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Master thesis

Designing a performance dashboard at Sigmax

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Business Information Technology

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PREFACE

Completing my master thesis would not have been possible without the aid and support of many people. Therefore there are some people I would like to thank in particular for their contribution to this research.

I would like to thank Sigmax for the opportunity they gave me for this research. Everybody I met at Sigmax has always been very kind and willing to help. I would like to thank my supervisor Rudy for his support in this research.

I would also like to thank my supervisors Klaas en Christiaan for their critical guidance throughout this process. They have put me back on track multiple times when I was completely lost. I'm very grateful they continued their persistence in pushing me to finish writing my thesis in the last months. The last feedback meetings have been tremendously valuable in getting me to this end result.

And last, but definitely not least, I would like to thank Manon. The last past months have not been easy. Working a 40-hour a week job and spending the evenings and weekends on finishing the thesis has been tough. Thank you for keeping up with me.

Joris van Soest

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MANAGEMENT SUMMARY

At Sigmax, the information needed to give guidance to the process of managing projects is often not quickly and in an aggregated form available. Multiple information systems are used to record information. Reports are created by hand which costs a lot of time; up to 2 days a month for certain project managers. Current status of projects are not readily available at any given time. A problem analysis showed the following results;

- reports are not suited for comparison,
- there are many (unlinked) sources of information,
- it takes a lot of manual work to create reports,
- project managers cannot act quickly because of lack of signals.

The objective of this research is to improve the overview of project management related information by designing a prototype performance dashboard for the project managers and upper management of Sigmax.

A literature study has taken place on the subjects of performance dashboard and project management. We encountered that performance dashboard research is still very young, although we did get a comprehensive picture what a dashboard should contain. We explored the subject of project management on a general level, to determine how to use a performance dashboard in the setting of project management. Completing a project with success is the art of balancing the following six constraints: scope, time, cost, quality, resources and risk. When these aspects are managed correctly, the project has a high chance of success. These areas of project management have become the content for our dashboard.

A dashboard prototype was designed and validated in two iterations. Based on the available data it was not possible to create a full functioning dashboard. A prototype was designed to show the possibilities. Based on feedback of a number of project managers, we improved the prototype in a second version. This second version was validated through a survey based on the Technology Acceptance Model, since acceptance of the dashboard was considered as a key element. Based on the results of the survey, we are certain that a performance dashboard will be accepted at Sigmax.

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1 INTRODUCTION

This chapter provides an introduction to this master's thesis. We start by giving a short background to provide some context, followed by our research objective. Then a short description of the setting in which this research takes place is presented. We elaborate on our research framework, research questions and the research strategy next. We conclude this chapter with an outline for the rest of this thesis.

1.1 BACKGROUND

The creation of products is often done on a project base. A project is "*a temporary endeavor undertaken to create a unique product, service, or result*" (PMI, 2008). Temporary indicates that a project has a defined beginning and end. This makes a project often time-constrained, but a project can also be constrained by funding or deliverables. The result of a project could be almost anything, from building a house, creating advice reports, to creating software. To bring projects to a success, they need to be managed. Project management can be defined as "*the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements"* (PMI 2008). So in general, project management consists of the activities involved to bring the project to a success. These activities can vary from planning and organizing to controlling resources. Projects are led by project managers. They are often in charge of the planning, execution and closing of a project. They are the ones that are accountable for accomplishing the goals of a project. A project manager is often in direct contact with the client to determine the exact needs of the client and to communicate progress.

Project managers need to complete their projects as efficiently as possible, within time and budget, but also with customer satisfaction (among others). The financial department often wants to know the status of projects. For this, project managers create reports on a regular basis. The information used in these reports comes from different sources, like Gantt-charts made in Microsoft Project, spend hours from time registration tools, or financial information from ERP systems. All the relevant information for a project needs to be extracted and combined to create an overview of the status of a project.

At Sigmax, the information needed to give guidance to the process of managing projects is often not quickly and in an aggregated form available. Upper management, but also project managers, often need to process the needed information by hand out of all the different IT systems. This information is then presented in an Excel spreadsheet in an aggregated form. This takes too much time away from the project manager, up to 2 days a month for certain project managers, which could have been spent on other tasks. The current status of different projects is therefore not readily available at any given time.

1.2 RESEARCH OBJECTIVE

The objective of this research is to improve is to improve the overview of project management related information by designing a prototype performance dashboard for the project managers and upper management of Sigmax.

1.3 SIGMAX

This research will take place at Sigmax, an IT company located in the east of the Netherlands. Sigmax was founded in 1998. The company has since grown into a business with over 100 employees, divided over four different Business Units, each with a separate legal and financial entity (see Figure 1);

- Sigmax ICT Specialists (SIS) provides services to external companies for both the arrangement and the management of IT infrastructure focusing on four key areas of the ICT environment: security, availability, accessibility and management.
- Sigmax Law Enforcement (SLE) is specialized in digital law enforcement and supervision through mobile enforcement products. This is primarily a mobile solution for recording fines, quick and direct insight into laws and regulations, preparation of police reports and checking permits. These products are used by the police, municipalities and public transportation companies.
- Sigmax Field Mobility (SFM) focuses on mobile solutions for employees in the field such as field service technicians and inspectors using the modular extensible standard solution Field Mobility Suite.
- Sigmax Mobile Solutions (SMS) focuses on the market of mobile solutions for field staff and provides a full suite of mobile applications and information systems. Based on own developed modular packages and associated hardware, a complete customized solution is provided to the customers, including aftercare and service. SMS is also the innovation platform, a kind of incubator, from which any new products find their way into standard within the product portfolio of Sigmax.

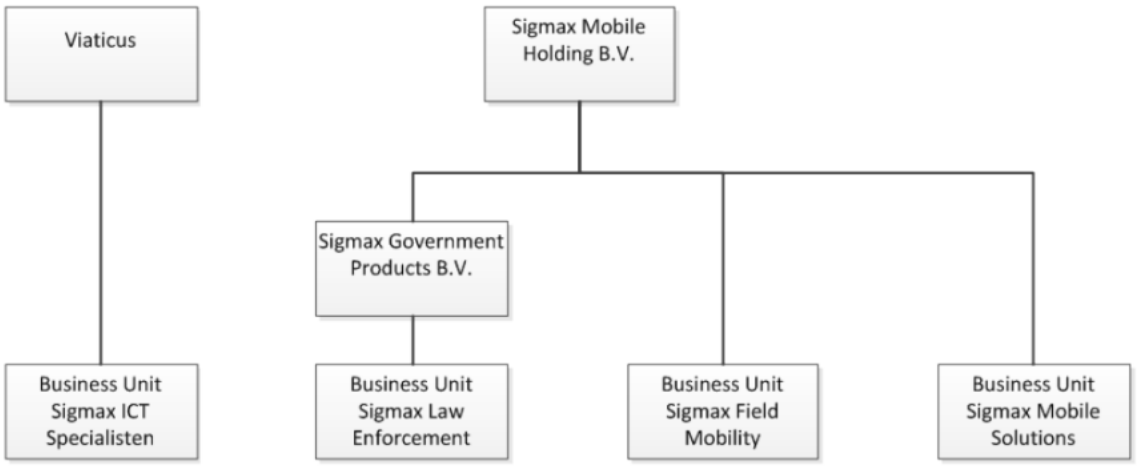

FIGURE 1: Organization structure

This research will take place at Sigmax Mobile Holding, more specifically the three Business Units Sigmax Law Enforcement, Sigmax Field Mobility and Sigmax Mobile Solutions. These three

Business Units have a lot of similarities in the products they deliver, they all create (mobile) software solutions for clients.

