Eindhoven University of Technology

Master Thesis Proposal: Business Process Enactment in Healthcare

Comparing a generic Object Oriented Model Driven Engineering tool with a specialized Case Handling tool (Mendix vs. BPM|One).

Author:	G.J.M. Muijres
Student ID:	0555168
Supervisor:	Dr. P.M.E. van Gorp

Abstract

This report is written as a proposal for a master thesis project. The project is about business process enactment in a healthcare situation. In this context, a generic object oriented model driven engineering tool (Mendix) is compared with a specialized case handling tool (BPM|One). This is done for a healthcare situation, since this domain has not fully recognized the potential of using IT support for business processes. There are a lot of different tools, notations, and paradigms available for business process management, but a clear systematic evaluation mechanism is missing. Case handling is developed as a relaxation of the rigid workflow paradigm, whereas model driven software engineering is formed as a restriction of the flexible software engineering paradigm. The two approaches have a different background, but they are moving in a common direction. In comparing the two approaches, flexibility is very important, but the efficiency of development as well. Since flexibility is an important aspect in the healthcare domain, the case to evaluate the approaches will be in a healthcare situation. The tools are compared to learn to (dis-)advantages of both approaches in this particular scenario, which could simplify the choice in another scenario, since the evaluation is based on a generic comparison scheme. This report further describes the methodology of how to structure the project, and a project plan with a time schedule is given.

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1. Introduction

Business process modeling is the systematic, structured method of representing enterprise processes in a model. This is done to analyze, improve, control, and manage the processes. A business process can be described "as a set of logically related tasks performed to achieve a defined business outcome" (Davenport & Short, 1990). Business processes have two important characteristics: (1) a process has customers – internal or external customers, and (2) a process crosses organizational boundaries – it can be across or between business units. According to Davenport & Short, a process model shows which steps are required to execute the business process, in what order these steps need to be taken, and who needs to take these steps. More recently, process modeling approaches have emerged to paradigms where to order of execution is not specified explicitly. An important example of this kind of approaches is case handling, but more about that later on.
Business process modeling is used to trace and solve problems or to find opportunities to improve the business processes. There are actually two different kinds of models which can be used; simulation models and enactment models. To make use of a simulation model, detailed probabilities and time-related annotations are needed. For the implementation of the business processes (for workflow execution purposes), an enactment model can be used, for which operational details, like data sources and user interface interactions are needed. The focus in this thesis will be on enactment models.

Workflow systems involve the concept of business processes, which can be described as a set of activities with a common goal (Salimifard & Wright, 2001). A workflow represents a set of activities, which require either human or other resources of an enterprise, to meet the terms of predetermined requirements. Business process models can be used to configure workflow engines that can be used as a guide in the completion of daily activities. It can also be used for the automatic detection of bottlenecks and finally it can also provide facilities for electronic document storage, messaging, etc. Although workflow systems can be used for a wide variety of appliances, but a clear systematic evaluation mechanism is missing.

There are a lot of different modeling methods available, and there is not just one industry standard. Although these methods all use different notations, they are used to model the same processes. The focus in this thesis will be on visual notations, since these notations have an advantage over non-visual notations; readability. Visual notations make it possible for organizations to optimize their inherent business processes and communicate them to partners to simplify business to business transactions (Vasko & Dustdar, 2006).

Case handling, as described before, can be seen as a rather new paradigm, where the order of the execution of processes can be decided by the worker in charge. This is in contrast to the rigid workflow paradigm, where the order is predetermined. On the other hand there is the model driven software engineering paradigm, which originates from a restriction of the flexible software engineering paradigm. These in background varying paradigms are moving in a common direction now. That is why this thesis is aimed at evaluating today's remaining

differences, and the implications for their applications in a healthcare environment. To do this, two state of the art modeling tools are used, one representing each paradigm. These two tools will be Pallas Athena's BPM|One as a case handling tool, and Mendix as a model driven software engineering tool. More about the two different tools will be in the following chapters.

The remainder of this report is structured as follows; chapter 2 gives a delineation of the project, chapter 3 describes the possible cases which will serve as data source, chapter 4 describes the methodology of the study, followed by the planning in chapter 5 and a conclusion in chapter 6.

