

IMPROVING THE PRODUCT DEFINITION DOCUMENT AT PILOTFISH

BSc Industrial Engineering and Management thesis, Patrick Methorst, 2020

IMPROVING THE PRODUCT DEFINITION DOCUMENT AT PILOTFISH

MANAGEMENT SUMMARY

Pilotfish is a design bureau that struggles with using their IT systems to their full capacity. This became very clear in the Product Definition Document. From interviews it was learned that the PDD had some negative but also some positive factors. These positive factors of the old PDD included the agility and freedom to change the document so it could fit the highly differentiating projects of Pilotfish. On the contrary, the PDD had a information overflow and was difficult to use (especially for new employees of Pilotfish). The PDD has been updated and new technologies were applied to the document. This ensured more standardization and less ambiguity surrounding the PDD. The new working methods ensured a quick process for changing and adapting the new PDD.

The medical Design History File was taken as inspiration for the new PDD. This method changed the PDD from a document with an information overflow to a document that includes all key in- and outputs for the project and serves as an index for all of the other information and documents. In an exploratory survey it was found that the employees of Pilotfish thought this was a better method and that it was estimated to save the employees time.

ACKNOWLEDGEMENTS

I want to thank my supervisors for having (a lot of) patience with me. Mr. Yazan for being critical and forcing me to improve my academic skills rapidly. And especially Marco Heusdens, who had faith in me and gave me this opportunity. I want to thank him for inviting me to his office in Taipei, Taiwan. This year has been different than expected due to the Covid-19 pandemic. After some tough discussions with Marco, I decided to return to the Netherlands. Even though Taiwan was (and at this moment still is) a safer place than the Netherlands. However at the time I was unsure about how the world and the pandemic would evolve. But, I think that at this point in time I can admit that Marco was right and that it was safer to stay in Taiwan and finish my thesis over there. Finally, I want to thank Marco and all the people of Pilotfish for their patience when my motivation and structure was broken down upon my return when going into the first Covid-19 lockdown.

TABLE OF CONTENTS

Management summary	5
Acknowledgements	7
Table of contents	9
Glossary	10
1. Introduction	13
Analysis of the current situation	14
The research question	15
2. Literature	15
Literature on virtual business tools and projects	15
BPM	16
SLR Business Applications	19
3. Methodology	20
The semi-structured interviews	20
Evaluation survey	21
4. Business processes	21
5. Results	24
The interview results	24
Solution generation	26
VBA for Word	28
Microsoft PowerApps	29
Solution choice	29
Tool design	30
6. The evaluation survey	33
7. Discussion & conclusions	36
Discussion	36
Conclusion	37
Limitations & suggestions for future research	38
References	39
Appendices	41
Appendix A	41
Interview template	41

Appendix B	46
Interview analysis table	46
Appendix C	54
Systematic Literature Review Business Tool Design	54
Appendix D	65
Business Process Pilotfish	65
Appendix E	66
Appendix F.....	66
MPSM Phase reports 1-5	66

GLOSSARY

Abbreviation	Meaning	Explanation
AMS	Amsterdam office	One of the office locations of Pilotfish
BER	Berlin office	One of the office locations of Pilotfish
BPD	Business Process Diagram	Diagram that uses the BPMN to visualise Business Processes
BPM	Business Process Modelling	The activity of creating models that suit the processes within a company
BPMN	Business Process Modelling Notation	Notation language that was developed to create BPDs
DHF	Design History File	Required for the ISO 13485 certification related to medical design, is used as an index for other documents
DSRP	Design Science Research Process	Methodological approach to the design of IT solutions
EE	Electrical Engineering/Engineer	Department that handles the electronical part of the project
ID	Industrial Design/Designer	Department that handles the design of the product
IEM	Industrial Engineering and Management	In Dutch: Technische Bedrijfskunde
IT	Information Technology	All of the digital solutions, activities etc.
MD	Managing Director	The director that is responsible for the office and its activities
ME	Mechanical Engineering/Engineer	Department responsible for the mechanical part of the project
MM	Manufacturing Manager	Responsible for the manufacturing of the final product
MoSCoW-rule	Must have, Should have, Could have, and Want-to have	Rule to hierarchically approach a decision making process
MPSM	Managerial Problem Solving Method	Methodological approach for solving problems that occur in business environments
MVP	Minimum Viable Product	The end result that fulfils the lower boundary of what is required

PDD	Product Definition Document	Document that is leading in the projects of Pilotfish and contains all information the client produces and requires
PM	Project Manager	Responsible for managing the project in which a product is designed, tested and made for the client
POC	Proof Of Concept	The concept model of the final product of the project, that is tested, fulfils all requirements, and is approved
R&D	Research and Design	Process of researching a product and its possibilities and designing new products
SLR	Systematic Literature Review	Systematic approach to literature research
TPE	Taipei office	One of the office locations of Pilotfish
UI	User Interface	The way the product interacts with the end-user
UI/UX	User Interface/User Experience	Combination of user interface and the user experience
UX	User Experience	The way the end-user experiences the final product
VBA	Visual Basics Applications	Programming language within Microsoft Office that enable automatization of documents/actions within documents

1. INTRODUCTION

Pilotfish is a contract engineering company. This means that they do the R&D (Research and Design) for (parts of) products of other companies. Sometimes Pilotfish also handles the production the product. Pilotfish has locations in Amsterdam, Berlin, and Taipei. When working on a project, they often work on the project from different offices. This causes the problem that it takes effort to make the required information available and that there are many information flows. Pilotfish is hoping to decrease documentation time to increase the design capacity. Pilotfish documents all the requirements for the product in the Product Definition Document (PDD). They use the PDD to agree with the customer on the final requirements.

A design company such as Pilotfish can act as a technology broker. The company can introduce knowledge and solutions to sectors where these solutions were previously unknown (Hargadon & Sutton, 1997). The process model presented by Hargadon & Sutton (1997) acknowledges the need for a company for access, acquisition, storage, and retrieval of these possible technologies (Hargadon & Sutton, 1997). In particular the storage and the retrieval of these solutions applies to the presented PDD problem.

The complete process starts with the sales force (often one of the managing partners) that negotiates with the client. This is a long process because the client has specific wishes. The specific wishes and different company cultures within the customers companies makes every project different and makes communication difficult.

At the moment, Pilotfish works with a Plan, Do, Check, Act cycle. Their process usually starts with a workshop where the client and the designers get together and define the requirements and how to test the prototype. The result of this workshop is the first draft of the Product Definition Document. This is a document that is hard to work with and is not intuitive. The Product Definition Document currently is a word template. It contains information such as plans on how to test the prototype that is created by Pilotfish, when this will happen, how to get the CE-mark, what the purpose of the product is etc. Another important issue is what to do when the product changes. If the product changes, some or even all of the testing work have to be redone.

The people working at Pilotfish are mainly designers. They want to use the maximum of their capacity to design products for their customers. With the current PDD they have to document more than they wish. This has to be made easier. Besides the amount of documentation Pilotfish uses a lot of standard tests for their products, which have to be added to the PDD easier in an easier manner.

In Figure 1, problem cluster an overview can be found with all identified (relevant) problems. The cluster leads to the following core-problem: *the complicated and time-consuming template (PDD) makes the entire process less efficient.*

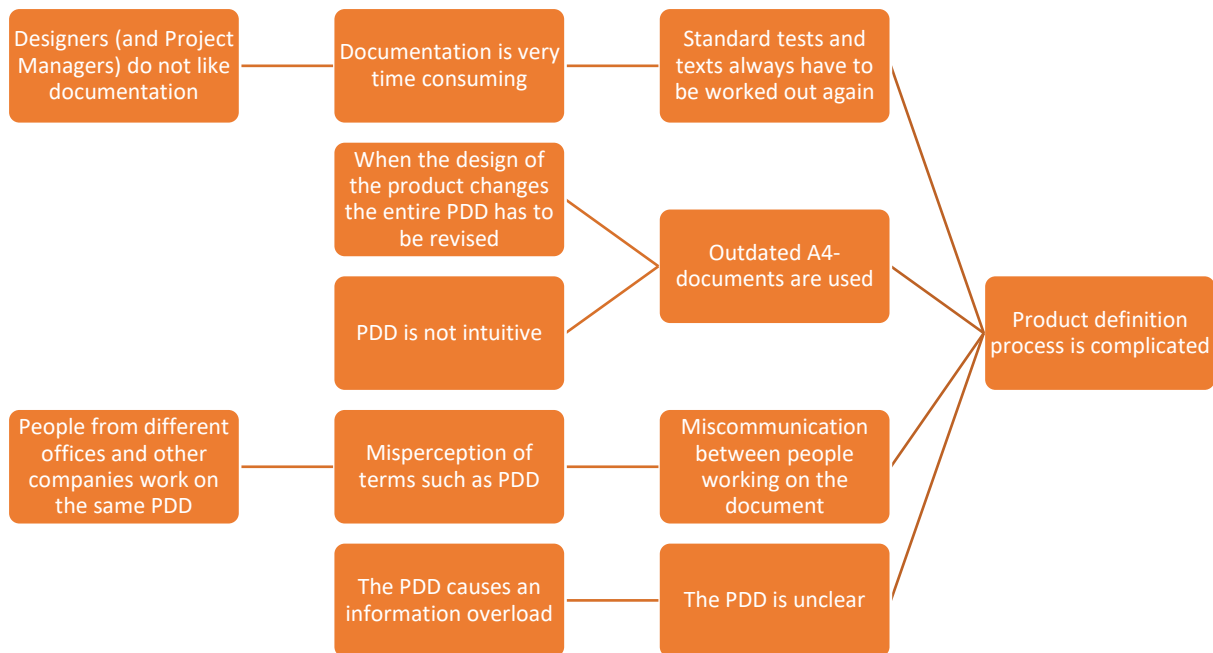


Figure 1, problem cluster

Analysis of the current situation

The current PDD is a Word document, that the people of Pilotfish rate with a fairly low score. The PDD is where the improvement can be made for the entire process. The first meeting with the client is about asking a lot of questions: what do they want? For who is it meant? Etc. After this kick-off meeting the first draft of the PDD is made. The documents consists of several chapters with information about, for example, the requirements, the tests and what materials to use.

An overview of issues with the PDD was made:

- The document has copy-pasted sketches and morphological overviews.
- The Bill Of Materials is made in a word table.
- All the requirements for the design have to be looked up by the designer and checked if they are fulfilled.
- When a requirement changes or the design changes, this has a variable impact on the product. Currently the impact has to be looked up in the PDD.
- The prices of the product are defined at the start of the product, during the design process this is kept in mind and checked if this requirement is fulfilled. The actual price is calculated every time something changes (in a later stadium).
- Every time a revision is made to the document this is noted in the revision table and marked by hand in the document itself. It is saved as a new version of the PDD, this can go to over 18 different versions of the document. The company uses Microsoft office 365.

- The document is hard to understand and not user friendly.

The use of the PDD can be split into two different types of processes: the process where Pilotfish only designs the product and the process where Pilotfish also produces the product. Two different workflow models will be made to analyse the process.

The research question

The problems stated in the previous sector can be solved by creating a more interactive and standardized tool. This leads to the Minimum Viable Product (MVP). A more interactive improvement of the template that maps the workflow and is more convenient to work with. This leads to the research question:

“How can Pilotfish improve their Product Definition process with the help of an interactive tool?”

The answer to this research question will provide a practical framework on how to document and store relevant documents during a project, and how to store and retrieve knowledge from both active as previous projects.

2. LITERATURE

Pilotfish is a company that does not take full advantage of its IT possibilities. Processes are sometimes informally managed. The implementation of Microsoft Office 365 helped improve the IT-architecture of Pilotfish. However, the company acknowledges that not all their tools and business processes are optimal. Therefore, Pilotfish is looking to improve their internal processes and the templates they use for the considered processes. To gain more knowledge about the company itself and managerial views on IT, virtual tools, Business Process Modelling, and business application, literature studies were performed.

Literature on virtual business tools and projects

The sources were acquired via the company or found via databases (Web Of Science). Since Pilotfish works in offices in three countries over the world, the project teams are considered to be virtual project teams. Even though the communication within each office is very direct and often face to face. When the teams work together with an office in another country, it is important for them to communicate with their colleagues in a well structured manner. This can be achieved by standardization of project in- and outputs. Luring dangers of project work in virtual teams are overemphasizing the reporting aspect, communication, and project in- and outputs (Martinic, Fertalj, & Kaplic, 2012). From this it can be concluded that it is important to be aware of the in- and outputs. The PDD is a tool to clarify the project in- and outputs. Figure 2, that was adapted from Martinic et al. (2012) shows the cost of personnel during the project life cycle. The graph shows that the costs are highest when most of the work is done. It is important to manage the expectation in the early stages of the project. These are the inputs for the project, the PDD manages these expectation and contains the requirements set by the customer. Therefore as can be seen in Figure 2 the amount of documentation for the PM (red line) is highest during the initial stages where inputs and expectations are managed. This information was retrieved from the interviews that were conducted at Pilotfish see Appendix A and Appendix B. Projects in virtual teams should be supported by tools for monitoring and control with standardised in- and outputs (Martinic, Fertalj, & Kaplic, 2012). The PDD containing these in- and outputs can be one of these tools. The PDD can be used to standardise deliverables (i.e. a test report).



Figure 2, adapted from Martinic (2012)

It is important to ignore local fast changing application and focus on the applications that are used throughout the company (Akkermans & Van Der Horst, 2002). The focus on what to standardise should be in- and output and the activities in the process. The standardization of IT infrastructure is more important to a networked firm than to regular firms. Standardization facilitates changes within the organisational network (Akkermans & Van Der Horst, 2002). Coercive standardization is when the standardization is ordered from upon. This type of standardization works best when (Akkermans & Van Der Horst, 2002):

- The management has the power to enforce the standardization
- The management has made the right strategic choice for the specific standardization
- The environment does not change that much or not rapidly

This type of standardization is applied to the PDD. It is ordered by the management that is not satisfied with the current PDD.

BPM

Business Process Management (BPM) is a method to analyse and improve the process within a company. The scope of this thesis is not only the PDD itself but also the entire process of using the PDD. The book Business Process Management sets some definitions about BPM:

“Definition 1.1 A business process consists of a set of activities that are performed in coordination in an organisational and technical environment. These activities jointly realise a business goal. Each business process is enacted by single organisation, but it may interact with business processes performed by other organisations.” (Weske, 2012)

This definition defines what should be considered to be a process. It mentions the business goal, therefore it will be important to keep the business goals in mind when working on BPM. The focus is only on the process within the company. The next relevant definition is:

“Definition 1.2 Business process management includes concepts, methods, and techniques to support the design, administration, configuration, enactment, and analysis of business processes.” (Weske, 2012)

This definition mentions the ‘toolbox’ that BPM supplies and what it can be used for, e.g. the PDD process has to be analysed to find the weaknesses of the processes and where the focus should be on. The final relevant definition is:

“Definition 1.4 A business process model consists of a set of activity models and execution constraints between them. A business process instance represents a concrete case in the operational business of a company, consisting of activity instances. Each business process model acts as a blueprint for a set of business process instances, and each activity model acts as a blueprint for a set of activity instances.” (Weske, 2012)

The business process model or Business Process Diagram (BPD) defines the process and can be used as a guideline for how the process should be executed.

Business Process Modelling is the process of creating a BPD. A BPD is a graphical model of a business process; it shows the flows (activities) within the process. A method to make BPDs is the Business Process Modelling Notation (BPMN) (White, 2004). Within the BPMN there are 4 basic categories being (White, 2004):

- Flow objects, i.e. start/intermediate/end events, these are represented by a circle. These events show the start or end of a certain process. An other example of a flow object is an activity, this is represented by a rectangle with rounded corners, activities are all activities that are (or might be executed within the process). The final flow object is a gateway, gateways are represented by a diamond shape. A gateway is used to control the flows it can be assumed to be certain decisions made in the process or when flows are splitting towards several activities at the same moment.
- Connecting objects, the most important connecting objects in BPMN are sequence flows. Sequence flows represent the flow from one activity to another. It connects the activities and shows the order in which the activities are executed. The sequence flow is visualised by a solid line with an arrowhead. An other example of a connecting flow is the message flow, which represents messages between two participants in the process. It is visualised by a dashed line with an empty arrowhead.
- Swim lanes, are divided in pools and lanes. The pool represents a participant, e.g. the company. The lanes represent sub-participants e.g. the employees within the company.
- Artifacts, artifacts can be used to clarify the diagram by for example showing where data is used or when there are particular groups.