To support their business processes, Sigmax has introduced different information systems in the past years. The general philosophy behind the choice of enterprise systems is the "best of breed" approach. This ensures the business processes are supported by the best tools for the job. Examples of such enterprise software at Sigmax are a project- and time-registration system, a homemade ERP-system called 'ShERPa', and a financial system 'Unit4 Multivers'. While the possibilities of ShERPa are limited compared to off-the-shelf products available on the market today, it fits very well into the specific business processes at Sigmax. Since Multivers does not provide all the reporting facilities needed by the financial department out of the box, a BI tool 'Unit 4 Multivers for Windows Business Intelligence' is used. This tool is not very user-friendly but once the correct queries are set up, the results are very useful for reporting activities. Other enterprise information is mostly stored in the format of a Microsoft Excel spreadsheet.

1.4 RESEARCH FRAMEWORK

To give our research more structure we use the guidelines of Verschuren et al. (2010). They state that before the research questions are formulated, we should begin with a research framework. This research framework is a "*schematic and highly visualized representation of the steps that need to be taken in order to achieve one's research objective*." They serve as an overview of how this research will look like.

In order to achieve our research objective we need to have an understanding of the available literature. More specifically literature about project management and (performance) dashboards. These two concepts combined give us the characteristics of a performance dashboard. Based on preliminary research and interviews with project managers we will conduct a problem analysis. The problem analysis and characteristics of a performance dashboard will guide us to the creation of our first prototype. Project managers will then give feedback on this first design. Based on the feedback a second version of the prototype will be constructed. This second version is then validated through a survey. Figure 2 below shows a visual representation of our research framework.

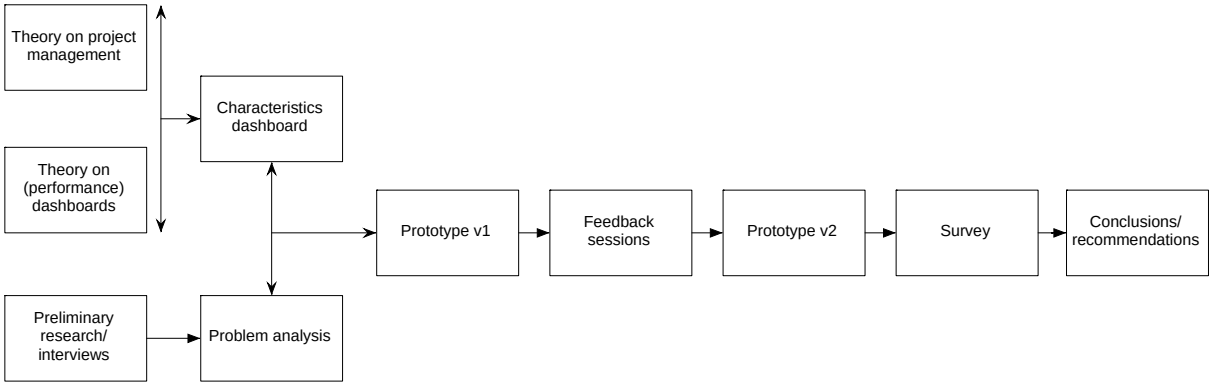

FIGURE 2: RESEARCH FRAMEWORK

1.5 Research Questions

The main research question is:

> *"How can the overview of project management related information at Sigmax be improved?"*

We have decomposed our main research question into the following sub-questions;

RQ1 *What are the characteristics of a performance dashboard when it is used in the context of project management?*

RQ2 *What are the current problems at Sigmax related to the status information of projects?*

RQ3 *How can the identified problems be mitigated by a performance dashboard?*

RQ4 *How will the performance dashboard be received by Sigmax?*

1.6 Research Strategy

In this section we will elaborate more on how we will conduct this research. Based on the four research questions we describe our strategy to answer these questions.

1.6.1 Literature

A literature review is conducted in which we will form general characteristics of a performance dashboard. To be able to apply this knowledge to the setting of project management, we need to have common knowledge about general project management practices. This is especially important to be able to determine which information project managers need, and which need to be present in our dashboard.

1.6.2 Problem Analysis

To define the current situation we use the USE IT method of Spil et al. (2004) as a basis for conducting semi-structured interviews. This method has proved itself in the setting of implementing IT systems in the health-care industry, but should provide enough fundaments to use this in other settings as well. The data generated by the interviews will be used to formulate the current situation and problems at Sigmax related to project management.

1.6.3 Performance Dashboard

The performance dashboard is designed with an iterative approach. Two prototype versions are made. Prototypes are made because not all the data needed to construct a full functioning dashboard is available at Sigmax. We use the detailed data for a single project, which is provided by a project manager, for our prototypes. This project manager has kept a very detailed administration of a certain project in Microsoft Project. With this detailed data, and the data available in different information systems, we can design a performance dashboard. The first version of the prototype will concentrate on the functionalities and the information it contains. The second version will incorporate project managers feedback on the first version. The

prototypes are constructed with the Technology Acceptance Model (TAM) in mind. Our design goal is a dashboard that will be accepted and used by the project managers once it is build.

1.6.4 VALIDATION

Each version of the prototype is validated. The first version is validated through feedback sessions with some project managers (see Chapter 4). In these sessions we ask project managers what their first reaction on the prototype is. Based on the feedback on the first version of the prototype we have made changes to a second version. This version is then validated by all project managers of Sigmax through a survey (see Chapter 5). In the survey the TAM model has a prominent place, as well as additional remarks about the prototype.

1.7 OUTLINE

The thesis is structured as depicted in Table 1. After the introduction (this chapter), we conduct our literature review in chapter 2. The problem investigation takes place in chapter 3. In chapter 4 we design our first version of the prototype performance dashboard. Feedback on this first version is also included in chapter 4. Based on the feedback a second version of the prototype is described in chapter 5. This second version is validated through a survey (also in chapter 5). In the final chapter we come to our conclusions (chapter 6).

Topic	Chapter
Introduction	1
Literature	2
Problem investigation	3
Dashboard design – version 1	4
Dashboard design – version 2	5
Conclusions	6

TABLE 1: OUTLINE THESIS

2 LITERATURE

The first step in this thesis is to understand the problem domain. To get an understanding of what a performance dashboard is, and how this can be applied in the domain of project management at Sigmax, a literature study is presented in this chapter. We explore these areas to get to a general overview of current knowledge.

In section 2.1 we will discuss what a performance dashboard is. In Section 2.2 we will discuss a general view on project management.

2.1 PERFORMANCE DASHBOARD

With current technological progress in the field of Information and Communication Technologies as well as the rapidly changing business environments, a lot more data is generated within organizations. Managers are presented with different information systems like Enterprise Resources Planning (ERP) or Business Intelligence (BI) software used for reporting. All these systems try to provide the right kind of information for the job at hand. This can become too much to handle, this is generally known as information overload.

A performance dashboard might be a solution for the information overload problem. A performance dashboard is much like a dashboard in a car; it displays the most important information at a glance. In a car, you want to know the speed, how much fuel is left in the tank, and if there is something wrong with the car. Information like how much braking fluid is present, is only relevant when it is below a certain threshold. A performance dashboard is generally seen as an information system that is able to collect, aggregate and present data from multiple sources so that the user can see some kind of performance indicator(s).

Scientific literature has failed to keep up with the developments in the area of performance dashboards. There are books (Few, 2006; Rasmussen et al., 2009) and articles in business press (Kawamoto & Mathers, 2007; Miller & Cioffi, 2004) on the topic of dashboards, but little is written in academic journals. There are a few studies regarding motivation (Pauwels et al., 2009; Wind, 2005), implementation stages of dashboards (Pauwels et al., 2009; Reibstein et al., 2005), selection of metrics (DeBusk et al., 2003; Pauwels et al., 2009) and adoption and success of dashboards (Clark et al., 2006). How to design a performance dashboard is currently not explicitly addressed in literature. Maybe that is because there is no consensus on how to visualize information used for decision making (O'Donnell & David, 2000). Some researchers think that the information system needs to be designed based on the types of tasks (Dilla & Steinbart, 2005; Vessey, 1991), knowledge (Cardinaels, 2008), or personality (Kostov & Fukuda, 2001; Tan & Lo, 1991) of the users. Huber (1983) argued that creating flexible decision support systems (DSS) to fit the different cognitive styles of users is difficult, if not impossible.