2. Delineation of the master thesis project

Within this chapter, an overview is given of what is being studied within the master thesis project. Besides this information, the expected results of the study are described, alongside with a description of what should be done with these results. This chapter consists of two subchapters; the first one describes what is being studied, and why, while the second one describes the expected conclusions and how they can be interpreted.

2.1. What precisely is being researched, and why?

First a description is given about what is being studied in this thesis. This subchapter is divided into three paragraphs; first the goal of the thesis is described, next the benefit of this research is noted, and finally the knowledge already known in this area is explained.

2.1.1. Goal of the thesis

There are a lot of different business process modeling (BPM) methods, as described in the introduction. With the focus on visual notations, the area is still very wide. Within the literature study, some basic research is done about this field. An introduction to UML ((Fowler, 2004) (Holt, 2005) (Jahnke & Zündorf, 1998) (Pilone, 2006) (Scott, 2004)), workflow modeling ((Mentzas, Halaris, & Kavadias, 2001) (Murata, 1989) (Salimifard & Wright, 2001)) and story driven modeling ((Diethelm, Geiger, & Zündorf, Systematic Story Driven Modeling, a case study, 2002) (Diethelm, Geiger, Maier, & Zündorf, 2002) (Fischer, Niere, Torunski, & Zündorf, 1998) (Jahnke & Zündorf, 1998) (Köhler, Nickel, Niere, & Zündorf, 2000) (Van Gorp, 2007)) is given and they are compared along certain guidelines, to find the advantages and the disadvantages in each situation in which they can be used. This background study acts as a foundation for the next part of the thesis. One of the findings was that there is not but no systematic evaluation mechanism available. That is why this thesis is aimed at comparing two state of the art modeling tools, based on a generic comparison schema. The comparison will take place with means of a case study which is described in chapter 3. The comparison scheme should work for multiple situations if it is correctly instantiated. The actual goal of the thesis is summarized in the subtitle of this report; Business Process Enactment in Healthcare: comparing a generic Object Oriented Model Driven Engineering tool with a specialized Case Handling tool (Mendix vs. BPM|One). The two tools will be compared by

building a prototype of a workflow management system application in a healthcare situation. The two modeling tools will be compared on a number of characteristics, like the time needed to build the prototype, the usability, the needed amount of frames/screens/entities, etc.
To be able to build the automated workflow prototypes, a certain number of process models is needed. Besides these needed models, two other kinds of models can be developed as well. The first kind of model makes an abstraction of the technical details needed for the prototype, so to hide certain data. The second kind of models explicitly show certain data which is hidden in the prototype models, so these can be seen as some kind of documentation models. The ease of making these two other kind of models and the possibility of linking these models to the prototype models can also be seen as an evaluation aspect on comparing the two tools. These models can also be seen as an extra deliverable for the company.

2.1.2. Benefit of the research

By comparing the two tools (and the underlying approach) based on some characteristics, the most suitable tool for building a WFMS application in this situation can be found. By having the comparison based on a generic comparison framework, a mechanism should become available for selecting the most promising solution in other situation. With means of this study it can be found out which tool can be used to build an application in the least of amount of time, or with the highest usability. In this way the usage of workflow management systems in the healthcare domain can increase, which can lead to improvements in the business processes, or might decrease the number of wrong decisions which could be made because of a lack of overview on the process.
Another benefit is related to the documentation models. Because of this research, healthcare organizations should be able to remain involved in IT projects, related to the enactment of their core business (patient care paths). If these models were not available, a healthcare organization might get too dependent on external consultants.

2.1.3. Known knowledge in this area

The use of IT support for business processes has already been recognized as a tool for staying competitive in a market (Weber & Reichert, 2010). This same need is not fully recognized in healthcare yet. Within healthcare processes different organizational units are cooperating, and process support is crucial in such a situation (Lenz & Reichert, 2007). IT support for processes can create an improvement in healthcare quality if used in a proper way. As a response on the need for IT support for business processes, a lot of possible options are available. Different business process management tools have been created for enterprises to implement and execute complex scenarios either within or across organizational settings (Weber & Reichert, 2010). But what is missing is a clear evaluation on when to use what tool.
Supporting the different tools are the underlying different process support paradigms like workflow management and case handling. Workflow management systems are most useful

for business processes which are well structured and have a high degree of repetition (Weber & Reichert, 2010). Players in the healthcare domain often do not recognize their processes as having a high degree of repetition. This lack of flexibility is more dealt with in the second paradigm; case handling systems. Case handling is suited for more flexible process execution by avoiding restrictions which workflow management systems do have (van der Aalst, Weske, & Grünbauer, 2005). However case handling systems are not perfect either. They are for example not suitable for fully automated business processes.

