the interviews is that if a link is necessary, the main way of linking applications with processes is with the help of Enterprise Architecture. Due to more and more SaaS applications, application management is becoming less important. The reason

[4] 60.5% of the survey responses use less than 100 applications. See Table 28.

why an application is used is becoming more important, which is mainly to store and retrieve certain information. This information will be used when answering the research question: “How can the intertwining of business and application processes be made clear?”.

The definition of process and application manager was not given in the survey, which leaded to biased responses. The interviews helped to gain more knowledge about these questions. Process managers are often referred to as process owners, who are often directors or managers, who have process owner as a role. There are process managers as a function, these often function on directional level. Application managers are often referred to functional application managers, who are mainly responsible for keeping an application up to date and working.

3.1.6. Conclusion

In this section, the research question “How and to what extent do organisations describe their application and business processes?” will be answered.

According to the first statistical test, the core problem is present in the population. This means that most of the organizations do not model the link between processes and applications and that application and business processes are unclearly intertwined. Furthermore, it can be concluded that most organizations do not model the processes in the lowest abstraction level. Table 6 gives the percentage of survey respondents that use process models as process description per abstraction level. The data is transformed, because multiple levels of descriptions are also possible (e.g. low and medium).

Table 6: % of responded organizations that uses process models (Low abstraction level is tested with a statistical test)*

Abstraction level	**Level of description (x)**	**Use of business process models (y)**	**% of responded organizations that uses process models (x*y)**
Low*	71.2%	22.9%	16.3%
Medium	65.4%	41.7%	27.3%
High	60.6%	46.2%	28.0%

This means that 16.3% models their low abstraction level processes by process models, 27.3% models their medium abstraction level processes by process models and 28.0% models their highest abstraction level processes by process models. Because the research is mainly focused on the processes in the lowest abstraction level, this information is important to take into account.

According to the interviews, Enterprise Architecture is the best way to realize links between applications and processes, but a statistical test shows that most organizations do not use Enterprise Architecture. This means that most of the organizations do not model links between applications and processes with an Enterprise Architecture. Chapter 3.3 will give more information about linking applications and processes.

3.2. Process modelling tool

There is a lack of knowledge on which tooling can be used best for modelling processes in combination with the ProductivityPerformer. The research question is:

Which tooling can be best used for modelling (business and application) processes?

3.2.1. Requirements and desires

Requirements for the tooling are determined by looking at the combination PP and process modelling at organizations. The following are determined:

1. Widely used tool – the tool has to be widely used at organizations. The survey results show the best tool for this requirement.
2. Office 365 integration – the ProductivityPerformer is integrated in Office 365. Therefore, it is required that the modelling tool is also integrable into Office 365, to maintain the single-sign-on functionality.
3. Security – due to the fact that the modelling tool holds confidential information of the company, it is important that the tool is secure. The single-sign-on functionality helps with this requirement.
4. Accessibility/Cloud – nowadays, everything has to be accessible from everywhere. Therefore, it is important that the modelling tool can be accessible from the cloud. Just like the PP is accessible from the cloud, the modelling tool should be as well.
5. Modelling languages – the tool has to have at least the following languages: BPMN 2.0 and Archimate, because these languages/standards will be used in the model that is determined in the next section.

3.2.2. Conclusion

There are a lot of tools available for modelling processes. According to the survey results, most of the organisations use Microsoft Visio, which means the first requirement is met. Visio is made by Microsoft and is a(n) (extended part of) Office 365. Therefore, the second requirement is met. Because Microsoft is also the developer of the other applications in Office 365, it can be assumed that Visio is also secure to use, therefore also the third requirement is met. Visio is also accessible via the Office 365 server on the cloud. The last requirement is also met, because BPMN 2.0 is a standard language for Visio and an Archimate package can easily be downloaded and imported into Visio.

Alternatives for Visio are e.g. LucidChart and Sensus, which are also capable of modelling BPMN 2.0 and Archimate, are safe and accessible from the cloud. But because of the survey results (54.1% uses Visio), the conclusion can be made that **Visio** is the best tool to model processes.

3.3. Linking applications with business processes

In chapter 2 an introduction to Business Process Modelling as well as Enterprise Architecture is given. This information is used to answer the following research question:

How can the intertwining of business and application processes be made clear?

To answer this question, a way of linking applications and processes is determined. This should clear the intertwining of business and application processes.

3.3.1. Combining EA and BPMo

EA has a standard way of describing processes, but the processes "do not list the flow of activities in detail" (The Open Group, 2019). This means that EA only covers high-level business processes. Next to this, BPMo comes short in linking processes to applications. To solve these problems, a combinational method of EA and BPM will be made to link low-level business processes and applications. This means that the only the business and application layer will be used. IT hardware is not part of the research focus, which also applies for the other modelling layers of EA (e.g. strategy, physical, motivation, etc.).

The combination means that the business layer of EA become the business processes, modelled with BPMN 2.0.2 and that the application layer will be modelled using Archimate 3.0. Furthermore, the links between the business and application layer will be modelled by using Archimate 3.0. By using Figure 5, a visualization can be made for how the two different languages are used (Figure 13). This model can be used for the lower abstraction level processes. Because this model is only needed for the low abstraction level, the processes of the higher abstraction levels can be modelled according to the Archimate standard.

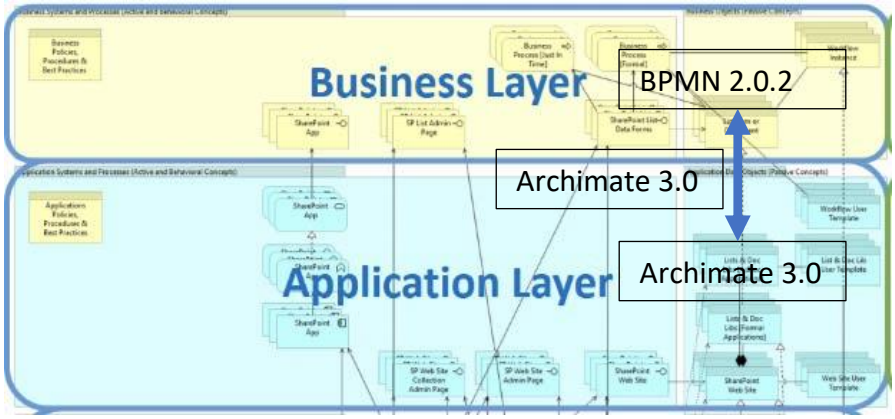


Figure 13: Explanation of layers and used languages for lower abstraction level processes

Figure 14 gives a simple example of the combination. The example has three groups:

1. Business Layer – This group gives the business processes in a BPMN 2.0.2 notation.
2. Application services – This is a part of the Application layer. The services that a certain application delivers are given in an ArchiMate 3.0 notation.
3. Application components – Also a part of the Application layer. The applications that the services need are given.

The relationships that are mainly used are:

1. Sequence flow – The relationship between the events and activities within the Business layer.
2. Serving relationship – The relationship between the application services and the activities of the business process. The service delivers a certain service to execute the activity.
3. Realization relationship – The relationship between the application components and services. An application service needs an application component to realize the service.

The model can be extended in all kinds of manners, by using the modelling languages BPMN and Archimate.

So, applications can be linked to business processes by modelling an Enterprise Architecture for the higher abstraction levels. For the lower abstraction level, links can be made by modelling processes according to the model that combines BPMN and Archimate. By combining these two languages, the process is modelled in the desired detail and the application components and services are given. Therefore, by modelling the application and business processes are no longer unclearly intertwined.

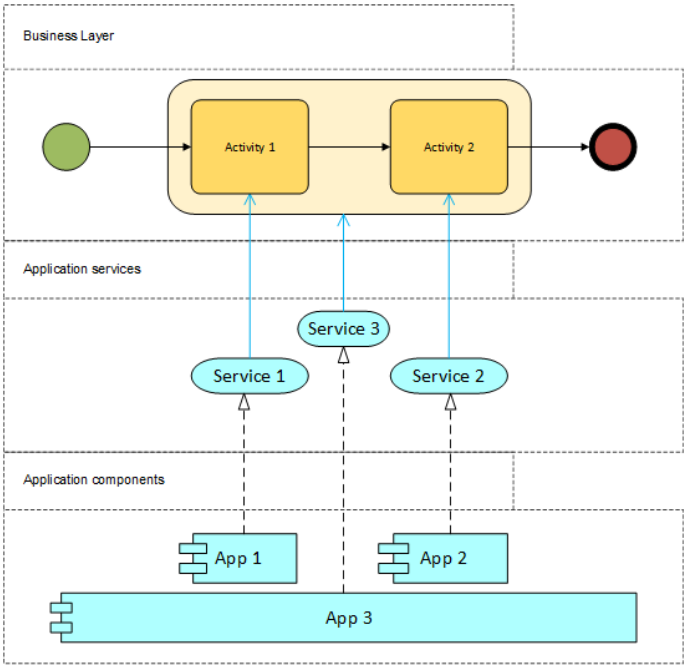


Figure 14: Simple example of combining Archimate with BPMN

The answer to the question "How can the intertwining of business and application processes be made clear?" is to use the modelling method of combining BPMN and Archimate (from now on 'the EA-BPMo model'). This will make the intertwining of business and application processes clear.

3.3.2. ProductivityPerformer

However, the problem that still exist is that by modelling the processes with the EA-BPMo model, the link is there, but the end-user's actual problem still exists: an end-user with low digital skills still does not know how to execute e.g. activity 1 (Figure 14) and the end-user does not know where to find the process, as described by the EA-BPMo model. This problem can be solved by using the ProductivityPerformer. Within the PP it is possible to make a user guide. Within this user guide, chapters can be made. Also, images can be uploaded. An example of a user guide, which uses a process flow, is given in Figure 15. By modelling one activity or gateway as one application process, an AWI can be linked to the activity. By naming the activity the same as the corresponding AWI, it is easy to find the right AWI for the right step. When a process has a sub-process, a sub-chapter can be made in the user guide. An image can also be added within the sub-chapter.

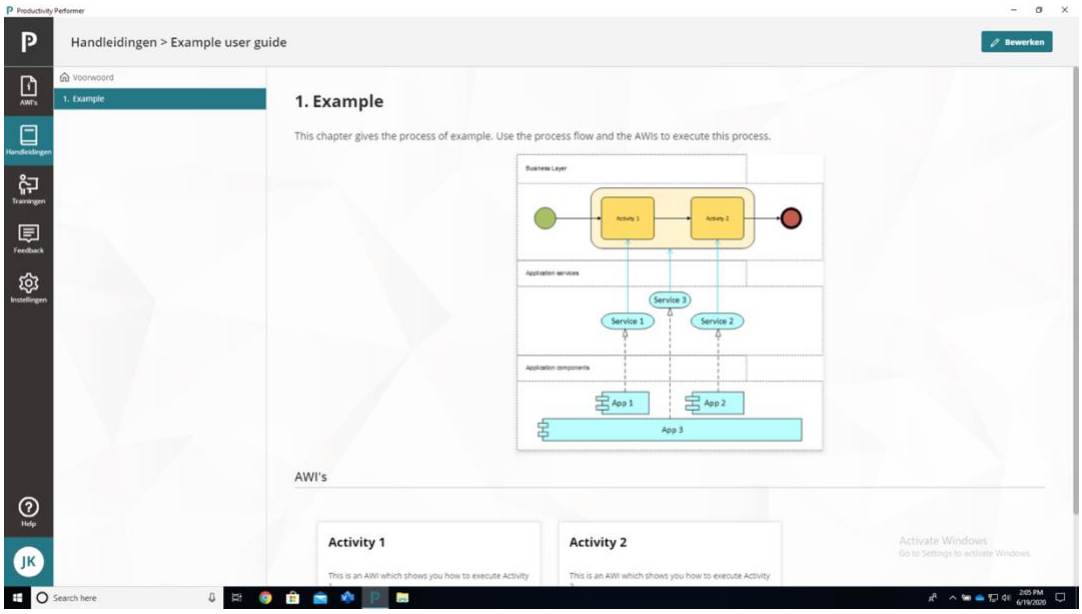


Figure 15: Example PP - Process flow

An activity in the process flow is a summary of an application process. According to the survey results, 49.6% (Table 29) of the sample uses instructions for describing application processes. These instructions can be made by the PP, which solves the problem of how to execute application processes. By doing this, application processes do not have to be modelled. This is important, because according to the survey results, more organizations use instructions than models for describing application processes. Furthermore, the PP is also functioning as a central database which has a high accessibility for the end-user.

The following guidelines are important for using the EA-BPMo model integrated into the PP:

1. The process as described by the EA-BPMo model is the business process, not the application process.
2. One activity or gateway of the business process with a link to one or more applications should represent one application process, that can be represented by one AWI.
3. The AWI that is linked to an activity or gateway, should have the same name as the activity or gateway.
4. If activities are grouped for one application, one activity should still represent one AWI.
5. An application service should represent the added value of the application. An application component describes the actual application.

3.3.3. Conclusion

The final answer to the question “How can the intertwining of business and application processes be made clear?” is to integrate the processes that are modelled according to the EA-BPMo model into the ProductivityPerformer. This means that the business and application processes are no longer unclearly intertwined, that the end-user knows which application to use for which process and that the end-user knows how to execute a certain application process. If the PP is implemented properly, this can reduce the loss of time drastically.

4. Implementation theory

It is clear how to make the intertwining of business and application processes clear, namely by integrating the EA-BPMo model into the ProductivityPerformer. The remaining problem is the lack of an implementation method for this solution. To solve this, the fifth phase of the problem-solving approach has to be executed by doing research into implementation theory. First of all, a literature review is done to gather different models/theories. After that, a decision method is executed to choose the best one for this research. The research question for this chapter is:

What type of model/theory can be best used for implementing the ProductivityPerformer?

A part of the interview was to gather data about how to implement software applications. The results are that it is mainly important to look at the user adoption, to make sure that the application is actually used after implementation. Therefore, the (research for the) methods of implementation that are formulated are focused on the user adoption of an implementation and not on the technical implementation of a software application. Because in literature information about implementing software applications was not about user adoption, another perspective is chosen: change management. Also, a study about implementation methodologies suggests that "challenges in people change management need to be addressed in a comprehensive manner (…)" (Varadaraj & Goud, 2012), therefore change management is an interesting perspective for implementing software applications.

4.1. Alternatives

This section gives a summary of three well-known theories/models about implementing change in organisations are given in this chapter.

4.1.1. The Prosci ADKAR model

A model for change management is the Prosci ADKAR model. This is "a goal-oriented change management model to guide individual and organizational change" (Prosci, 2019). ADKAR is an abbreviation for the following:

- **A**wareness – Make the target group aware that change is needed.
- **D**esire – Create the desire for change in the target group.
- **K**nowledge – Give the target group the knowledge on how to change/use the new application.
- **A**bility – Create the bridge to close the gap between knowledge and ability (when and how to use the knowledge in practice).
- **R**einforcement – Monitor the change. Celebrate success and follow the developments.

When implementing a software application (or any other change), these steps can be followed sequent. Figure 16 gives a visualization of the model.

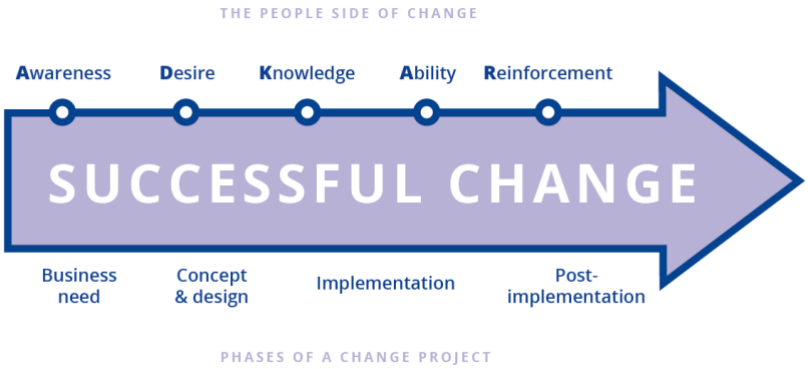


Figure 16: Phases of a change project according to the Prosci ADKAR model (Prosci, 2019)

Advantages

An advantage of the Prosci ADKAR model is that it combines personal and organizational change. Another advantage is that there is extensive writing about how to use the model, even with an example on how to use the model when implementing a software tool. Also, the ADKAR model focusses on employees and individuals, instead of on senior management. It can also be applied to organizations of every size (Galli, 2019).

Disadvantages

A disadvantage of the Prosci ADKAR model is that the model has to be used sequential, which disables an organization to start at another point than “Awareness” and “Business need”.

4.1.2. Kotter’s change management theory

According to Kotter (Kotter, 1995), changes in organizations have a success rate of 30%. After doing extensive research, Kotter came up with his change management theory, which consists of eight steps (Kotter, 2020):

1. Create a sense of urgency;
2. Build a guiding coalition;
3. Form a strategic vision and initiatives;
4. Enlist a volunteer army;
5. Enable action by removing barriers;
6. Generate short-term wins;
7. Sustain acceleration;
8. Institute change.

The main goal of his theory is to largen the success rate of organizational change. By following the 8 steps of his theory, organizations should have to execute less adaptions during a change project which improves the success rate.

Figure 17: The 8 steps for change management (Kotter, 2020)

Advantages

An advantage of Kotter's change model is that there is extensive writing on how to use the model. Furthermore, the model is based on extensive observation research during changes in organizations (Kotter, 2020).

Disadvantages

A disadvantage is that the model is mainly focused on senior management, instead of on employees and individuals. Also, the model cannot be engaged at large organizations (Galli, 2019).