There is no commonly used definition of a performance dashboard available in academic literature, or used by software vendors. Software vendors try to use definitions which include

characteristics of their own software. In academic literature, the dashboard has different uses and is in different stages of development (Pauwels et al., 2009). Few (2006) defines a performance dashboard as;

> *"A dashboard is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance."*

The definition of Eckerson (2010) does not differ much from that;

> *"A performance dashboard is a layered information delivery system that parcels out information, insights, and alerts to users on demand so they can measure, monitor, and manage business performance more effectively."*

In an extensive literature review of dashboard in performance management, Yigitbasioglu and Velcu (2012) created the following definition;

> *"[A performance dashboard is] a visual and interactive performance management tool that displays on a single screen the most important information to achieve one or several individual and/or organizational objectives, allowing the user to identify, explore, and communicate problem areas that need corrective action."*

2.1.1 Purposes and Characteristics

There are several purposes of a dashboard. Pauwels et al. (2009) defines four purposes;

- Enforce consistency
- Monitoring performance
- Plan
- Communicate

A dashboard enforces consistency across departments and business units regarding measures and measurement procedures. Monitoring performance is the ongoing process of checking the metrics, which are an indicator of performance, and taking corrective actions when needed. A dashboard can also be used to plan strategic decisions, or simulate different scenarios using what-if analysis. Communication of performance to different stakeholders is important, but a dashboard can also be used to communicate its corporate values by the choice of metrics (for example customer loyalty).

Eckerson (2010) describes that each performance dashboard actually consists of three applications, all working together;

- monitoring application,
- analysis application,
- management application.

The monitoring application consists of displaying important information using timely and relevant data. Graphics like charts and stoplight symbols are often used. The analysis application aids the user in finding the root cause of problems. The data can often be analyzed at different levels of detail (drill-down). The management application can be used to spread business

information across the organization. Managers are able to 'steer' the organization based on the right information.

A performance dashboard has the ability to display the data in different ways. Usually this starts with a graphical representation, and the dashboard provides the possibility to 'drill-down' and view more detailed information. Eckerson (2010) talks about three layers (or views) of information;

- graphical metrics view
- multidimensional view
- detailed or operational view.

In a normal flow, a user starts with a graphical representation of the information. When there are signals that require the user to see more information, it is possible to drill down. The source of the problem can be analyzed, all the way to the actual data to verify the cause.

This is much in line with what Pauwels et al. (2009) thinks a performance dashboard should contain. He argues that the adoption and success of a performance dashboards is driven by the following factors;

- choice of metrics which are included,
- level of sophistication
- visual display using colored graphs and stoplights,
- drill down capability

Performance dashboards can serve different users. Staff needs to act on different information then managers or executives. Eckerson (2010) makes a distinction in three types of dashboards;

- Operational dashboards
- Tactical dashboards
- Strategic dashboards

These different types focus on different tasks. Table 2 shows the differences across the three types of dashboards. Eckerson (2010) makes an important remark about these dashboards; while each dashboard might serve its own purpose, it is important that metrics have the same definition, the data is shared and that a common infrastructure is used. In this way, you can have different versions of different types of dashboards, but they represent the same information.

	Operational	Tactical	Strategic
Purpose	Control operations	Optimize processes	Manage strategy
Scope	Operational	Departmental	Enterprise
Users	Staff +	Managers +	Executives +
Primary activity	Act	Analyze	Review
Focus	Current	Past	Future
Data refresh	Daily/Intraday	Daily/Weekly	Monthly/Quarterly
Information	Detailed	Detailed/Summary	Summary
Architecture	Core systems	Data warehouse	Excel or data mart
Metrics	Drivers	Drivers/Outcomes	Outcomes
" Looks like a ... "	Dashboard	Metrics Portal	Scorecard

TABLE 2: Main characteristics of performance dashboard, adapted from Eckerson (2010).

2.2 PROJECT MANAGEMENT

In this section we will elaborate on what a project is, and what project management consists of. To help us in this process, we will use 'A Guide to the Project Management Body of Knowledge' (PMBOK Guide) published by the Project Management Institute (PMI, 2008). In the first edition (1996), the PMI collected general knowledge about project management with the idea to standardize the project management profession. We will use the fourth edition to describe project, and project management related concepts.

While there are more approaches to project management, for example PRINCE2 (PRojects IN Controlled Environments), PRiSM, Agile- and Lean-project management, we choose to use the PMBOK Guide because of its general approach.

2.2.1 PROJECT

The Project Management Institute defines a project as "*…a temporary endeavor undertaken to create a unique product, service, or result*" (PMI, 2008). There are a few elements in this definition that require some elaboration. The first one is 'temporary'. This indicates that there is a beginning and an end. Temporary does not mean that the results of a project are temporary or that the project is short in duration. For example, the renovation of the Rijksmuseum in Amsterdam took 10 years to complete (from 2003 to 2013), and will likely last many years to come. There can be multiple reasons to end a project. Often this is because the project goal has been achieved, but it can also be because the goals cannot be met. For example when there are some unforeseen extra costs and the financial means are not available. The unique characteristics tell us that no two projects are the same. There can be activities within a project that are repetitive, but the project itself is not. Building the same house at a different place is considered a different project, because the location is different which might result in the use of another type of foundation.

2.2.2 PROJECT MANAGEMENT

Project management is defined as "*the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements*" (PMI, 2008). The project requirements are often the start of a project (initiation), followed by some sort of plan (planning). Then the actual planned work is conducted (executing). During the execution there is usually a process in place to check if everything is going as planned (monitoring and controlling), before the project comes to an end (closing). These process steps are displayed in Figure 3 below.

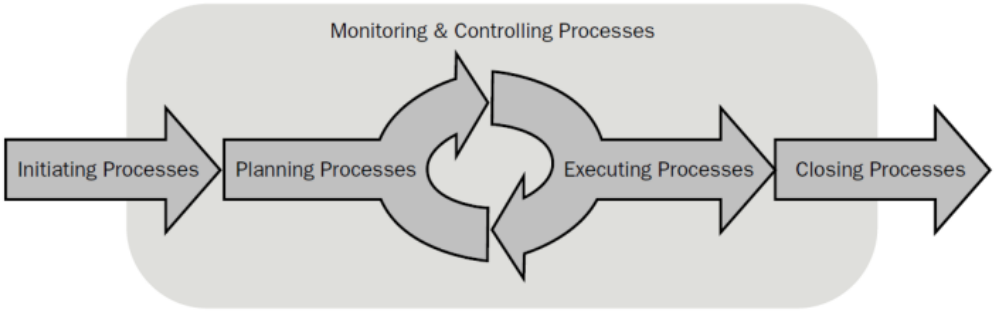

FIGURE 3: Project management process steps (PMI, 2008)

2.2.3 CONSTRAINTS

To manage a project, you need to address the different needs of stakeholders. There is often a balance in what you can and cannot do to manage a project. Therefore the following constraints are important for the success of a project (PMI, 2008);

- Scope
- Time (or Schedule)
- Cost (or Budget)
- Quality
- Resources
- Risk

If one of these constrains changes in a project, most likely this has influence on at least one other constraint. For example, if an employee gets sick you might not get all the work done in time. You could sacrifice quality to reach the deadline, or add extra resources which might increase the costs.