At the extreme end of the flexibility spectrum, you have the option to implement a new system from scratch, using a general purpose programming language. Writing everything from scratch is counter-productive. Therefore, in model driven software engineering one is complementing general purpose programming languages with Domain-Specific Languages (DSLs) to improve development efficiency (France & Rumpe, 2007). Besides the rather big BPM field, the software engineering field is also a big research community, so a combination of both fields could lead to an optimal solution. Therefore, traditional engineering techniques and paradigms (like object-oriented engineering) should be combined with engineering principles to improve the support for business processes (like case handling) (Weber & Reichert, 2010). That is why in this thesis the generic object oriented software engineering tool Mendix will be compared with the specialized case handling tool BPM|One. To find out which approach gives the best results, to possibly boost the demand for IT support in healthcare as well.

2.2. What are the conclusions, what is their value and what should be done as a result of it?

The conclusions of this study should lead to the most suitable tool for building a WFMS application in this healthcare situation. More importantly, by having the evaluation based on a generic comparison framework, a mechanism should become available for selecting the most promising solution in other situation as well. As described in the previous paragraph, this could lead to a boost in demand for IT support in healthcare. This demand is already available in other domains, and has proven its success. This usage can also improve the quality in healthcare processes as well. The conclusions will give results for two specific modeling tools in a specific healthcare situation, but the results should be generalizable across process support situation throughout the entire healthcare domain. This is possible because of the previously mentioned generic comparison framework.

Based on the conclusions, one of the two tools will be selected as the most suitable tool for this situation. With this tool, a complete workflow management system application can be build, based on the prototypes build for this thesis. Building the actual application is outside of the scope of this study, but the prototypes should be a good basis for further efforts.

3. Data source

To be able to use the two different modeling tools for creating a prototype WFMS application, a case is needed to build it for. The chosen case relates to modeling processes

for the Eye care Network in Rotterdam. There is a confirmation from this player, and the case will briefly be described in the following section.

- The case is about the Eye care Network which originates in Rotterdam. The Eye care Network is a collaborating network of different players within the ophthalmology domain. The original network is active in Rotterdam, but the principle of cooperating players is being used in more and more areas throughout the Netherlands. By keeping the patient as a focus point, the network is aimed at improving the quality of the medical care within the network. All sorts of protocols are available for creating different treatment paths for a patient. The necessary information is stored in an electronic patient record which can be used by all the players from the network (as long as the patient gives permission to do so). This case is also thoroughly documented since it was part of a final report for the master course Healthcare Business Networks at the Eindhoven University of Technology (https://venus.tue.nl/owinfo-cgi/owi_0695.opl?vakcode=1BM70&studiejaar=2010). Besides the full report about the ophthalmology domain in the Netherlands, an interview with the director of the Eye care Network is included. This information can be used as an input for the prototype WFMS application. Besides this already available information, more interviews will be conducted throughout the available time period. More about the planning of the remaining time period in chapters 3 and 4.

4. Research design (methodology)

This chapter will give an explanation of how this study will be dealt with. An explanation will be given of the chosen tools, alongside of the reason for this choice. After that, the approach of getting to the solution is described, followed by a description of criteria to test the validity of this solution. The intermediate steps taken to reach this solution are explained, and finally some other details on how to find required information are mentioned.

The purpose of this thesis is to compare a generic Object Oriented Model Driven Engineering tool with a specialized Case Handling tool. To be able to do this, two state of the art modeling tools are needed to have a fair comparison.

According to Gartner's Magic Quadrant for business process management suites (Sinur & Hill, 2010), a nice player is a player who has achieved "… *significant-enough market awareness to be in the top 25 vendors*…" One of these players is Pallas Athena, with the tool BPM|One. Pallas Athena is a world leading business process management software provider with its roots in the Netherlands. One of Pallas Athena's suites is BPM|One, which is a web-based case handling tool. The few remarks made by Sinur & Hill on BPM|One are mainly focused on the limited installations beyond the Benelux – with respect to customer support – but since this research takes places in the Netherlands, this will not be a problem.