4.1.3. Lewin's change management model

Lewin's change management model consists of three steps (Sarayreh et al., 2013):

1. Unfreeze – Employees do their work on their own standard way. To make changes, this 'equilibrium' first has to be 'destabilized'. According to Sarayreh et al. (2013) Lewin believed that "before old behavior can be discarded (unlearnt) and new behavior successfully adopted, the equilibrium needs to be destabilized (unfrozen)."
2. Change – After the standard is destabilized, the change has to be implemented.
3. Refreeze – Now that the change is implemented, the new way of working has to become standard for the employee. A new 'equilibrium' has to be made.

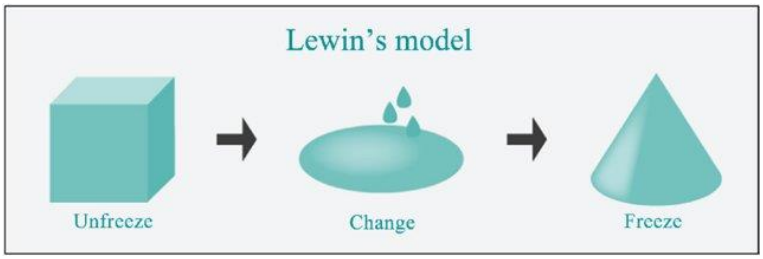


Figure 18: Lewin's change management model (Samat et al., 2019)

Advantages

The advantage of Lewin's model is that it is a goal and plan oriented model. Also, the model is simple to understand. Furthermore, Lewin's model focusses on employees and individuals, instead of senior management.

Disadvantages

A disadvantage of Lewin's model is that it does not take into account the personal factors. It does get the stakeholders enthusiastic, but due to not taking into account the personal factors, the stakeholders get over enthusiastic. Also, the model has few guidance in how to implement the change.

4.2. Choosing the best theory

In this section, a decision method is executed to determine the best model or theory for the implementation of the ProductivityPerformer. To decide which is the best method of implementation, the following method is used: first of all, objectives/requirements have to be determined. After that, weights have to be given to the objectives. Also, the objectives have to be scored. With the weights and the scores, a total score can be calculated for every model/theory. The model with the highest score will be used as a base for the implementation method.

The first step is to determine objectives. These are taken from a paper by Galli (2019):

1. **Focus on employees and individuals instead of focus on management**

For the ProductivityPerformer it is important that the employees/end-users use it, because the tool focuses on a uniform way of working in applications for the end-user. This requires change with them, and not with the management.

2. **Can be applied in small and large organizations**

The target group of the PP is not just small or just large organizations. The target group is every organization, that wants to work in a uniform and consistent way.

3. **Good guidance is available**

Because the PP can be sold to any organization, it is important that every organization gets how to use the method. PolderValley prefers that the implementation can be done by the buying company, without using consultancy. Therefore, there needs to be good guidance on the method.

The second step is to give the objectives importance, by giving weights. The total of the weights needs to be equal to one. Table 7 gives the weights per objective, these are in line with organizational policy.

Table 7: Weights per objective

Objective #	Weight	Explanation
1	0.4	The ProductivityPerformer is developed for employees (end-users), to execute application processes in a uniform way. Therefore, it is (shared) most important that the implementation focusses on the employees (or end-users), and not on management.
2	0.2	It should be possible to implement the PP in every organization, no matter the size.
3	0.4	Because the target group is wide, good guidance for the method of implementation should be present. Because the use of consultancy is not desired by the company, this is (shared) most important.

Now that the objectives and the weights are determined, a score has to be given. The score will be an ordinal scale between 1-5, where 1 is not good and 5 is very good. The scores per theory/model are added in Table 8. These are based on the (dis)advantages that are given in the previous chapter, which are the result of a literature review.
The total score is calculated by the following formula:

$$Total\ score = \sum_{n=1}^{4} w_i * s_i$$

In this formula, w_i is the weight for objective i and s_i is the score for objective i.

Table 8: Decision-making Method of implementing

Objective (i)	Weight (w_i)	Score (s)		
		ADKAR	Kotter	Lewin
1 - Focus on employees and individuals instead of focus on management	0.4	4	2	4
2 - Can be applied in small and large organizations	0.2	5	1	5
3 - Good guidance is available	0.4	4	5	2
Total	1	4.2	3.0	3.4

So, according to the total score, the Prosci ADKAR approach is the best as base for an implementation method for the PP. Because the difference is rather big (0.8 on 5 total), the other two models/theories will not be used.

4.3. Conclusion

After first selecting alternatives and second applying a decision method, the best theory for implementing the ProductivityPerformer is the Prosci ADKAR model. This model combines a business dimension with a people dimension (Figure 16). The business dimension consists of the following steps:

1. Identify a business need or opportunity;
2. Define the project;
3. Design the business solution;
4. Develop the new processes and systems;
5. Implement the solution.

The people dimension has the following steps and is executed during the steps of the business dimension, dependent on the situation:

1. **A**wareness
2. **D**esire
3. **K**nowledge
4. **A**bility
5. **R**einforcement

The Prosci ADKAR model will be used as a base for implementing the PP at ExplainiT as case material.

5. Implementing at ExplainiT

In this chapter, which is the sixth step of the problem-solving approach, it is described how the ProductivityPerformer is implemented at ExplainiT. The ProductivityPerformer will be implemented using the results of phase 4 and 5: the processes of ExplainiT will be modelled and integrated into the PP using the EA-BPMo model and the implementation will be based on the Prosci ADKAR model. This chapter addresses, among other things, the following research question:

What are the processes and (organization specific) applications within ExplainiT and how do they work?

The implementation will be based on the Prosci ADKAR model, which is described in chapter 4.1.1. This model has a Business and a People dimension of change (see Figure 16), which are executed during a change project. The business dimension is to create good content, good usability and to create a uniform way of executing (application) processes, where the people dimension is to create a high user rate. Also, the results of chapter 3 are used to implement the ProductivityPerformer.

The Prosci ADKAR model gives the following steps for the Business dimension (Prosci, 2019):

1. Identify a business need or opportunity;
2. Define the project;
3. Design the business solution;
4. Develop the new processes and systems;
5. Implement the solution.

Due to the fact that the ProductivityPerformer is a supportive tool, which is already been developed these steps will be adapted relative to the standard Prosci ADKAR way.

The people dimension (ADKAR) is given at the step of the business dimension where it is used (chapters 5.x.y).

5.1. Execute the technical implementation of the PP

This step is added relative to the ADKAR model. The ProductivityPerformer is a cloud-based application, which is accessible from an internet browser (preferably Google Chrome). Only Editors need to have a desktop application to create AWIs. During the technical implementation, a link will be made (explainit.productivityperformer.com). Also, the PP will be integrated into Azure DevOps, which enables single-sign-on for the organization.

5.2. Identify a scope of implementation (department, team, etc.)

The scope of implementation will be the sales team. This is a team of six people (four account managers and two sales coordinators). This team is the organization (except director and two trainers). The product-owner is the director of ExplainiT.

5.3. Identify the application and business processes within the scope

First of all, the applications and the processes have to be identified. To make the business and application processers clearly intertwined, first of all the processes have to be modelled according to the EA-BPMo model. The modelled processes are given in Appendix K: Modelled

processes ExplainiT. A top-down approach is used to model the processes, by starting at the high-abstraction level and going towards the low abstraction level processes. The goal of the modelled processes is to visualize the processes that are true for 95% of the cases at ExplainiT. The answers to the research questions are given by the modelled processes, which also include the applications that are used. Figure 19 gives an overview of the modelled processes and their dependencies. Due to the fact that the processes are modelled according to the EA-BPMo model, as described in chapter 3.3, the links between applications and processes are modelled at a low abstraction level, which makes the intertwining of applications and processes clear.

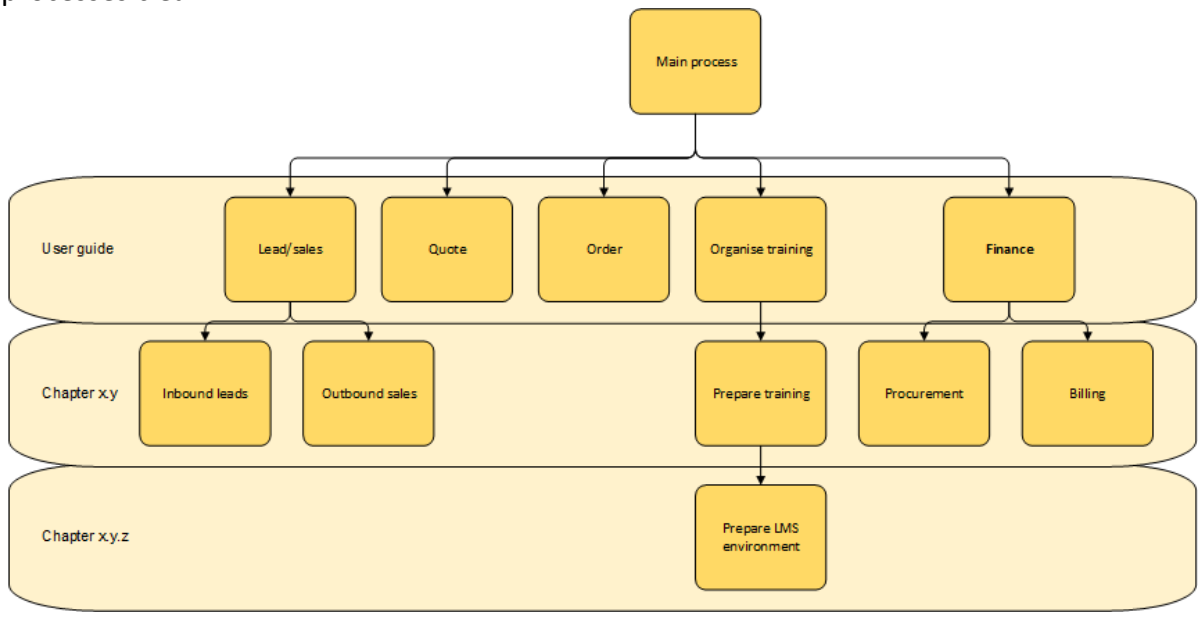


Figure 19: Structure of processes

5.3.1. Create Awareness for the need of change

During this research, the company was busy optimizing their main application (CRM) for the processes. Due to this, the awareness was already there. Furthermore, the PP is a product that developed by sister company PolderValley, which makes the company enthusiastic more easily. Also, to identify the processes, meetings with the end-users took place. The goal of the meetings was made clear, to create more awareness.

5.3.2. Create the Desire to participate in and support the change

Due to the fact that the sister company of ExplainiT (PolderValley) developed the PP, a desire to participate and support was already there.

5.4. Create the Table of Contents for user guides/courses

In this step, the structure of the user guides will be given. To keep the user guides clear, the main process will not be used as user guide[5]. The structure that is given in Figure 19 is also the base for the chapters of the user guides and therefore, the table of contents.

[5] The main process is at the highest abstraction level. This process has no linked applications and therefore, a user guide is not needed.

5.5. Make AWIs for the user guides/courses

The table of contents for the user guides that are determined now have to be filled with Application Work Instructions (AWIs). These AWIs have to be created by Editors, which is a role within the PP. When making AWIs, the rule of thumb is that one AWI represents one activity or gateway in the process model.

Figure 20 gives a screenshot of an example User Guide: Organize training, which contains a process which is modelled according to the EA-BPMo model. Every User guide has a structure similar to the example. As can be seen on the left of the example, there is one sub-chapter (1.1 Prepare training), which has a sub-chapter (1.1.1. Prepare LMS environment). One activity in the process has a sub-process (identified with a "+"), which is the sub-chapter.

Beneath the process flow, multiple AWIs are given. Every activity or gateway with a blue arrow towards it has its own AWI. Due to this, every application process is explained by an AWI and can therefore be executed properly by the end-user. Due to time constraints, only the Organize training User Guide is fully developed. The other User Guides' structures are given, but AWIs still have to be made.

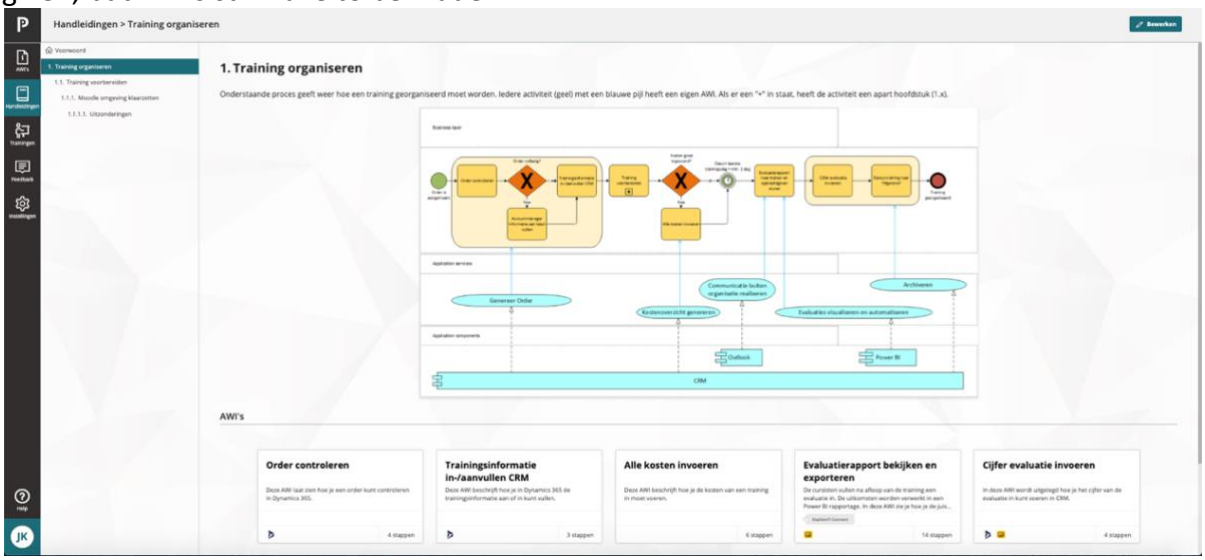


Figure 20: Example of developed User Guide

5.5.1. Give Knowledge of how to change;

A part of the team has to sell the product to potential clients, which is also done by giving demonstrations; therefore, knowledge was already present. The other part already practiced with the application before the start of this assignment. During this practice, a demo has been given.

5.5.2. Create the bridge for the gap between knowledge and Ability;

Due to the fact that a part of the team gives demonstrations the bridge between knowledge and ability is already there. The other part of the team has practiced during the implementation of a learning management system; therefore, the bridge is already there.

5.6. Implement the solution

Now that the content has been made, the end-users will need to use the PP. Further development of content and user guides can be done.

5.6.1. Reinforce the change.

This step is outside the scope of this thesis and will be done by the director of the company. By reinforcing the change, application use is done more efficient and more uniform, which leads to a decrease in the loss of time, which is the main goal of the implementation.

5.7. Conclusion

By using Prosci ADKAR as a base, the ProductivityPerformer can be implemented properly. Also, the integration of the EA-BPMo model into the PP works to clear the intertwining application and business processes. The implementation needs to be evaluated to be improved and to transform Prosci ADKAR into an implementation method for the ProductivityPerformer combined with the EA-BPMo model.

The loss of time before and after the implementation is not measured, therefore conclusions about this indicator cannot be quantified. The measurement is not done due to the fact that a limitation is there. The limitation is that ExplainiT is the sister company of PolderValley. Due to this, a part of the sales team also works for PolderValley and actually sells the ProductivityPerformer. Results of measurement in the loss of time would therefore be biased and unable to be used for a conclusion. Therefore, a recommendation is to do another case implementation at another company. By measuring the loss of time at that case implementation, conclusions can be drawn. Also, this should create more evaluations and more improvements. Due to time constraints, this is not done in this research.

6. Evaluation and improvement

In this chapter it is described what improvements came out of the evaluation of the implementation at ExplainiT. Also, the information about implementations that is gathered during the interviews is processed here. This is the seventh step of the problem-solving approach. The information gathered in this phase is used for determining the method of implementation in the next phase.

6.1. Advises from the interviews

A conclusion from the interviews is that a process owner is often a director or manager. An advice from one of the interview respondents was to let the process owner find out if and how the application solves his problems, instead of letting a consultant, IT-manager or anyone else tell him that the application solves the problem. This leads to more ownership at the process owner. Therefore, it is important that the process owner is intensively involved during the implementation. This is mainly important when developing user guides and modelling processes, because this person is responsible for these processes.

The information that is gathered during the interviews mainly is that the people dimension is very important. For the people dimension it is hard to describe a step-by-step approach. Therefore, advices are given. The process owner needs to fill the steps of this dimension according to the certain situation. The question to "what is the added value for the end-user?" should be very clear. The following points were given as important: Involving the end-user and creating awareness on why to change and creating the desire to change. These are elements of the ADKAR model and are therefore already taken into account.

6.2. Feedback functionality[6]

In the implementation method, it is important to push towards using the feedback function of the PP. This is the main feature for keeping AWIs and User guides up to date. Therefore, in the people dimension, the step where ability is central is extended with the advice to push end-users to use the feedback functionality. This means that end-users learn how and why to use this functionality.

6.3. Reading of EA-BPMo models

An advice that needs to be added to the Knowledge and Ability part of the implementation method is to give knowledge and to create the ability on how to read the process flows of the EA-BPMo model. If the users are not capable of reading process flows, the user guides cannot be used as they are meant to be.

6.4. Too short user guides

This improvement is linked to the fourth step of the business dimension. It is found that the user guides are too small. Therefore, the improvement is that a user guide can also be a role within the company (which will be used for ExplainiT, see Figure 21) or the process that is

[6] The feedback function of the PP helps to keep AWIs and User guides up to date. See also Appendix H: ProductivityPerformer.

used as user guide can be changed for a more abstract one with multiple sub-processes. This step is dependent on the organization where the PP will be implemented.