In early literature the most important constraints are considered; time, cost and quality. This can be found in one of the early definitions of project management by Olsen (1971) in his view of the 1950's, where he mentions these constraints; "*Project Management is the application of a collection of tools and techniques [...] to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints."* This was also known as the "Triple Constraint" or the "Iron Triangle". It was considered that if these three constrains where managed properly, the project will come to a success. Many authors have agreed on these three success criteria (Ballantine et al., 1996; De Wit, 1988; Morris & Hough, 1987; Saarinen, 1990; Turner, 1999; Wateridge, 1998), but is not limited to those three. The PMBOK Guide includes scope, (human) resources and risk as constraints.

In the next sub-sections we elaborate more on the six constraints of the PMBOK Guide.

2.2.3.1 SCOPE

The scope constraint compromises different processes which are required for the management and control over the projects requirements. The scope defines all the work that need to be done in a project, and only the work that need to be done, with the successful completion of the project in mind. Defining and controlling what is included in the project and what not, can be seen as managing the project scope.

According to PMBOK Guide there are five processes involved in the scope;

- collect requirements,
- define scope,
- create WBS,
- verify scope and
- control scope.

Collect requirements involves defining and documenting the stakeholders' needs required to meet the end goal of a project. Requirements should be documented clearly and be approved by the stakeholders. They should contain enough detail of the work what will be done before the

project begins. This document will live during the complete project, and is used in other processes of project management as well.

Define scope is the process of creating a detailed description of the project. With a detailed scope description the project deliverables and work required to create these deliverables are presented. This will form a common description for all stakeholders involved in the project, including what the deliverables are. It may contain exclusions to the scope, which might be useful for managing the stakeholders' expectations.

Create WBS is the process of decomposing the project work into smaller, more manageable work items. WBS stands for Work Breakdown Structure and is an hierarchical decomposition of the work to be done, with each lower level presenting a more detailed description of the work. The planned work should be at the lowest level of the WBS, also called work packages. These work packages can then be planned, budgeted, monitored and controlled.

Verify scope is the process of creating formal acceptance of the project deliverables. This means that the stakeholder has approved all the deliverables which will be created during the project.

Control scope is the process of monitoring the scope, and managing changes to the scope.

2.2.3.2 TIME

The time constraint included processes which are required to manage the on-time completion of the project. In order to do so there are different steps to create a schedule;

- Define activities
- Sequence activities
- Estimate activity resources
- Estimate activity durations
- Develop schedule
- Control schedule

Define activities is the process of identifying which actions need to be performed to create the project deliverables. The lowest level of the WBS are work packages, these can be decomposed further to create activities which are required to complete a work package. These activities form the basis for estimating, scheduling, executing, and monitoring and controlling the project work.

Sequence activities involves identifying and creating relationships between project activities. Sequencing is often done with project management tools like Microsoft Project.

Estimate activity resources is the process of appointing people, equipment or supplies to the different activities which are needed for the execution.

Estimate activity durations is the process of estimating the amount of work periods needed to complete the activities with the appointed resources.

Develop schedule is the process where the actual schedule is created. It contains all the above processes to build a time schedule. This is often done with the aid of project management tools, and presented in Gantt charts. The planned start and finish dates for all the project activities are included in the schedule.

Control schedule is the process of maintaining an up to date status of the projects progress. It is possible that changes are needed to the schedule when certain unexpected events occur.

2.2.3.3 COST

The cost constraint involves the activities to ensure the project is completed according to the approved budget. These activities include;

- Estimate costs
- Determine budget
- Control costs

Estimate costs involves estimating which resources and how many of the resources are needed to complete the project. Resources can be physical (equipment or materials), but also people.

Determine budget involves assigning the estimated costs of the project to individual activities. This is done to create a baseline to which the performance can be measured.

Control costs is the ongoing process of monitoring the status of the cost baseline. It involves determining if the cost baseline has changed, and ensure that the changes are approved.

2.2.3.4 QUALITY

The quality constraint involves processes to ensure the quality of the end product. This includes that policies and procedures are followed in order to successfully complete the project. The following processes are included;

- Plan quality
- Perform quality assurance
- Perform quality control

Plan quality involves identifying which quality standards are important for the execution of the project, and how to implement them.

Perform quality assurance involves all the activities within the project which ensure that the quality is according to the determined standards.

Perform quality control is the ongoing process of ensuring that the quality standards are followed. It also includes the recommendation of changes to ensure the quality is guaranteed.

2.2.3.5 RESOURCES

The resources within PMBOK Guide refer to the human resources. The resources constraint involves processes to setup a project team and how to lead them. The project team are all the people that are needed to execute the project. Within a project, the team can change (people can be added to the project), but also roles of individual team members can change. The processes include;

- Develop human resources plan
- Acquire project team
- Develop project team
- Manage project team

Develop human resources plan involves determining which roles, responsibilities and skills are required to execute the project with success.

Acquire project team involves the allocation of available people to this project to be able to carry out the work.

Develop project team involves activities to improve the performance of the project team. Project managers should motivate, lead and inspire the project team to increase their performances.

Manage project team involves the process of measuring the team members performance, providing feedback, resolve issues to optimize the performance of the team.

2.2.3.6 RISK

The risk constraint includes processes to manage the uncertainties which can occur during the execution of the project. There are always some events that are not foreseen at the beginning of a project. Managing risks increase the chance that unknown events have a positive impact on the projects. The impact can be on any level, on the cost, schedule or performance. In order to manage risks, the following processes are recommended;

- Plan risk management
- Identify risks
- Perform qualitative risk analysis
- Perform quantitative risk analysis
- Plan risk responses
- Monitor and control risks

Plan risk management involves defining how to approach the risk management activities for a project. It is important to think about the way risks should be handled in an early stage. This ensures that there is enough time and resources available to manage the uncertain events which might occur.

Identify risks is the ongoing process of determining whether uncertain events are occurring and documenting its characteristics.

Perform qualitative risk analysis involves the prioritizing of risks for further actions. Organizations may focus on risks that have an high impact and/or have a high probability of occurring first.

Perform quantitative risk analysis involves analyzing the effects of the identified risks on the projects objectives numerically. Determining what consequences the risks have is important for choosing the right actions.

The plan risk responses involves the development of options and actions reduce the negative impact of the risk. It involves the assigning of a person to take responsibility of the response.

Monitor and control risk is an ongoing process during the project. In involves keeping track of identified risks, monitor remaining risks and identifying new risks.

3 PROBLEM INVESTIGATION

In this chapter the problem investigation is presented. First the current problems at Sigmax are described; these came up during interview sessions with the project managers. These problems are discussed, and at the end of this chapter a short treatment selection is given.

3.1 INTRODUCTION

The goal of the problem analysis is to see if there are problems at Sigmax that can be treated by designing a performance dashboard.

The management of Sigmax has noticed that the current situation regarding the information provisioning of project related data towards project manager could be improved. One possible solution might be the construction of a performance dashboard. To see if this is a solution to the problems at hand, we need to know what the current problems are. Is a performance dashboard really the best solution at this time? What are the problems that the project managers experience? These questions need to be answered first before any attempt is made constructing a performance dashboard. If we see a performance dashboard as a solution or treatment, we need to make sure there exist a problem to which a performance dashboard can be the solution. This is a situation where we must not focus on the end goal – creating a performance dashboard, and finding a problem to justify that specific choice. This problem analysis is set up to be neutral and objective. Once the problems within Sigmax are clear and written down, we move on to a treatment selection. The outcome could as well be that a performance dashboard is a solution to some problems, but that the true problems are not solved with the creation of a performance dashboard.