Gartner has recognized another enterprise located in the Netherlands, but this time the tool is a model driven engineering tool. Gartner listed Mendix – market leader in model-driven development for business solutions – as a 'Cool Vendor' in the category 'Cool vendors in application development' in 2009 (Norton, 2009). A 'Cool Vendor' is described as a company that offers technologies or solutions which comply with three characteristics. These characteristics are (Roos, 2009):

- **Innovative**: it enable users to do things which they could not do before;
- **Impactful**: it has, or will have, business impact (so it is not just technology for the sake of technology);
- **Intriguing**: it has caught Gartner's interest or curiosity within approximately the past six months.

Mendix is providing tools to quickly design, build, test, integrate, deploy, manage and optimize service-oriented business applications within any existing business and IT environment. Mendix claims that you can build applications 5 times faster, at about half of the cost of traditional development platforms, by using their tool.

4.1. Are you reusing some existing solution or developing something from scratch?

As described in chapter 3, no choice has been made yet on the case for which the prototype WFMS application will be made. Depending on this choice, an existing solution might be reused or something will be developed from scratch. But since the data which is available in the cases is not modeled in one of the two tools which will be used (Mendix or BPM|One), the application which will be created can be seen as a development from scratch. Certain models which are needed to develop the application might be reused, but the actual application is brand new. If the input models are in favor of the modeling language or paradigm of one of both tools, this poses a threat to the fairness of the comparative part of the study, but this concern will be taken into account.

4.2. How will you get your ideas for your solution development?

To be able to build the application in the two different tools, certain input process models are needed. These models will need to be created and validated with the company of the selected case. The next step will be to actually build the application. This step might be easier in one tool, or equally difficult in both. As a guiding reference for ideas, both tools have an online support community which can be of assistance when getting stuck during modeling.

4.3. What criteria shall be used to test the validity of the answer?

To be able to actually compare the two different tools, two different frameworks can be used which are described in the literature study. One of these techniques makes use of the cognitive dimensions framework (Green & Petre, 1996). The second framework focuses on designing cognitively effective visual notations (Moody, 2009). Principles from both

frameworks – complemented with information like: time needed to build the application, and the possible linkage with the two other kinds of models described in the goal of the thesis chapter – can be used to compare the tools. This should give a valid answer to the research question of which of the two tools gives the 'best' application.
Besides this validation of the two applications by using the different framework dimensions, the applications should also be tested and validated by healthcare professionals in the field. This can be done by the company of the selected case and/or by the people they work with in the field. Criteria followed in this part of the validation might be characteristics like ease of use and understandability.

4.4. Why was the chosen method selected?

The method described in the previous paragraph is selected because of two reasons. The first reason is based on the usage of the evaluation frameworks, the second reason is the need for validation from the field. The first part of validation is using dimensions from the two previously mentioned evaluation frameworks. This part is selected to make sure that the comparison of the two tools takes place as objective as possible. Two different frameworks are used, so the drawbacks of one framework can be compensated by the other. The framework from Green & Petre is chosen because of its recognized value (based on the high number of citations on this work). The framework from Moody is chosen as a more recent addition, to make sure all aspects are covered. The second part of the validation process is the validation by healthcare professionals in the field. This method is chosen, since these are the people who might actually use the application. So these people should know exactly what is good about the application, or what they might be missing. By using this second approach, it can be made sure that the applications have a practical relevance in the field.

Some comments on why other research methods are not used can also be given. A large scale expert survey could also lead to evaluation possibilities regarding the different tools and paradigms. There are a couple of reasons why this is not chosen as an option. The first reason is that more fine-grained information is needed, which requires one concrete case study (like the way the research is planned right now). A possible second argument could be that the consulting field in the healthcare domain is really immature, so this could lead to consultants being biased with vendor interests. Finally it is reasonable to expect that you will not find consultants that all have worked with one same set of tools, and therefore it will be really difficult to collect concrete comparable information.