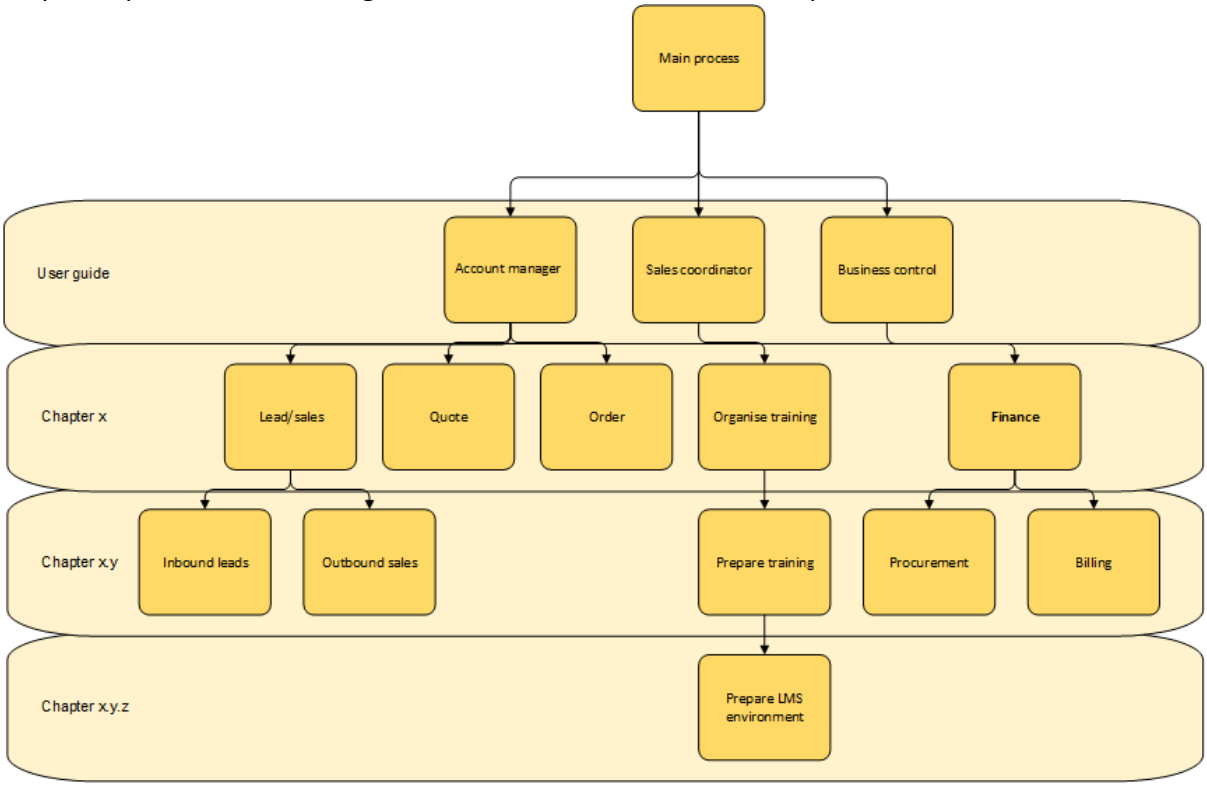


Figure 21: Improvement of structuring user guides

7. Making a method of implementation

Now that the ProductivityPerformer is implemented and evaluated at ExplainiT together with the EA-BPMo model integration, a method of implementation will be determined. This is the seventh and final step of the problem-solving approach. Figure 22 gives an overview and a visualization of the implementation method.

The implementation method is based on Prosci ADKAR. The main steps of the method are the business dimension. The steps from the people dimension are given by bolding the letter of ADKAR, e.g. (**A**DKAR), so **Awareness**. Although the people dimension steps are given next to a business dimension step, it is possible that these do not go fully linear. An explanation about how to execute the step of the people dimension is given in chapters 7.x.y.

7.1. Execute the technical implementation of the PP

The ProductivityPerformer is a cloud-based application, which is accessible from an internet browser (preferably Google Chrome). Only Editors need to have a desktop application, to create AWIs. During the technical implementation, a link will be made (<tenant>.productivityperformer.com). The tenant is chosen by the buying organization. This step also gives the opportunity to integrate the PP into Azure AD or to the TOPDesk environment. PolderValley will execute this step in cooperation with the IT department of the buying organization. The IT department of the buying organization is responsible for possible integrations and the accessibility for the end-users, where PolderValley creates the environment for the organization and has a supportive role.

7.2. Identify a scope of implementation (department, team, etc.)

First of all, it is advised to assign one product-owner within the organization that manages the implementation (and after the implementation the use, quality of information and the processing of the feedback). After the PP is implemented, it is filled with a lot of information about applications (and processes). Therefore, it is advised that the product-owner is either an information manager of a manager of functional application management. This way, the right function manages the tool. The product-owner is therefore involved during and after the implementation.

In order to implement the ProductivityPerformer in a proper way, start with one department or team (from now on: team). This will be the first scope of implementation. Choose this team wisely, by looking at the members of that team. The team should have constructive members, who can give helpful feedback on the implementation, but should also have a wide range of end-users (low and high skilled) and possibly a wide range of applications. To identify the right scope of implementation, involve the following people: high management (CxO level), the (to be) assigned product-owner, functional application manager and information manager. After the team is chosen, involve the process-owner of that particular team. According to the interview results, the process-owner often is the manager of that team. If not, involve both the process-owner and the manager of that team.

7.3. Identify the application and business processes within the scope (ADKAR)

The team that is chosen, has a certain set of application and business processes. Identify the applications and processes. Limit yourself to the applications and processes that are used within that team. Make use of a top-down approach, from abstract to detailed and document the approach. If multiple teams are already using the PP (after further implementation this will be the case), make sure that you do not create duplicates by using the same (documented) top-down approach.

This step requires the modelling of the links between applications and processes according to the EA-BPMo model. According to the survey results, the majority of the organizations does not model the processes at the lowest abstraction level. Therefore, the chance is high that this still has to be done. By a cooperation between functional application management, process management[7] and the process-owner, these processes have to be modelled according to the EA-BPMo model. By doing this, the intertwining of application and business processes will be made clear. During the modelling of the processes, the following guidelines have to be followed:

1. The process as described by the EA-BPMo model is the business process, not the application process;
2. One activity or gateway of the business process with a link to one or more applications should represent one application process, that can be represented by one AWI;
3. The AWI that is linked to an activity or gateway, should have the same name as the activity or gateway;
4. If activities are grouped for one application, one activity should still represent one AWI;
5. An application service should represent the added value of the application. An application component describes the actual application.

It is advised to involve the following people during this step: the process-owner, functional application management and if present process management. If these are not present as a function, search for the people that have these function descriptions as a role.

7.3.1. Create Awareness for the need of change

Creating awareness is an important part of the people dimension. Make sure that end-users understand that the PP helps to execute (application) processes in a uniform way, which often leads to a better/easier use of a certain application and a lower loss of time. This task can be best executed by the process-owner/manager of the team. This person knows the end-users best and therefore knows how to create the awareness.

7.4. Create the Table of Contents for user guides/courses (ADKAR)

Now that the scope and the project is defined, the user guides/courses that will be created have to be determined. The applications and processes are already determined in step 3. One user guide stands for one process (or role etc., dependent on organization). This process can have multiple sub-processes. The sub-processes can stand for a sub-chapter. Do not use too much (sub-)chapters and (sub-)processes, this makes a user guide unclear. Make use of a

[7] A process manager, as described in chapter 3.1.5, often works on directional level and models processes on a high abstraction level.

visualized structure, to keep track on what is already there. An example of how to determine user guides out of a process structure is given by the implementation at ExplainiT.

The following people are advised to be involved: the process-owner and functional application management. The process-owner can determine the most important processes and applications, where functional application management can determine the table of contents. Involve some end-user to discuss/check the results.

7.4.1. Create the Desire to participate in and support the change

Creating desire to participate and support the change is an important continuation of creating awareness. This step can also be best executed by the process-owner/manager of the team, who can translate the change into a personal need for the end-users. Coaching and conversations are important during this step, therefore, discuss the results of the business dimension steps with the end-users. By letting end-users give their opinion before official implementation, the desire is for change becomes higher. An option for creating support is to determine (an) editor(s) within the team, who can cooperate with functional application management. This way, the opinion of a team member is taken into account when creating user guides and AWIs. By doing this, the involved team member can automatically (without instructions of doing so) help in creating the desire with the other team members. Also, make clear that a proper implemented PP (with EA-BPMo modelled processes) is meant to reduce loss of time for end-users.

7.5. Make AWIs for the user guides/courses (ADKAR)

The Table of Contents that are determined now have to be filled with Application Work Instructions (AWIs). These AWIs have to be created by Editors, which is a role within the PP. It is advised to use Functional Application Management to make the AWIs, then no or few editors are needed within the team. If no functional application management is present in the organization, assign Editors within the team, by looking at the knowledge about certain applications and their ability to understand other people's needs. Discuss rules and standards for making AWIs (e.g. what will be a tag and how many steps per AWI). During this process, it is important to keep managing and guiding the editors. One AWI should represent one activity or gateway that has a blue arrow towards it in the EA-BPMo model. Make sure that the names of an activity/gateway are the same as the AWI. If it is found that the AWIs are too short or too long, discuss this with process management.

Involve the process-owner, functional application management, process management and the editors in this step. One important task of the product-owner is to make sure that the rules and standards for making AWIs are the same for the entire organization.

7.5.1. Give Knowledge of how to change

An important part of the implementation is the process flows according to the EA-BPMo model. Give the users the knowledge to read process flows of the EA-BPMo model by training them. Reading process flows is not hard, but some training should be in place, by explaining the elements and the way of reading. Keep in mind that they do not have to model these by themselves, only read them.

The application itself is developed with the idea that usage is simple. Therefore, in principle, training is not necessary. The process-owner/manager of the team might decide that a demo or training is necessary within the team. If so, arrange this.

7.6. Implement the solution (ADKAR)

Now that the content has been made, the end-users need to use the PP. Use a wide range of end-users (high and low skilled) and follow the developments closely. Make sure that the feedback function will be used by the end-users in the team. If determined necessary after feedback, adapt the standards and rules for making an AWI.

Make sure that process managers are involved in the implementation. When a process gets changed, it is important to also change the user guide. The feedback function is also important for this step, to keep not only AWIs, but also the user guides up to date.

The product-owner, the process-owner and the end-user are most important in this step. Process and functional application management is more important in keeping the content up to date.

7.6.1. Create the bridge for the gap between knowledge and Ability

Make sure that users have practiced with the application in a real-world situation, to understand when and how they can use the PP in practice. Also, make sure that when a user asks about how to use a certain application, refer to the ProductivityPerformer. One of the main features that needs to be used is the feedback functionality. This is important to keep AWIs and User guides up to date. Make sure that the users have practiced with reading and using the process flows.

7.6.2. Reinforce the change

Try to follow the developments after the implementation. Are processes executed as they are described in the PP? If not, why are the users not using the PP (correctly)? Try to identify successes and share these with the end-users. Also check whether or not the users are logged in in the PP. Also measure if the loss of time will decrease. This can also be done by asking end-users if they feel like the loss of time is decreased.

7.7. Implement the solution further into the organization (ADKAR)

During this step, the steps 2-5 are repeated at different departments. It is advised to use the team managers within the organization to manage the implementation in their units, under supervision/with the help of the product-owner. Use the same standards and rules for making AWIs organization wide. Keep in mind that an AWI can be used in multiple user guides, but be aware that when an AWI is changed, the change will be in every user guide.

7.7.1. ADKAR

Because this step repeats the steps 2-5, all the elements of ADKAR are used.

7.8. Overview

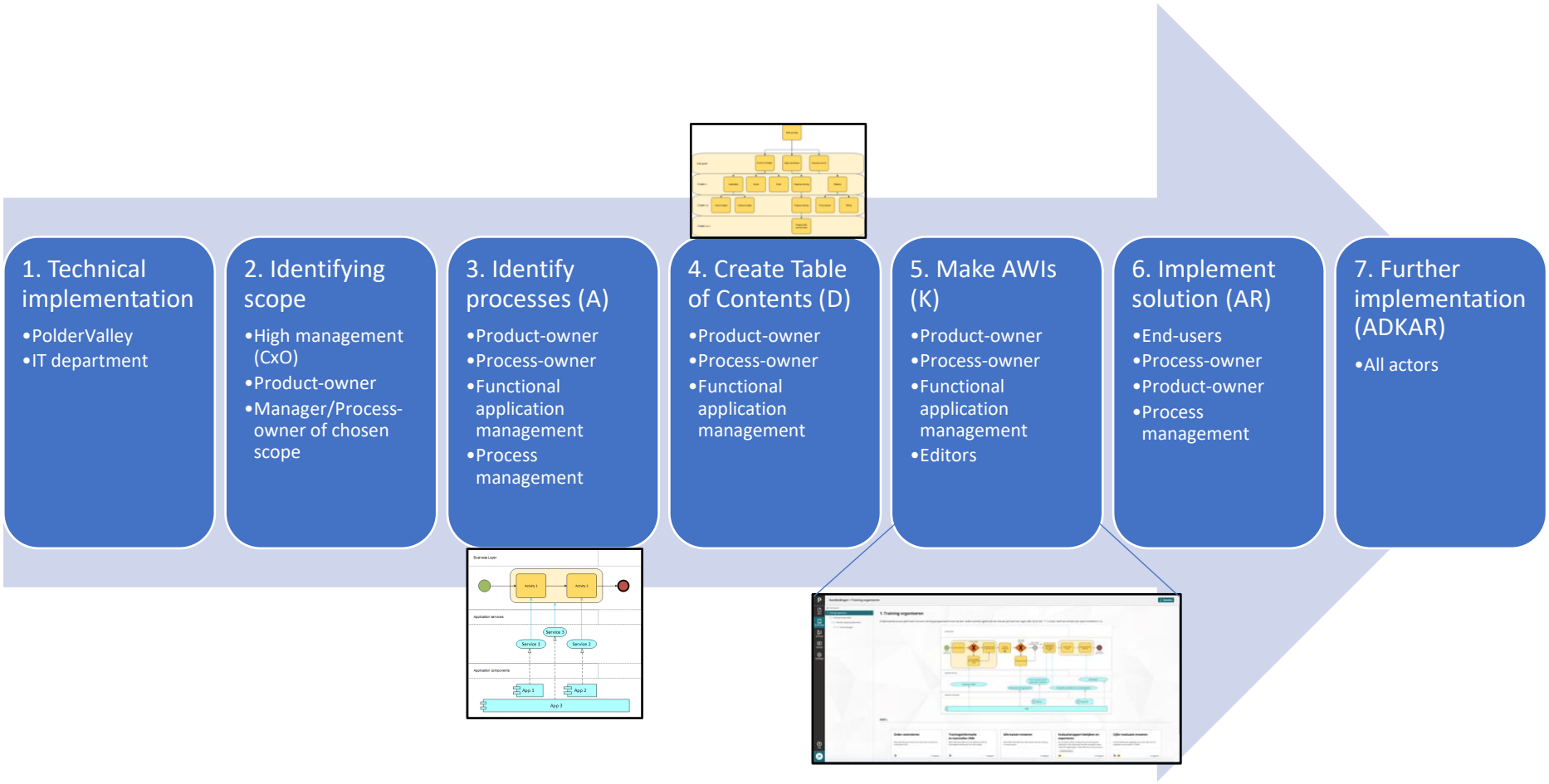


Figure 22: Overview Implementation method PP with actors

Table 9: Role of persons involved in implementation

Person/department	Role
PolderValley	Execute technical implementation and support during rest of implementation (and use).
IT department	Realize integration in existing application landscape, O365, TopDesk, etc.
High management (CxO)	Assign product-owner and chose scope (together with product-owner).
Product-owner	Chose scope (together with CxO) and manage implementation and use of tool after implementation. Advised to be manager from functional application management or information manager.
Process-owner	(Often) Manager of chosen scope. Work together with product-owner to implement. Responsible for people dimension.
Functional application management	By using knowledge about the applications, defining the project, design the solution and possibly create content. Also help process-owner with step Knowledge of ADKAR. Provides editors and probably the product-owner.
Process manager*	Define project by (helping with) modelling processes according to the EA-BPMo model. Making sure that when processes change, also the content in the PP changes.
Editors	Create content and keeping content up to date. Also play a role in the Desire step of ADKAR.
End-users	Use the ProductivityPerformer and give feedback.

*According to the interviews and the survey, a process manager often works on directional level. Therefore, they are helpful when using a top-down approach for modelling processes.

8. Conclusions and recommendations

This chapter first gives the conclusions. After that, recommendations (for further research) are given.

8.1. Conclusion

The core problem was described as “Software applications and business processes are unclearly intertwined”. This core problem has a causal relation to the general problem “digital performance regarding business applications is low”. This problem is operationalized into an action problem “The loss of time due to low digital skills is on average an 3.6% at the potential customers of PolderValley, while this should be a maximum of 2.5%.”.

To solve this problem, research has been done on how and to what extent organizations describe their business and application processes. By conducting a survey and three interviews, it is found that most organizations do not model business processes in the lowest abstraction level. It is found that the lower the abstraction level, the less business processes are modelled.

According to the survey results the majority of the organizations in the sample does not use Enterprise Architecture. According to the interviews and a literature review, the main way to realize a clear link between application and business processes is to use Enterprise Architecture. Therefore, it is assumed that this means that the core problem is present in the population. This knowledge is used in the research to find the proper way of making the intertwining of application and business processes clear. The results of that research are that EA is indeed the best way. However, when processes are modelled in an EA, the activities in the processes in the low abstraction level are not listed in detail. To solve this problem, a combinational model of EA (Archimate 3.0) and BPMo (BPMN 2.0) is determined for low abstraction level processes. The EA-BPMo model is as follows:

1. Business layer – contains BPMN 2.0 modelled business processes;
2. Application layer
    a. Application services – contains Archimate 3.0 modelled application services;
    b. Application components – contains Archimate 3.0 modelled application components (software applications).