The problem analysis was conducted in the following way. First semi-structured interviews where held with all the project managers of Sigmax. Second, based on these interviews cause and effect diagrams where drawn. Last, these diagrams combined with the information about performance dashboards from the literature resulted in the treatment selection.

3.2 APPROACH

The semi-structured interviews where constructed using the USE IT method by Spil et al. (2004). The USE IT method was developed at the University of Twente and was successfully applied by the introduction and evaluation of ICT-applications in the healthcare sector. With the aid of this method the relevance of an application for the end user can be determined on a micro level. Micro-relevance is defined as the degree in which the end user expects that the application will solve the here-and-now problems or helps to accomplish his actual goals.

Our goal was not to inform the project managers about the performance dashboard, but to see what their attitude was against the implementation of a new information system. Since at

Sigmax there exist quite some information systems, the addition of one might not be ideal for all the project managers. The interview protocol of the USE IT method is focused on the current way of working and what information is needed to do the job. The authors of the USE IT method encourages that this interview protocol is used in other domains than the healthcare. The interview protocol included in the USE IT method needed to be edited very slightly to be used in our setting.

The semi-structured interviews with the project managers were set up individually. A meeting room was reserved where the project manager could freely speak. The interview took approximately 1 hour to complete. In this time the interview protocol was followed as much as possible, but there was often room for discussion to get to the root cause of problems. The results of these interviews are elaborated on in the next sub-sections.

3.2.1 NO DETAILED REGISTRATION OF WORK DONE

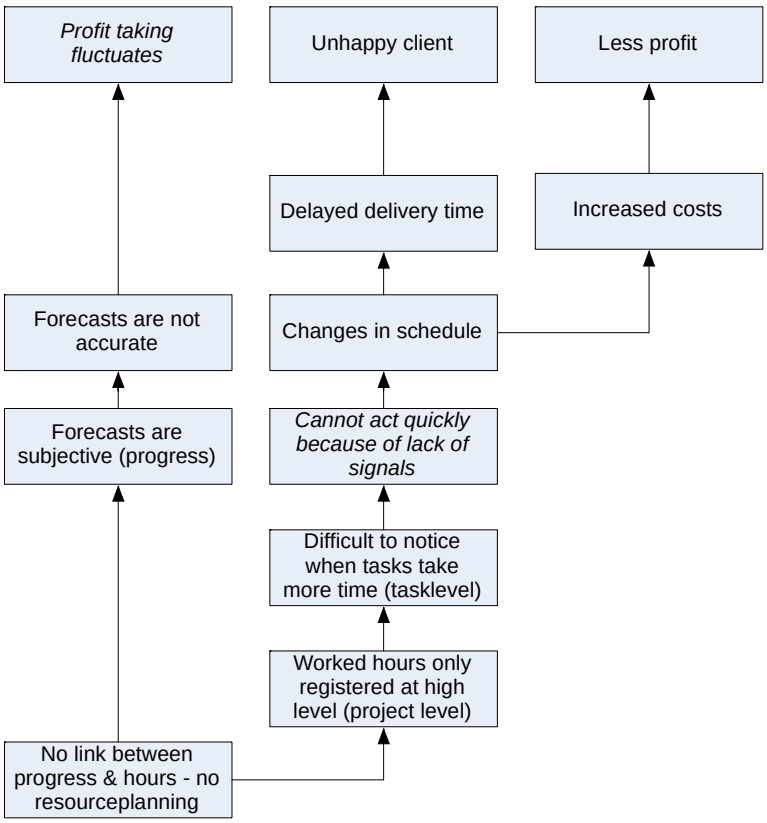

FIGURE 4: NO DETAILED REGISTRATION OF WORK DONE

When a project is undertaken, the deliverables are sold for a fixed amount of money. There are projects in which the client pays the actual costs, but the majorities have a fixed price. So when the gross profit is fixed Sigmax tries to divide the profit in ratio with the forecasted hours to be spent on the project, spread out over the months in which the project is undertaken. So each month Sigmax takes a small piece of the profit, opposed to taking the full profit of a project when the project is completed. When all profits of all projects are spread out per month, it gives the management a clear overview of how the business is doing. With this way of financial accounting, you eliminate the possibility of recording losses for a few months in a row when there are a number of projects about to complete that will result in a large profit in one month.

Currently the profit taking is fluctuating too much according to the financial department. When the pieces of profit which are planned to be taken in a month needs to be changed negatively, for example when there are more hours spent on a project than anticipated, it needs to be compensated in the next month with less profit or even a loss. This results in changes, which are not foreseen, and makes financial planning on the long term difficult. In the ideal situation the profit taking is close to reality, and little changes are needed.

The reason that the profit taking is fluctuating can be found in the forecasts that are made by the project managers. These forecasts are not accurate. Often a project manager expects a certain number of hours to be spent on a project, but at the end of the month this number is higher. Ideally the forecast should be close to reality.

The lack of precision of the forecasts of the project managers is a result of the subjective nature of the forecast. The project managers estimate the progress of a project, but the basis to which this forecast is made is subjective. It lacks an objective base. It is not linked to hard numbers like historical data. It is personal estimation by the project manager, which make it a rough estimate.

The forecasting is subjective because there is the progress is not linked to the hours spent on a project. If a project manager knows each task and how much hours it will take to complete that task, it objectively knows the progress. Currently the progress is not linked to the hours spent. There is no resource planning mechanism, this limits the possibility to plan the work for the upcoming month. It is not clear how much resources are available to do all the work, so it might happen that there is more work planned in a month, then can be executed by the people working on the projects. The resources are not dedicated to a single project; they are shared amongst multiple projects.

Project managers cannot act quickly when tasks are taking more resources (hours) than planned. This is because there is a lack of signals towards them, which give them an indication of these overruns.

It is difficult for project manager to take notice when tasks take more time than planned. There is no registration of work on the task level of a project. So when a task is taking twice as many hours as planned, there is no signal towards the project manager. There are situations where the project manager asks the project members about the status, or when project team members proactively tell the project manager about the overrun.

The lack of registration of worked hours on task level results in the worked hours only being available on high level, the project level. All hours worked on a project are available on just one level; no easy separation can be made to which part certain hours are related to in a project.

Because the worked hours are only registered at project level, it becomes difficult to link the progress to the hours spent on a project.

The lack of signals to a project manager will lead to more changes in the schedule. When the signals arrive early, the project manager might be able to minimize the disturbance caused by the overrun. But when there are changes in the schedule of a project, the delivery time might get pushed forward, resulting in unhappy clients. The costs of the project might increase as well as there are more hours needed to finish the project, resulting in less profit.

3.2.2 PROJECT ADMINISTRATION TAKES UP A LOT OF TIME

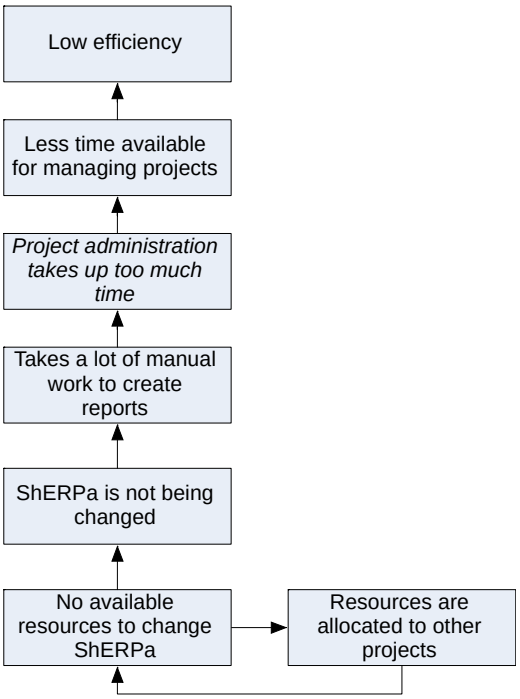

FIGURE 5: PROJECT ADMINISTRATION TAKES UP A LOT OF TIME

Because of the limitations in the functionalities of ShERPa, it takes a lot of time to extract project management information out of the hour registration system. This varies between project managers from half a day to two days per month to generate reports.