4.5. Can you identify some intermediate steps in your solution development?

The intermediate steps can be divided into three paths. The first path is the modeling part, the second part is the development of the evaluation framework, and the third path is getting more information about case handling and model driven software engineering. The first path can be seen in Figure 1, the second and the third path can be seen in Figure 2.

To be able to develop the actual prototype application, certain input information (which describes the actual workflow) is needed. This data is needed to start building the application, so gathering this information, studying it for usability, and checking it for errors can be seen as a first step. Building the actual applications can be seen as step 2. The goal of the thesis chapter also described the two other kinds of models which will be created based on the application. The creation of these two kinds of models can be seen as step 3 and step 4. The final step is the process of actually comparing the two modeling tools. These different steps can be seen in Figure 1.

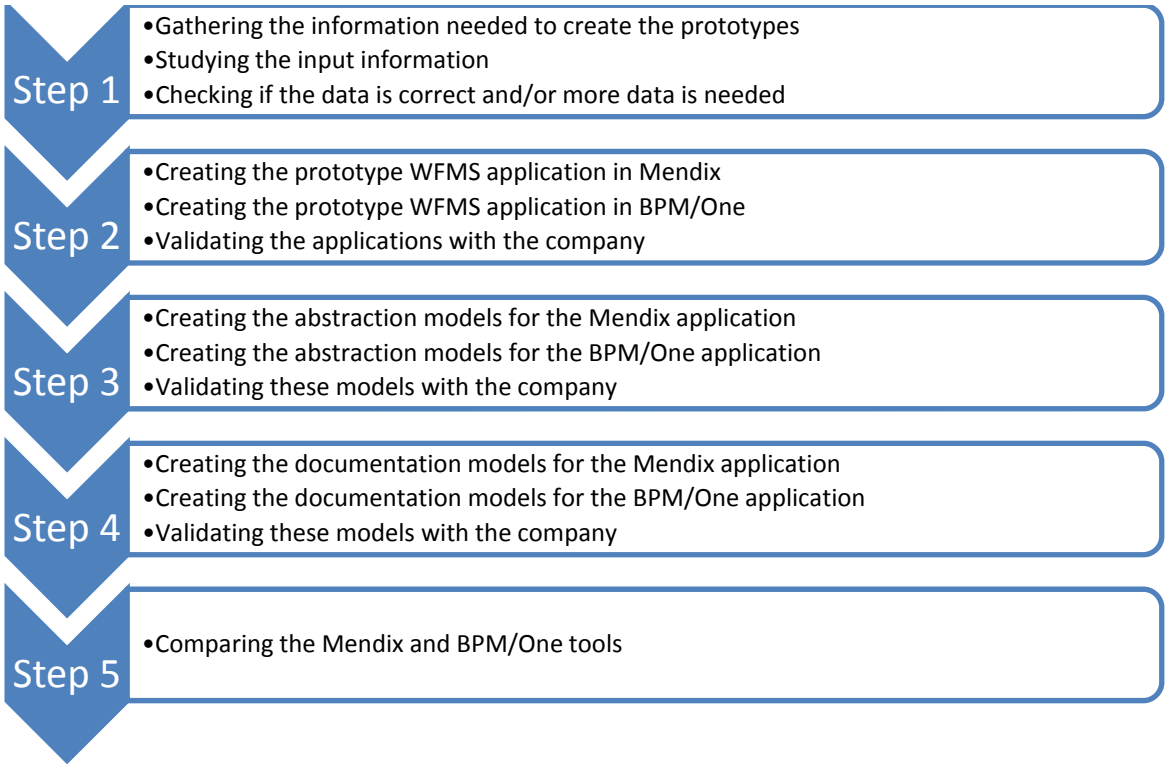

Figure 1: Different steps in the thesis process

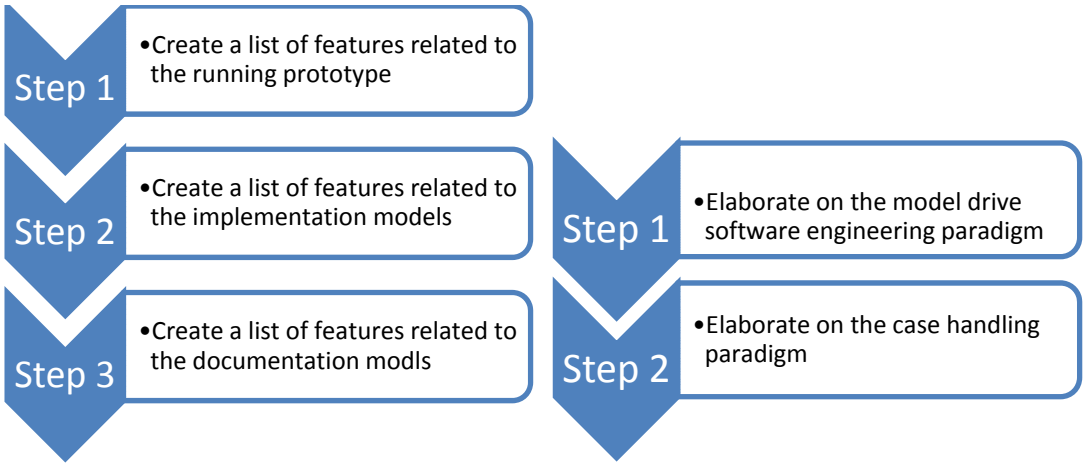

Figure 2: Different steps in the thesis process 2

Besides the modeling steps, the development of the evaluation framework is also necessary. This second stream can be divided into a couple of intermediate steps as well, as can be seen

in Figure 2. The final stream is the elaboration on case handling and model driven software engineering. This can be summarized in a number of reference concept maps based on (Rodríguez-Priego, García-Izquierdo, & Rubio, 2010).

4.6. To what extent will the findings be capable of generalization?

Since the findings are aimed at finding the best suitable modeling tool in a healthcare situation, these findings should be capable of generalization across the entire healthcare field of workflow management. It might even be the case that it is generalizable outside of the healthcare domain as well. It may also be possible that the results are specific for the healthcare situation for which the application is created. It is difficult to predict the exact outcome of this.

4.7. How great can the reliability/validity of the results be expected to be?

Since the evaluation will be based on scientifically funded frameworks, these results can be expected to have a high reliability. The fact that two different frameworks (both based on research) are used, increases the validity as well. Since the different models created in each step are validated with healthcare professionals in the field, the validity can also be expected to be high. But this research is only a first step, and even higher degrees of confidence will be possible if future research uses the evaluation framework again with more tools and on other cases.