The relationships between the layers are modelled according to Archimate 3.0 standards. So, a model is determined that is able to create a linkage between applications and processes on every abstraction level and make the intertwining of application and business processes clear.

The problem that still exists is that the end-user with low digital skills still does not know how to execute activities within the process model and does not know which applications are used for which processes. By integrating the EA-BPMo model into the ProductivityPerformer, this problem is solved. With the use of the user guide functionality within the PP, complete processes (modelled according to the EA-BPMo model) can be elaborated. This means that the business and application processes are no longer unclearly intertwined, that the end-user knows which application to use for which process and that the end-user knows how to execute a certain application process.

After it is clear how to make the intertwining of application and business processes clear, a model/theory for implementing the PP has to be determined. Research showed that the most important to look at when implementing software applications is user adoption. Therefore, a literature review is conducted into change management theories/models. By first giving alternatives and executing a decision method the Prosci ADKAR model is found most fitting to use for implementing the PP. With this model as a base, the PP is implemented at ExplainiT as case material. During this implementation, the processes of ExplainiT are modelled according to the EA-BPMo model and user guides are created with the help of these processes. These user guides are now instructions for how to execute an entire process. Also, the applications are linked to the processes. Therefore, the intertwining of applications and processes is clearer at ExplainiT. Due to a limitation in the research, the loss of time has not been measured, but it is expected that the loss of time is decreased with an unknown percentage. This means that the digital performance regarding business applications is improved.

The implementation at ExplainiT is evaluated and improved. After doing so, an implementation method is determined based on the Prosci ADKAR model and the case material. This implementation method is visualized in Figure 22. The method has two dimensions, the business and the people dimension. A summary of the method is as follows:

1. Execute the technical implementation
2. Identify a scope of implementation (department, team, etc.)
3. Identify the application and business processes within the scope (by using the EA-BPMo model)
    a. Create **A**wareness for the need of change
4. Create the Table of Contents for user guides/courses
    a. Create the **D**esire to participate in and support the change
5. Make AWIs for the user guides/courses
    a. Give **K**nowledge of how to change
6. Implement the solution
    a. Create the bridge for the gap between knowledge and **A**bility
    b. **R**einforce the change
7. Implement the solution further into the organization (repeat steps two to six)
    a. **ADKAR.**

As can be seen in Figure 22, step 3 requires modelling the processes according to the EA-BPMo model. In step 4, these processes are used to create table of contents for the user guides, by making a hierarchy in the processes (top-down approach). In step 5, user guides with the modelled processes and AWIs are created. To conclude, by implementing the ProductivityPerformer according to the implementation method, process models are modelled according to the EA-BPMo model. This means that the intertwining of application and business processes are made clear. By integrating these processes into the ProductivityPerformer, AWIs can be linked to the process. Due to this, the end-user knows how and when to execute a certain application process. Furthermore, if problems are occurring due to low digital skills, the solution can be found in a central place: the PP.

Although it is not measured (see 8.3.1), it is highly expected that, due to the focus on the end-user, there will be a significant decrease in loss of time. This means that digital performance regarding business applications will be improved by the solution as given in this thesis.

8.2. Recommendations

This section gives recommendations for ExplainiT and PolderValley.

8.2.1. Implementation method

To make the intertwining of software applications and business processes clear and to improve the digital performance regarding business applications, it is recommended to use the implementation method of the ProductivityPerformer as is described in this thesis. By doing this, the EA-BPMo model is used for process modelling, which makes sure that links are modelled between applications and processes. By using the EA-BPMo model and the ProductivityPerformer, the expectation is that the loss of time will decrease and therefore the digital performance regarding business applications will improve.

To do so, it is advised to extent the guidelines on how to use this implementation method. During this process, it is advised to include scenarios e.g. per sector. As soon as they are present, also use best practices to support the claim that this method should be used. The people dimension is hard to prescribe, due to the personal focus that is needed. Therefore, mainly for this part, best practices and scenarios are important.

8.2.2. Development ProductivityPerformer

Recommendations on improvements for the ProductivityPerformer are given in this section. These are given, because they could further improve the solution and therefore improve digital performance regarding business applications.

Interactive process flow

Being able to embed a process model, which is modelled in e.g. Visio, would improve the possibility of using user guides. By embedding the process models, the models always keep up to date. It also saves time, by eliminating the exporting of a picture and uploading this picture into the PP. It would also enable the user to zoom in or out, which improves usability.

Applications used

An improvement of the user guide functionality would be to show which applications are used. An AWI itself already shows which applications are used. It would be an improvement to see an overview of the applications needed in the chapter of a user guide.

Supply pre-defined AWIs

A recommendation would be to enable buyers to already buy standard content (e.g. Microsoft Teams, SharePoint, Outlook). This can shorten the implementation period and make the implementation cheaper, because less time is needed to make AWIs. This could also include models of standard processes within certain sectors.

8.3. Limitations and further research

This section gives the limitations that are present in this research. Some of these are elaborated by advising on further research.

8.3.1. Proving the solution

The loss of time before and after the implementation at ExplainiT is not measured. The measurement is not done due to the fact that the case material would not give useful results (see next limitation). Further research is needed to conclude whether or not the solution actually decreases the loss of time with 30%.

8.3.2. ExplainiT as case material

The limitation is that ExplainiT is the sister company of PolderValley. Due to this, a part of the sales team also works for PolderValley and actually sells the ProductivityPerformer. Results of measurement in the loss of time would therefore be biased and unable to be used for a conclusion. Therefore, a recommendation is to do another case implementation at another company. By measuring the loss of time at that case implementation, conclusions can be drawn. Due to time constraints, this is not done in this research.

8.3.3. Standards for AWIs, User Guides and Courses

Further research on how to build a good AWI would improve the implementation method. This means creating some kind of guidelines for e.g. length, descriptions and titles of an AWI. This is also the case for user guides and courses. For the user guides, some guidelines are already given (one AWI means one activity or gateway), but deeper research can be done on this topic.

8.3.4. Extent of (application and business) process modelling

Definition of application and process manager

A survey bias was present due to the lack of defining “application manager” and “process manager”. Due to this, the results of this question are not trustworthy. A recommendation for further research is to define these terms by giving a clear definition. For this research, the results of the interview have unbiased these results.

Balance sheet total

The survey contained a question about the balance sheet total. This question was only asked if the revenue was unknown, for the organizations that do not measure the revenue, or do not think this is an important variable for their organization. But, according to the open-ended results of the survey, the balance sheet total is also not used as a KPI. A recommendation for further research is to either do not measure revenue or balance sheet total, or to use revenue or budget. This information could be useful to categorize responses and draw conclusions per category.

8.3.5. Implementation method

A more extensive comparison between theories and models of change management can be made. Only three well-known models and theories were taken in this research, while many are available.

9. Bibliography

Archimate. (2020). *Resources*. ArchimateTool. https://www.archimatetool.com/resources/

Bandara, W., Gable, G. G., & Rosemann, M. (2005). Factors and measures of business process modelling: Model building through a multiple case study. *European Journal of Information Systems*, *14*(4), 347–360. https://doi.org/10.1057/palgrave.ejis.3000546

Berry, J. C. (2008). *An Introduction to Statistics* (Aug 2008). University of Louisiana.

Camunda. (2020). *BPMN Tutorial*. Camunda. https://camunda.com/bpmn/

Galli, B. J. (2019). Comparison of Change Management Models: Similarities, Differences, and Which Is Most Effective? In *R&D Management in the Knowledge Era* (pp. 605–624). Springer, Cham.

Heerkens, H., & Winden, A. Van. (2017). *Solving Managerial Problems Systematically* (1st ed.). Noordhoff Uitgevers bv.

Hu, Q., Mason, R., Williams, S. J., & Found, P. (2015). Lean implementation within SMEs: a literature review. *Journal of Manufacturing Technology Management*, *26*(7), 980–1012.

Iacob, M. (2019). *Enterprise Modelling*. University Of Twente.

Iacob, M., Jonkers, H., Quartel, D., Franken, H., & van den Berg, H. (2012). *Delivering Enterprise Architecture with TOGAF and ArchiMate* (1st ed.). BiZZdesign.

ISO. (2015). *Quality management principles*. https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100080.pdf

ISO. (2018). *ISO 20000-1: 2018*. ISO.Org. https://www.iso.org/standard/70636.html

ISO. (2020). *About us*. ISO.Org. https://www.iso.org/about-us.html

Janssen, K. J., & Ravesteyn, P. (2015). Business Processes Management in the Netherlands and Portugal: The Effect of BPM Maturity on BPM Performance. *Journal of International Technology and Information Management*, *24*(1).

Jobhero. (2020). *What is an Application Manager?* Jobhero.Com. https://www.jobhero.com/what-is-an-application-manager/

Kotter. (2020). *8-STEP PROCESS*. Kotterinc.Com. https://www.kotterinc.com/8-steps-process-for-leading-change/

Kotter, J. P. (1995). *Kotter's 8-Step Change Model*. MindTools.Com. http://www.mindtools.com/pages/article/newPPM_82.htm

Kutosev, S. (2020). The Hard Side of Business and IT Alignment. *IT Professional*, *22*(1), 47–55.

La Rosa, M. (2015). Strategic business process management. *ACM International Conference Proceeding Series*, *24*, 177–178. https://doi.org/http://dx.doi.org/10.1145/2785592.2785620

Lankhorst, M. M., Proper, H. A., & Jonkers, H. (2009). The Architecture of the ArchiMate Language. In *Lecture Notes in Business Information Processing* (Vol. 29). Springer, Berlin, Heidelberg.

Lindemann, N. (2019). *What's the average survey response rate? [2019 benchmark]*. Surveyanyplace.com. https://surveyanyplace.com/average-survey-response-rate/

Meijer, D. (2018). *Statistics for Engineers*. University Of Twente.

Mickovic, A., & Wouters, M. (2020). Energy costs information in manufacturing companies: A systematic literature review. *Journal of Cleaner Production*, *254*. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.119927

Object Management Group. (2013). *Business Process Model and Notation (BPMN) Version 2.0.2*. https://www.omg.org/spec/BPMN/2.0.2/PDF

Patig, S., & Casanova-Brito, V. (2011). Requirements of Process Modeling Languages – Results from an Empirical Investigation. *Proceedings of the 10th International*

Conference on Wirtschaftsinformatik, *2*, 756–765.
PolderValley. (2020). *ProductivityPerformer*. PolderValley.Com. www.productivityperformer.com
Prosci. (2019). *The Prosci ADKAR Model: Overview*. Prosci.Com. www.prosci.com
Samat, N. A. A., Muthu, S., & Yunus, M. md. (2019). Enhancing English Communication Skills among Malaysian Primary School Pupils. *Creative Education*, *10*, 48–58.
Sarayreh, B. H., Khudair, H., & Barakat, E. alabed. (2013). Comparative Study: The Kurt Lewin of Change Management. *International Journal of Computer and Information Technology*, *02*(04), 626–629.
The Open Group. (2019). *ArchiMate® 3.1 Specification*. https://pubs.opengroup.org/architecture/archimate3-doc/toc.html
The Workforce View. (2018). *Slecht management grootste "killer" voor productiviteit werknemer*. ADP. https://www.adp.nl/over-adp/persberichten/2018/02-15-slecht-management-grootste-killer-productiviteit-werknemers/
Thomé, A. M. T., Scavarda, L. F., & Scavarda, A. J. (2016). Conducting systematic literature review in operations management. *Production Planning & Control*, *27*(5), 408–420. https://doi.org/10.1080/09537287.2015.1129464
van Deursen, J. A. M., & van Dijk, A. G. M. (2012). *CTRL ALT DELETE. Productiviteitsverlies door ICT-problemen en ontoereikende digitale vaardigheden.*
van Sinderen, M. (2018). *Introduction business process modelling*. University Of Twente.
Varadaraj, M., & Goud, N. (2012). Successful software adoption - A study of Software implementation methodologies. *International Journal of Computer Applications*, *41*(16), 42–47.
Venkatraman, N., Henderson, J. C., & Oldach, S. (1993). Continuous Strategic Alignment: Exploiting Information Technology capabilities for Competitive Success. *European Management Journal*, *11*(2), 139–149.
Weske, M. (2012). *Business process management: Concepts, languages, architectures, second edition* (2nd ed.). Springer. https://doi.org/10.1007/978-3-642-28616-2
Zennaro, I., Finco, S., Battini, D., & Persona, A. (2019). Big size highly customised product manufacturing systems: a literature review and future research agenda. *International Journal of Production Research*, *57: 15-16*, 5362–5385. https://doi.org/https://doi.org/10.1080/00207543.2019.1582819

Appendix A: Comparison MPSM-Problem-solving approach

The differences of the MPSM and this problem-solving approach will be elaborated in the following table. Phases 1 until 3 are left out, because there are no differences.

Table 10: Comparison MPSM and problem-solving approach

Phase	MPSM	Problem-solving approach	Chapter of elaboration	Difference compared to MPSM
3	-	Theoretical perspective	2	This is added in the problem-solving approach.
5	Formulating (alternative) solutions Choosing a solution	Implementation theory	4	This problem-solving approach focusses on developing an implementation method as a solution; therefore, the problem-solving approach gives this step to find theory for implementing software applications. Also, this step is combined with the MPSM step "Choosing a solution".
6	Implementing the solution Evaluating the solution	Using the implementation theory at ExplainiT (case material)	5	Case material instead of final solution implementation. The determined implementation theory will be used to implement the PP at ExplainiT. Also, this is step is combined with the MPSM step "Evaluating the solution".
8	-	Making a method of implementation	7	This is added, because PolderValley is interested in using this implementation method at all their potential customers. Therefore, the method cannot be specific for one organisation.

Appendix B: Time Plan M12

Activity	Plan start	Duration	20/04/2020	27/04/2020	04/05/2020	11/05/2020	18/05/2020	25/05/2020	01/06/2020	08/06/2020	15/06/2020	22/06/2020	29/06/2020	06/07/2020
			1	2	3	4	5	6	7	8	9	10	11	12
Problem identification	1	0.5												
Problem-solving approach	1	0.5												
Analysing the problem/research	2	3												
How does BPM work?	2	2												
How and to what extent do organisations use BPM?	2	3												
Which tooling can be best used for modelling processes?	4	1												
Formulating methods of implementation	5	2												
Which are implementation methods for combining processes with applications?	5	2												
Choosing a method of implementation	6	1												
Implementing (case material)	7	2												
What are the processes within the company and how do they work?	7	1												
What are the (organisation specific) applications within the company and how do they work?	8	1												
Evaluating and improving	9	1												
What are possible improvements for the implementation method?	9	1												
Standardizing	9	1												
How can the implementation method be standardized?	9	1												
Documentation and presentation	2	8												

Figure 23: Time Plan M12

Appendix C: Problem cluster

Table 11: Problems identification

Problem	Identification	Relation
Digital performance regarding business applications is low	Website ProductivityPerformer (https://www.productivityperformer.com/). Applications are changing more and quicker and are intertwining with business processes in an unclear manner. Therefore, traditional user guides or work instructions are hard to maintain. More generally formulated: digital performance regarding business applications is low.	
There are no (proper) application work instructions	Website ProductivityPerformer (https://www.productivityperformer.com/)	Causal, work instructions are not sufficient enough, therefore Digital performance is lower.
Organization specific applications only have standard instructions available	Website ProductivityPerformer (https://www.productivityperformer.com/)	Causal, because the applications are organisation specific, work instructions are not sufficient enough, therefore Digital performance is lower.
Application work instructions are not easily accessible	Website ProductivityPerformer (https://www.productivityperformer.com/)	Due to not having fast access to work instructions, the end-user needs to do more effort to work with the applications.
Application work instructions are not up to date	Website ProductivityPerformer (https://www.productivityperformer.com/)	Due to the use of not up to date work instructions, there are more failures and more time is lost.
Adaption for new employees takes too long	Website ProductivityPerformer (https://www.productivityperformer.com/)	New employees have a hard time learning how to use certain applications.
Software applications and business processes are unclearly intertwined	Interviews and survey.	Due the unclear intertwining of application and business processes, the digital performance is lower.

Appendix D: Variables and relationships

Table 12: Variables explanation

Variable	Type of variable	Relation to	Relation	Measurement
Type of organisation	IV-DV	Extent of processes modelled	It is believed that the type of organisation has significant effect on the extent of processes modelled.	Survey
Size of organisation	IV-DV	Extent of processes modelled	It is believed that the size of organisation has significant effect on the extent of processes modelled.	Survey
Application process description	IV-DV	Extent of processes modelled	The way of describing the application processes is believed to have significant effect on the extent of business and application processes modelled.	Survey and interviews
Application management	MV-(IV-DV)	Application type - Extent of processes modelled	The above described relation is believed to be affected by the application management in an organisation.	Survey and interviews
Process description	IV-DV	Extent of processes modelled	The way of describing the processes is believed to have significant effect on the extent of processes modelled.	Survey and interviews
Process management	MV-(IV-DV)	Process description - Extent of processes modelled	The above described relation is believed to be affected by the process management in an organisation.	Survey and interviews

Appendix E: Protocol Systematic Literature Review

The research questions that will (partially) be covered with this review are the following:

1. What is BPMo?
2. How and to what extent do organizations model their business and application processes?

The focus lies on discovering how Business Process Modeling works. This is a part of Business Process Management, which is also indicated with BPM. Therefore, it is useful to take this difference into account when searching. The second research question focusses on whether or not and to what extent organisations model their processes. The literature review should help determining variables and indicators to measure this.

The following tables give the exclusion and inclusion criteria.

Table 13: Exclusion criteria

#	Criteria	Reason for exclusion
1	Pre-2014	The latest version of BPMN is launched in December 2013.
2	Framework	Frameworks are not interesting for my research.