Spending half or even two days a month on creating reports, means that a project manager has less time to manage its projects. Resulting is lower efficiency.

Retrieving information, like hours book on a certain project or the approval of hours, is a tedious process with a lot of manual work. Because this information retrieval is such a tedious process project managers are not retrieving this on a regular basis.

The main reason for the manual work of creating reports is that ShERPa is too limited in the reporting functionality. At this time ShERPa is not being changed to add this kind of functionality, because there are not resources available for the change. The resources are allocated to more important tasks, like working on client projects.

3.2.3 NO LEARNING MECHANISM FOR PROJECTS

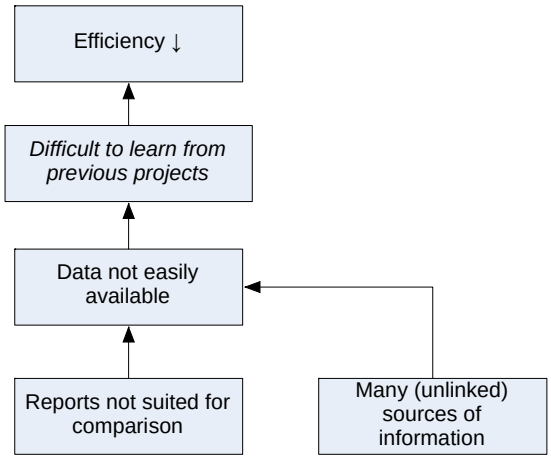

FIGURE 6: NO LEARNING MECHANISM FOR PROJECTS

Project managers have stated that it is difficult to learn from previous projects. This can be on the level of planning, for example the amount of hours that is generally needed to provide support when a project has just been completed. But also on how certain risks are managed. This results in less efficiency, as the same problems might occur in different projects with the same outcome.

The main reason for this is that project related information is not easily available. Currently a project is only discussed on the financial level. So there are reports on how the projects are performing. But these reports alone do not tell the complete story of the progress of a project.

The reports are not suited for comparison between projects. The basis for the reports is financial, which makes it hard to record other aspects of the project in these reports.

Information is stored in many different information systems, varying from emails, Word- and Excel-documents to ShERPa and Multivers. Knowledge about how well project have been managed in the past is mainly stored in the personal assets of Sigmax, in the minds of the project managers. All these sources are not directly linked to each other, making it difficult to retrieve this kind of data.

3.2.4 BUDGETING

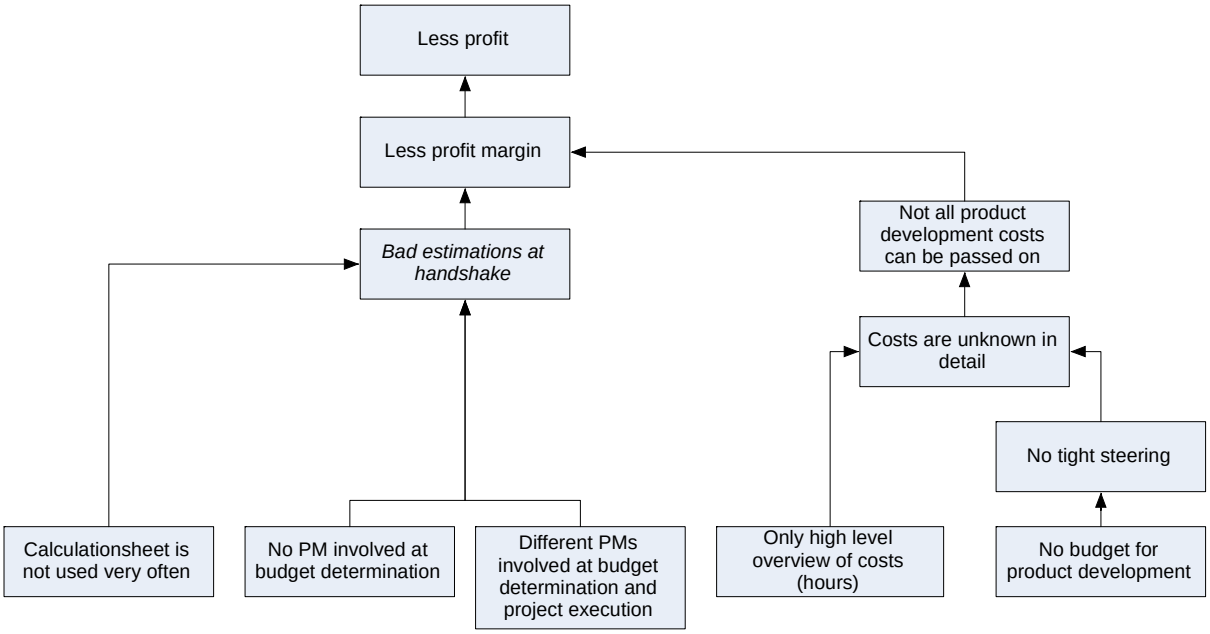

FIGURE 7: BUDGETING

The project managers often note that at the handshake of a project (the moment that a project is handed over from the account manager to the project manager) the estimations of work needed is not accurate.

The Sales department has constructed a tool, a calculation sheet, to aid them in the progress of creating the quotation. With this calculation sheet, the account manager can calculate the hours needed for different tasks in a project and determine the sales price of the product. With the aid of a project manager this sheet is filled in to determine the price of the product, which the client has to pay. Often this calculation sheet is not used, which results in a discrepancy when a project manager creates the detailed Work Breakdown Structure of the project. This might result in a project that will need more hours to finish then the account manager had foreseen, resulting in a loss.

Another reason for the bad estimation at the handshake is that there is no project manager involved at the budget determination phase. When the account manager is the only person that does the estimation of work, he might not include work that a project manager would not forget, like testing or the work related to putting three versions in a test- or acceptance-environment before the product is delivered (in production).

There is also the case that a project manager is involved in the budget allocation phase, but a different project manager is appointed to execute the project. This might result in a different view on how the project is undertaken. It is possible that some parts of the work are estimated at less (or more) hours work.

Differences in budget determination at the handshake might result in fewer profit margins. More work needs to be done than sold to the client, resulting in less profit.

Another reason for the profit margin being low is that not all the costs of product development can be passed on. This can be because the costs are not known in detailed. Like we said before, the costs of any project (including product development) is only available at high level.

Product development at Sigmax is often done with a carte blanche. A new technology needs to be developed, without a clear budget. This makes it difficult to steer the product development, and to be in control of the outcome. When there is no control about the costs, it makes the costs difficult to determine in detail.

3.2.5 SCRUM

Note: This problem is only applicable to Sigmax Field Mobility, and Sigmax Law Enforcement since they use the Scrum methodology.