4.8. What is the main field of research for relevant sources?

The two main fields of research will be software engineering and business process management. This will be linked with the field of information systems usage in the healthcare domain. Publication information can be found via a non-exhaustive list of search engines. These are also used to find the background information, used to write the literature study. These are search engines like Google Scholar, ABI/Inform, JStor, and more. The information found in these publications can be used in the remained of the study as well, with the addition of newly found and/or published reports.

5. Project plan & time schedule

Figure 3 gives a detailed time schedule for the planning of this master thesis project. This chapter gives a more detailed explanation of the different tasks. The planning takes place over a time span starting at the 14th of February and ending at the 24th of June. Most of the milestones are planned on the pre-scheduled biweekly meetings with supervisor Pieter Van Gorp.

Since this research is closely related to the research Hector Diaz is performing, some parts of the research can be done in collaboration. Both studies will use the same case study, and most company visits will probably be planned together. Some major milestone can be used as a synchronization point with the study done by Hector Diaz. It is difficult to fully plan these synchronization points in this point of the study.

The first task can take place throughout the entire time span of the thesis. The writing process can continue, during the other steps, documenting what happens at each step. Two other steps are also starting at the same time at the start of the project. The first one is selecting a company which serves as a case to develop the models. This step is really important and could really slow down the project if no case is selected. Two weeks are planned to meet the milestone on the 25th of February. At the same time of selecting the case, a start is made with investigating the two tools; Mendix and BPM|One. To have measureable milestones combined with this task, two milestones are planned on February 22 and March 8. These milestones represent the demonstration of a working application for both tools. Online instruction tutorials are available for both tools to build your own application. The idea for these two milestones is to have a custom made application – similar to the ones in the tutorials – based on a healthcare situation. The application should have multiple user options, and multiple underlying process steps.