Table 14: Inclusion criteria

#	Criteria	Reason for inclusion
1	Study must focus on Process Modelling	Management is not interesting for the research question.
2	English or Dutch language	Study must be in English or in Dutch, because those are the languages that I can read academically.

In the course given in Module 11 by P. Noort, the following table was presented.

Table 15: Databases overview

Database	Scopus	PsycINFO	Web of Science	Google Scholar	Business Source Elite
Type	Database	Database	Database	Search engine	Database
Focus	Multidisciplinary	Behavioural	Multidisciplinary	Multidisciplinary	Management, economics
Scope	70 million records, titles of more than 22,800 peer-reviewed journals and trade publications	2,500 peer-reviewed journals, over 4 million records. Thesaurus of Psychological Index Terms.	Over 90 million records and more than 1 billion cited references, over 20,000 peer-reviewed journals (with Impact Factor), plus other records	Unknown, but estimated 100-389˙ million indexed records	over 1,000 business publications and economics journals, thesaurus with relevant subject headings
Content	Peer-reviewed articles, conference proceedings, books, patents	Peer-reviewed articles, conference proceedings, book chapters	Peer-reviewed articles, conference proceedings, books	Peer-reviewed and non-peer reviewed articles, books, reports, websites, etc.	Peer-reviewed articles, company profiles (MarketLine)

According to this table, there are at least two useful databases to use:

1. *Scopus* – Because this database is multidisciplinary and has much records, this database can be very useful for my research.
2. *Business Source Elite* – Because this database is focused on management and economics, there can be more specific literature about the subject. Therefore, this database will also be used.

The topic of the research question was already discussed in Module 3; therefore, sources of this module will be used. Furthermore, Google Scholar will be used mainly as database for

known articles (e.g. for searching for a full article, when not available on Scopus or Business Source Elite).

Describing the search terms and the used strategy

Table 16: Search matrix

Constructs	Related terms	Broader terms	Narrower terms
BPM	Business process modelling, process modelling	Business process management, business process management	BPMN
Organisations	Company, firm	-	-
Extent	Degree, depth	-	Maturity

Search string 1:
(TITLE-ABS-KEY (bpm OR "Business process modelling") AND TITLE-ABS-KEY (maturity)) AND PUBYEAR > 2013 AND NOT (framework)
This search string included a lot of records about beats per minute (bpm), therefore the search string is adapted with a NOT "heart rate".
Search string 2:
(TITLE-ABS-KEY (bpm OR "Business process modelling") AND TITLE-ABS-KEY (maturity)) AND PUBYEAR > 2013 AND NOT (framework OR "heart rate")

Table 17: Number of entries

Action	Number of entries
String 1 search Scopus	32
String 1 search Business Source Elite	45
Total	**77**
Language English or Dutch	-4
Duplicates	-3
Total	**70**
Not accessible (Scopus)	-3
Wrong topic (Scopus)	-20
Scholarly (peer reviewed) Journals (BSE)	-13
Wrong topic (BSE)	-23
Total	**7**

On the next page, a conceptual matrix is given with the results of reviewing the literature.

Table 18: Conceptual matrix

#	Source	Author(s)	Year	Subject	Conclusion	Findings
1	Business Process Management in Small- and Medium-Sized Enterprises: an Empirical Study	R. Singer	2015	A research on how BPM is used in SME in Austria is conducted, by combining qualitative and quantitative research.	BPM needs to be defined generally, because the findings of the sample differed too much.	This could also be an outcome for my research.
2	Strategic Business Process Management	M. La Rosa	2015	The paper is about what is and how to use BPM.	-	Theoretical knowledge.
3	Business process management: a maturity assessment of Saudi Arabian organizations	O. AlShathry	2015	The paper shows a study of maturity in BPM in Saudi Arabian organizations.	The difference between BPM in IT and in business strategy is not yet clear. Not mature.	The methodology and approach are interesting for my research.
4	Assessment model for organizational business process maturity with a focus on BPM governance practices	F.G. de Boer, C.J. Müller & C. Schwengber ten Caten	2015	This paper shows a study on how mature governance practices are with business processes.	A model for determining the maturity of a governance practice is developed and validated.	The developed model can be used in my research.
5	Business Processes Management in the Netherlands and Portugal: The Effect of BPM Maturity on BPM Performance.	K.J. Janssen & P. Revesteyn	2015	This paper compares the maturity of BPM of organisations in Portugal with the Netherlands.	Raising BPM maturity can positively influence performance.	Research methods can be used in my research.
6	Analysis of business process maturity and organisational performance relations.	T. Bartosz Kalinowski	2016	The papers research question is: “Does higher process maturity lead to better organisational performance?”	The conclusion is that higher process maturity does lead to better organisational performance.	Research design can be helpful.
7	Identification and analysis of key Business Process Management factors	A.S. Randelović, R. Milojević & M. Radosavljević	2018	The paper studies the factors that most influence the maturity of BPM.	Managing employee is detected as the most important factor.	Knowledge on what factors are important.

Appendix F: Archimate 3.0 Notation Overview

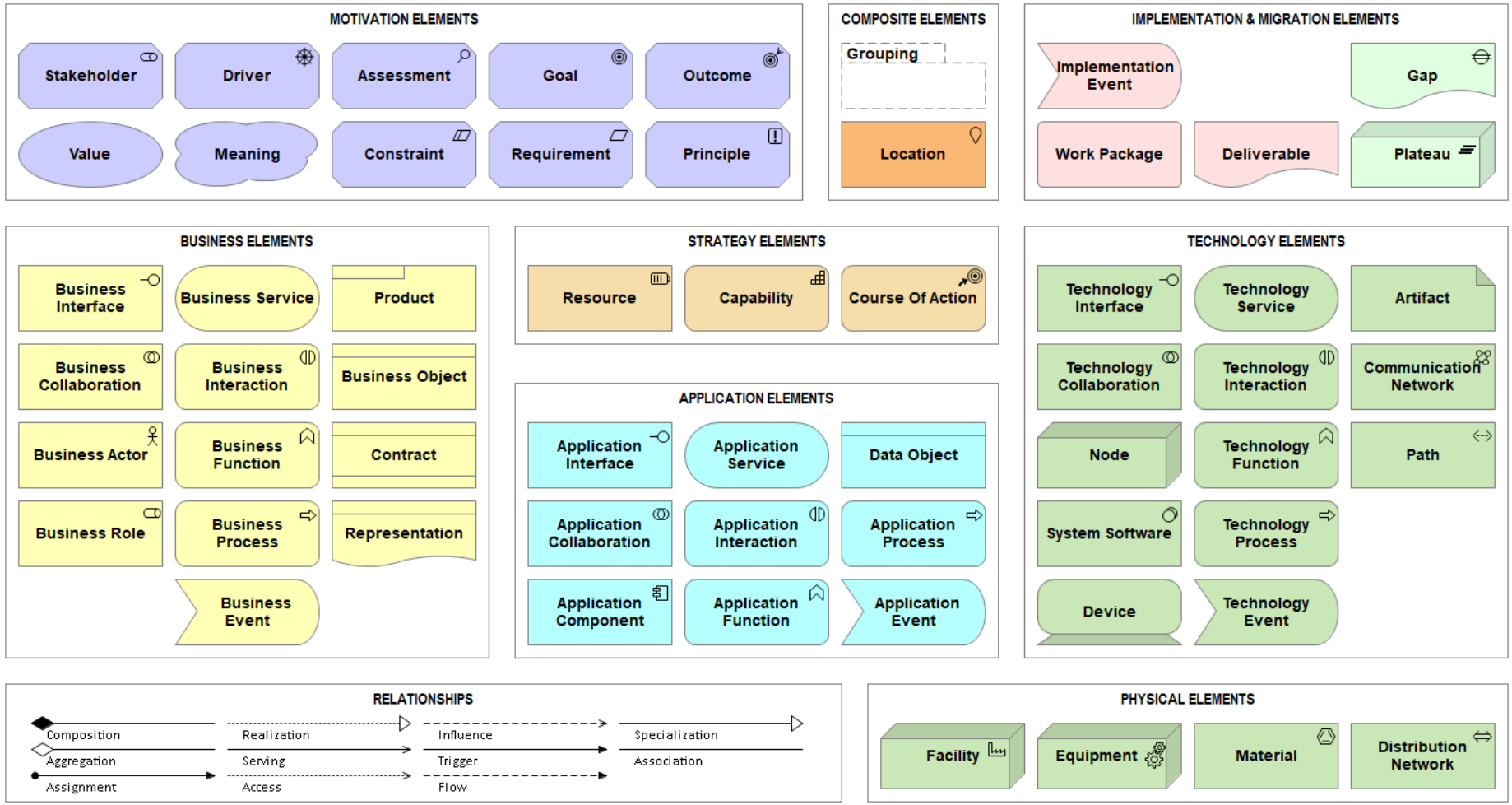


Figure 24: Archimate® 3.0 Notation Overview (Archimate, 2020)

Appendix G: Survey

This appendix gives an explanation on how the survey is determined and structured.

Appendix G-1: Survey structure and questions

The survey is based on the research model, which is given in Figure 9: Research model. Furthermore, the survey is based on indicators, which make the variables measurable. The survey questions are given in Table 19, the questions are in Dutch, because the sample were all Dutch people.

Table 19: Survey questions

Variable	Indicator	#	Question	Type of question
Openingsvragen	Respondent	1	Mijn functie is:	Open-ended
Openingsvragen	Verantwoordelijkheden	2	Binnen mijn organisatie heb ik kennis over de volgende onderwerpen:	Multiple choice
Openingsvragen	Organisatie	3	De organisatie waar ik voor werk is:	Open-ended
Type of organisation	Sector of organisation	4	De organisatie waar ik voor werk zit in de volgende branche:	Multiple choice
Size of organisation	# FTE employees	5	Hoeveel FTE zijn er totaal werkzaam bij uw organisatie?	Multiple choice
Size of organisation	Revenue	6	Wat is de jaarlijkse omzet (in miljoenen euro) van uw organisatie?	Multiple choice
Size of organisation	Balance sheet total	7	Wat is de jaarlijkse balanstotaal (in miljoenen euro) van uw organisatie?	Multiple choice
Process management	# FTE procesmanagers	8	Hoeveel FTE procesmanagers zijn er werkzaam bij uw organisatie?	Multiple choice
Process management	Level of proces management	9	Op welk niveau worden de processen gemanaged?	Multiple choice
Process management	Methodology	10	Van welke methodiek wordt gebruik gemaakt bij het procesmanagement?	Multiple choice +

				other, namely
Process management	Methodology certification	11	Indien van toepassing, zijn de procesmanagers gecertificeerd volgens deze methodiek?	Multiple choice
Process management	ISO 9001 certification	12	Is uw organisatie ISO 9001 gecertificeerd?	Multiple choice
Process description	Describing of processes (Boolean)	13	Welke processen worden binnen uw organisatie beschreven?	Multiple choice
Process description	Method of describing	14	Hoe beschrijft uw organisatie haar processen met een hoog abstractieniveau?	Multiple choice
Process description	Method of describing	15	Hoe beschrijft uw organisatie haar processen met een middelmatig abstractieniveau?	Multiple choice
Process description	Method of describing	16	Hoe beschrijft uw organisatie haar processen met een laag abstractieniveau, die ook als procedures, taken of stappenplannen beschreven kunnen worden?	Multiple choice
Process description	Modelling tool	17	Welke tool wordt gebruikt voor het modelleren van de processen?	Multiple choice + Other, namely
Process description	Modelling language	18	Welke modelleertaal wordt gebruikt voor het beschrijven van de processen?	Multiple choice + Other, namely
Application type	# total applications	19	Hoeveel applicaties gebruikt uw organisatie totaal?	Multiple choice
Application type	# organisation specific applications	20	Hoeveel procent van de applicaties binnen uw organisatie zijn organisatie specifiek?	Multiple choice
Application management	# FTE Application managers	21	Hoeveel FTE applicatiemanagers zijn er werkzaam bij uw organisatie?	Multiple choice

Application management	Methodology	22	Van welke methodiek wordt gebruik gemaakt bij het applicatiemanagement?	Multiple choice + Other, namely
Application management	Methodology certification	23	Indien van toepassing, zijn de applicatiemanagers gecertificeerd volgens de methodiek die gebruikt wordt?	Multiple choice
Application management	ISO 20000	24	Is uw organisatie ISO 20000 gecertificeerd?	Multiple choice
Application management	Application processmodeling	25	Worden de applicatieprocessen beschreven/gemodelleerd binnen uw organisatie?	Multiple choice + Other, namely
Application management	Enterprise Architecture	26	Is er een Enterprise Architecture gemodelleerd binnen uw organisatie?	Multiple choice
Afsluitingsvragen	Resultaten	27	Ik wil graag de resultaten van het onderzoek ontvangen, zodra deze beschikbaar zijn.	Multiple choice
Afsluitingsvragen	Interview	28	Er mag contact met mij opgenomen wordcen voor een interview, om dieper op dit onderwerp in te gaan.	Multiple choice
Afsluitingsvragen	Interview (contact)	29	Mijn e-mailadres is (tbv het interview of de resultaten):	Open-ended
Afsluitingsvragen	Opmerkingen	30	Heeft u nog op- en/of aanmerkingen?	Open-ended

Table 20 gives the options for answering the questions.

Table 20: Measurement scales

#	Multiple answers											
1	Open-ended											
2	Procesmanagement	Procesbeschrijving	Applicaties en beheer	Applicatiemanagement								
3	Open-ended											
4	Dienstverlening	Industrie	Onderwijs	Overheid	Zorg	Woningcorporaties	Overig					
5	x ≤ 10	10 < x ≤ 50	50 < x ≤ 250	250 < x ≤ 500	500 < x ≤ 1000	1000 < x ≤ 2000	x > 2000					
6	x ≤ 1	1 < x ≤ 10	10 < x ≤ 50	50 < x ≤ 100	100 < x ≤ 200	x > 200	Weet ik niet					
7	x ≤ 1	1 < x ≤ 10	10 < x ≤ 20	20 < x ≤ 50	50 < x ≤ 100	100 < x ≤ 200	x > 200					
8	0	1	2	3	4	5	6	7	8	9 of meer		
9	Op organisatieniveau	Op afdelingsniveau	Op teamniveau									
10	Business Process Management (BPM)	Business process re-engineering (BPR)	Lean Management	Lean Six Sigma	Six Sigma	Theory of Constraints (TOC)	Total Quality Management (TQM)	Geen	Anders, namelijk			
11	Ja, de managers die op organisatieniveau werken.	Ja, de managers die op afdelingsniveau werken.	Ja, de managers op teamniveau werken.	Nee	Niet van toepassing							
12	Ja	Nee										
13	Processen met een hoog abstractieniveau (de bedrijfsprocessen)	Processen die een middelmatig abstractieniveau hebben (deelprocessen van de bedrijfsprocessen).	Processen met een laag abstractieniveau, die ook als procedures, taken of stappenplannen kunnen worden beschreven.	Geen								
14-16	Stappenplannen	Procesmodellen	Textueel	Anders, namelijk								
17	Appian	Bizagi	Capterra	Comindware	IBM	Nintex	Oracle	Pega	SAP	Visio	Geen	Anders, namelijk
18	Activity Nets	Amber	Block and Arrow	BPEL	BPMN (1.0 or 2.0)	Data flows	EPC (ARIS)	Flow charts	Petri Nets	UML	YAWL	Anders, namelijk
19	x ≤ 100	100 < x ≤ 300	300 < x ≤ 500	500 < x ≤ 1000	1000 < x ≤ 1500	1500 < x ≤ 2000	x > 2000	Weet ik niet				
20	x = 0%	0% < x ≤ 5%	5% < x ≤ 10%	10% < x ≤ 15%	15% < x ≤ 20%	20% < x ≤ 30%	30% < x ≤ 50%	40% < x ≤ 50%	50% < x ≤ 60%	60% < x ≤ 70%	x > 70%	Weet ik niet
21	0	1	2	3	4	5	6	7	8	9 of meer		

22	Application Services Library (ASL) 2	Integrated Service Management (ISM)	ITIL Foundation	ITIL4 Foundation	Geen	Anders, namelijk	
23	Ja, alle applicatiemanagers.	Ja, maar aleen de hoogste applicatiemanagers.	Nee	Niet van toepassing			
24	Ja	Nee					
25	Ja, aan de hand van instructies.	Ja, aan de hand van procesmodellen.	Ja, aan de hand van zowel instructies als procesmodellen.	Nee	Anders, namelijk		
26	Ja	Nee					
27	Ja	Nee					
28	Ja	Nee					
29	Open-ended						
30	Open-ended						

Appendix G-2: Email sent to the sample

Dutch:

Geachte heer/mevrouw,

Ik ben Jethro Kiers, bachelor student Technische Bedrijfskunde aan de Universiteit Twente. Voor mijn afstudeeropdracht doe ik onderzoek naar de mate waarin bedrijfs- en applicatieprocessen gemodelleerd en gecombineerd worden. De onderzoeksvraag luidt als volgt:

Hoe en tot in hoeverre worden bedrijfs- en applicatieprocessen gemodelleerd bij organisaties in Nederland?

Om tot een goed onderzoeksresultaat te komen, is een enquête opgesteld. De enquête is bedoeld voor bijvoorbeeld:

- Applicatiemanagers
- Procesmanagers
- Operationeel directeuren
- Algemeen directeuren
- IT-teamleiders, -managers of -directeuren

Ik zou het erg op prijs stellen als deze e-mail doorgestuurd kan worden naar de juiste persoon binnen uw organisatie.

Graag nodig ik de desbetreffende persoon uit om de enquête via deze link in te vullen. De antwoorden zijn, tenzij anders gewenst, anoniem. Het beantwoorden van de enquête duurt ongeveer 10-15 minuten.

Indien er vragen, op- en/of aanmerkingen zijn, ben ik te bereiken via onderstaande contactgegevens.