The BPMN can be used to communicate information to wide audiences. The two basic types of BPDs are:

- Business to business process, where there is a collaboration with another company
- Internal business process, where the company just works for a client

Depending on the purpose of the BPD different levels of details can be used. The modelling process starts with capturing the high-level activities and usually goes down to further levels of detail. The high-level BPD usually exists out of several sub-processes, these are marked with a ‘+’ at the bottom of the ‘activity’. The low-level is more detailed and shows how the sub-processes work.

Business processes can be classified in several dimensions. These can be found in Figure 3 that was retrieved from Weske (2012). Especially the bottom two processes are relevant when working on the PDD. But also the organisational business process is involved in this research. The separate levels in Figure 3 are all affected by the other levels. Business Goals and Strategies and the Organisational Business

Process will have to be taken into account when working on Operational Business Process and Implemented Business Processes. These processes are focussed on the execution of the actual process and show the relevant relations between activities. The way these boxes affect each other in Pilotfish case is that one of the business goals is to work as efficiently as possible. In the organisational business process box the PDD-project relates to the way that documents and the data is stored. On the operational business process level the PDD is used and the way employees interact with the system and use the PDD to communicate. Finally, the implemented business process level the way the PDD is used is applied.

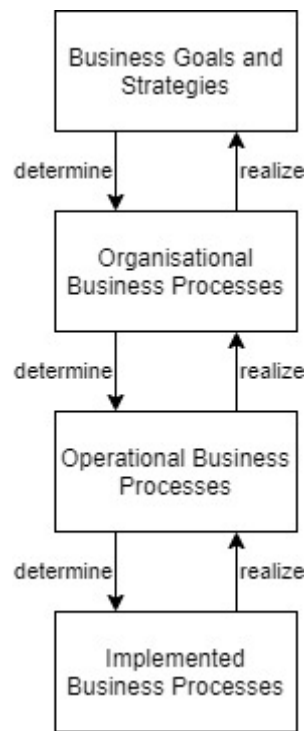


Figure 3, process hierarchy retrieved from Weske (2012)

To consider the organisational level, the next figure was retrieved from (Weske, 2012) see Figure 4.

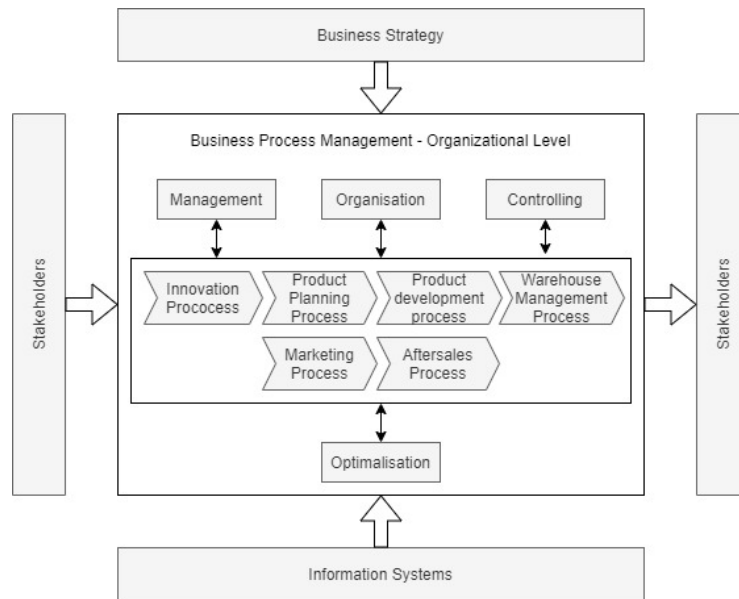


Figure 4, processes and influencing factors

The figure shows that the organisational level business process is influenced by both the business strategy and information systems. Stakeholders are, but are not limited to, external business partners, customers, and employees (Weske, 2012). The internal structure of the organisational level differs per organisation. The organisation in Figure 4 is an example. A table including process name, responsible process manager, type of process, in- and outputs, supplier processes, and customer processes can be used to describe the organisational business process.

BPM can be used to provide more flexibility for the company. A good and explicit BPD can be used for adaption of the process. It is easier to adapt than written information or software codes.

SLR Business Applications

The PDD can be considered to be a business tool. It is not a common software solution but it is considered to be an application used by the employees of Pilotfish. To gain more knowledge on Business Applications, a Systematic Literature Review (SLR) was performed, the complete SLR can be found in Appendix C.

The research question was “what are the attention points when making a business tool that is related to projects in design and engineering?”. The found articles were quite general, but because of their abstractness they can also be applied to a project in design and engineering. In the PDD process there is still a system, entities, and several communications.

The first point of attention that was addressed in the articles was to make a structured business model (Baresi, Fraternali, & Houben, 2007), (Wieringa, Blanken, Fokkinga, & Grefen, 2003). It is important to make a structured approach when identifying the involved entities. What are their roles and what type of access do they have (Wieringa, Blanken, Fokkinga, & Grefen, 2003)? How are the entities involved in the environment? What are the business goals and what are the business requirements?

The application modelling should be focussed on how the entities are communicating and how the software is involved (Shishkov, Van Sinderen, & Quartel, 2006). What are the user requirements and how do you apply them to your architecture.

Concluded from the article could also be that business modelling is important and that it is important to have a structured approach for application modelling (Baresi, Fraternali, & Houben, 2007), (Shishkov, Van Sinderen, & Quartel, 2006), & (Wieringa, Blanken, Fokkinga, & Grefen, 2003). In the articles several steps are taken for this structured approach.

3. METHODOLOGY

The problem that is solved in this thesis can be seen as a case study where a practical problem is solved. During the thesis data will be collected via semi-structured interviews, which will provide qualitative data, and via an evaluation survey, which will provide quantitative data. This data will be used to analyse the problem and at the end of the project the quantitative data can be used to draw conclusions on whether the solution is successful.

To solve the given problem a hybrid version between the Managerial Problem Solving Method (Heerkens & Van Winden, Geen Probleem, 2012) and the Design Science Research Process (Peffer, et al., 2006) will be used. For the explanation about this methodology the project plan by Methorst (2020) can be consulted. This problem solving methodology provides the right combination between the MPSM and the DSRP, especially the solution implementation phase is less suitable for the concerned project this phase will be substituted by the design and development, and the demonstration phase of the DSRP. The used phases of the DSRP are better suited for creating an interactive tool.

Besides interviews, a survey, and a structured approach to solve the problem, workflows and BPM can be used to analyse the company and to help solve the problem by providing a fundament for the solution. By creating an overview of the company and its processes, the diagrams can be used as a guideline for the solution implementation (Weske, 2012).

The semi-structured interviews

Semi-structured interviews have advantages and disadvantages. By conducting a semi-structured interview you can gather information that you would not gather by use of a survey (Heerkens, Microlecture Methodology, 2014). In the Essay assignment IEM (Methorst, 2019), a checklist was made for conducting interviews. This assignment provided a checklist for interviews, the checklist was made by taking information from various sources within deferent field of research (Cooper & Schindler, 1976), (Guion, Diehl, & McDonald, 2001), (Heerkens & Van Winden, Geen Probleem, 2012), & (Jacob & Furgerson, 2012). The checklist concluded in to the following questions (Methorst, 2019):

- Was the interview thematised/the topic researched before the interview?
- Was the structure of the question sheet good? Did the interviewer have a preface? Small space for notes? Post interview comment sheet?
- Were the conditions denoted?
- Did the interview start with a scripted introduction/small talk?
- Did the interviewer use a recording device?

- Were the questions open ended and expansive?
- Did the interviewer use prompt to steer the interview in a certain direction?
- Did the interviewer identify hobby-horses?
- Did the interviewer stay neutral?

By using the guidelines, a good interview can be made that can be used to collect sufficient qualitative data to help solve the solution. However, qualitative research also has a major disadvantage. It is a vast amount of work to analyse the qualitative data. A method to analyse qualitative data is to use software that analyses the given answers. This software analyses the given answers and searches for certain themes within the given answers (Dennis & Bower, 2008). The given answers are labelled by their theme. It was proven useful to use dichotomies such as positive/negative, increase/decrease etc. (Dennis & Bower, 2008). From the codes, a frequency list can be developed (Dennis & Bower, 2008). The choice was made to manually list all answers to the interview questions in a document and give the answers a 'tag' for analysis purposes and to list whether the given answers were positive or negative about the PDD. This method filters the rough unmanipulated data from the interviews to manageable amounts of data in the same manner that software would. Besides giving the answers tags, the answers given on the questions were marked as either positive (pos), neutral/indifferent (-), or negative (neg) see Appendix B.

Evaluation survey

At the end of the project, a quantitative survey was held to gain some knowledge about the effectiveness of the proposed solution. This is part of the final phase of the MPSM. The Likert scale was used for this survey. The advantages of the Likert scale are that it is easy and quick to construct surveys using the Likert scale, it differentiates between favourable and unfavourable answer options, it provides more reliable data, and it provides interval data (Cooper & Schindler, 1976). The result were analysed. However, since there are only few people working with the PDD, the statistical significance of the survey is limited. The answers to the survey might still give an implication about the success of the project. Hence, the survey is exploratory.

4. BUSINESS PROCESSES

The analysis of the business process was started by creating a full overview of the entire project process. This is a large extensive process that covers the full project and the entire business process of Pilotfish. The full image can be found in Appendix D. This figure was made using the BPMN, this provides a clear overview of the processes within Pilotfish. Using the theory by Weske (2012) these processes can be analysed and the need for the right solutions can be identified.

Pilotfish is a design company that uses its knowledges and talents by using the most suitable employees for each project. The locations, Amsterdam, Berlin, and Taipei, are led by a managing director. However, there is no such thing as middle management within the company (Pilotfish has a flat organisational structure). Each office is supported by an office manager that supports the local staff with their needs and questions. The organisational 'structure' can be seen in Figure 5.

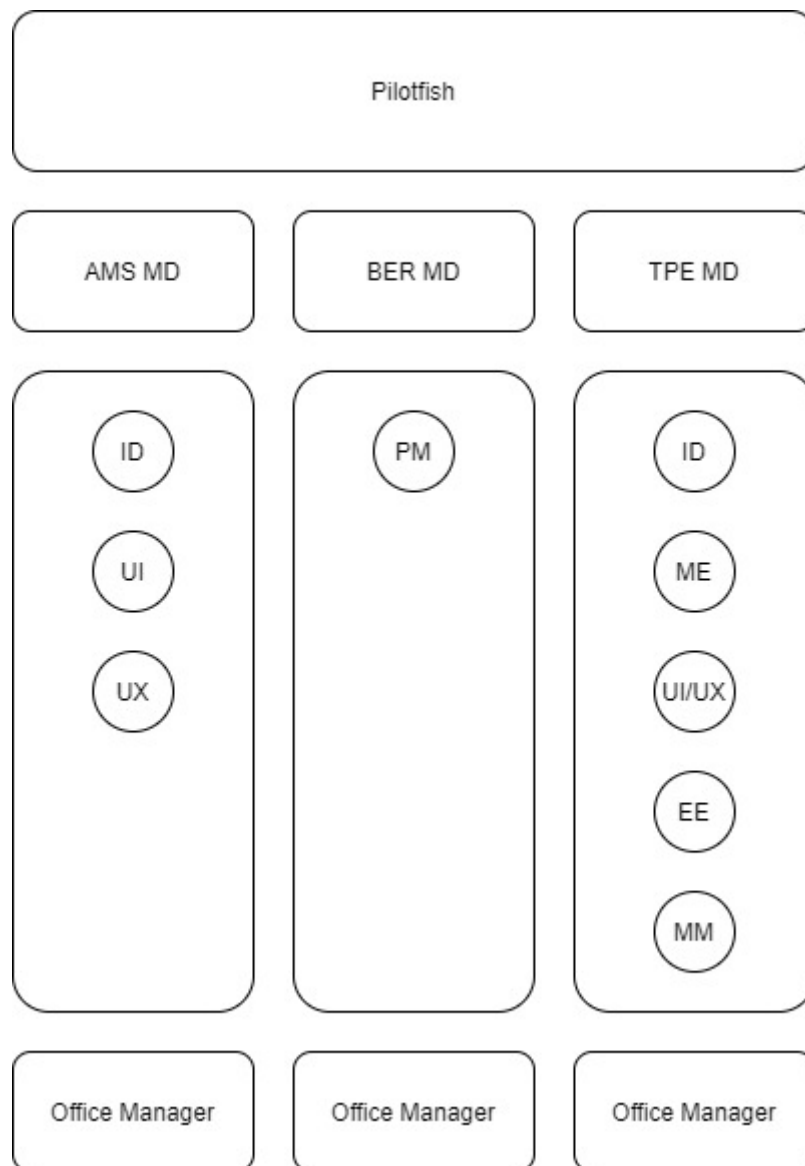


Figure 5, organisational structure Pilotfish

The different talents from the different offices are combined in a project. However, (almost) all of the projects involve the TPE office since this is the biggest office with the most expertise and knowledge.

The full process, as can be found in Appendix D, is the full project with all of its phases. This is a long and extensive process that involves every project from start to finish. However, there are different starting point for different projects. Some of the clients have already finished the first few phases of the project by themselves. E.g. the client has made their product design, but needs the expertise of Pilotfish in the engineering phase of the project. This can also be found in the Business Process Model. The Documentation that is leading are the deliverables such as the POC and the PDD. The maiden difference between the deliverables specific to a phase and the PDD are that the specific deliverables are finished and closed off at the end of the phase whilst the PDD is approved and will evolve during the project. At the end of the project the PDD has evolved from rough key in/outputs to a complete overview of the entire product/project. The Process of a PDD can be found in Figure 6, at the start of a project, Pilotfish makes a bid for the project and documents its use-case. During the project kick-off workshop the use-case

document evolves into a more complete document with most of the information necessary for the start of the project. The customer has to approve the PDD after every phase, when they disapprove the PDD the document has to be improved and approved by the client again. From Figure 6 it can be seen that the process is a cycle that after every phase is updated. Hence, it is important for the client that the PDD is easy to read and understand. It has to be recognizable for the client. Besides that the PDD should enable the evolving nature of the document and keep its agility to satisfy the clients wishes.

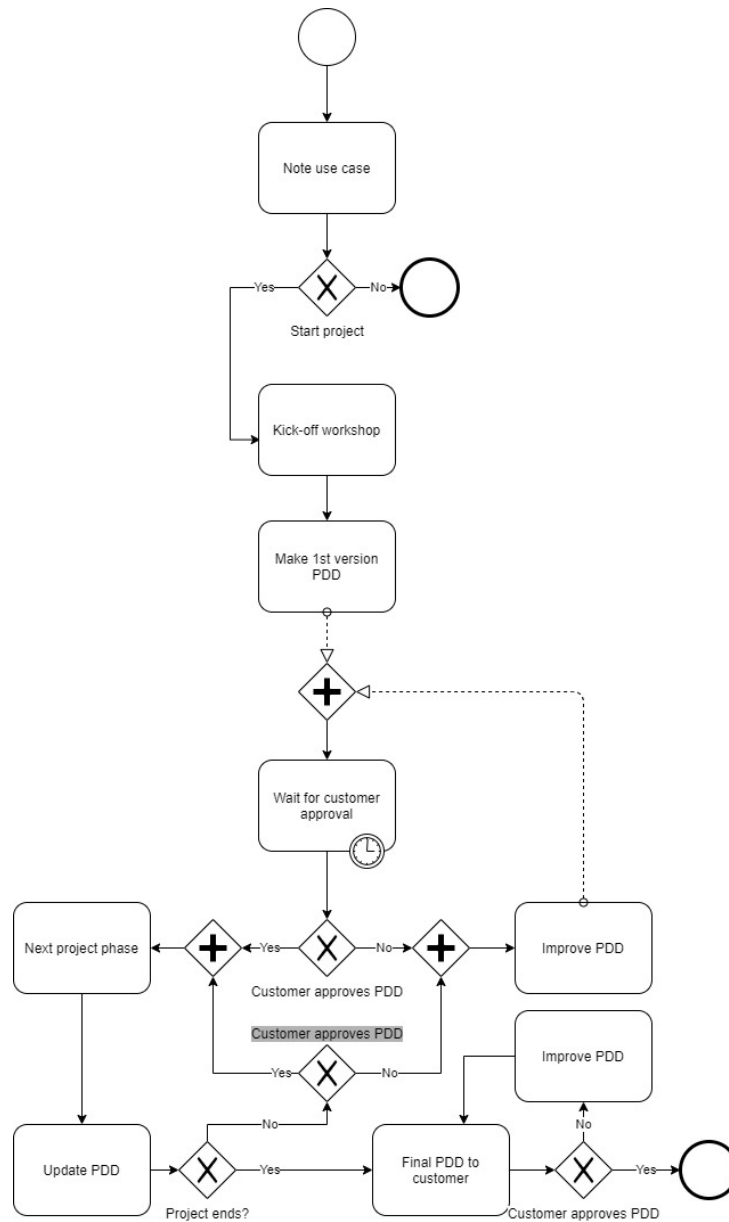


Figure 6, PDD process

The next process flow can be found in Figure 7. This figure visualises the communication process between the client and the project team with regard to the PDD. From the figure can be learned that the PM is in the pivotal position of the communication process with the client. After each phase the PM communicates the changed PDD and its deliverables to the customer. The solution should enable easy communication with the client, where the client needs less updates via the PDD.