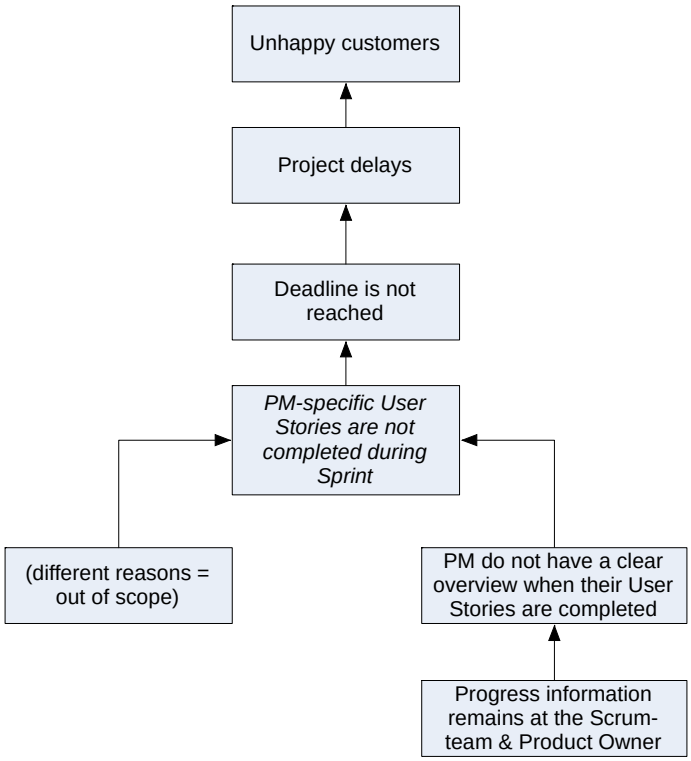

FIGURE 8: SCRUM

The Scrum-team is responsible for the development of Sigmax' products. They use a 4-week Scrum period in which they release a new version of the product. In that time they do their utmost to complete all the User Stories assigned to that Scrum period. It does happen sometimes that not all User Stories are completed. The User Stories can represent custom functionalities related to a project manager's client. Since multiple project managers are providing User Stories to the Scrum-team, the project managers all want their User Stories to be completed.

For different reasons it might happen that not all the User Stories are completed at the end of Sprint. Progress reports, like the Burn-down chart, or other progress information is not being communicated to the project managers. It remains at the knowledge of the Scrum-team and the Product Owner. The project managers are not actively informed about the progress.

When certain functionalities for a client are not completed in the Sprint it often means that it will be completed in the next Sprint, four weeks later. This means great delays to the client, who might not be happy when it was promised it would be completed this month.

3.3 TREATMENT SELECTION

As we can see there are many problems related to the work of the project manager at Sigmax. To make a proper choice which solution we need to take, a solution matrix has been constructed (see Table 3). In this matrix the root causes from the previous sections have been summarized. Each root cause has a possible solution. There might be more than one solution to some of these root causes, but the most cost effective ones have been included. We then rate each possible solution on effectiveness and feasibility on a scale of 1 to 5, where 1 is very low and 5 is very high. These two number multiplied give an overall score. Based on the overall score we then determine if action will be undertaken.

Root Cause	Possible solution	Effective-ness	Feasi-bility	Overall	Action
No link between progress & hours - no resourceplanning	Introduce new planning system	5	2	10	No
No available resources to change ShERPa	Change ShERPa	4	4	16	Maybe
Progress information remains at the Scrum-team & Product Owner	Product Owner needs to communicate better	3	4	12	No
Calculationsheet is not used very often	Use it more	4	3	12	No
No PM involved at budget determination	Involve PM at every budget determination	3	2	6	No
Different PMs involved at budget determination and project execution	Involve Operations Manager at every budget determination	4	1	4	No
Only high level overview of costs (hours)	Change ShERPa	4	4	16	Maybe
No budget for product development	Better determine what the budget is	3	2	6	No
Reports not suited for comparison	Introduce performance dashboard	4	4	16	Yes
Many (unlinked) sources of information	Introduce performance dashboard	4	4	16	Yes

TABLE 3: SOLUTION MATRIX

We must note that a lot of problems have emerged which have little to do with a performance dashboard. It is not possible to mitigate all problems, but if some problems are addressed this will most likely be an improvement to Sigmax. Constructing a performance dashboard is likely to be one of the least radical organizational changes, with possible large impact (positive) in the workload of project managers.

Based on the findings in this chapter and the above matrix, we chose to construct a performance dashboard. We are convinced that constructing a performance dashboard is addressing the issues at Sigmax and will solve (some of) the problems presented by the project managers.

3.4 UPCOMING CHANGES TO SHERPA

Before we start constructing a performance dashboard, we need to address the baseline. In the recent past, Björn Lunter completed his BSc degree at Saxxion Enschede on the topic of changing ShERPa to the new standards of Sigmax. Notably the changes from project oriented organization to a more product oriented organization. He researched the changes needed in ShERPa to support this. While in the meantime the changes have not been implemented, there is a will to do this in the near future.

Our assumption from here on includes the proposed changes made by Björn Lunter. The changes are not radical; the current way of working is only slightly adjusted. The database has been altered to add information like a hierarchical view on the project activities. Currently there is only the possibility to register work hours to one project and no sub-projects. In the upcoming changes it is possible to have nesting within the project. This is our baseline to construct the performance dashboard. In our design we take these changes in ShERPa as if they were currently implemented.

4 DASHBOARD DESIGN – VERSION 1

In this chapter we elaborate on how the first version of the dashboard is designed. We start at the design criteria, followed by the design process. We will describe which information is available for the back-end and the front-end. We conclude this chapter with the results of the first feedback session on this version of the dashboard. Based on this feedback changes are listed which will be included in a second version.

4.1 DESIGN CRITERIA

The dashboard is designed with the Technology Acceptance Model (TAM) in mind. The Technology Acceptance Model is oriented towards information systems settings. The model predicts how users accept and use a technology on their jobs. TAM identifies two factors that influence the decision; Perceived Usefulness and Perceived Ease of Use. Perceived Usefulness is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis et al., 1989). Perceived Ease of Use is defined as "*the degree to which a person believes that using a particular system would be free from effort*" (Davis et al., 1989).

These two core constructs (Perceived Usefulness and Perceived Ease of Use) form the basis for our design criteria. We want to create a dashboard that is useful and will be used by the project managers. The project managers already have numerous information systems they need to interact with. The addition of another information system might encounter resistance. By focusing on the usefulness of the dashboard, we try to overcome this. The same counts for the ease of use of the dashboard. We try to take away the resistance by showing the possibilities and the concept of linking multiple sources of data and generating relevant information all centralized in one place.

When we look at the problems in Chapter 3 we see that there are some problems which are related to functionalities, like;

- reports not suited for comparison,
- many (unlinked) sources of information.

There are two problems that can be linked to the two core constructs of the Technology Acceptance Model. These problems are related to the usefulness and ease of use of a dashboard, namely;

- takes a lot of manual work to create reports,
- cannot act quickly because of lack of signals.

4.2 DESIGN PROCESS

A mission statement was constructed to provide guidance to what we do want to achieve with our performance dashboard. A mission statement can be seen as an agreement of what the system would contain and what is left out of the scope. This document provides us with a clear vision of what the prototype's functions will be.

The goal is stated as follows:

The goal of this prototype is to serve as a proof of concept, aimed at showing the possibilities of a performance dashboard that makes use of existing data sources. In the case of ShERPa (in the hour registration system), the proposed changes will be taken into account. The performance dashboard will provide the project managers an accurate overview of current project status so that they will not need to manually retrieve all the project related information. The prototype will be used to gather relevant feedback from the users.

There are some exclusions clearly written down what the prototype will not contain;

- *Only available data (including the changes to ShERPa) is used, there will not be a possibility to enter data into the performance dashboard.*
- *The performance dashboard will not replace any existing project management tool; it should serve as an addition to the current systems.*
- *The prototype will not be fully functional. It is intended to show the possibilities and retrieve feedback.*

The full mission statement can be found in Appendix A.

The available data used as input for the performance dashboard are the operational databases and report templates. The operational databases are the accounting information system Multivers, and the time registration system ShERPa. For the reporting of projects, different templates are used by project managers. These templates are lightly based on information gathered from these databases, like a list of projects currently in progress by a specific project manager. A last source of information used in this prototype is a Microsoft Project file of an arbitrarily chosen project. This was done to provide the prototype with data regarding a time-phased plan. A time-phased plan is a schedule of activity based on an appropriate time scale. This will represent data that will be included in the future version of ShERPa and provides us with additional details about projects currently not stored in the databases, like how many hours are spent on sub-projects.