Met vriendelijke groet,

Jethro Kiers
Afstudeerstudent BSc Technische Bedrijfskunde aan de Universiteit Twente
E-mail UT:

Werkt de link niet? Kopieer dan deze link in uw browser:

English:

Dear sir/madam,

I am Jethro Kiers, bachelor student Industrial Engineering & Management at the University of Twente. In the context of my graduation assignment, I am researching the extent that business and application processes are modelled and combined. The research question is:

How and to what extent do organisations model their business and application processes?

To get significant results, a questionnaire is determined. The questionnaire is meant for e.g.:

- Application managers;
- Process managers;
- Operational directors;
- Executive directors;
- IT team leaders, managers or directors.

I would appreciate it if this e-mail can be forwarded to the right person within your organisation.

I would like to invite the certain person to fill in the questionnaire via this link. The answers are anonymous, unless desired otherwise. Answering the questionnaire takes about 10-15 minutes.

If there are any questions or remarks, you can reach me via the contact details below.

Kind regards,

Jethro Kiers
Graduate student BSc Industrial Engineering & Management at the University of Twente
E-mail UT:

Appendix H: ProductivityPerformer

The ProductivityPerformer is described as “the platform for effective use of applications, with the goal to let employees work independent, consistent and complete with IT applications, in line with the organisational policy” (PolderValley, 2020). The ProductivityPerformer is a tool that helps organizations to easily make (organisation specific) application work instructions (AWI). An AWI is a step-by-step (imaged) description of actions within applications, focused on processes, sharing of knowledge and course material. The tool also helps to keep those AWIs up to date. The PP makes it possible to save AWIs on a central place, which makes sure that employees do not have to search thoroughly for information. These AWIs can help employees to work faster with applications or to integrate into a company easier. The PP is mainly helpful for organisation specific applications, which are often hard to use due to the lack of instructions, but is also very helpful for standard applications, because the entire application process can be recorded. The goal of the ProductivityPerformer is to increase digital performance.

Advantages

The website (https://www.productivityperformer.com/) mentions the following advantages:

1. Easily make and maintain content;
2. Ability to work with applications independent everywhere;
3. Pursue policy with a uniform and correct use of applications;
4. Faster and smoother onboarding;
5. Organisation specific and customized;
6. From business processes to use of application;
7. Good securing of knowledge.

Functionalities

AWI Library

The AWI library is the central place where all the AWIs can be found. Users can search and filter on name, tags and applications.

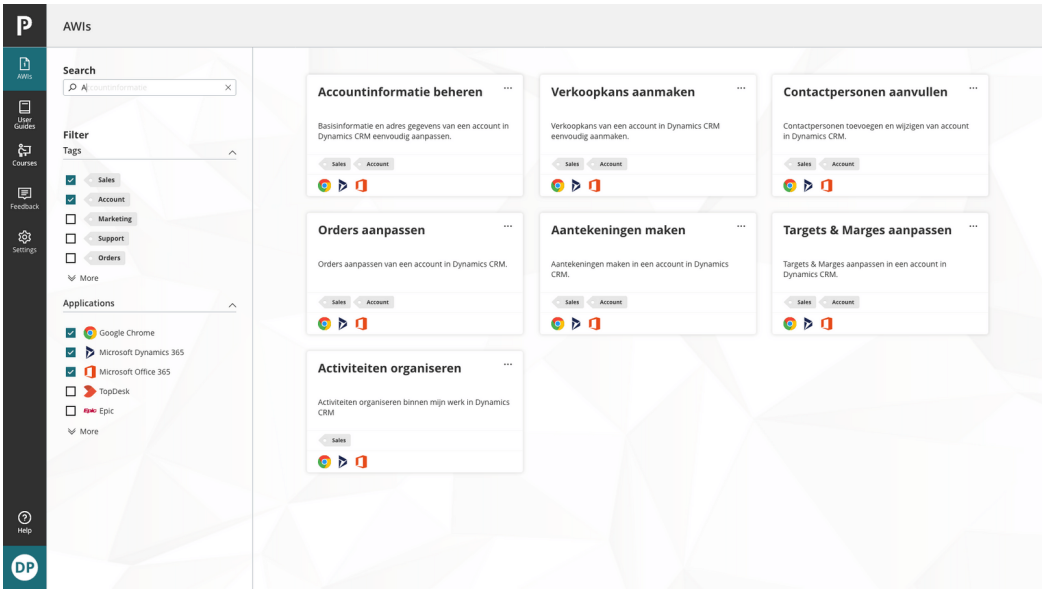


Figure 25: AWI Library

AWI Viewer

When an end-user clicks on an AWI, the viewer is shown. This viewer is more user-friendly than the editors view, to make it as easy as possible for the end-user to follow the steps.

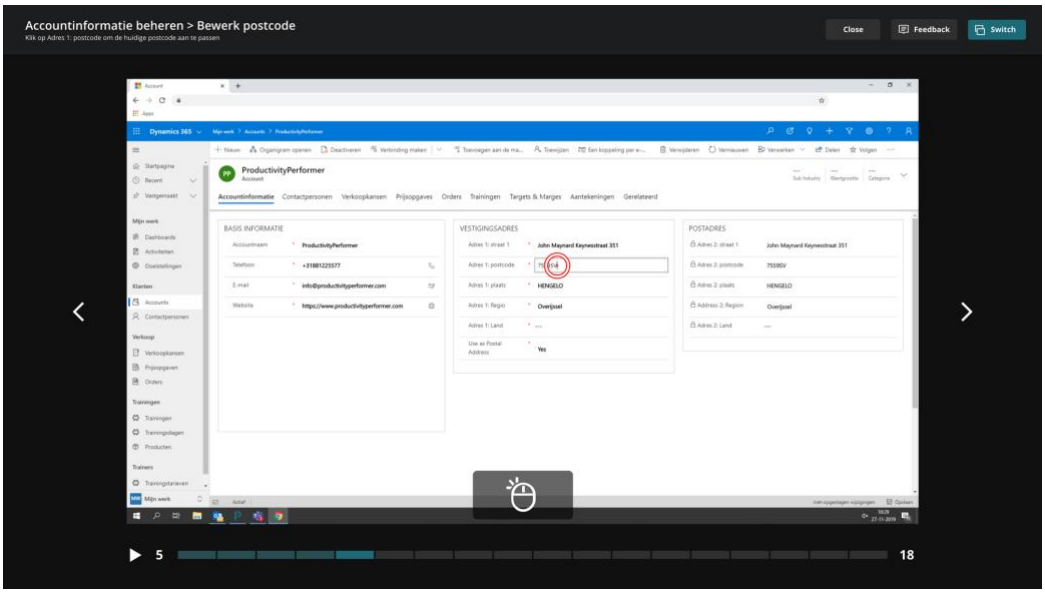


Figure 26: AWI Viewer

Feedback

An end-user can give feedback on an AWI if something is wrong or not up to date. The editor gets a notification of this feedback and can make the AWI up to date again. The feedback option makes it possible to keep the instructions as up to date as possible.

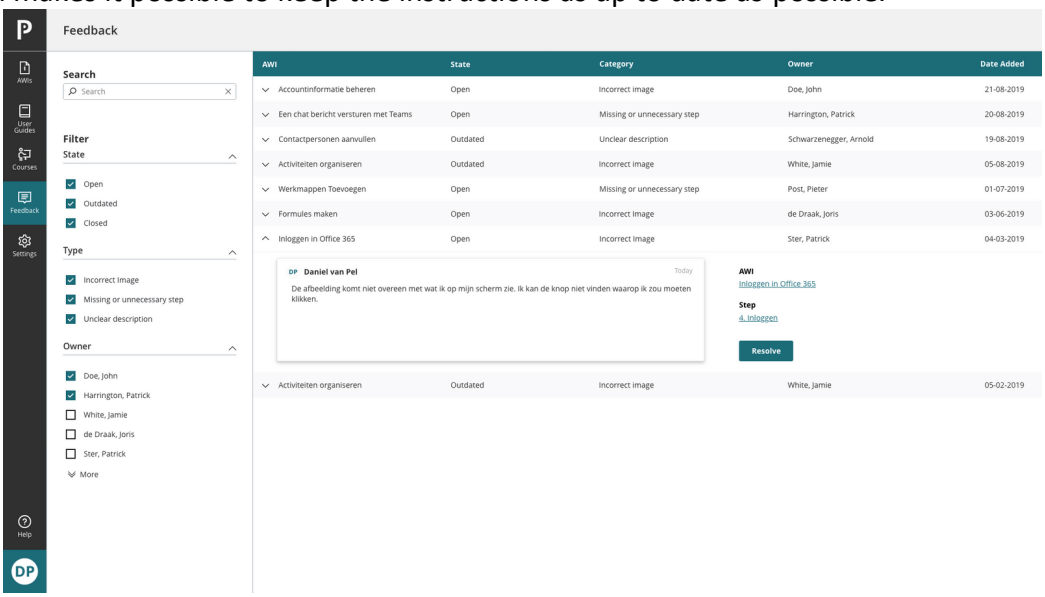


Figure 27: Feedback

User guides

User guides focus on one application or process. Within a user guide, chapters can be made. Within a chapter, an image (e.g. process flow) can be added. The steps (or activities) in a process can link to an AWI.

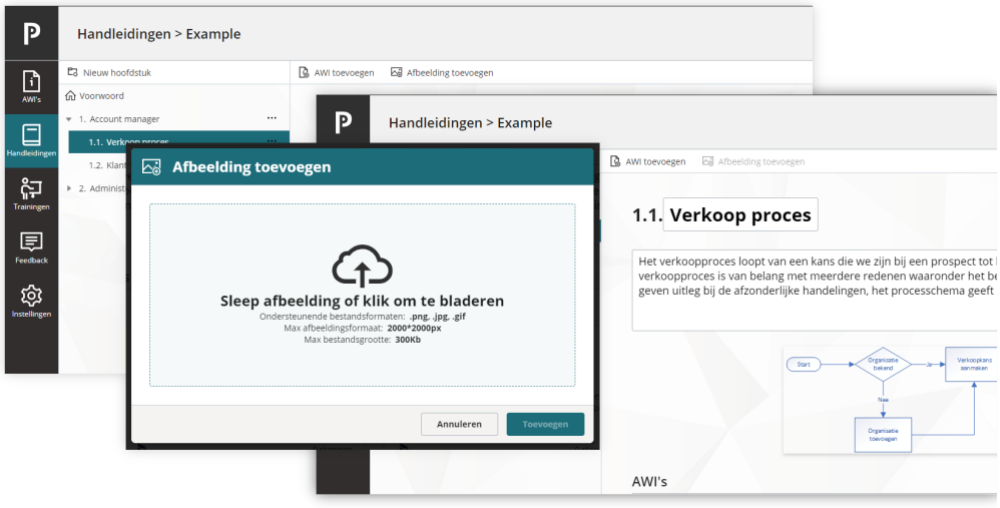


Figure 28: Image in chapter

This is an important functionality for this research, because this links applications with processes.

Courses

Courses can be given with the help of AWIs. Processes or procedures can be offered to a user or student, who can follow the steps given. This can also be very helpful for new employees that need knowledge on how certain applications work.

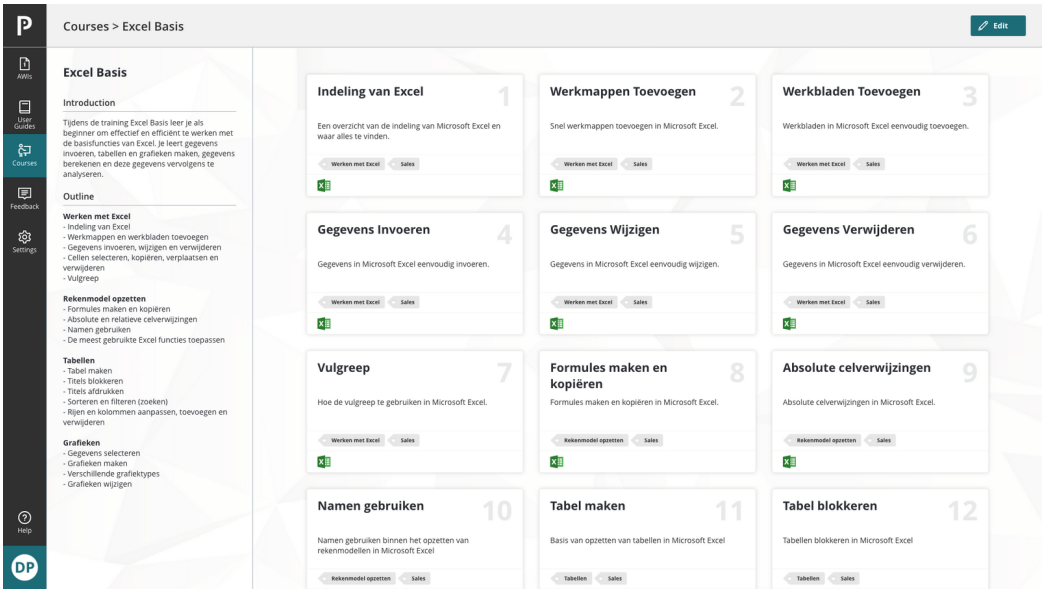


Figure 29: Courses

AWI Recorder & Editor

The PP has an AWI Recorder & Editor. This Recorder makes screenshots by clicking or by pressing ENTER or TAB on the keyboard. After recording the steps, the editor can edit some steps and give textual explanations to the steps. The recorded image has a red circle on the place where the recorder clicked during the recording. The editor can also add censuring, e.g. for the sake of privacy or corporate sensitive information. If unnecessary steps were taken, these can be hidden by the editor. Also, an editor can give an AWI a name, a general description, a tag, the applications used and the estimated time.

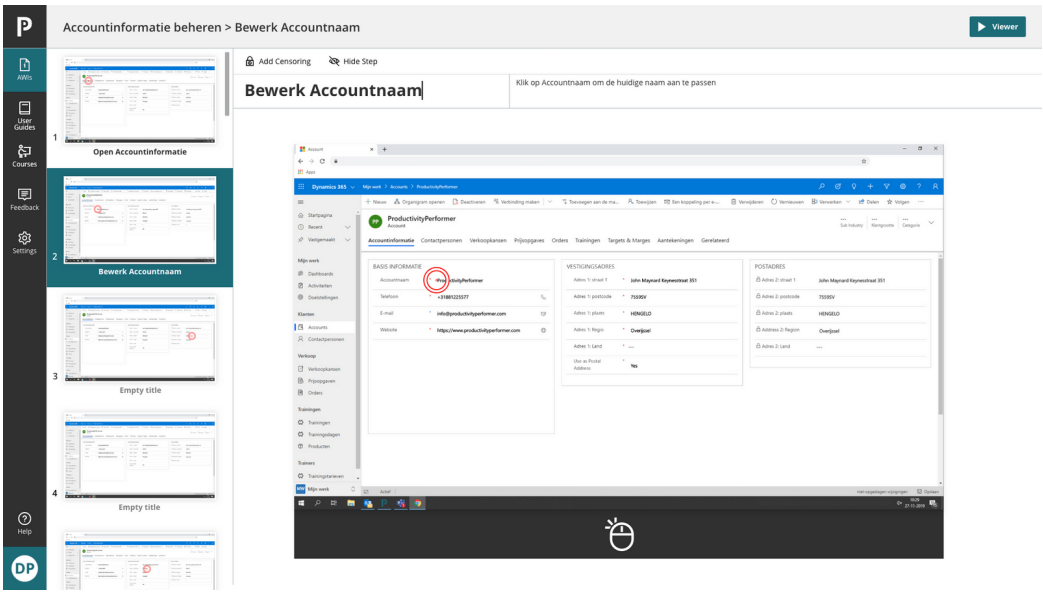


Figure 30: AWI Recorder & Editor

Integration with Azure AD/Office 365

The PP can be integrated in Office 365, which means that a user does not have to log in on an extra platform.

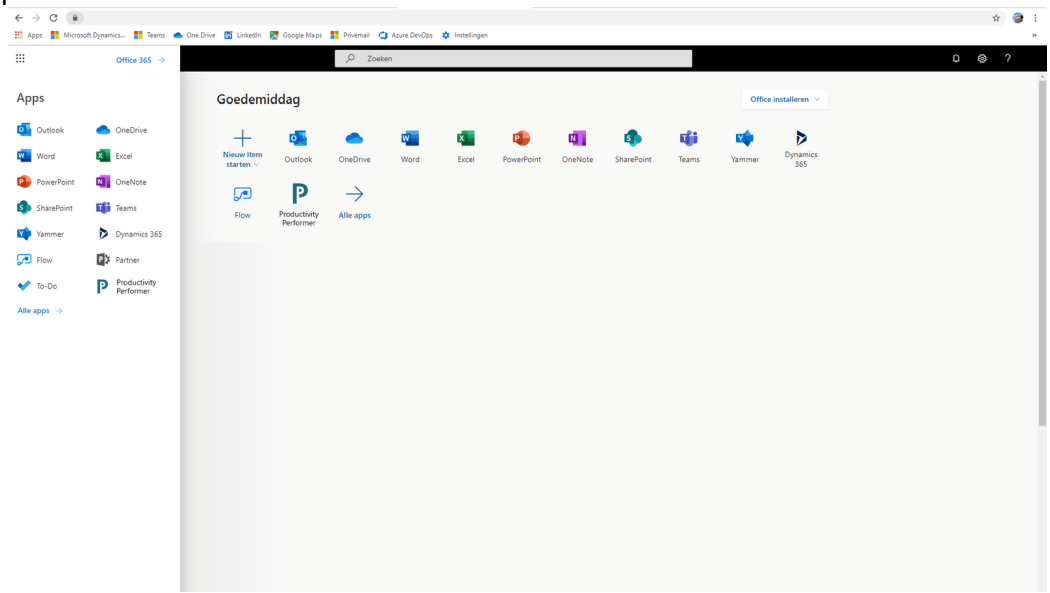


Figure 31: Integration AD

Appendix I: Results Survey

Appendix I-1: Function description

The first question of the survey was what the function title of the respondent was. Due to the wide variability in these titles, this was an open-ended question. The responses are categorized in 17 function titles. The main response comes from IT managers (31.3%) and Managing Directors (12.9%).