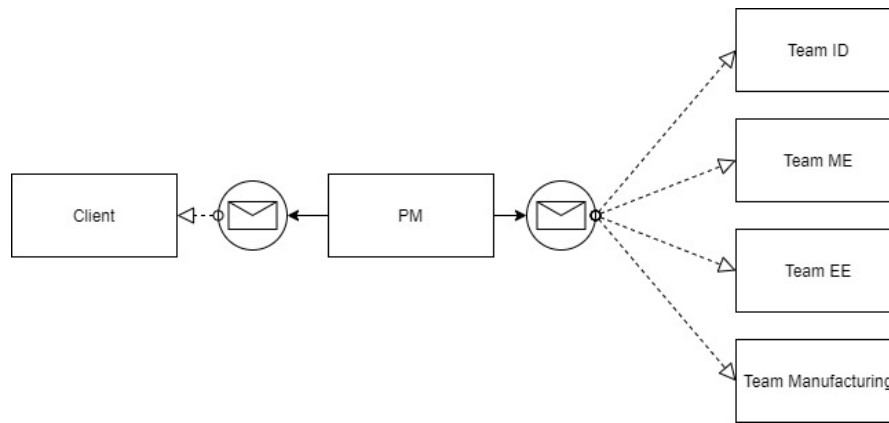


Figure 7, communication with the client

The conclusions that can be drawn from the business processes is that the PDD is an important communication tool with the customer. The PM is the key communicator with the client and thus it should be easy and understandable for the PM to update the client. The PDD should inform the client about its content and all other deliverables, that differ per phase. For the PDD to be approved, the client should understand what the PDD is about and the PDD should be recognisable to the client. This can be achieved by applying some standardization, but with keeping the agility that is needed for the differentiating moments to start a project and the variable subjects of the projects.

5. RESULTS

The research was started by analysing Pilotfish' structure and its processes. The full overview of this can be found in chapter 0. Besides that knowledge had to be gained by interviewing the employees of Pilotfish. The semi-structured interview provided enough freedom to gain 'unexpected' answers and advices.

The interview results

The interviews were held on location or via the online communication platform Microsoft Teams. The full interviews and the transcriptions can be found in Appendix A. The results were analysed as has been explained in the paragraph: The semi-structured interviews. Of the given answers an analysis was made based on the tags that could be related to the given answers. The full table of the tags can be found in Appendix B. The frequency table of the tags can be found in Table 1, Table 2, and Table 3.

Q1	Freq	Q2	Freq2	Q3	Freq3	Q4	Freq4
PM	4	Unfamiliar	4	Key in/outputs	4	Phase dependent	6
ID	2	Familiar	3	Requirements	3	Not often	1
UI/UX	2	Very familiar	2	Customer agreements	2	Boring	1
MD	1	dependent on project	1	Summary	1	Not sure	1
ME	1	Scoping	1	Structure	1		
MM	1	Procastrinate	1	Unsuitable	1		
PD	1	communication	1				

Table 1, frequency table Q1-Q4

Q5	Freq5	Q6	Freq6	Q7	Freq7	Q8	Freq8
Cultural difference	2	Incidental	8	Interpretation	3	Key in/outputs	3
Strategic alignment	2	Information alignment	1	Standardization	2	User friendliness	2
Communication	2	Approval	1	Roles	1	Adaptability	2
Own interpretation	1			Working methods	1	DHF	1
Unclarity	1			Client focus	1	Communication	1
Cooperation	1			Project scope	1	Categorised	1
Good	1			Updating	1	Attachments	1
Dependent	1			Alignment	1	Incomplete	1
Irrelevant parts	1					Irrelevant parts	1
						Phase dependent	1

Table 2, frequency table Q5-Q8

Q9	Freq9	Q10	Freq10	Q11	Freq11	Q12	Freq12
Agile	3	Personal	2	User friendliness	2	Definition	2
Size	2	Interpretation	1	Focussed PDD	1	Medical Design	1
Structure	2	Standardization	1	Communication	1	Alignment	1
						User friendliness	
Guidelines	2	3	2	Definition	1	friendliness	1
Unsuitable	2	2,5	1	Simple use	1	Key in/ouputs	1
Inconvenient	1	5	1	Alignment	1	Freedom	1
Incomplete	1	4	1	Demand management	1	EE	1
				Agility	1		
				Freedom	1		
				EE	1		
				Macro functions	1		
				Differentiation	1		

Table 3, frequency table Q9-Q12

One of the most interesting given answers was to keep the Design History File (DHF) in mind. The DHF is an obligatory collection of all documents related to medical devices. Pilotfish hopes to receive an ISO13485 certification in the future; the DHF is part of that. The DHF can be seen as an index that links to all relevant information and documentation of the product.

It is also interesting to note that not every employee is familiar with the PDD. This is often related to their function in which they are not creating the PDD themselves. The employees that are familiar with the PDD are often PM/MD/MM. According to the employees of Pilotfish, the PDD is about the key in/outputs set by the clients requirements. How often the PDD is used by the employees is phase dependant. This is an indication that the PDD evolves and has different types of use during the different stages of the projects. One thing that was interesting about the question regarding communication between the separate office was that the employees thought there were some cultural differences, but especially some strategic misalignment and unclarity. This might be solved by standardizing the PDD so everybody has the same idea of what the document is about. However, communication mistakes between the offices only occurred incidental.

The Pilotfish employees thought that there was a space for own interpretation in the old PDD and that it needed more standardization. They expected the PDD to contain the key in/outputs and to be user-friendly and adaptable. The employees thought that the old PDD was agile, but also very large, missing structure and guidelines and that it was sometimes unsuitable for the specific project.

Interestingly the question how they would rate the old PDD was for some employees hard to answer. Others rated it average, whilst some rated it high because they well understood the PDD and therefore rated it high. On average the given grade was a fairly high 3,5 (however this grade is including the high grades based on personal experience). From the final question about personal advice, the answers were very diverse, and differed from user-friendliness, alignment and agility to adding an electrical engineering part (which was missing) and using macro functions to improve the Word document. The final remark about what stood out during the interviews included definitions, alignment, and user-friendliness. But also adding an EE part and taking inspiration from medical design.

Finally the number of positive and negative answers regarding the PDD were analysed. From the given answers 37 were tagged as being negative towards the existing PDD. Negative answers were for example answers about the employees being unfamiliar with the PDD, employees missing strategic alignment within the PDD, and the PDD being inconvenient/unsuitable and not user-friendly. Positive answers good be related to the high degree of freedom/agility of the current PDD and the personal experiences of the employees. The full analysis of the interview including the tags and the positive/negative tags can be found in Appendix B.

Solution generation

To solve the problem, there are two possible solutions that fit the company. Meaning that they are available within the IT-architecture (the office 365 environment of Pilotfish). Both might be able to fulfil the requirements. The possible solution are:

- VBA for Word
- Microsoft PowerApps (low-code application builder)

The decision will be made using a weighted decision, where criteria will be used and judged. The weighting of the criteria will be based on the so called MoSCoW-rule, this stands for; Must-have (qualifier), Should-have (important, however the solution also works without this criteria), Could-have (not too important, these criteria receive a lower weight), and the Want-to-have (not important, these criteria are the first criteria to be dropped). The cumulative of the weights should be equal to 1,0.

$\sum_{i=1}^N w_i = 1,0$. The criteria will be graded with a score on a scale from 1 to 5. The solution that receives the highest average score will be the advised solution to the problem.

The criteria that are set for the solution are chosen based upon the needs of the company and other requirements that are considered necessary. As been noted before, the weights of each criteria is based on the MoSCoW-rule.

Must-have (qualifier):

Must be available within the companies IT-infrastructure, the possibilities within office 365 are considered to be sufficient to solve the problem. Therefore there is no need to make extra investments for the solution to this problem

Ability to document the requirements, the PDD is about documenting all requirements for the products designed by Pilotfish within its projects.

Should-have (high weight):

1. *Possibility to adapt to new situations*, projects at Pilotfish are highly customised to the customer's wishes. This means that every new project is different from former projects. This might also affect the PDD.

2. *Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer*, the PDD is meant as a method to communicate the requirements to the customer. The customer has to approve the document to proceed on the project. Besides communicating to the customer, the PDD can also be used as a source of information to the employees working on the project. Each of the different teams has different interests in the content of the PDD.

Could have (medium weight):

3. *Methods to make the PDD more intuitive*, the main problem of the current PDD template is that it is hard to work with. It should become more intuitive and easier to get a clear overview.

4. *Possibility to insert guidelines on how to work with the solution*, the current template lacks information on how to use it. For new employees that work on it for the first time this might be helpful to make the document.

Want-to-have (low weight):

5. *A automated logbook of the changes within the document*, changes on the document have to be noted for the customer to get a clear overview from what changed since the previous version of the PDD.

6. *A function to easily insert other documents*, the PDD might refer to 3D models or other reports.

The criteria are scaled in categories. The must-have criteria do not receive a weight since they are qualifiers and thus have to be met. If the qualifier criteria are not met, the solutions are not an option. These criteria are only rated with a yes or a no.

The other criteria are weighted as follows: High (0,30), medium (0,15), and low (0,05). These weights are scaled such that $\sum_{i=1}^N w_i = 1,0$. The high importance criteria are twice as high as the medium criteria. This means that there is a clear difference between the should-have criteria and the could-have criteria. Because of this distinction in weights the MoSCoW-rule is correctly applied. Finally the low weight are a third of the medium weight and a sixth of the high weight. They account less to the grade than high or medium.

As been noted before, the available solutions are:

- VBA for Word

- Microsoft PowerApps (low-code application builder)

Both these solutions fulfil the must-have requirements. The solutions will therefore be tested with the decision making table, that can be found in Table 4.

Criteria	VBA for Word			Microsoft PowerApps		
	Score	Weight	Total	Score	Weight	Total
Criterion 1 (Adapting)	4	0,3	1,2	2	0,3	0,6
Criterion 2 (Clear overview)	3	0,3	0,9	4	0,3	1,2
Criterion 3 (Intuitive)	3	0,15	0,45	3	0,15	0,45
Criterion 4 (Guidelines)	2	0,15	0,3	3	0,15	0,45
Criterion 5 (Logbook)	2	0,05	0,1	1	0,05	0,05
Criterion 6 (Insert documents)	3	0,05	0,15	4	0,05	0,2
			3,1			2,95

Table 4, MoSCoW-table solution decision

From the decision process, it can be concluded that VBA for Word is the best option, although this is by a narrow margin. Both alternatives might not be the optimal solution. However, these solutions lay within the scope of the project and suit the current situation at Pilotfish. Other solutions will be considered in the chapter on further research.

VBA FOR WORD

VBA for Word was chosen as a solution because it has possibilities to automate certain tasks within Word. Word is available within the company and can be used to inform both the customers as the employees within the company.

Possibility to adapt to new situations, the solution scored 4 out of 5 for this criterium. The users are very familiar with Word and can always add new bits to the document by hand. This could be the case when a new chapter that normally is not used within the project has to be added to the PDD. However it might be the case that the VBA part will not work for this added part.

Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer, the solution scored 3 out of 5 for this criterium. With the right use, Word can be very clear. VBA will help with this. However when the solution is not correctly used, it might become more less clear.

Methods to make the PDD more intuitive, the solution scored 3 out of 5 for this criterium. VBA will help making the PDD more intuitive, but the own input of the user will also remain important.

Possibility to insert guidelines on how to work with the solution, the solution scored 2 out of 5 for this criterium. It is possible to insert guidelines. However it is unclear if this can be done in an aesthetic way.

An automated logbook of the changes within the document, the solution scored 2 out of 5 for this criterium. With VBA it is possible to automate certain tasks. However it is unclear if there is an aesthetic method to reach this goal

A function to easily insert other documents, the solution scored 3 out of 5 for the criterium. It already is possible to add documents to a Word document. However it might be a more ambiguous way to add a document.

MICROSOFT POWERAPPS

PowerApps is a low-code application builder that is available in the office 365 package that Pilotfish uses. It can be used to show information to all people that have access to the App.

Possibility to adapt to new situations, the solution scored 2 out of 5 for this criterium. New parts can be added to existing apps, although this is ambiguous and for ever new project a new app has to be made.

Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer, the solution scored 4 out of 5 for this criterium. The apps give a clear overview and can easily be used on multiple devices. It might be a bit harder to supply the customer with all information.

Methods to make the PDD more intuitive, the solution scored 3 out of 5 for this criterium. An app is more intuitive than a template document. Especially with the right design it is possible to make an intuitive app.

Possibility to insert guidelines on how to work with the solution, the solution scored 3 out of 5 for this criterium. It is possible to insert guidelines within the app. However, the functionality of the PowerApps platform that is available seems restricted.

A automated logbook of the changes within the document, the solution scored 1 out of 5 for this criterium. It seems impossible to apply this to an app correctly with the functionalities that are available for PowerApps.

A function to easily insert other documents, the solution scored 4 out of 5 for the criterium. It is possible to add documents to an app.

To conclude, PowerApps is especially lacking on the ability to adapt to new situations. Pilotfish works in projects where sometimes unforeseen situations (and thus chapters) happen in a project. Therefore, Pilotfish requires a agile solution that can easily be adapted to new situations.

Solution choice

The proposed solution of phase 4 was presented to the company supervisor. After an explanation about why certain criteria where set and grades were given to criteria, the company supervisor agreed with the proposed solution. The concern that had to be checked is that VBA for Word would be available for the long term. After consulting the Microsoft roadmap, no signs could be found to show that Microsoft would stop the usage of VBA. It could also be assumed that Microsoft would not stop using VBA because companies did invest in VBA tools. To conclude, the chosen solution to implement in phase 6 is VBA for Word.

However, after experimenting with the application of VBA user forms, it was found that this solution was not sustainable for the company. Due to the limited agility and the too limiting tunnel vision created by the user form that was used to fill in the document. Therefore, the choice was made to switch to controls in Microsoft Word these are still a part of VBA. These enable the same kind of standardization but are more agile and easier to understand for the employees working with the document

Tool design

The tool was made based on the several requirements and ideas set by the interviews and the findings of the different business processes. The requirements can be found in chapter 0. Besides the requirements also some ideas should be applied to the final product:

- Focus on key in and outputs
- Create guidelines for the employees using the PDD
- Created in a way that it suits the central communication role of the PM
- The use of clear definitions
- Make the template more user-friendly
- Easy alignment via the PDD
- Keeping the agile nature of the old PDD
- Support the evolution of the project
- Taking inspiration from the DHF

Combining these ideas led to a Word document that enabled easy communication.

As a base for the new PDD, the old PDDs content was used as an input. However, the order of chapters in the old-PDD seemed unsuitable for the right evolution of the project. Hence, the order of chapter was changed to suit the project evolution better. For example, every project starts with an use-case, then develops through design to the technical documents, testing and the practical information such as the transportation boxes. The new PDD was set-up to follow this path.

Next to the unsuitable chapters, the great amounts of information overflow were identified and set-up as separate documents. The separate documents can be placed in the dedicated folder structure and are linked to within the PDD. This has been inspired by the index function of the DHF. The use of the DHF method is a first step towards gaining a ISO 13485 certification. The set-up of the cloud folder structure and the way they link to the PDD can be found in Figure 8. Via the program Microsoft SharePoint (that links to the cloud database) Pilotfish will share the available documents with its clients. The PDD will have links to the several SharePoint locations.