The next tasks are to acquire the input data necessary to build the prototypes, and to study it for understandability and usability. Based on this, it is decided whether some interviews are needed to gather more information. At the same time the MDE paradigm is being elaborated, which will be concluded with a reference concept map, which is linked to the milestone on 11th of March. After this the same is done for case handling, and the corresponding milestone for this is on the 1st of April.

When all the input data are known, the application can be created in Mendix, and it can be demonstrated on the 22nd of March, which is set as the milestone date. After creating the application in Mendix, the same can be done in BPM|One, which can be demonstrated on April 5. After creating both applications, they also need to be validated by the company, which will probably lead to some changes. The validated applications can then be demonstrated at April 19.

The next step is building the abstraction models for both tools, validating them, and demonstrating them, which is again on a milestone date; May 3. The same is done for the documentation models, where the demonstration is split in two milestones; one on the 17th of May, and one on the 31st of May. When all models are made in the two tools, both tools can be thoroughly compared, alongside a predetermined framework. It is unclear at this point in time, which exact models will be created as abstraction and documentation models, which makes it difficult to predict how long these steps will take. More in general, since it is difficult to fully predict how long each step is going to take, two weeks of possible delay are scheduled near the end of the project. After these weeks a first presentation will be given for the project supervisor, and at the end a final presentation will be given for all involved parties. These two presentations are scheduled on June 20 and June 24, but this can change based on availability etc.

ID	Task Name	Duration	Start	Finish
1	Writing report	95 days	Mon 14-2-11	Fri 24-6-11
2	Selecting company as case	10 days	Mon 14-2-11	Fri 25-2-11
3	Case selected	0 days	Fri 25-2-11	Fri 25-2-11
4	Investigating Mendix & BPM|One	10 days	Mon 14-2-11	Fri 25-2-11
5	Demonstrate working Mendix application	0 days	Tue 22-2-11	Tue 22-2-11
6	Demonstrate working BPM|One application	0 days	Tue 8-3-11	Tue 8-3-11
7	Gathering information needed to create prototyp	5 days	Mon 28-2-11	Fri 4-3-11
8	Study input information/check if input is sufficient	5 days	Mon 28-2-11	Fri 4-3-11
9	Possibly conduct interviews to acquire more input	5 days	Mon 7-3-11	Fri 11-3-11
10	Elaborate on MDE paradigm	15 days	Mon 21-2-11	Fri 11-3-11
11	Demonstrate input information	0 days	Tue 8-3-11	Tue 8-3-11
12	Finish reference concept map for MDE	0 days	Fri 11-3-11	Fri 11-3-11
13	Creating application in Mendix	12 days	Mon 7-3-11	Tue 22-3-11
14	Elaborate on case handling paradigm	10 days	Mon 21-3-11	Fri 1-4-11
15	Demonstrate Mendix application	0 days	Tue 22-3-11	Tue 22-3-11
16	Finish reference concept map for case handling	0 days	Fri 1-4-11	Fri 1-4-11
17	Creating application in BPM|One	12 days	Wed 23-3-11	Thu 7-4-11
18	Demonstrate BPM|One application	0 days	Tue 5-4-11	Tue 5-4-11
19	Validating applications with company	5 days	Mon 11-4-11	Fri 15-4-11
20	Demonstrate validated applications	0 days	Tue 19-4-11	Tue 19-4-11
21	Creating Mendix abstraction models	5 days	Mon 18-4-11	Fri 22-4-11
22	Creating BPM|One abstraction models	5 days	Mon 25-4-11	Fri 29-4-11
23	Demonstrate abstraction models	0 days	Tue 3-5-11	Tue 3-5-11
24	Validating models with company	5 days	Mon 2-5-11	Fri 6-5-11
25	Creating Mendix documentation model	5 days	Mon 9-5-11	Fri 13-5-11
26	Demonstrate Mendix documentation model	0 days	Tue 17-5-11	Tue 17-5-11
27	Creating BPM|One documentation model	5 days	Mon 16-5-11	Fri 20-5-11
28	Validating models with company	5 days	Mon 23-5-11	Fri 27-5-11
29	Demonstrate BPM|One documentation model	0 days	Tue 31-5-11	Tue 31-5-11
30	Comparing Mendix & BPM|One	5 days	Mon 30-5-11	Fri 3-6-11
31	Possible delay in steps	10 days	Mon 6-6-11	Fri 17-6-11
32	First presentation at TU/e	0 days	Mon 20-6-11	Mon 20-6-11
33	Final presentation	0 days	Fri 24-6-11	Fri 24-6-11