Table 21: Function titles of response

Function (NL)	Function (EN)	Count
Algemeen directeur	Managing Director	19
Applicatiebeheer	Application management	7
Directiesecretaris	Executive secretary	3
Enterprise Architect	Enterprise Architect	1
Informatie Analist	Information Analyst	1
IT Adviseur	IT Advisor	9
IT Directeur	IT Director	8
IT Manager	IT Manager	46
IT Medewerker	IT Collaborator	7
IT Teamleider	IT Team leader	10
Manager Operations	Manager Operations	4
Manager overig	Manager other	15
Medewerker overig	Collaborator other	2
Procesadviseur	Process advisor	3
Procesanalist	Process analyst	1
Procesmanager	Process manager	6
Projectleider	Project leader	5
Total		147

Appendix I-2: Overall results

Organisation information

The information given in the following table is to categorize the organisations in size, by looking into the total number of FTE that works for the company, the yearly revenue (in millions of euros) and, if the revenue is unknown, the yearly balance sheet total (in millions of euros).

Table 22: Overall Organisation information

Total FTE		Revenue		Balance sheet	
x ≤ 10	2.7%	**x ≤ 1**	4.1%	**x ≤ 1**	25.0%
10 < x ≤ 50	10.2%	**1 < x ≤ 10**	11.6%	**1 < x ≤ 10**	6.3%
50 < x ≤ 250	24.5%	**10 < x ≤ 50**	21.1%	**10 < x ≤ 20**	12.5%
250 < x ≤ 500	22.5%	**50 < x ≤ 100**	17.7%	**20 < x ≤ 50**	12.5%
500 < x ≤ 1000	15.0%	**100 < x ≤ 200**	14.3%	**50 < x ≤ 100**	12.5%
1000 < x ≤ 2000	11.6%	**x > 200**	9.5%	**100 < x ≤ 200**	6.3%
x > 2000	13.6%	**I do not know**	21.8%	**x > 200**	25.0%

Process management

In the section Process management, the respondent was asked to fill in the number of FTE process managers, the levels the processes are managed, the method that is used to manage the processes, if the managers are certified for this method and if the organisation holds an ISO 9001 certification.

Table 23: Overall FTE process managers and level of management

FTE Process managers		Level process management	
0	36.2%	**Organisational level**	16.7%
1	19.8%	**Department level**	19.4%
2	8.6%	**Team level**	9.7%
3	7.8%	**Organisational and department level**	12.5%
4	6.9%	**Organisational and team level**	1.4%
5	4.3%	**Department and team level**	8.3%
6	4.3%	**Organisational, department and team level**	31.9%
7	0.9%		
8	0%		
9 or more	11.2%		

Table 24: Overall Method of process management and Certification

Method process management		Certification process managers	
Business Process Management (BPM)	18.6%	**Yes, the managers who work on organisational level.**	26.2%
Business process re-engineering (BPR)	2.4%	**Yes, the managers who work on department level.**	16.7%
Lean Management	24.6%	**Yes, the managers who work on team level.**	11.9%
Lean Six Sigma	9.6%	**No**	27.4%
Six Sigma	1.8%	**Not applicable**	17.9%
Theory of Constraints (TOC)	0.6%		
Total Quality Management (TQM)	4.8%		
None	26.9%		
Other	10.7%		

Table 25: Overall ISO 9001 certification

ISO 9001 Certification	
Yes	38.8%
No	61.2%

The overall conclusion that can be drawn from the process management part is that organisations mainly manage their processes on organisational level. The process managers on the lower levels (department and team) are often not certified by a method or do not work according to a certain method, where the managers on organisational level are.

Process description

This section uses certain abstraction levels, namely:

- Low abstraction level – these are the processes that can also be written as procedures, tasks or step-by-step plans;
- Mediocre abstraction level – these are the processes that are subprocesses of the business processes.
- High abstraction level – these are the business processes.

Table 26: Overall Levels of process description

Level of process description	
Low abstraction level	14.4%
Mediocre abstraction level	9.6%
High abstraction level	12.5%
Low & mediocre abstraction level	13.5%
Low & high abstraction level	5.8%
Mediocre & high abstraction level	4.8%
Low, mediocre & high abstraction level	37.5%
None	1.9%

Table 27: Overall Tool and Language of process modelling

Tool process modelling		Language process modelling	
Visio	54.1%	**Flow charts**	47.1%
Engage	4.7%	**BPMN (1.0 or 2.0)**	10.3%
Sensus	3.5%	**Data flows**	8.0%
Mavim	2.4%	**Block and Arrow**	4.6%
Archimate	2.4%	**Petri Nets**	1.2%
Oracle	2.4%	**None**	9.2%
None	8.2%	**Do not know**	10.3%
Other	22.4%	**Other**	9.2%

Although there is a lot of diversity in the use of tooling, Microsoft Visio is mostly used. Furthermore, the processes are mainly modelled by flow charts.

Applications

This section of the questionnaire asked about the number of applications that the organisation uses and the percentage of organisation specific applications.

Table 28: Overall Application information

# of applications		% organisation specific applications	
x ≤ 100	60.5%	**x = 0%**	7.0%
100 < x ≤ 300	26.4%	**0% < x ≤ 5%**	24.8%
300 < x ≤ 500	4.7%	**5% < x ≤ 10%**	10.1%
500 < x ≤ 1000	3.1%	**10% < x ≤ 15%**	8.5%
1000 < x ≤ 1500	2.3%	**15% < x ≤ 20%**	3.1%
1500 < x ≤ 2000	0.0%	**20% < x ≤ 30%**	3.9%
x > 2000	0.8%	**30% < x ≤ 40%**	4.7%
Do not know	2.3%	**40% < x ≤ 50%**	6.2%
		50% < x ≤ 60%	8.5%
		60% < x ≤ 70%	10.1%
		x > 70%	7.0%
		Do not know	6.2%

Application management

This section asked the respondents to fill in their knowledge about application management within their organisation. The number of FTE application managers, the way of describing application processes, the method of management and the certification of that management is asked among other things.

Table 29: Overall FTE and description application management

FTE application managers		Description application processes	
0	16.8%	**Instructions**	24.8%
1	12.9%	**Process models**	13.9%
2	11.9%	**Instructions and models**	24.8%
3	9.9%	**No**	27.7%
4	5.0%	**Other**	8.8%
5	8.9%		
6	8.9%		
7	3.0%		
8	0.0%		
9 or more	22.8%		

Table 30: Overall Method of application management and certification

Method of application management		Certification managers	
Application Services Library (ASL) 2	11.6%	**All application managers**	24.2%
Integrated Service Management (ISM)	3.9%	**Only highest managers**	19.7%
ITIL Foundation	29.5%	**No**	45.5%
ITIL4 Foundation	12.4%	**Not applicable**	10.6%
BisL	7.8%		
None	27.1%		
Other	7.7%		

ITIL Foundation is the main used method for application management. After ITIL, most organisation do not use a method at all. The managers are mainly not certified for the used method.

Table 31: Overall ISO 20000 and Enterprise Architecture

ISO 20000 accreditation		Enterprise Architecture	
Yes	7%	**Yes**	38%
No	93%	**No**	62%

A small portion of the organisations has the ISO 20000 accreditation. Almost forty percent has a modelled Enterprise Architecture.

Ending

Table 32: Ending questions

Interested in results		Willing to give interview	
Yes	35.4%	**Yes**	25.9%
No	64.6%	**No**	74.1%

Due to the fact that these questions are asked at the end of the survey, it can also be assumed that the questionnaire was interesting enough for the respondents to either ask for the results or are willing to give an interview. This assumption helps the unbiasedness of the survey.

Appendix I-2: Power BI report

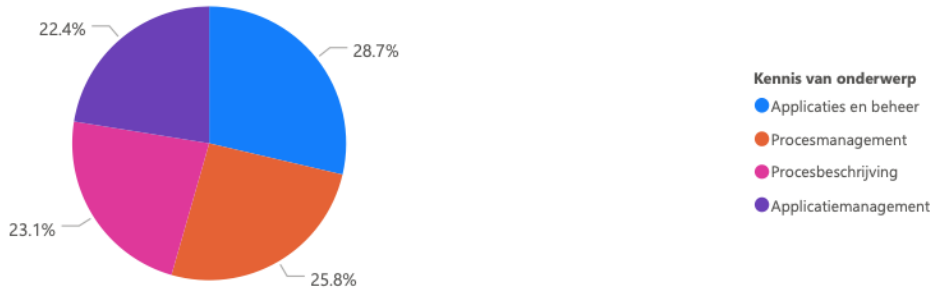
Resultaten enquete bedrijfs- en applicatieprocessen

147

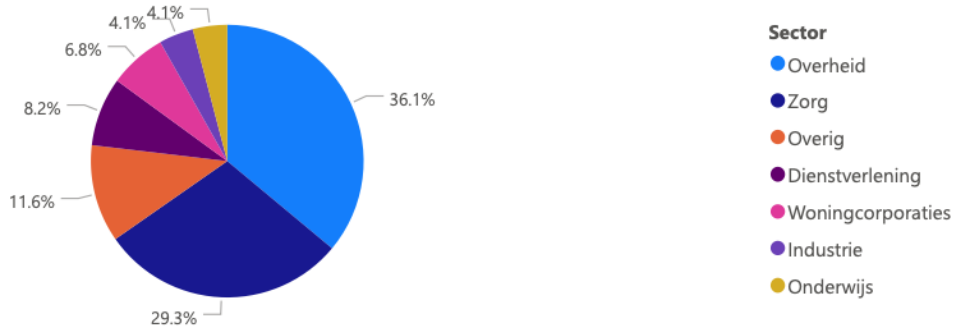
Aantal ingevulde enquetes

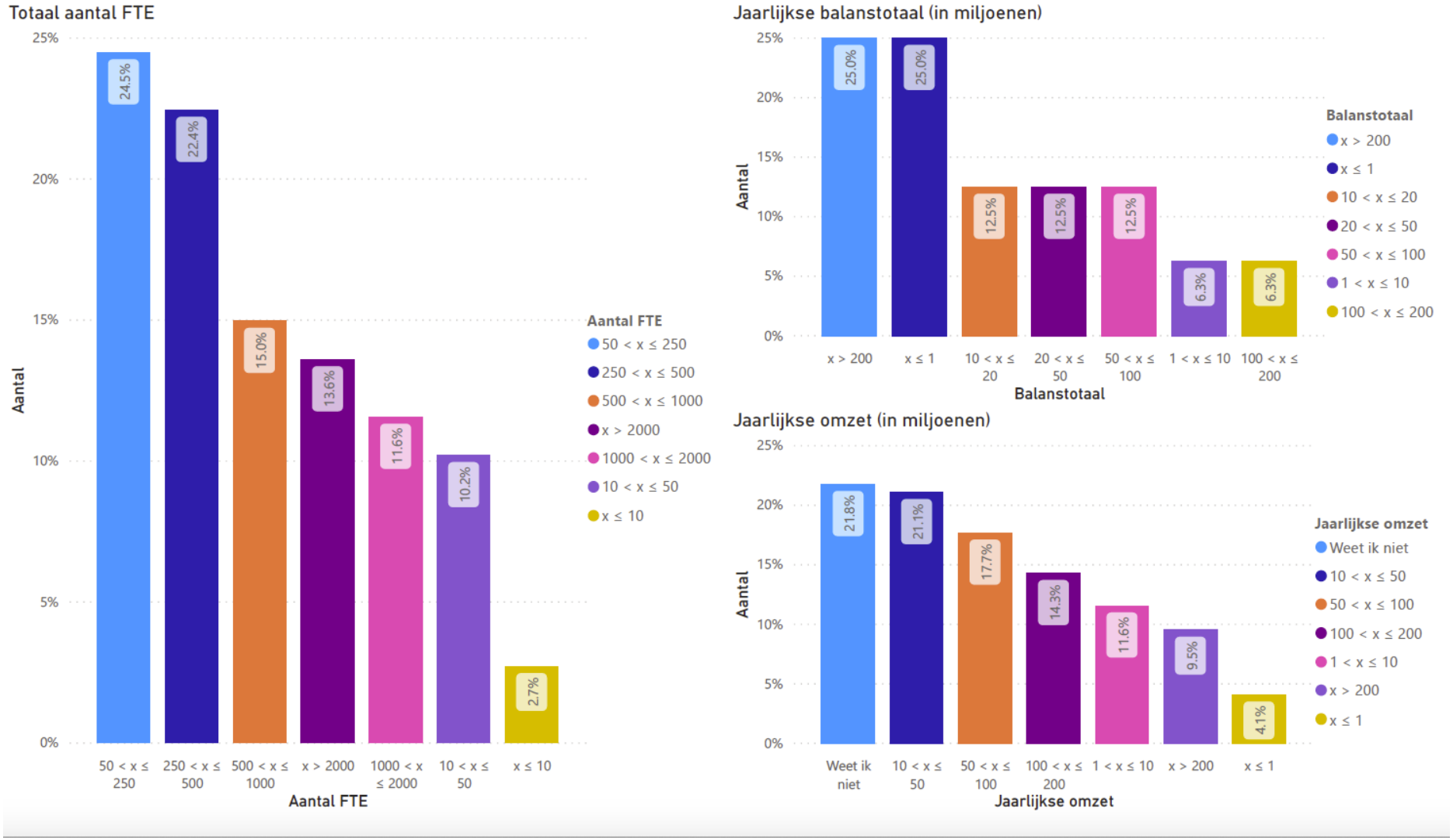
Functiecategorie	Aantal
IT Manager	46
Algemeen directeur	19
Manager overig	15
IT Teamleider	10
IT Adviseur	9
IT Directeur	8
Applicatiebeheer	7
IT Medewerker	7
Procesmanager	6
Projectleider	5
Manager Operations	4
Directiesecretaris	3
Procesadviseur	3
Medewerker overig	2
Enterprise Architect	1
Informatie Analist	1
Procesanalist	1
Totaal	**147**

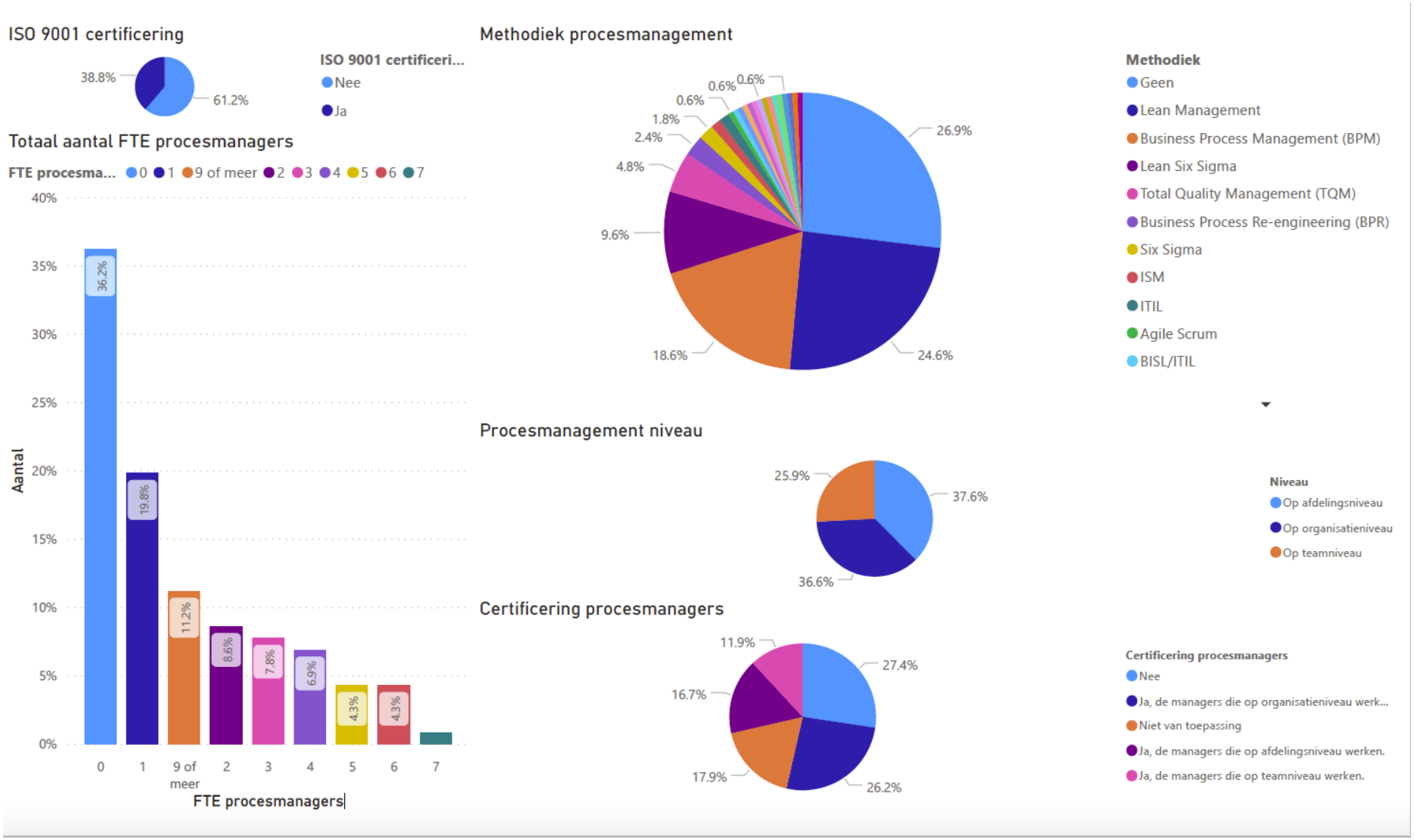
Response per kennis van onderwerp



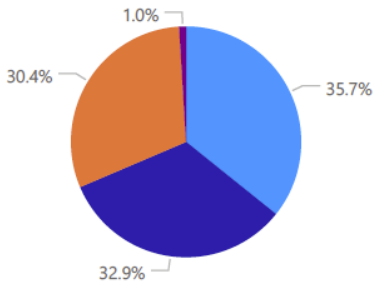
Response per sector




Totaal aantal FTE
25%
20%
15%
10%
5%
0%
Aantal
24.5%
22.4%
15.0%
13.6%
11.6%
10.2%
2.7%
50 < x ≤ 250
250 < x ≤ 500
500 < x ≤ 1000
x > 2000
1000 < x ≤ 2000
10 < x ≤ 50
x ≤ 10
Aantal FTE
Aantal FTE
50 < x ≤ 250
250 < x ≤ 500
500 < x ≤ 1000
x > 2000
1000 < x ≤ 2000
10 < x ≤ 50
x ≤ 10
Jaarlijkse balanstotaal (in miljoenen)
25%
20%
15%
10%
5%
0%
Aantal
25.0%
25.0%
12.5%
12.5%
12.5%
6.3%
6.3%
x > 200
x ≤ 1
10 < x ≤ 20
20 < x ≤ 50
50 < x ≤ 100
1 < x ≤ 10
100 < x ≤ 200
Balanstotaal
Balanstotaal
x > 200
x ≤ 1
10 < x ≤ 20
20 < x ≤ 50
50 < x ≤ 100
1 < x ≤ 10
100 < x ≤ 200
Jaarlijkse omzet (in miljoenen)
25%
20%
15%
10%
5%
0%
Aantal
21.8%
21.1%
17.7%
14.3%
11.6%
9.5%
4.1%
Weet ik niet
10 < x ≤ 50
50 < x ≤ 100
100 < x ≤ 200
1 < x ≤ 10
x > 200
x ≤ 1
Jaarlijkse omzet
Jaarlijkse omzet
Weet ik niet
10 < x ≤ 50
50 < x ≤ 100
100 < x ≤ 200
1 < x ≤ 10
x > 200
x ≤ 1