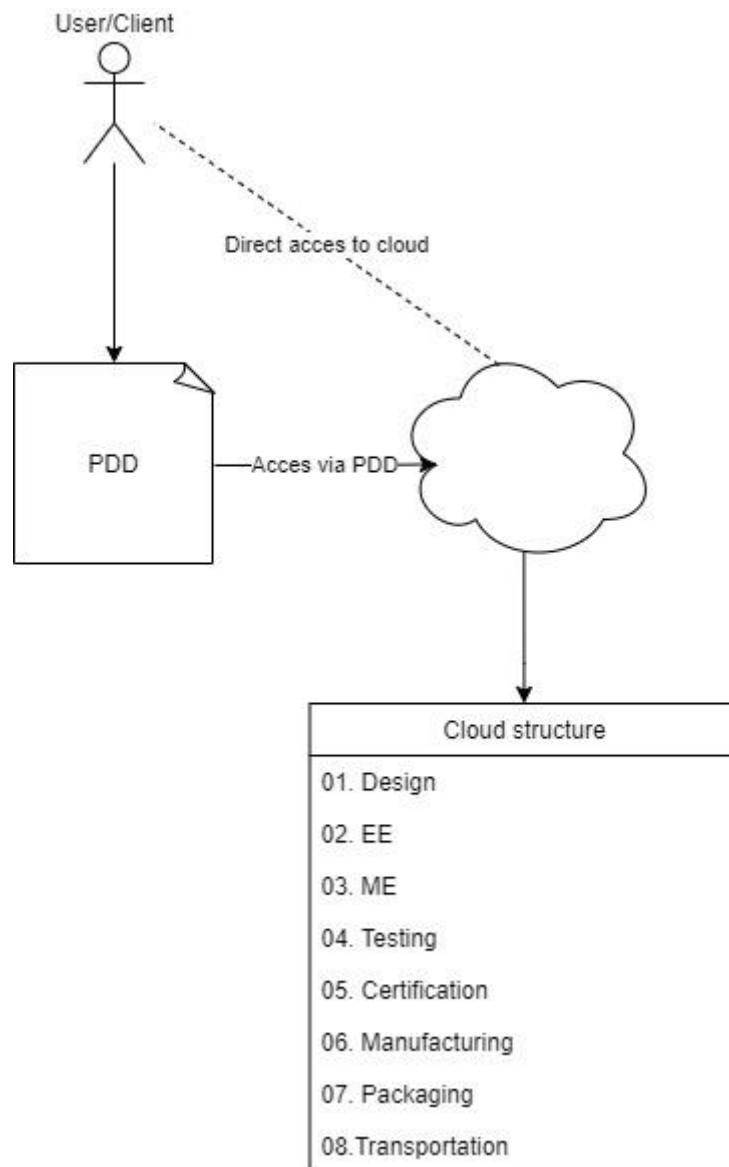


Figure 8, PDD and folder structure

To make the document easy to use, several types of controls were used when making the PDD. The full working PDD can be found in Appendix E. These controls were:

The rich text content control

This control has the option to copy and paste texts, tables and figures. Besides the option of copy-pasting texts, tables and figures into the content control, a guideline text can be used to hint the user towards what is expected in that dedicated area. For example, the product use case needs a description of how the user uses the product. This description can be stimulated by asking question such as: How does the user operate the product.

The picture content control

By using a picture content control it is easy and fast to insert a picture into the PDD. Since most of the 3D sketches will be available in the folder structure less picture of the 3D model in the PDD are needed. The user can click the control and insert it in the PDD very quickly. An example of the picture that will be used

in the PDD is an overview of the full assembly (whilst the more details can be found in the 3D models in the folder).

The check box content control

For some of the parts, it is easier to make a choice based on options where more options are available. The checkbox will enable the user with quick to use lists. An example where this control is used is the EE part, where the user can select the electrical source type, port types etc. This form has options that have to be selected.

The combo box and dropdown list content control

The difference between the combo box and the dropdown list is marginal, however in the case of Pilotfish it is important. A combo box gives the freedom to type in other options than the given ones in the list. On the other hand the dropdown list narrows down the options for the users and forces them to make a choice. For the PDD freedom is important. Hence, the combo box content control is used instead of the dropdown list. Because of the evolving and differentiating nature of the project the agility of the combo box is needed.

The date picker content control

The date picker content control provides the user with a simple method to fill in dates into the document. For example to update the last revision date of certain documents in the cloud.

The building blocks content control

Finally the last content control the building blocks enable the user to adapt and easily choose entire pieces of text that include content controls. This control is used for chapters that are variable on their content or unused in the early stages of the projects. It provides the opportunity to refer to the fact that the given chapter will be added in the latter stages of the project. A so called “nested” system is used by applying building blocks within building blocks. This causes the document to have a cleaner look and easier to understand for both the employees of Pilotfish as its clients.

When creating the new PDD the role of the PM was kept in mind and a structured approach of the document was used for the PDD. However, content wise the new PDD is not fully complete since the PDD template should evolve and perfected on its content by trial and error.

6. THE EVALUATION SURVEY

The evaluation survey only received 6 responses. Therefore, no statistical validity can be put upon the survey. However it can be assumed to be an exploratory survey, where the answers do give an indication about whether the PDD has been improved.

1. How on a scale from 1 to 5 (1 is low satisfaction, 5 is high satisfaction) would you rate the new PDD

● 1 (very unsatisfying)	0
● 2 (unsatisfying)	0
● 3 (neutral)	4
● 4 (satisfying)	1
● 5 (very satisfying)	1



Figure 9, explorative survey question 1

The answers given on the first question in Figure 9 are either neutral (people are not satisfied nor unsatisfied by the PDD) to very satisfying.

2. Do you think the new PDD is an actual improvement?

● 1 (high decline)	0
● 2 (decline)	0
● 3 (neutral)	0
● 4 (improvement)	5
● 5 (high improvement)	1

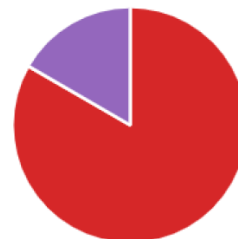


Figure 10, explorative survey question 2

The second question, see Figure 10, points out that everybody agrees that the new PDD is an improvement. This is a positive outcome and a sign that the solution works for the employees of Pilotfish.

3. How much time do you think the new PDD will save? (based on how much time you used to spend on it in percentage)

● 0%-10%	1
● 11%-20%	1
● 21%-30%	3
● 31%-50%	0
● More than 50% of time	1



Figure 11, explorative survey question 3

To the third question in Figure 11, most people answered that they thought that they would save time, only one respondent answered with the first option 0% - 10% which indicates that the respondent think that the new PDD does not save the respondent some time. However the majority think the new PDD will save a lot of time with the most frequent given answer being between 21% - 30%.

4. Do you think the new PDD will be easier to understand and work with (for both the client and you)? (5 point)

● 1 (very hard to understand)	0
● 2 (hard to understand)	0
● 3 (neutral)	1
● 4 (easy to understand)	3
● 5 (very easy to understand)	2



Figure 12, explorative survey question 4

The respondents were either neutral (1 respondent) to positive about how easy it was to understand the new PDD. This can be seen in Figure 12.

5. How well do you think the standardization of this document will work?

● 1 (very bad)	0
● 2 (bad)	1
● 3 (neutral)	1
● 4 (good)	3
● 5 (very good)	1



Figure 13, explorative survey question 5

On the last question about the standardization of the PDD the given answers were more differentiating, see Figure 13. The answers were more diverse with one respondent that thought that the standardization would not work well. However still the majority of the responses indicate that the employees of Pilotfish think that the standardization works well.

To conclude from the exploratory evaluation survey, most of the employees are positive about the proposed solution. However, some employees seem to be more neutral or critical about the new PDD. This might be caused by the fact that the content of the PDD is not fully optimized to the content of the projects. The content of the new PDD should be optimized by applying it to some practical cases.

7. DISCUSSION & CONCLUSIONS

Discussion

A structured approach is important when making digital tools. What are the needs of the user and how are the user needs applied to the final product? The new PDD enables the user to work faster. The use of interactive tools makes life easier for the Pilotfish employees and ensures more strategic alignment by making use of standardization and guidelines.

The PDD is a very evolving document as has been identified, through phases and client approval/disapproval the document grows. The new PDD enables methods to make this easier and provides the employees of Pilotfish with easy adaptation methods. This also lines up with the goals of Pilotfish to gain an ISO13485 certification in the future. The first step towards that was taken by using the index philosophy of the DHF and apply it to the new PDD. This makes it easy to adapt documents apart from the PDD.

Since Pilotfish is only a small enterprise, the evaluation survey was limited in its statistical validity, the evaluation can be seen as explorative. To gain more validity more people should fill in the survey to gather data. However, this is not possible within the limits of Pilotfish. This is a first direction for future research: how does the application of content controls to create an agile, evolving document work in other comparable design bureaus. However, this is also dependant on the size of the firm. Big firms are known to have their own platforms in which they share their documentation. Whilst smaller firms have their own working methods. Besides researching different design bureaus another option for gathering more quantitative data for statistical analysis is conducting a survey amongst the clients of Pilotfish. However, there are only a few projects that Pilotfish works on at the time. So gathering this data will take a long time.

The systems of Pilotfish are limited, and the technical resources were sufficient to solve the given problems at Pilotfish. Using other systems/apps would have been more expensive for Pilotfish and unnecessary since the tools that are available at Pilotfish are sufficient. The new PDD is agile and provides the user with plenty of freedom to adapt to the projects.

To conclude, the new PDD enables the employees of Pilotfish to work more efficient with the documents and will make the PDD writing process quicker. It was available within the systems of Pilotfish and did not need extra investment from Pilotfish' perspective. The MVP was fulfilled because a more interactive tool as a solution to the PDD problem was made.

Besides improvements to the PDD itself, this study also provides BPMs. These models show the processes in which the PDD is involved. Since the PDD is one of the key communication methods with the clients this is a fairly important step into identifying potential bottle necks within the process. So besides the new working method for Pilotfish and an new tool these BPMs are also contributing to Pilotfish practical knowledge and will help the company improve all of their processes.

The theoretical contribution of this thesis is that it involves a method to store and share qualitative information into a database. This thesis presents a method that involves the DHF and applies it to non-medical cases. It proves to be a clear method, that does not cause an information overflow for the

receiving users. Databases tend to provide quantitative information, documents and sharing them with users require a different approach. This research presents one approach to share documents.

Conclusion

The research question that was set is; *“How can Pilotfish improve their Product Definition process with the help of an interactive tool?”*. The answer to the research question can be divided into two parts; What methods are available, and what approach should the tool take to improve the process.

The process that a project goes through is a long, complicated process that evolves over time. It is important that the PDD aligns with this evolving process. First of all one of the main requirements was that the solution would be available within Pilotfish’ digital environment. Due to the fact that Pilotfish uses Microsoft 365 as their digital environment 2 possibilities were available, Microsoft PowerApps and using VBA in Microsoft Word. The interviews that were held at the start of the project supplied requirements and useful tips for creating the new tool. Taking this in consideration, the choice between PowerApps and VBA was made. Especially the agility needed for the differentiating projects of Pilotfish made the difference between the options. In the end the choice was made to use VBA in Microsoft Word. However, the look and feel did not satisfy the people at Pilotfish. Therefore, an other approach was used and Controls were used to create the tool. This resulted in a tool that was agile enough to fulfill the needs for the projects but was standardised enough to simplify the process.

The approach towards the PDD was changed. Instead of overloading the PDD with information the choice was made to use the PDD as an index to the database with only the necessary information. SharePoint enables easy data sharing from the cloud database that Pilotfish has. By using this index method, Pilotfish starts using a DHF inspired method and takes its first step towards a ISO 13485 certification. Using the different available Controls the PDD was standardised and made easier and quicker to use. By saving time on documentation, the employees of Pilotfish will have more time to do the rest of their jobs. Especially the role of the PM was kept in mind when creating the new PDD, the PM plays a pivotal role in the communication process.

The new PDD was presented to the interviewed employees of Pilotfish. After studying the new PDD they completed a survey about the new PDD. The employees of Pilotfish expected the new PDD to be easier to work with and that it would save a lot of their time. Besides the time of the employees they also expected that the client would like the new PDD and that the client would understand it better. The employees of Pilotfish tended to be positive about the new PDD, hence the improvement can be seen as successful.

A concrete advise to Pilotfish is to start using the new improved PDD. However, the new PDD is not finished yet and will need improvement. The improvements have to come from practical experiences. Unfortunately, the project was not tested in a real case. Therefore, from the experiences of the different projects the PDD can be improved. When SharePoint is set-up correctly it can be used to share data with clients. If this is the case the index function of the PDD will be successful. The PDD should contain only the key in- and outputs of the project, for all other documents the PDD will have the index function and tell the client where to find the separate documents. The PDD should be one of the key communication methods with the client.

Limitations & suggestions for future research

Pilotfish is a fairly small company, there were a few qualitative interviews and afterwards a evaluation survey to gather quantitative data. However, the group of respondents to the survey was small with only six responses. Therefore, the evaluation survey is statistically invalid. The survey can be assumed to be exploratory. A bigger test group and population would be needed to gain validity. This can be achieved by conducting the research in a bigger company. However, bigger design bureaus have more resources and have other methods to share their data. For example an own online platform to share information with clients. An other method to gain more responses would be to change the survey slightly and to conduct the survey with clients. On the contrary, clients can not or to a lesser extent provide a comparison on how it is different to work on the PDD.

An other limitation to this research was that Pilotfish wanted to use a solution that was available within the companies digital resources. The platform Microsoft 365 was found to be sufficient for a company the size of Pilotfish. Otherwise it would be an option to design a dedicated platform like the bigger design bureaus have. A dedicated online platform would require (unnecessary) investment.

In future research it can be researched how this solution is valued by the customers of Pilotfish. Is it a real improvement for the client and do they still receive the same amounts of information. Also as has been stated a bigger population would be needed for statistical validity. This might be achieved by conducting the research at several small design bureaus. However, the secretive nature of this branch would probably limit the possibilities to gather enough participants.

REFERENCES

- Akkermans, H., & Van Der Horst, H. (2002). Managing IT infrastructure standardisation in the networked manufacturing firm. *Int. J. Production Economics*, 16.
- Baresi, L., Fraternali, P., & Houben, G.-J. (2007). *Web Engineering*. Como, Italy: Springer.
- Cooper, D. R., & Schindler, P. (1976). *Business research methods*. McGraw-Hill Education.
- Dennis, B. w., & Bower, T. (2008). Using Content Analysis Software to Analyze Survey Comments. *University Libraries Faculty & Staff Publications*, 24.
- Guion, L. A., Diehl, D. C., & McDonald, D. (2001). *Conducting an in-depth interview*. Florida, USA: Department of Family, Youth and Community Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
- Hargadon, A., & Sutton, R. (1997). Technology Brokering and Innovation in a Product Development Firm. *Administrative Science Quarterly*, Dec. 1997, Vol 42, No. 42, 716-749.
- Heerkens, H. (2014). *Microlecture Methodology*. Enschede: University of Twente.
- Heerkens, H., & Van Winden, A. (2012). *Geen Probleem*. Nieuwegein: Van Winden Communicatie.
- Jacob, S. A., & Furgerson, S. P. (2012). *Writing Interview Protocols and Conducting*. The Qualitative Report, 17(42).
- Martinic, A., Fertalj, K., & Kaplic, D. (2012). Methodological Framework for Virtual Team Project Management. *International Journal od Innovation*, 7.
- Methorst, P. (2019). *Essay assignment IEM*. Enschede: University of Twente.
- Peppers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Hui, W., Virtanen, V., & Bragge, J. (2006). *The Design Science Research Process : A Model for Producing and Presenting Information Systems Research*. Claremont: CGU.
- Shishkov, B., Van Sinderen, M., & Quartel, D. (2006). SOA-Driven Business-Software Alignment. *IEEE International Conference on e-Business Engineering (ICEBE'06)* (p. 9). Enschede, The Netherlands: Department of Computer Science, University of Twente.
- Weske, M. (2012). *Business Process Management*. Potsdam, Germany: Springer.
- White, S. A. (2004). *Introduction to BPMN*. USA: IBM Corporation.
- Wieringa, R. J., Blanken, H., Fokkinga, M., & Grefen, P. (2003). Aligning Application Architecture to the Business Context. *Proceedings of the 15th International Conference on Advanced Information System Engineering (CAiSE 2003)* (p. 17). Berlin: Springer.

Figure 1, problem cluster	14
Figure 2, adapted from Martinic (2012).....	16
Figure 3, process hierarchy retrieved from Weske (2012).....	18
Figure 4, processes and influencing factors	19
Figure 5, organisational structure Pilotfish	22
Figure 6, PDD process.....	23
Figure 7, communication with the client	24
Figure 8, PDD and folder structure.....	31
Figure 9, explorative survey question 1	33
Figure 10, explorative survey question 2	33
Figure 11, explorative survey question 3	34
Figure 12, explorative survey question 4	34
Figure 13, explorative survey question 5	34

APPENDICES

Appendix A

INTERVIEW TEMPLATE

Interviews at Pilotfish

Thesis: "improving the PDD at Pilotfish".

Location:

Date and starting time:

Name and function of respondent:

Special circumstances:

Other notes:

Due to privacy protection, the interviews have been deleted.

Do you agree with me recording the interview for academic purposes?

Welcome, I'm here to ask some questions about the way of working at Pilotfish. I am especially focused on the Product Definition Document. During my graduation I hope to improve the current PDD. For me to get a clear view of the situation at Pilotfish, I want to ask you to be as honest as possible and to explain your answers. Lets start with the interview.