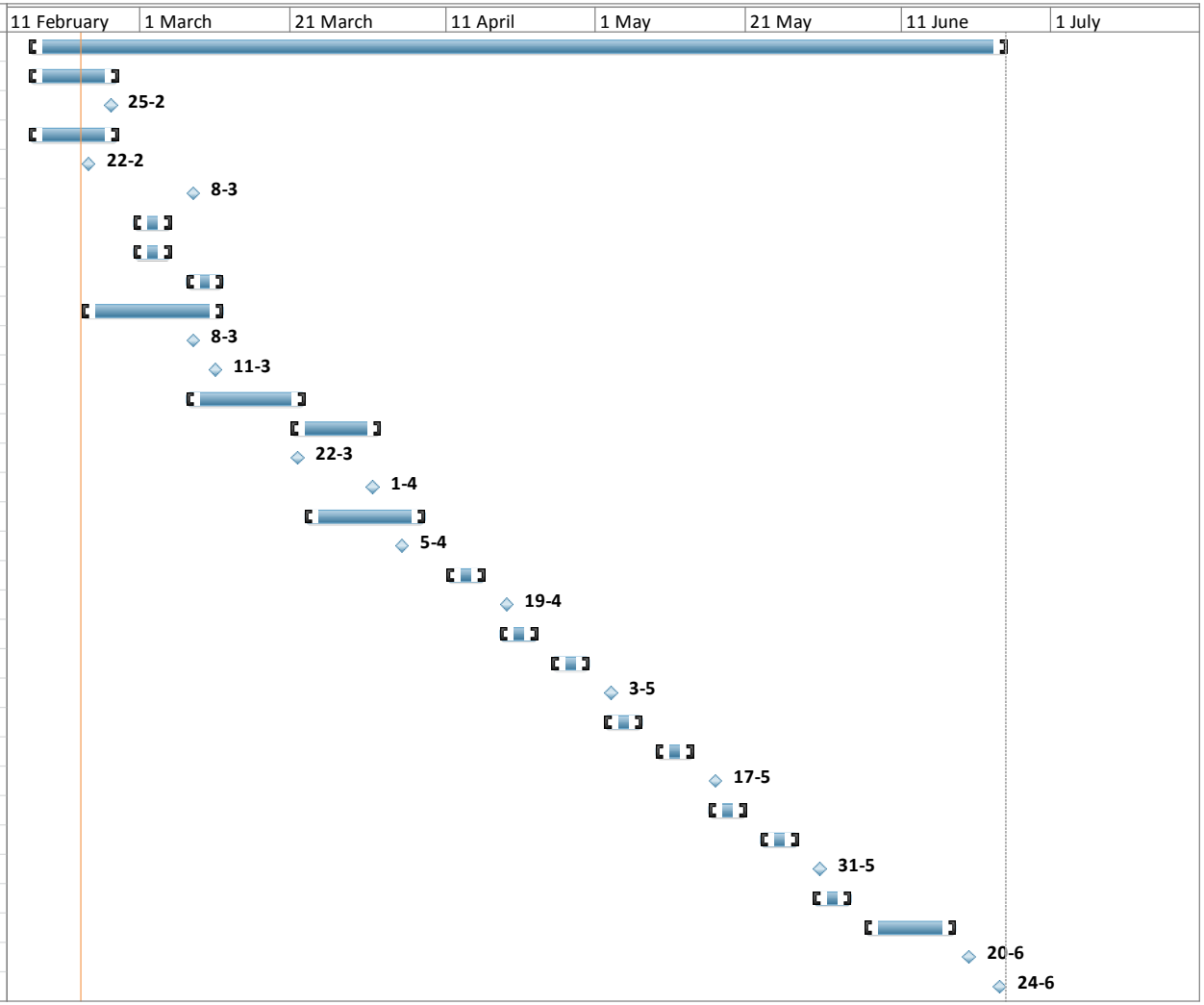

Figure 3: GANTT chart

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