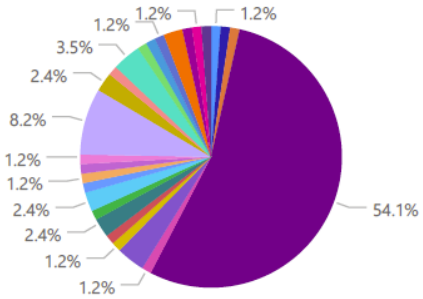

ISO 9001 certificering
38.8%
61.2%
ISO 9001 certificeri...
Nee
Ja
Totaal aantal FTE procesmanagers
FTE procesma... 0 1 9 of meer 2 3 4 5 6 7
40%
35%
30%
25%
20%
15%
10%
5%
0%
Aantal
36.2%
19.8%
11.2%
8.6%
7.8%
6.9%
4.3%
4.3%
0
1
9 of meer
2
3
4
5
6
7
FTE procesmanagers
Methodiek procesmanagement
26.9%
24.6%
18.6%
9.6%
4.8%
2.4%
1.8%
0.6%
0.6%
0.6%
Methodiek
Geen
Lean Management
Business Process Management (BPM)
Lean Six Sigma
Total Quality Management (TQM)
Business Process Re-engineering (BPR)
Six Sigma
ISM
ITIL
Agile Scrum
BISL/ITIL
Procesmanagement niveau
25.9%
37.6%
36.6%
Niveau
Op afdelingsniveau
Op organisatieniveau
Op teamniveau
Certificering procesmanagers
11.9%
27.4%
16.7%
17.9%
26.2%
Certificering procesmanagers
Nee
Ja, de managers die op organisatieniveau werk...
Niet van toepassing
Ja, de managers die op afdelingsniveau werken.
Ja, de managers die op teamniveau werken.

Procesbeschrijving niveau



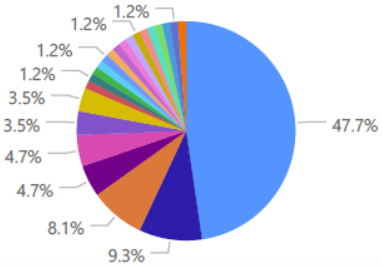
Procesniveau
- Processen met een laag ab...
- Processen die een middel...
- Processen met een hoog a...
- Geen

Tool procesmodellering



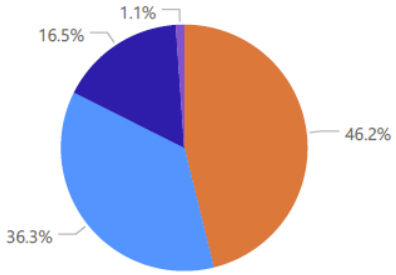
Tool
- Word
- Weet even de naam niet
- Visual Paradigm
- Visio
- Symbio
- Sensus
- Scienta
- SAP

Taal procesmodellering



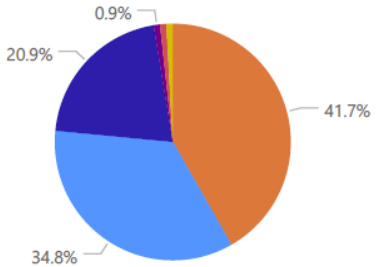
Modelleertaal
- Flow charts
- BPMN (1.0 or 2.0)
- Data flows
- Block and Arrow
- Geen
- geen idee

Procesbeschrijving hoog abstractieniveau



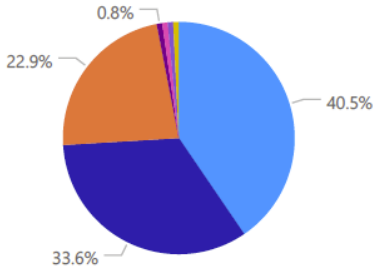
Beschrijving
- Procesmodellen
- Textueel
- Stappenplannen
- Volgens landelijke standaa...

Procesbeschrijving middelmatig abstractieniveau



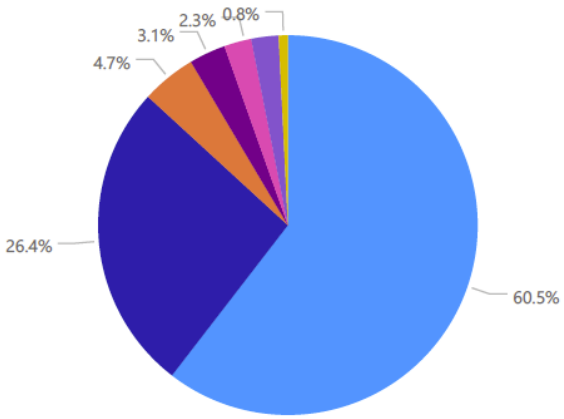
Beschrijving
- Procesmodellen
- Textueel
- Stappenplannen
- RACI tabel
- Stroomdiagrammen
- Turtle

Procesbeschrijving laag abstractieniveau



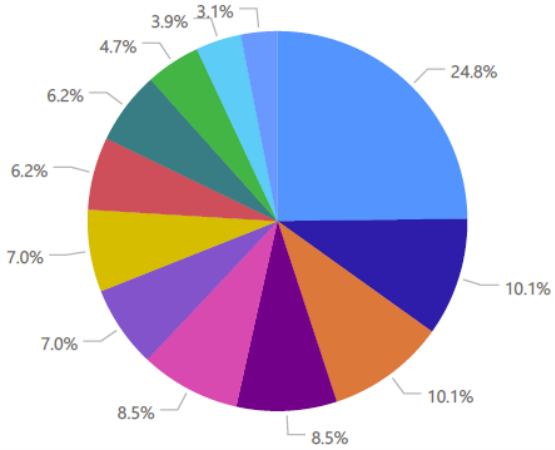
Beschrijving
- Textueel
- Stappenplannen
- Procesmodellen
- ITIL processen
- RACI tabel
- Stroomdiagrammen
- werkinstructie

Aantal applicaties gebruikt

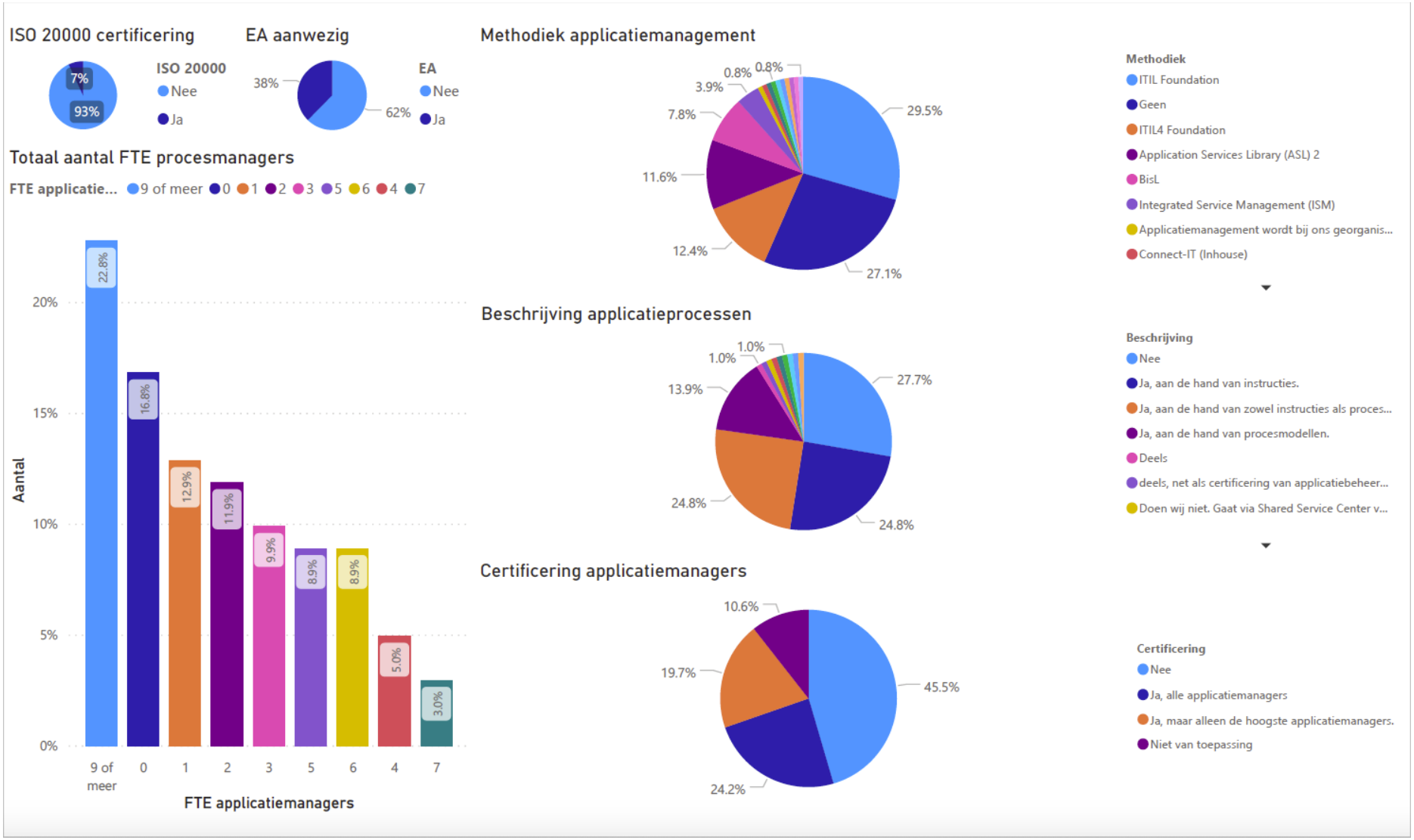


Aantal applicaties gebruikt
- x ≤ 100
- 100 < x ≤ 300
- 300 < x ≤ 500
- 500 < x ≤ 1000
- 1000 < x ≤ 1500
- Weet ik niet
- x > 2000

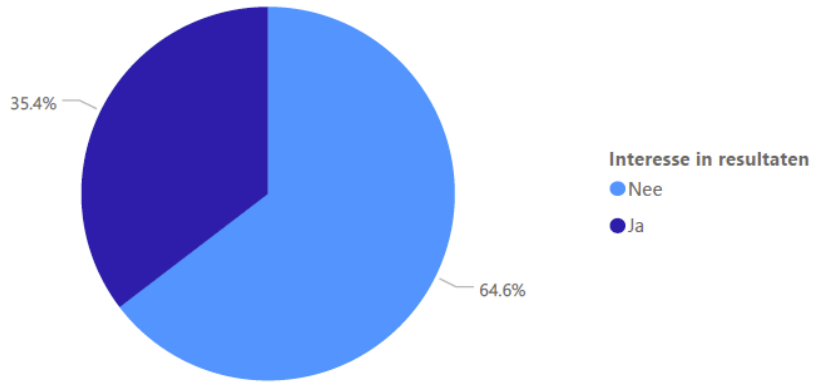
Percentage Organisatiespecifieke applicaties



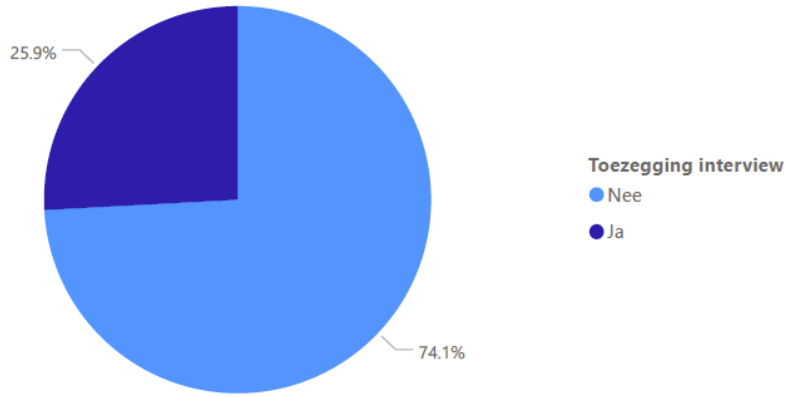
Organisatiespecifiek
- 0% < x ≤ 5%
- 5% < x ≤ 10%
- 60% < x ≤ 70%
- 10% < x ≤ 15%
- 50% < x ≤ 60%
- x = 0%
- x > 70%
- 40% < x ≤ 50%
- Weet ik niet
- 30% < x ≤ 40%
- 20% < x ≤ 30%
- 15% < x ≤ 20%


ISO 20000 certificering
7%
93%
ISO 20000
Nee
Ja
EA aanwezig
38%
62%
EA
Nee
Ja
Totaal aantal FTE procesmanagers
FTE applicatie...
9 of meer
0
1
2
3
5
6
4
7
Aantal
20%
15%
10%
5%
0%
22.8%
16.8%
12.9%
11.9%
9.9%
8.9%
8.9%
5.0%
3.0%
9 of meer
0
1
2
3
5
6
4
7
FTE applicatiemanagers
Methodiek applicatiemanagement
29.5%
27.1%
12.4%
11.6%
7.8%
3.9%
0.8%
0.8%
Methodiek
ITIL Foundation
Geen
ITIL4 Foundation
Application Services Library (ASL) 2
BisL
Integrated Service Management (ISM)
Applicatiemanagement wordt bij ons georganis...
Connect-IT (Inhouse)
Beschrijving applicatieprocessen
27.7%
24.8%
24.8%
13.9%
1.0%
1.0%
Beschrijving
Nee
Ja, aan de hand van instructies.
Ja, aan de hand van zowel instructies als proces...
Ja, aan de hand van procesmodellen.
Deels
deels, net als certificering van applicatiebeheer...
Doen wij niet. Gaat via Shared Service Center v...
Certificering applicatiemanagers
45.5%
24.2%
19.7%
10.6%
Certificering
Nee
Ja, alle applicatiemanagers
Ja, maar alleen de hoogste applicatiemanagers.
Niet van toepassing

Aantal per Interesse in resultaten



Aantal per Toezegging interview



Appendix J: Interviews

Also see 3.1.4 Interviews.

Appendix J-1: Outline interview

As preparation for the interview, an outline is determined for the progress of the interview.

- Welcome
- Results survey
    - Are there any questions or remarks about the results of the survey?
- Interviewee
    - What does your function mean?
    - How are process and application management linked to this function?
- Process managers
    - Is a process manager a role or a function?
    - If function: is this a full-time function?
    - What does this role/function mean?
- Process descriptions
    - Per level:
    - How are the processes described?
    - By what type of function is this done?
- Application management
    - What does the role/function application manager mean?
    - Can the application management be separated into abstraction levels?
- Application process description
    - My definition: a business process that is executed by or with the help of an application.
    - Are application processes described according to this definition?
    - Is this being done at different abstraction levels? If yes, which one?
    - And by who?
- Business & IT alignment (link between business processes and applications)
    - How
    - Does your organization have an Enterprise Architecture or something comparable?
- Software implementation
    - Are you familiar with implementing software applications within an organization? I do not mean the technical part, but adoption/people/change.
    - If yes: how can you make sure that there is good adoption of users when implementing a software application?

Appendix J-2: Summary interview 1

Appendix J-3: Summary interview 2

Appendix J-4: Summary interview 3

Due to confidentiality or privacy related issues, these sections are not published.

Appendix K: Modelled processes ExplainiT

Due to confidentiality or privacy related issues, these sections are not published.

Appendix L: Example screenshots implementation ExplainiT

Due to confidentiality or privacy related issues, these sections are not published.

Appendix M: Reflection on professional functioning

Due to confidentiality or privacy related issues, these sections are not published.