Q1. What is your exact job at Pilotfish?

Q2. How familiar are you with the PDD? (Do you use it often? Every day or ever week? Or not that much?)

Q3. What do you see as the definition of the PDD?

Q4. What part of time do you spend doing the thing you like? (for example designing new products?)

Q5. How is the communication between the different offices?

Q6. How often are there communication mistakes between the offices? (How many are caused by the PDD?)

Q7. Do you think there are different points of view on the PDD? (Do other people in other offices use it differently?)

Q8. What do you expect from a PDD? What do you want to see in the document?

Q9. Do you think the current PDD is inconvenient? (Do you think that you can save more time by using a different method?)

Q10. At a scale from 1 to 5 how would you rate the current PDD?

Q11. Do you have any other advices for me?

Did you notice anything during the interview?

What did the respondent behave like?

Do you think the answers were truthful or the did the respondent give “desired” answers?

Did the respondent have any “hobby horses?” (Q12)

Appendix B

INTERVIEW ANALYSIS TABLE

Answer I1	Tag	Pos/Neg
Industrial design engineer, conceptualisation, user research project management. Internal communication within teams	ID	-
Never seen the template. Template, always in a different way. Different in and outputs. Define outcomes. What are you expecting. What is included? Scope of the project. General way of working/standard procedures, but with flexibility. Instead of everybody just working on it the way they think it should be.	Unfamiliar	Neg
Key in and outputs, summary. Use till the end of the research phase (start design). Revision of the same document. Especially in strict fields like medical.	Key in/outputs, Summary	-
Depends on what project, if good project 70 % documenting is not a problem (for Daniel)	Phase dependent	-
Better with BER than TPE, cultural difference. Time zones, in general good. TPE might not tell you directly about what annoys them	Cultural difference	Neg
It's important to have good documentation to regard with the PDD. Assignment based jobs, so no need for PDD. Hard to keep each other up to date. Especially with more collaboration within project, PM	Incidental	Neg
Marco is much more uniform (engineer/PM), Harm is a free thinker (an artist)	Roles	-
Document where you have all the important in and output. Used to communicate both internally as to the client. Keep track of major change (change of scope/broaden the target group) keep document fresh. Cornerstone of document (more strict within medical projects) design history file (just for medical devices). Design process. Clients are not always strictly asking for these kind of files.	Key input/output, DHF	-
-	-	-
-	-	-

Keep the document as focussed as possible (product definition, don't focus on project definition). Really basic about prototyping link out to outer documents. Convince Frantz to start using it, sometimes difficulty with accepting changes and documentation (change the way of working) find selling points.	Focussed PDD, Communication	-
Focus on medical design.	Medical Design	-

Answer I2	Tag2	Pos/Neg2
<i>I'm mainly responsible for all the digital work in the company, so since one of their one of our goals is to bridge hardware and software together into product experiences. I'm facilitating the software products all the interface from the user research to the, Wireframes and visual design of the application or website or interface integrated in products, for example. Let's say there is Ingram in Taipei and me in Amsterdam and as the only two digital poll and masters in the company, so yeah, we still have a lot of to take care of it</i>	UI/UX	-
<i>to be honest, I never had to use it myself. I heard about it for the first time officially, I saw it for the first time, two months ago working with Berlin on the microsinetics projects Kenn from Berlin asked me how do I proceed with the PDD for all the digital projects and I told you I had no idea what he was talking about. So I never had one official document. I never use the word templates called for a deficient document. I Think I do the same probably in a different way. But, I never used this document</i>	Unfamiliar	Neg
<i>Agreements with customer. from what I understood, this is basically the boundaries of a project after the kick-off, so to make sure together with the client that you understand the same things and that you both agreed on the deliverables. And then from that's what I understood, but I also not sure if it's also included the updates of the project and that if it's a document that you have to update all along the project or if it's just the beginning and then that's it, that's something I don't know.</i>	Customer agreements	Neg
-	-	-
<i>AMS different from BER and TPE. Amsterdam is a bit different if you ask the other guys. I think Berlin and Taipei are working a lot together because they are doing the same thing and we are a bit outside of that of that process. I'm specifically outside. I've worked with Berlin two months ago, but I was the first time since I'm here. I used to work with Munich but since Munich is out of the game. I don't work that much so for me the communication with Taipei is almost none existent and Berlin is beginning so that definitely has to be improved so we started a few things like social media calls, like the I had one this morning with Marlous in Taipei and Marusa in Berlin. So it's a way to improve. Also I don't have that much description or projects with them.</i>	Cultural difference	Neg
<i>I don't know if there is communication mistakes. I think I'm not, as a user experience design, into the project that could involve Taipei or could involve Berlin, they're really into production or concept production. where I'm a bit at the side-line right now. But for example this morning we were talking about this project that didn't win an award, that we were participating in. I had no idea what this project was about. We started to improve this this connections with like teams folders descriptions and those kind of things. If I have to find one mistake of point where we think it's like Marc Marco and Harm the three founders yeah, they're really together and the news or at least Harm, For the Amsterdam office, (because I don't know exactly for the other office) don't spread that news often or always so sometimes we just don't know what's happening outside.</i>	Information alignment	-
<i>Yes, I think so. I don't want to talk for them but I think the question about what's the definition of PDD might be different from Marco to Harm for example. So that's definitely the first thing would be to align that definition. And answer what the PD is about and what is this function? Before trying to improve it.</i>	Interpretation	-
<i>Well it all depends what it is, at the end. But if it's what I've described, what I think it is for me. I think it should be something: Well, first of all, it should be something that it's easy to use. So if it's something that the main goal is to share with your clients to be sure you aligned, then you should should have an easy to use templates. Maybe you need to use some pictures that are part of what you discuss some sketches that you sketch during a meeting with so the way you integrate paper to digital should be something easier to upload or something that are looks nice outside of some different documents. A bit more worked out than a word document and then since I'm using a</i>	User friendliness, communication	Neg

<i>lot of software in user interface development when you can easily share something and got feedback, a bit like the PDF comments. Although it's not that incredible. Those kind of things, when it's necessary back and forth communication into a document could be interesting.</i>		
<i>I never used the PDD. I'm judging right now only on what Kenn showed me last time. A typical word template document where it just brightens what we discussed with the clients; this is a deliverable, this is what we're going to do, this is the product architecture. So there was no nothing fan nothing special about it. It it all depends if it's only something you send to client and the client like "a great" then yeah it's fine. If it's this is it then I'm not even sure you need something better than that. If it's something where the clients says okay. If the client has to give feedback or if it's something where let's say after a month you see how but the project changed here the we're going to do that so it's something you need to fill up in the product then you need to improve the word document doesn't work anymore. It all depends on the functionality.</i>	Agile	-
-	-	-
<i>Definition, alignment. Different ways of working. Simple to use -> web based. As I already said it's really important to first answer what's the PDD is all about? If you can align that also, because I think that's what something to keep in mind. Before solving the problems you have to identify the problem. I think that's all our job here and so it makes sense. But, also and that might be the difficult part for you; we have different ways of working, Taipei, Berlin and Amsterdam. So I might be I might not be the most important person. In your request because I'm not using it and probably like Marco would you guys in Taipei really have a lot of questions a lot of things that don't like but it would be great if it could be as much as possible align for everyone or at least for most of the people. And then of course as UX designer I like things that are simple to use and If you can have something web-based, for example could be a save a lot of time also then you don't have to save it and unfold this and servers and teams and everything will become a mess.</i>	Definition, alignment, simple use	-
Alignment and definition of terms	Alignment, Definitions	-

Answer I3	Tag3	Pos/Neg3
MD + share holder + board. Applying strategy to AMS. Responsible for the business of AMS. Acquiring new customers/preserving current customers.	MD	-
Vroeger standaard bij begin of begroten opdracht, project definition vóór sales (scopen van de klant vraag). Product definition daadwerkelijke afspraken, vast zetten na workshop. Kick-off document.	Scoping	-
Initiële briefing, klant perspectief, design consulting perspectief. Fixeren van het product. Eindigd als conclusie van de exploratie fase. Zijn er nog nieuw regelgevingen aanstaande? Wat is het netwerk van de klant? Wie produceert? Een 360 view! Bij software wordt het PDD minder gebruikt. Oppassen dat je dingen niet te exotisch gaat maken, anders krijg je problemen. Exploratie fase gaat over product definition, project definition is het scopen van je werkzaamheden.	Customer agreements	-
Weinig, misschien maar 1% want wordt het gelukkigst van creatief bezig zijn en oplossingen bedenken.	Not often	-
Slecht. Structureel te weinig tijd, vecht alleen maar voor eigen belang. We zijn strategisch gezien onsamenvattend en onhandig bezig. Manoeuvreren naar een positie waar je niet profiteert van elkaar sterktes maar juist door elkaar zwaktes minder wordt.	Strategic alignment	Neg

Tussen medewerkers zelf weinig. Andere belangen/activiteiten, eerst duidelijk plan. PDD associeert vooral met klant. Nooit met interne vragen, dat is misschien waar het ook wel fout gaat. Kort en simpel.	Incidental	Neg
Veel meer sales georiënteerd. Denk gelijk aan een overzicht voor andere projecten binnen hetzelfde bedrijf. Terwijl Marco misschien wel de discipline heeft om op het huidige project gefocust te blijven. Ik kijk gelijk wat kunnen we nog meer doen op basis van dit. Marc weer anders meer samenwerking met corporate ventures. Komt niet aan uitgebreide PDD toe omdat het soms al behoorlijk duidelijk is.	Interpretation	-
Kort en krachtig, niet alles valt er in te coveren. Terugkoppeling naar de klant moet Crisp en snel zijn. Ruimte bieden om in overleg met de klant het pad aan te passen. Lean and mean	User friendliness, key in/output	-
Erg groot, maar nog niet compleet (het is nog een work in progress).	Size, incomplete	Neg
Veel verschillende, iedereen op een eigen manier. Gebruikt hem zelf te weinig. Niet altijd gebruikt, bijvoorbeeld bij vervolg projecten (doen hoeft je niet weer alles opnieuw te doen). Veel losse eindjes. Voorkom een information over load (niet teveel in 1 workshop. Voorstander van een meer gestandaardiseerd PDD. Marco weet wat er bedoeld wordt de rest niet echt. Oude versie miss wel beter, iets meer uitleg binnen het document(combineren met vragen). Marco te abstract, maar ook te groot.	Interpretation, standarization	Neg
Bestaan om te leveren waar behoefte aan is, veranderen. Process met zn 3en snappen. Duitsers meer bezig met het goede doen, Taiwanese snel, snelle ROI. Amsterdam koopmans mentaliteit. Steeds minder over fysieke producten. Workshop vóór conversie, wat zijn de behoeftes vanuit Pilotfish. Hoe kunnen de costs of sales verminderd worden? Nu eerste workshop gratis.	Demand management	-
Definition of terms, how to take away pressure from directors	Definitions	Neg

Answer I4	Tag4	Pos/Neg4
Senior project manager, in charge of project management. Concept to production. Been at Pilotfish for 1 year. In charge over the entire project. Contact with the clients. Start from creative to more engineering. After concept ideation, from ideation to engineering with CAD software.	PM	-
Try to use it at the end of each phase, release a draft at the end of each phase. Not sure about what the others do. After feedback a different version. Client checks and validates it. After this we can start the mechanical engineering. At the end of the ID phase hand over the project to TPE, they have the best knowledge and connection with manufacturing. Depends on what I'm working on, when converging on what to present to the client. Also uses product dna workshop and presentation. Also released to the client. All notes from workshop as "wrap-up". When working on the project at least once per week. But on a sleeping project a lot less.	Very familiar, dependent on project	-
Needs to have al the information that TPE needs. You might miss on details in meetings. As understood when I arrived at the company, product requirements. All features and requirements.	Key in/outputs	-
Just sometimes quickly checking, during the day only 10% on the PDD 90% on the actual. At the end and beginning of the phase use it a lot more beginning (30/70) and end (70/30)	Phase dependent	-
Work on complementary art project, certain difference in terms of working and definitions. Mostly about the PDD. TPE it is important to them, but not sure how often they really use it after the hand-over. Important for alignment but not sure about how often they use it in their daily work. When started working at Pilotfish I was told about the importance of PDD. Quite some room for own interpretation. Never really understood how well they understand it. Definitely room for improvement and more structured for people that have never used it.	Unclarity, own interpretation	Neg

Don't know, in own case I don't recall any issues with production definition. Maybe that they sometimes forgot to take some information into account or they misunderstood. Maybe because the over-looked something because of the structure.	Incidental	-
Sure there is. Related to the way of working. Different culture (way of working in BER, AMS and TPE are different).	Working methods	-
I tend to compare with previous experiences. Before what I liked about my previous company is that the product requirement document was divided in different aspects of the product. General description – different sections: outlook finish etc. – functionality aspects – construction etc. More categorised, get all information if you don't know anything about the document. Everything has to be up to date (latest software, technical drawings etc.) now only has screenshots and drawings. Reference from latest drawings. Attach PDF in documents. So you can find it quickly.	Categorised, attachments	Neg
It is very free, can go fast. Open for interpretation. Gathering so many subcategories some section might grow a little bit too much. Need to be careful to not make it too complicated to use. Better structured might be nice. Have a clear guideline for using. For example when you have a form, saying what you have to fill in and where.	Agile, structure	Neg
3 out of 5		3 -
Do not hesitate to ask question. don't fear to annoy people. If you want information push for it. Try to be as objective as possible. Look at literature what exists right now what do other companies do. Build bridges between inputs. Simple, fast and friendly. Too serious or hard to digest will make the end user not read it. Don't forget the human aspect. Designers will never use the document if it is too much engineering. When it is easier to use it is more prone to be accepted by suppliers etc.	User friendliness	-
Easy to use, simple fast and user-friendly	User friendliness	-

Answer I5	Tag5	Pos/Neg5
Project manager, I make sure that the project runs smoothly. Keep client happy, inform them. Usually I run 4 projects at the same time	PM	-
I use it not that much, sometimes I get too busy and forget to use it. So I put it on the last place, sometime I work on it on quiet moments.	Familiar, Procastrate	Neg
List of the architecture, requirements, how to produce, what to test, when to test. All requirements and information.	Key in/outputs	-
Every time I work on the PDD I'd rather do something else, it is quite a boring job. It should be easier to jump between projects and to document. It is so much information. Easy table with versions (for example).	Boring	Neg
Very bad, AMS and BER work rarely together. The communication is not easy, the people doing the work are in TPE. Maybe we don't always understand what their days look like.	Communication, cooperation	Neg
Not too bad. Still involve TPE a lot in the process. Most mistakes because of time pressure, overlook somethings.	Incidental	Pos
PM might say that the PDD is very important but TPE would think it is too much. Too long paragraphs. Might not like it. More tables easy overview. The client does not complain. Some clients are happy that they get a very clear and complete document.	Client focus	Pos
Some cases you cant write everything down, in the beginning very rough later more detailed. Different paragraphs for mechanics, electronics, design, product finish, testing, requirements (when an on which prototypes). Everything until you package it. Link to file (sometimes forget to update). Putting tables with updates when was a certain thing updated (different versions).	Adaptability	-
Both convenient and inconvenient. Convenient, because there is freedom to adapt it to the project. Inconvenient because it is very big document with a lot of question	Agile, size	Pos/Neg

2.5, like I said without guiding it is not always clear. Sometimes need more guidelines. But I like the freedom	2.5	Neg
Keep in mind that we do very different things, stiff structures makes life difficult. PDD can get very large (look at PDD of more complex products, here it gets messy).	Agility, freedom	-
The document should be very inclusive and contain all information, but should also not become too rigid.	Key in/outputs, freedom	-

Answer I6	Tag6	Pos/Neg6
Senior product designer, from concept to mass production (including PDD for documenting to customer)	ID	-
Not yet, PM now does it. I will work with it later.	Familiar	-
I have seen one version, it is about product specs. What are the sizes/other requirements.	Requirements	-
Product design scope, and target user is what I have to look up in the PDD. Replacement etc. I don't use this document yet. So not sure how much time it would cost. Find requirements in email from the customer. Or note it myself in the meeting minutes.	Not sure	Neg
The process should be the same	Strategic alignment	-
Depends on the project. If we work with other offices it is okay.	Incidental	-
Use the documents depending on the project. Not so sure, but it should always be the same. Because the process is the same.	Standardization	-
Already named a lot of things.	-	-
All of the information should be included. Current PDD, UI is digital. Separate Digital and Product design/ME. Maybe separate reports.	Structure	Neg
PM has to update the PDD, but not to much information (information overkill). Design requirements should be clear.	-	Neg
Not that wasn't told already.	-	-
None	-	-

Answer I7	Tag7	Pos/Neg7
Mechanical engineer, measurements for every part. ME focus on the design. PM and also sometimes production tooling	ME, PM	-
Use it often, really important for the product and also for the communication with the client. About the function of the product	Very familiar, communication	Pos
All the requirements from the customer. First of all we have the product DNA, define the function etc. How will it work. Rough things edited to PDD, with more details. Then we have ID design, EE design etc. Guiding, tooling, production, how to test. Now most of the clients want Pilotfish to do most of the design, so more detail into the product definition. Guideline to follow. If client wants to change anything, based on the PDD we can ask for extra budget.	Requirements, structure	-
When we start we spend more time on the PDD, to document all information. During the project we keep it updated. Keep adding design BOM etc. How to test. After the project ends we hand over the PDD to the production team. Then everything is finished. It also includes how to pack and send it	Phase dependent	-
We have sometimes a PM in Berlin, they hand over the critical teams. So PM will edit the PDD and send it to TPE, this works well	Good	Pos
We will send it to the client to check the PDD. If something is wrong it will be checked and corrected. Every update is confirmed by client and approved	Approval	-

Based on the projects, some items of the PDD will be removed sometimes things will be added. Sometimes just plastic design sometime more difficult. For the template everything should be in there and the PM edits.	Project scope	-
The template is not complete, it misses electronics and firmware and how to test. Firmware engineer will help edit. In the original PDD only design, digital and production were included	Incomplete	Neg
For me it's fine, in know how to edit. But for some people it is hard to start with because sometimes not everything is in it. You have to have done it several times to learn how to use it. Guidelines would be useful for new people.	Guidelines	Neg
For me it's 1 (5), I now know how to use it. We sometimes miss things about the electronics. It can be more complete	5, Personal	Pos/Neg
Maybe you can have an interview with Wesley, he is an EE and maybe he can help you to set up a part for electronics in the PDD. Digital PDD is based on word, it has functions to easy edit. (macro functions) easy to see different versions. See what is changed by who.	EE, macro functions	-
Adding a better part about EE	EE	Neg

Answer I8	Tag8	Pos/Neg8
UX team leader, lead the designers and researchers to complete their projects	UX	-
I was in the ID team a few years ago, I still use it quite often. But the specs are quite different so I changed a lot of things.	Unfamiliar	-
The Spec of the project, everything of this document should be clear	Requirments	-
When the project starts I spend 2-4 to set up the draft. And in total I spend around 16-24 hours on it	Phase dependent	-
Going well, but need to spend more time when working with AMS then when working with designer next to me	Communication	Neg
It happened, I tell them something. But it happens but it is not right or wrong	Incidental	-
No, I think the PDD is quite clear. But there some tollerance. So for example a 'simple' design is open for interpretation.	Interpretation	Pos
In the current team, all in- and output should be clarified in the document. Everything should be clear from the document	Key in/output	-
The current template is not suitable for digital design, so I build a different PDD	Unsuitable	Neg
As I remember it I would rate it 4/5	-	Pos
Not at this moment. From our background, what do you need for the document.	-	-
-	-	-

Answer I9	Tag9	Pos/Neg9
Production manager, depends on customer request. For example checking schedule lead times etc. Do quality check and report. Shipping document. Contact company about customer	MM	-
Depends, when i'm involved in the project I am	familiar	-
Current PDD not always suitable for every customer. PM has to adapt. Template is not always suitable. In beginning its made from the meeting minutes. approval of customer. In the end to protect	Unsuitable	Neg
For me i can not judge about whether I don't like it. PDD is very important to customer. In the beginning a lot. When customer changes their mind also a lot. When working on project begin 20 % and latter 10%. Not working with PDD all the time.	Phase dependent	-
Depends on the PM. When design project PM and customer is near Berlin. Technical is in Taipei.	Dependent	-

PDD is not for discussion, because it comes from discussion because it is what customer wants. But tell PM what is possible. PDD is explained very clear by PM	Incidental	-
No not really because PDD is always the same. But sometimes PM does not update the PDD	Standardization, updating	Neg
For current document ok to use. But easier to adjust to PM and people that need to use it. But sometimes not everything in the template is needed. That makes it difficult to use it.	Adaptability, irrelevant parts	Neg
People do not always understand how to use it, people do not know how to deal with it. And take out the irrelevant parts.	Guidelines, Unsuitable	Neg
For me a 4, because it is can not reach 5. We have a lot of different customers.	4, Personal	Pos
Create different types of PDD, for different types of projects maybe different PDD are needed. Either options like abc etc.	Differentiation	-
No	-	-

Answer I10	Tag10	Pos/Neg10
Product developer and manager, communicate with client, requirement and design. After design is finished to mechanical engineering. Make sure requirement and deliverable are matched. Help solving and discuss with mechanical engineering. CAD engineering. Last few years I focussed on ID now more to production. Guiding from concept to production.	PD, PM	-
Not really familiar with the PDD. Did not use it that often. Communicate with client by mail. Putting all information in the PDD will cause an info overload.	Unfamiliar	-
When concept is defined, put in PDD. All confirmed information. All the defined information and conclusion.	Key in/outputs	-
Use it conclusion to meetings, PDD will grow. Appr. 5% of the day on documenting, but in beginning more and later update.	Phase dependent	-
Not familiar with creating PDD myself. After seeing PDD need to know what the product is about. PDD documents are of good quality. Not happy as a user, no guideline (how to use PDD). Template has many items, but some items in the template are irrelevant. But these take a lot of the template and have to delete until defined.	Irrelevant parts	Neg
Not really	Incidental	-
I don't know. But it is good to align everybody	Alignment	-
PDD grows up per phase, maybe it can be designed by process phase. So it is clearly what to design for for example ME.	Phase dependent	-
Yes inconvenient, not happy to use.	Inconvenient	Neg
For usability 1 and for communicating information with others 3. In general 3.	3	Neg
Make it easier to use.	User friendliness	Neg
None	-	-

Appendix C

SYSTEMATIC LITERATURE REVIEW BUSINESS TOOL DESIGN

Systematic literature review

The result of this project will be both the thesis and a tool to make the PDD more convenient. Since a tool will be made during the project it is important to learn how to make a good business tool. Since Pilotfish is a contract engineering company, that works mainly in projects. The main focus will be on tools for projects in design and engineering.

To find out what are the attention point when making such a tool, a SLR will be performed. The research question is “what are the attention points when making a business tool that is related to projects in design and engineering?”

The selection of data

Data will be used from different sources, a plan on what to look for will be made. Sources that can be used are articles from scientific journals, books, and (scientific) blogs. The sources can be in both English and Dutch (however English articles are preferred because the entire project is in English).

The in- and exclusion criteria can be found in the following tables.

	Criteria	Reason for inclusion
1	Must include the term “business tool” (or equivalent) in the title	Subject of the research question
2	Business research	Relevant field of research
3	Design and engineering	Main business of the company
4	Project	Working methodology at the company
5	Attention points/framework	Part of the research question

	Criteria	Reason for exclusion
1	Pre 2000 sources	Software has changed a lot since 2000, the sources might not be relevant anymore
2	Articles not including “tool” in abstract	Unlikely to be relevant to my research
3	Articles that are not freely available	There is no budget for this research
4	Articles with 0 citations	Not likely to be relevant or their quality is not of the right standards (unless not enough articles are available)

Selection of databases

For scientific research several databases are available. The databases can be found in the following table that was acquired from the lecture by P.D. Noort, 2019. Each database has its own strengths and weaknesses.

Database	Scopus	PsycINFO	Web of Science Database	Google Scholar Search engine	Business Source Elite Database
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)

The best option for the SLR is Web of Science since it is the largest database, it probably contains the necessary sources. If Web of Science is not sufficient another database, Scopus, can be used. This is a large database that contains a lot of sources and peer-reviewed (which will make the source more reliable) publications. If neither of the databases work the search engine Google scholar will be used, in this way almost all articles can be found. A disadvantage of Google scholar is that not all sources are as reliable. To sum up the selected databases:

1. Web of Science
2. Scopus
3. Google scholar

Search terms

Search that will be used during this SLR are:

- Business tool
- Contract engineering
- Design and engineering
- Project
- Framework

These are terms that are useful when looking for relevant sources, how ever including to many search terms will narrow down the amount of available sources to much. Search terms might be combined with

each other and business tool with “how to make” since this will possibly lead to a framework with attention points. Search terms will be combined with Boolean operators such as AND (if there are too many sources available) and NOT (if there are a lot of non-relevant articles).

Also other techniques like paraphrasing and truncation can be used to improve the search results.

Search results

The used search strings can be found in the following table.

String	Scope	Date	Entries
Business tool	Title	27-2-2020	697 (too many, irrelevant)
“business tool”	Title	27-2-2020	19 (not all are relevant)
“business tool” AND framework	Title and topic	27-2-2020	0 (too narrow)
Business tool AND “framework”	Title and Topic	27-2-2020	91 (too many, irrelevant)
Business tool AND “Framework” AND software	Title, topic and topic	27-2-2020	17 (not all are relevant)
Business tool AND “Framework” AND software AND design and engineering	Title, topic, topic and topic	27-2-2020	4
Total number of articles			4
Selection on relevance			-2
Selection on amount of citations			-1
Deleted after reading			-0
Selected for review			1

The source found was the book Web Engineering (Baresi, Fraternali, & Houben, 2007).

Since this is quite narrow at least one more source has to be found. The University of Twente library database was used. The search term used was “business application” and more relevant articles were found:

- Aligning Application Architecture to the Business Context (Wieringa, Blanken, Fokkinga, & Grefen, 2003)

- SOA-Driven Business-Software Alignment (Shishkov, Van Sinderen, & Quartel, 2006)

These were found to be useful and together the articles could provide an answer to the research question.

Conclusion from the articles

The first source is the book *Web Engineering* (Baresi, Fraternali, & Houben, 2007). This book contains an article/chapter about Smart Tools to Support Meta-design Paradigm for Developing Web Based Applications. Meta-design implies that the article is focussed on applications that are made by several people. However the article still supplies a framework for designing a web based application.

The result of the article is a hierarchical model that can be found in Figure 14, hierarchical model retrieved from Baresi et al. and was acquired from (Baresi, Fraternali, & Houben, 2007).

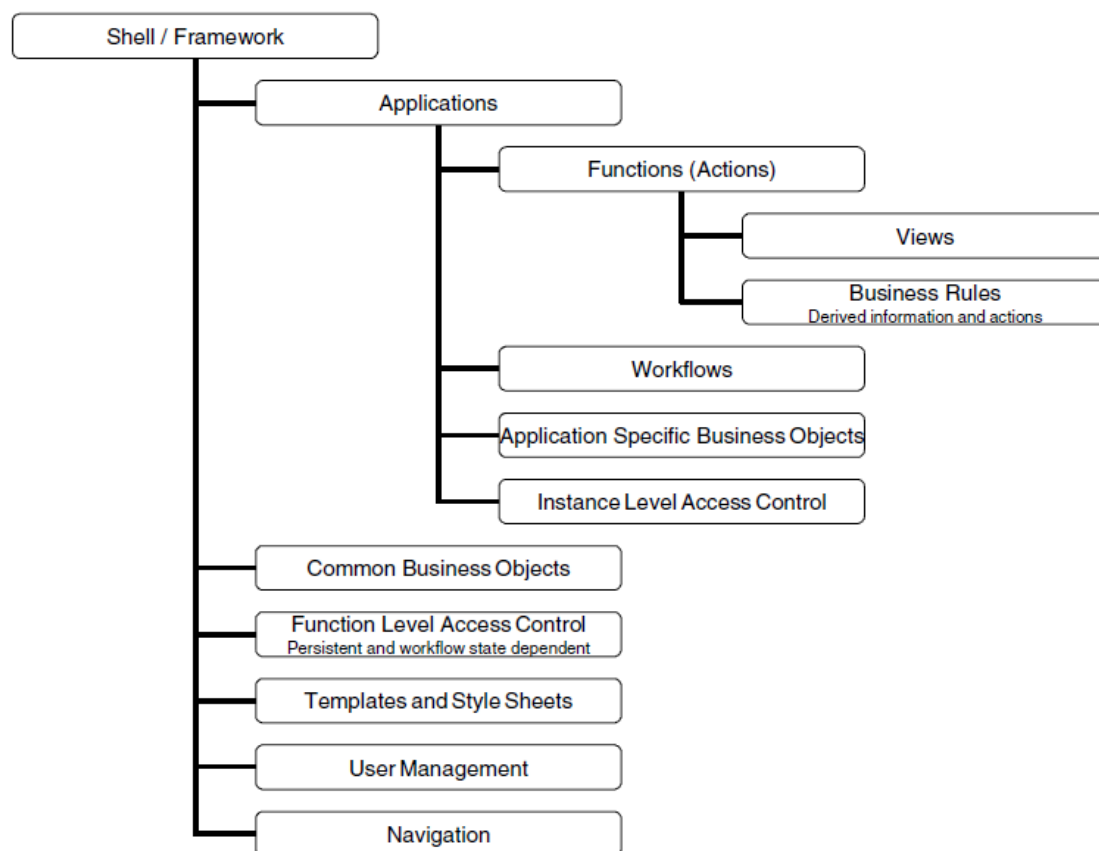


Figure 14, hierarchical model retrieved from Baresi et al.

The model was implemented in the CBEADS framework. The writers first had to develop ways to specify the information that was required to make a tool (Baresi, Fraternali, & Houben, 2007). They also had to develop a way to generate physical object (database), functions and workflows based on the meta-model. The writers developed a “set of smart tools” to achieve this. The writers made an architecture for “Smart Business Objects” and developed two tools. These tools are a builder and an UI generator (that includes several business rules) (Baresi, Fraternali, & Houben, 2007). From their activities the writers concluded that navigation and access control are related to each other. The writers made a workflow table with the columns; current state, actor, function, buttons, do action, and next state.

The conclusion for accessibility was that there are two types of access, access at any time and access when an request was done (Baresi, Fraternali, & Houben, 2007). Therefore, the writers used role based access for their application.

The next article, *Aligning Application Architecture to the Business Context* (Wieringa, Blanken, Fokkinga, & Grefen, 2003), is focussed on presenting the reader with a framework for analysing and operationalising. The writers summarised their findings to guidelines.

The articles starts with defining architecture. The definition the writers used was:

“The architecture of a system is the structure, or a set of structures, of a system, consisting of elements and relations between these, such that the relations between the elements create an overall coherent system with an added value for its environment.” (Wieringa, Blanken, Fokkinga, & Grefen, 2003).

This definition enables the use for both business systems as software systems.

In the next part of the article the framework is described. The writers have made a tree where information is mapped. It distinguishes different aspects of the architecture. It considers different layers of the system and divides them into different categories being; social, linguistic, and physical (Wieringa, Blanken, Fokkinga, & Grefen, 2003). The layering structure is depending on the situation.

The architecture frame work consists of (Wieringa, Blanken, Fokkinga, & Grefen, 2003):

1. Structuring systems into service provision layers
2. Each layer has entities with properties that can be classified
3. The entities can be described with many different levels of refinement

The framework presented in the article is based on another framework, that framework distinguishes two dimensions. The service dimension (containing IT infrastructure and business level) and the refinement (transition from high level abstract information to low level executable program) dimension (strategic and operational levels). Most of the common frameworks have three views, being; the function view, the behavioural view, and the data view. These correspond to the service, behaviour, and the service aspects of the writers framework. The framework on which the writers framework is based also distinguishes three kinds of descriptions; the data, the process, and the network descriptions. This also corresponds to the meaning, communication, and behaviour aspects of the writers framework. These descriptions can be used to describe the system from different perspectives. These perspectives can be systemised by placing them on various levels of services provision and the level of refinement.

The following figure shows the design approach from the article (Wieringa, Blanken, Fokkinga, & Grefen, 2003). An important note is that not every box in this figure has to be used when making an software architecture.

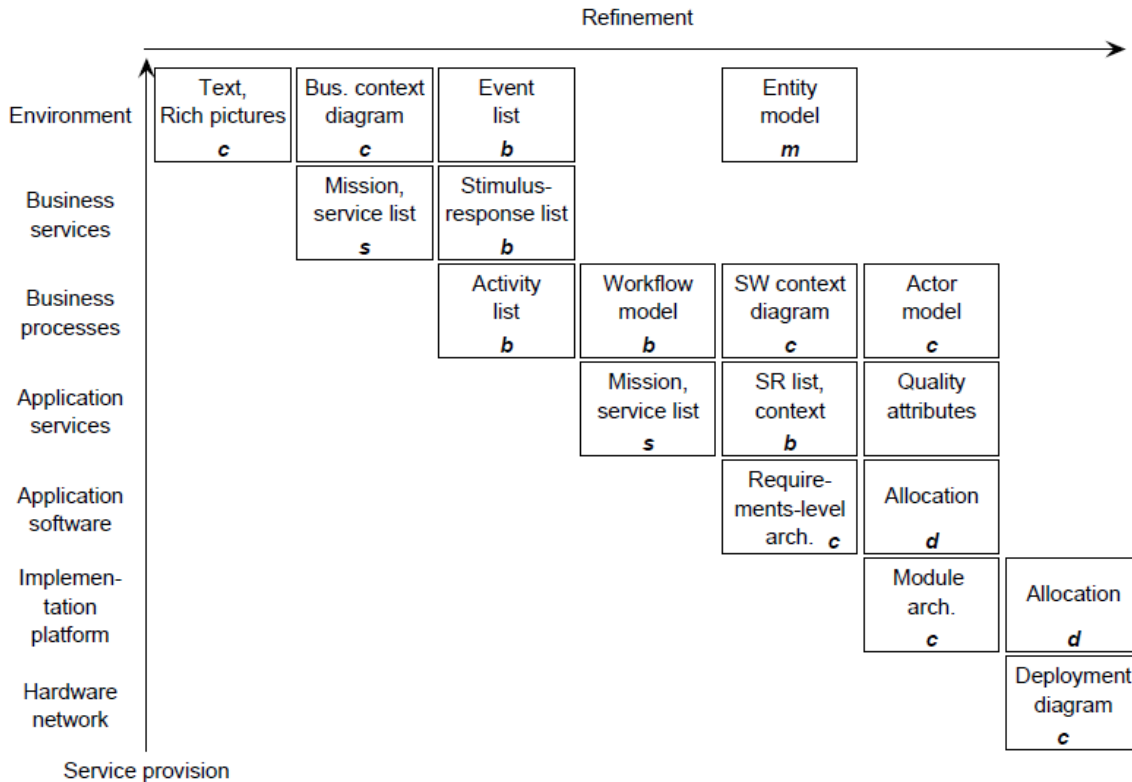


Fig. 6. Overview of some descriptions. **s** = service view, **b** = behavior view, **c** = communication view, **m** = semantic view (meaning), **d** = decomposition view.

Figure 15, service provision/refinement matrix retrieved from Wieringa et al.

The next element of the design approach is the design charter, Figure 16, design charter retrieved from Wieringa et al.. This design charter has two types of entities, entities that can not be changed and entities that can be changed (within the box). The design charter can look different based on what is included and what you can influence.

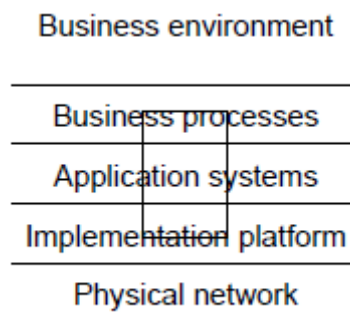


Figure 16, design charter retrieved from Wieringa et al.

For the viewpoint in Figure 16, design charter retrieved from Wieringa et al., there are several techniques to describe the viewpoints.

Next, the article gives an example on how to execute the design approach and how to describe the viewpoint by using, for example service, activity, and event list. This list can then be used to visualise business responsibilities, these are the main processes. It can be used to define the structure of the architecture (Wieringa, Blanken, Fokkinga, & Grefen, 2003).

The guidelines for solving the alignment problem are discussed in the article, being (Wieringa, Blanken, Fokkinga, & Grefen, 2003):

- Functional decomposition, each service that is delivered has an own defined component. This means that it has a software component for each business service.
- Communication-oriented decomposition, for each entity that is communicated with there is a component. This decomposition has three variants:
 - o Device-oriented, a component for each device that is communicated with
 - o Actor-oriented, a component for each actor that is communicated with
 - o Event-oriented, a component for each event that has to be responded to
- Behaviour-oriented decomposition, for each process that has to be monitored or controlled a component is defined. This means that if a business process is a business responsibility.
- Subject-oriented decomposition, for each subject wherefore data has to be maintained a component is defined. This is the standard guideline for databases.

If functions are independent from each other, functional decomposition leads to a modular architecture. But, if function are dependant on each other then functional decomposition does not lead to an modular architecture (Wieringa, Blanken, Fokkinga, & Grefen, 2003).

The final article, SOA-Driven Business-Software Alignment (Shishkov, Van Sinderen, & Quartel, 2006), focusses on the alignment of business processes and their supporting applications in the initial software design phases. It acknowledges the following properties of the model-driven service-oriented approach (Shishkov, Van Sinderen, & Quartel, 2006):

- There is a forced alignment between business processes and supporting applications
- Changes in the business environment can be traced to the application and vice versa
- The software modules have a high degree of autonomy
- Migration to new technology platforms can be supported trough the model

The writers state that it is important to avoid the mismatch between requirements and functionality. When designing an application different levels of abstraction should be considered (Shishkov, Van Sinderen, & Quartel, 2006). It should bridge between high-level business logics and the application functionality. This can only be achieved if the initial business model is (Shishkov, Van Sinderen, & Quartel, 2006):

- A valid reflection of the real-life situation
- A suitable foundation for generating an application model
- A suitable style for organising the application model such that it can be used for alignment

During all the design steps the writers only consider the external behaviour of entities. The writers state that composing services at high level (and hiding the technological complexity) speeds up the development of business aligned application models (Shishkov, Van Sinderen, & Quartel, 2006).

To be useful a business situation description must disclose both structure and behaviour as well as governing rules. Additional constraints to the design process are taken into account; it should be imposed by technology platforms that are used, motivated by project-driven technical restrictions, and reflecting the demands of the future users (Shishkov, Van Sinderen, & Quartel, 2006).

The main considered concepts are; system, environment, entity, and behaviour (Shishkov, Van Sinderen, & Quartel, 2006). A system is a regularly interacting/interdependent group of entities. This system is functioning in a certain context, the environment. The behaviour is considered to be what a system or entity does. The behaviour is modelled as a set of related events. There are two types of events, action and interaction (Shishkov, Van Sinderen, & Quartel, 2006).

The writers state that there are two crucial phases and milestones being; the business modelling phase with the milestone the business model, and the application modelling phase with as milestone an application model (Shishkov, Van Sinderen, & Quartel, 2006). The writers propose two different types of models; the structural aspect model (that envisions the statics of the system) and the behavioural aspect model (that envisions the dynamics of the system) (Shishkov, Van Sinderen, & Quartel, 2006).

The writers made some assumptions for their modelling approach. Which concludes that the writers are only interested in the service of a business process. When the business is decomposed into smaller processes, internal behaviour will be more interesting (Shishkov, Van Sinderen, & Quartel, 2006). Although this is still about the service of the smaller process.

The interactions between entities are also considered, this is structurally approached by using the Language-Action Perspective (LAP). LAP considers the inter subject relationships among entities to be the real basis of an organisations existence (Shishkov, Van Sinderen, & Quartel, 2006). This means that these interactions are commitments to the process. The interactions are divided into two types of acts, production acts, and coordination act. When executing production acts, entities contribute to the result of the process (Shishkov, Van Sinderen, & Quartel, 2006). When executing coordination acts, entities help distribute the commitments and agreements from the production acts. The acts are approached in modelling way (Shishkov, Van Sinderen, & Quartel, 2006). The interaction are modelled into a Generic Interaction Pattern (GIP), *see Figure 17 by* (Shishkov, Van Sinderen, & Quartel, 2006).

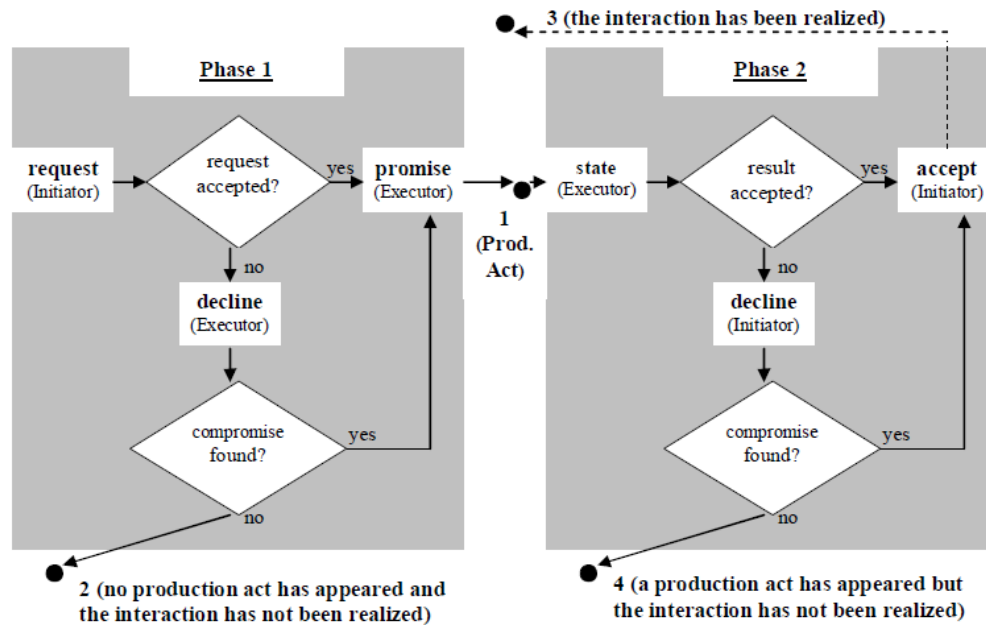


Figure 17, Generic Interaction Pattern retrieved from Shishkov et al.

The GIP is applied in the start of the business modelling phase. The reason for this is that it captures failures which are; when the requested result is irrelevant to the service provider, and when the result is not accepted by the requesting party (Shishkov, Van Sinderen, & Quartel, 2006). The writers use a case about a financial mediator to explain their finding.

The next chapter is about business-modelling, the writers use sub-phases to achieve the first modelling milestone. The first sub-phase, the structural modelling sub-phase includes the identification of; the business system that is studied, the relevant entities that belong to the system, the relations (connections) between the entities, and the roles (initiator/executor) towards the interactions (Shishkov, Van Sinderen, & Quartel, 2006). This builds up to a business entity model.

The following sub-phase is the behaviour modelling sub-phase. This phase adds information about the behavioural aspects. First, the systems external behaviour is modelled. In this step the system is considered as a black box (Shishkov, Van Sinderen, & Quartel, 2006). Next, the systems internal behaviour is disclosed (Shishkov, Van Sinderen, & Quartel, 2006). And finally, each interaction is replaced with a GIP.

The last subphase is the service identification sub-phase. This sub-phase includes, identifying units of behaviour by grouping interactions and modelling the relations of these behaviours (Shishkov, Van Sinderen, & Quartel, 2006). In the article the sub-phases are visualised by making models for each phase. These models are approached in a very structural way.

The next part of the article is about application modelling. It also has sub-phases; the delimitation-requirements sub-phase, the SOA (Service-Oriented Architecture) decisions sub-phase, the application design sub-phase, and the consistency analysis sub-phase (Shishkov, Van Sinderen, & Quartel, 2006).

The delimitation-requirements sub-phase is about which part of the business model is addressed by the application service and what are the user requirements and how are they applied to the application model (Shishkov, Van Sinderen, & Quartel, 2006). The next sub-phase is the SOA decisions sub-phase, it

addresses the SOA related decisions (Shishkov, Van Sinderen, & Quartel, 2006). It is about how services are addressed and coordinated via application specific components. This phase models where software should be used and how it interacts with the entities. The third sub-phase is the application design sub-phase. This phase is about refinement and extension of the existing models from the business modelling phase (Shishkov, Van Sinderen, & Quartel, 2006). It uses the results of the previous sub-phases. The fourth and final sub-phase, the consistency analysis sub-phase visualises the consistency between the original business models and the proposed application models (Shishkov, Van Sinderen, & Quartel, 2006). The phase is about validation of the different models.

The article concludes with an advice. For business-application alignment for the design of business application software, a model-driven service-oriented approach should be used. This can be achieved by using SOA, this applies a communicating component to the business model. It still has a high level of abstraction and is not too specific (Shishkov, Van Sinderen, & Quartel, 2006).

Answer to the research question

The research question was “what are the attention points when making a business tool that is related to projects in design and engineering?”. The found articles were quite general, but because of their abstractness they can also be applied to a project in design and engineering, because there is still a system, entities, and several communications.

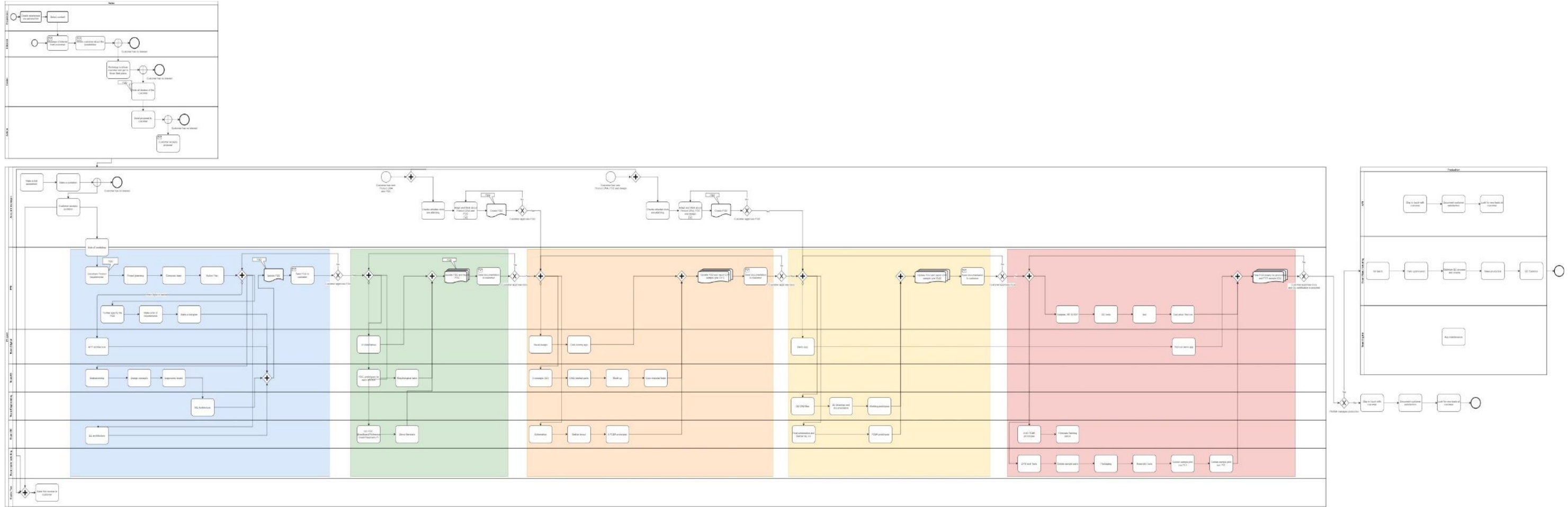
The first point of attention that was addressed in the articles was to make a structured business model ((Baresi, Fraternali, & Houben, 2007), (Wieringa, Blanken, Fokkinga, & Grefen, 2003)). It is important to make a structured approach when identifying the involved entities. What are their roles and what type of access they have (Wieringa, Blanken, Fokkinga, & Grefen, 2003). How are the entities involved in the environment. What are the business goals and what are the business requirements?

The application modelling should be focussed on how the entities are communicating and how the software is involved (Shishkov, Van Sinderen, & Quartel, 2006). What are the user requirements and how do you apply them to your architecture.

Concluded from the article could also be that business modelling is important and that it is important to have a structured approach for application modelling ((Baresi, Fraternali, & Houben, 2007), (Shishkov, Van Sinderen, & Quartel, 2006), & (Wieringa, Blanken, Fokkinga, & Grefen, 2003)). In the articles several steps are taken for this structured approach.

Appendix D

BUSINESS PROCESS PILOTFISH



Word count:

Appendix E

Due to Confidentiality, the PDD has been deleted.

Appendix F

MPSM PHASE REPORTS 1-5

Phase 1

Process description

The process starts with sales negotiating with the customers. This is a long and complicated process due to the customer having complicated wishes. The specific wishes and different company cultures makes every project different and makes communication difficult.

The designing process starts with a kick-off workshop. In the workshop Pilotfish learns the customers needs and requirements. In the workshop the client and designers will get together and define elements such as, the requirements of the product, how to test the prototype, logistics etc. The result of this workshop is the Product Definition Document (From now on referred to as PDD see glossary). The current PDD is a Microsoft Word template that is hard to work with and is not intuitive. It contains information such as; how to test the prototype, the requirements e.g. where and how big should the CE-mark be. An other important issue is what to do when the product design changes. When a product changes it should be checked whether all requirements are still fulfilled and all the tests will have to be redone.

Pilotfish has three location of which two in Europe (Amsterdam from now on referred to as AMS and Berlin from now on referred to as Ber) and one office in Taiwan (Taipei from now on referred to as TPE). The communication between offices is difficult. This is caused by time zones, but also by different working methods and different perceptions. Examples of the different perceptions are the definitions of certain terms used.

The people working at Pilotfish are mainly designers, they want to use the maximum of their capacity to design products for their customers. With the current PDD they have to document more than they wish. This has to be easier. Also Pilotfish uses a lot of standard tests for their products they have to be added to the PDD easier.

Analysis of the current situation

The current PDD is a Word document. The PDD is rated very low. The PDD consists out of several chapters:

- Introduction
- Product glossary
- Market requirements
- Innovation
- Product values (essence of the product)
- Product user interaction (UX concept)
- Product technical requirements – design constraints
- Product manufacturing/assembly/material

Word count:

- Next meeting with the client
- Deliverables
- Action points

The template is a interview with questions about the several chapters. These are questions about what the client wants, who is the targeted audience etc. Within the document copy-pasted sketches and morphological overviews can be found. The Bill Of Materials (from now on referred to as BOM see ...) is made in a Word table.

The designer uses the PDD to look up the requirements. After designing the designer checks. If all requirements are fulfilled. When a requirement changes or the design changes this has to be processed in the PDD. These changes have variable impacts on the product. Currently the impact has to be looked up in the PDD.

The target prices of the product are defined at the beginning of the document. During the designing process this is kept in mind. The cost price is calculated in a later stadium and changed every time the product changes.

Every time a revision is made to the document this is noted in a revision table and marked by hand in the PDD. Here after, the PDD is saved as a new version. This can go up to over 18 different versions of the PDD.

Pilotfish uses Microsoft office 365, Microsoft Teams is used as a communication platform.

Problem cluster

A problem cluster was made to inspect the problems at Pilotfish.

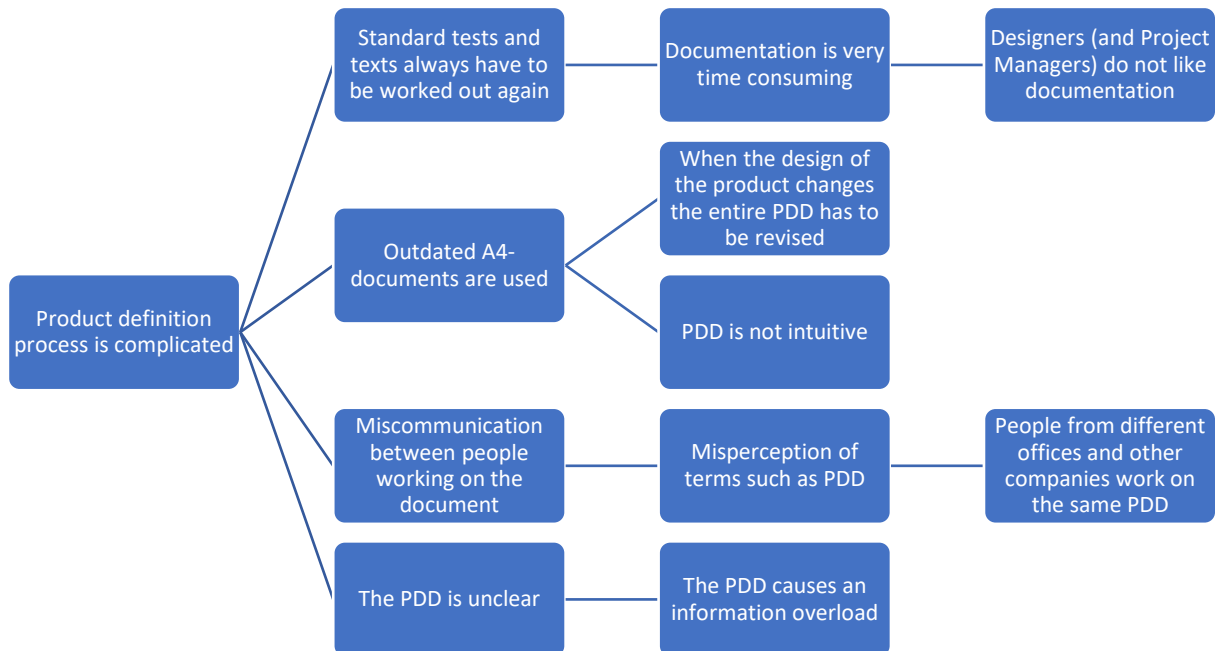


Figure 18, problem cluster

From the problem cluster it can be concluded that the product definition process is too complicated. There are several problems within the problems that can be solved. Not every problem is in the scope of the thesis. However some side problems might also be answered by the thesis.

The variable that might suit the problem is the convenience of the PDD, because the PDD is now very inconvenient. The PDD should be easy to work with and easy to understand. At the moment it is not as easy to work with, therefore there is a gap between norm and reality.

Phase 2

The involved stakeholders

The stakeholder analysis showed that there are several types of stakeholders. The key stakeholders and their goals were:

- Management, wants to improve the tool and improve the process
- Employees, wants to ease their jobs and are needed to improve the solution
- Student, wants to write a good thesis and make a functional solution
- Customers, want to have a clear overview of all the desired information

Besides the problem owners, the managing partners, the employees are also involved. Some of them use the PDD others might not use it often. Within the company there is a lot of knowledge on UX (user experience) and on how to make a Product Definition/Product requirement document. This knowledge

should be utilised. It is also important to involve people of the AMS office in the process, this might motivate them more to use the PDD. They are always open to help, however they should not be bothered too much because they are also busy with their daily jobs. The customers should also be taken into consideration, the document is an important way to communicate with the customers. The customer desires a clear overview that contains all information about the product. The company gets no complaints about the content of the PDD, this should remain the same and is an important thing to monitor during the project.

Information that is needed to solve the problem is:

- What does the organisation look like?
- What does the workflow look like? (The design workflow? The design and production workflow?)
- Literature about business process modelling
- SLR on benchmarking and how to execute it
- Benchmarking the PDD to competitors solutions
- What solutions are available?
- How to use the chosen solution?
- How to implement and design the solution?

People that can help me are the managing partner in TPE, the project manager in BER, and because there is a part of electrical engineering not complete in the document the electrical engineer in TPE.

Most of the problem is solved by me. However, in phase 5 the decision making phase, the managing partner is involved. For the rest of the project the UX designer in AMS and the project manager in BER will be asked to take a look at it. This will happen in the solution implementation phase where the tool will be made. In this phase also the knowledge on; how to use the chosen solution, and how to implement and design the solution will be needed. Also because the content is not complete for the EE part I will ask the electrical engineer to help building the necessary information about EE.

The minimum viable product is an more interactive improvement of the current PDD.

An action plan was made to show all activities during the project.

Action	When	Who	Comments
Problem identification (interviews)	Week 1 – week 5	Student	Interviews with employees to gather both qualitative data as quantitative data. Mapping the structure of the organisation and the workflows.
Literature review	Week 4 – week 5	Student	Find and study literature about business process management, benchmarking and possible solutions.
Problem analysis	Week 5	Student	Drawing conclusions from the data.
Decision making	Week 6	Student, company supervisor	Finding the criteria for the solution. Using a systematic approach to make a weighted decision. Together with supervisor make the final decision.
Solution implementation	Week 6 – week 8	Student, UX designer, PM	Make the solution, use UX designer to advise on the feel of the product and PM to check on the content.
Solution evaluation	Week 9 – week 10	Student, employees	Let the employees use the final solution and evaluate their comments
Writing and structuring thesis	Week 9 – week 10	Student	Most of the thesis will already be written however, changes might have to be made

and the thesis has to be properly structured.

Phase 3

A problem analysis was performed to find out what was wrong with the PDD. As will be explained in the research design paragraph, semi-structured interviews were conducting with employees at Pilotfish. The results of the interviews will be used to analyse the situation at Pilotfish.

The people at Pilotfish have already tried to improve the PDD. However, they were still not satisfied with the results of their activities. From the interviews could be concluded that the PDD is not complete. And, needed some more guidelines for unexperienced users.

Within the business the PDD is used as a method to list a requirements and pin them down. Sometimes customers would change their requirements. The question at that moment was who is responsible for this dissatisfaction, should Pilotfish do extra work because the requirements were not met or should the customer pay extra because they want expect more from the product than there was agreed upon? The PDD was not complete. This could be interpreted as the document is was not satisfying for the customer or there was room for discussion about some requirements/actions from Pilotfish.

The PDD should also be used as a test case for the final prototypes/first production run. At this point the expenses could run high if there are sudden changes because the customer is opinionated that not all the requirements are met. The PDD misses a test plan that the customer agrees upon in the early stages of the project.

The PDD also misses a sufficient part about EE. Currently the PMs working on the PDD adds a part about EE their selves. This causes this part to be more open for interpretation and to differ between the different PMs. To get a more general standardised document there should be a clear template/guideline for all parts of the documents including EE.

The guidelines that explain the PDD and help the user to work with the PDD should be useful for unexperienced users. From the interviews it could be concluded that Experienced PMs learned how to work with the PDD and how to adapt the PDD to their needs.

The scope of the project also influences the content of the PDD. Some projects require a PDD that is full of information, whilst other smaller projects might not contain every part of the template. Team digital uses their own PDD that is short and contains their in- and output needs (team digital is left out of the scope of this project because their needs are satisfied with a small document).

The PDD is gradually build up to a complete document during the project. At the begin of a project it only consist out of the 'product DNA'. During the later project phases it is build towards a complete document that contains all information about the product. During the first phases parts of the template will be deleted to make the PDD look appropriate for the customers first check, later on the PM has to add chapters and paragraphs.

Phase 4

To solve the problem there are two possible solutions that fit the company. Meaning that they are available within the IT-architecture (the office 365 environment of Pilotfish). Both might be able to fulfil the requirements. The possible solutions are:

- VBA for Word
- Microsoft PowerApps (low-code application builder)

The decision will be made using a weighted decision, where criteria will be used and judged. The weighting of the criteria will be based on the so-called MoSCoW-rule, this stands for; Must-have (qualifier), Should-have (important, however the solution also works without this criteria), Could-have (not too important, these criteria receive a lower weight), and the Want-to-have (not important, these criteria are the first criteria to be dropped). The cumulative of the weights should be equal to 1,0. $\sum_{i=1}^N w_i = 1,0$. The criteria will be graded with a score on a scale from 1 to 5. The solution that receives the highest average score will be the advised solution to the problem.

The criteria that are set for the solution are chosen based upon the needs of the company and other requirements that are considered necessary. As been noted before, the weights of each criteria is based on the MoSCoW-rule.

Must-have (qualifier):

Must be available within the companies IT-infrastructure, the possibilities within office 365 are considered to be sufficient to solve the problem. Therefore there is no need to make extra investments for the solution to this problem

Ability to document the requirements, the PDD is about documenting all requirements for the products designed by Pilotfish within its projects.

Should-have (high weight):

1. *Possibility to adapt to new situations*, projects at Pilotfish are highly customised to the customer's wishes. This means that every new project is different from former projects. This might also affect the PDD.

2. *Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer*, the PDD is meant as a method to communicate the requirements to the customer. The customer has to approve the document to proceed on the project. Besides communicating to the customer, the PDD can also be used as a source of information to the employees working on the project. Each of the different teams has different interests in the content of the PDD.

Could have (medium weight):

3. *Methods to make the PDD more intuitive*, the main problem of the current PDD template is that it is hard to work with. It should become more intuitive and easier to get a clear overview.

4. *Possibility to insert guidelines on how to work with the solution*, the current template lacks information on how to use it. For new employees that work on it for the first time this might be helpful to make the document.

Want-to-have (low weight):

5. *A automated logbook of the changes within the document*, changes on the document have to be noted for the customer to get a clear overview from what changed since the previous version of the PDD.

6. *A function to easily insert other documents*, the PDD might refer to 3D models or other reports.

The criteria are scaled in categories, the must-have criteria do not receive a weight since they are qualifiers and thus have to be met. If the qualifier criteria are not met the solutions are not an option. These criteria are only rated yes or no.

The other criteria are weighted as follows, High (0,30), medium (0,15), and low (0,05). These weights are scaled such that $\sum_{i=1}^N w_i = 1,0$. The high importance criteria are twice as high as the medium criteria, this means that there is a clear difference between the should-have criteria and the could-have criteria. Because of this distinction in weights the MoSCoW-rule is correctly applied. Finally the low weight are a third of the medium weight and a sixth of the high weight, they account less to the grade than high or medium.

As been noted before the available solution are:

- VBA for Word
- Microsoft PowerApps (low-code application builder)

Both these solutions fulfil the must-have requirements, the solutions will therefore be tested with the decision making table.

Criteria	VBA for Word			Microsoft PowerApps		
	Score	Weight	Total	Score	Weight	Total
Criterion 1	4	0,3	1,2	2	0,3	0,6
Criterion 2	3	0,3	0,9	4	0,3	1,2
Criterion 3	3	0,15	0,45	3	0,15	0,45
Criterion 4	2	0,15	0,3	3	0,15	0,45
Criterion 5	2	0,05	0,1	1	0,05	0,05
Criterion 6	3	0,05	0,15	4	0,05	0,2
			3,1			2,95

From the decision process it can be concluded that VBA for Word is the best option, however this is by a narrow margin. Both alternatives might not be the optimal solution. However, these solutions lay within

the scope of the project and suit the current situation at Pilotfish. Other solutions will be considered in the chapter on further research.

VBA for Word

VBA for Word was chosen as a solution because it has possibilities to automate certain tasks within Word. Word is available within the company and can be used to inform both the customers as the employees within the company.

Possibility to adapt to new situations, the solution scored 4 out of 5 for this criterium. The users are very familiar with Word and can always add new bits to the document by hand. This could be the case when a new chapter that normally is not used within the project has to be added to the PDD. However it might be the case that the VBA part will not work for this added part.

Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer, the solution scored 3 out of 5 for this criterium. With the right use Word can be very clear, VBA will help with this. However when the solution is not correctly used it might become more less clear.

Methods to make the PDD more intuitive, the solution scored 3 out of 5 for this criterium. VBA will help making the PDD more intuitive, but the own input of the user will also remain important.

Possibility to insert guidelines on how to work with the solution, the solution scored 2 out of 5 for this criterium. It is possible to insert guidelines, however it is unclear if this can be done in a aesthetic way.

A automated logbook of the changes within the document, the solution scored 2 out of 5 for this criterium. With VBA it is possible to automate certain tasks. However it is unclear if there is an aesthetic method to reach this goal

A function to easily insert other documents, the solution scored 3 out of 5 for the criterium. It already is possible to add documents to a Word document. However it might be a more ambiguous way to add a document.

Microsoft PowerApps

PowerApps is a low-code application builder that is available in the office 365 package that Pilotfish uses. It can be used to show information to all people that have access to the App.

Possibility to adapt to new situations, the solution scored 2 out of 5 for this criterium. New parts can be added to existing apps, however this is ambiguous and for ever new project a new app has to be made.

Possibility to make a clear (overview) document for both the employees (for each different team a different overview) as the customer, the solution scored 4 out of 5 for this criterium. The apps give a clear overview and can easily be used on multiple devices. It might be a bit harder to supply the customer with all information.

Methods to make the PDD more intuitive, the solution scored 3 out of 5 for this criterium. An app is more intuitive than a template document. Especially with the right design it is possible to make an intuitive app.

Possibility to insert guidelines on how to work with the solution, the solution scored 3 out of 5 for this criterium. It is possible to insert guidelines within the app. However, the functionality of the PowerApps platform that is available seems restricted.

A automated logbook of the changes within the document, the solution scored 1 out of 5 for this criterium. It seems impossible to apply this to an app correctly with the functionalities that are available for PowerApps.

A function to easily insert other documents, the solution scored 4 out of 5 for the criterium. It is possible to add documents to an app.

To conclude, PowerApps is especially lacking on the ability to adapt to new situations. Pilotfish works in projects where sometimes unforeseen situations (and thus chapters) happen in a project. Therefore, Pilotfish requires a agile solution that can easily be adapted to new situations.

Phase 5

The proposed solution of phase 4 was presented to the company supervisor. After an explanation about why certain criteria were set and grades were given to criteria the company supervisor agreed with the proposed solution. The concern that had to be checked is that VBA for word would be available for the long term. After consulting the Microsoft roadmap, no signs could be found to show that Microsoft would stop the usage of VBA, it could also be assumed that Microsoft would not stop using VBA because companies did invest in VBA tools. To conclude, the chosen solution to implement in phase 6 is VBA for Word.