We have chosen to divide all the project related information into sections according to the project management literature. The project management literature states that six categories are important in the controlling phase of projects; scope, time, cost, quality, risk and resources. Of these six categories two were intentionally left out of the prototype; scope and quality. Scope is an element that is used as input in the Work Breakdown Structure. It defines what is included in the project and what is not included. This is maintained in project management tools by the project managers (for example Microsoft Project or Microsoft Excel). Since we do not want to replace project management tools, according to the mission statement, we do not include the scope element in the performance dashboard. Quality is the other category that is not included in the prototype. Quality is hard to determine and measure, especially during the execution of a

project. When the project is completed the quality can be measured by how the customer experiences the end result. But during the execution it is more difficult. Hard numbers like defect count do not provide a total view of the quality, as quality consists of more than just the technical properties of a product. This is why quality is left out as well. Based on the remaining four categories, time, cost, risk and resources, the prototype has been built.

For the design process of the prototype, we have chosen to use the rapid prototyping approach, which is a type of software prototyping. Software prototyping refers to creating a prototype of a software application, which can be seen as incomplete versions of the software application under development. This prototype usually displays part of the functionalities of the end product. The main reason for this is because it was not possible to use live data to construct the dashboard.

To construct our prototype we use Axure RP, an interactive wireframe software & mockup tool. This tool allows us to create dynamic HTML pages which the sketchiness of tools like Balsamiq. The dynamic pages of Axure RP are easily created with just a few clicks. This enables us to create a prototype quickly and be flexible enough to change, add or remove components in the prototype.

4.3 BACK-END

Dashboards use a data warehouse to combine all the sources of data as back-end system. Data warehouses are more than just plain databases; they often include Extract, Transform, Load functionalities.

In this thesis we will not make a choice for a certain vendor of data warehouse. We do find it important to say something about the data sources available, how these can be used in a data warehouse system, and which data we have used in our prototype dashboard.

4.3.1 AVAILABLE SOURCES

The dashboard should use multiple sources of data and be able to combine them to provide an overview of the projects. This data is coming from different information systems. Where there are databases in which relevant project management information is saved (for example the time registration in ShERPa), but there is also relevant information stored in Microsoft Excel files. These Microsoft Excel files are used for reporting and contain data about the past (for example how many hours are spent), and a prediction of the future (planned work).

The data currently in use by project managers for the purpose of reporting and planning at Sigmax is displayed in Table 4.

Source	Description
ShERPa (database)	ShERPa is the hour registration tool. It records projects and the hours written to projects by all employees. This is stored in a Microsoft SQL database. Per Business Unit there is one ShERPa database.
Multivers (database)	Multivers is a commonly used financial suit, mostly used in SME (Small and Medium Enterprises). Through an ODBC connection the information stored in the database can be retrieved.
Besprekingsrapportage (xls-file)	This is a report used each month at Sigmax. It is used by large projects and all the relevant project information is stored in this document. Planned versus actual progress is displayed here, as well as risks and how they are handled.
Project list (xls-file)	This is a document displaying all the projects of a project manager. He has to provide how far the projects are completed, so that the financial department can take a piece of profit.
Microsoft Project	Most project managers use planning tools like Microsoft Project to plan their project activities in detail.

TABLE 4: AVAILABLE DATA SOURCES

4.3.2 METRICS USED IN THE PROTOTYPE

As discussed in section 4.2 we have divided the screens of the dashboard into four parts; time, cost, risk and resources. To ease the navigation towards those detailed screens, we have made a project list screen which displays all the projects of a project manager. This screen will have a high level view of all the projects. This provides the dashboard with a drill-down functionality.

Once a project is selected from this list, an overview page will be displayed where some information about the project is given (not all). This is the main screen of the overview of a project. It will display the relevant information on which a project manager can see the status of his project at a glance. If he wants to see more information, he can drill down towards a subject, for example cost related. An overview of the sitemap of the prototype is displayed below (Figure 9).

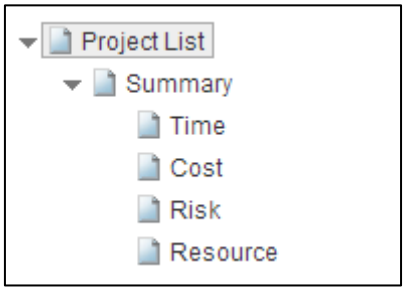

FIGURE 9: HIERACHICAL VIEW OF THE NAVIGATION

The metrics which have been used in the dashboard are displayed below, per page. Their respective source is also given.

4.3.2.1 PROJECT LIST SCREEN

Item	Source
Project name	Multivers
Stage	(new)
% complete	Project list (manual entry)
Schedule indicator	"Besprekingsrapportage.xls"
Budget indicator	"Besprekingsrapportage.xls"
Risk indicator	"Besprekingsrapportage.xls"
Resource indicator	"Besprekingsrapportage.xls"
Start date	ShERPa
End date	ShERPa

TABLE 5: PROJECT LIST SCREEN

4.3.2.2 SUMMARY

Item		Source
Total amount of hours		ShERPa
"	End forecast	ShERPa (new)
sub-project list	Name	ShERPa (new)
"	Start-date	MS Project
"	End-date	MS Project
Risk matrix		"Besprekingsrapportage.xls"
Total spend hours per week		ShERPa
Milestones		"Besprekingsrapportage.xls"

TABLE 6: SUMMARY

4.3.2.3 TIME

Item	Source
sub-project list	ShERPa (new)
Milestones	"Besprekingsrapportage.xls"
Total amount of hours	ShERPa
End forecast	ShERPa (new)
Total spend hours per week	ShERPa
ToBeSpend hours per task	MS Project

TABLE 7: TIME

4.3.2.4 COST

Item		Source
Gross profit calculation		"Besprekingsrapportage.xls"
Purchase calculation		"Besprekingsrapportage.xls"
Installments	Installment nr	Multivers
"	Date	Multivers
"	Installment amount	Multivers
"	Invoice description	Multivers
"	status	Multivers

TABLE 8: COST

4.3.2.5 RISK

Item		Source
Risks	Risks	"Besprekingsrapportage.xls"
"	Impact	"Besprekingsrapportage.xls"
"	Opportunity	"Besprekingsrapportage.xls"
"	Risk-number	"Besprekingsrapportage.xls"
"	Corrective actions	"Besprekingsrapportage.xls"
Status	Date	"Besprekingsrapportage.xls"
"	Explanation	"Besprekingsrapportage.xls"
"	Corrective actions	"Besprekingsrapportage.xls"

TABLE 9: RISK

4.3.2.6 RESOURCES

Item	Source
Total amount of hours spend per person	ShERPa
Hours per month per person	ShERPa
Hours per person per week	ShERPa
Total spend hours per week	ShERPa

TABLE 10: RESOURCES

4.4 FRONT-END

Like we said above, we have used Axure RP for the creation of our prototype. Axure RP is a software tool that enables users to create interactive wireframes and mockups. It does so by providing the user a WYSIWYG (What You See Is What You Get) interface to create interactive HTML pages which in the end look like a software application, website or even mobile phone interface.

The purpose of the dashboard is to provide the project manager with an up to date overview of his projects. This will potential reduce the time needed to gather and extract the information from all the information systems. By automating this process, and by providing the right information, it is expected that the project manager is able to have a clearer picture about the status, thus improving his job performance (Perceived Usefulness).

The dashboard is also designed with and easy to use interface in mind. The first screen of the dashboard is the Project list where all the projects of a selected project manager is displayed. When a project is selected from this list, you are transferred to a page with an overall view of the status of the project (Summary page). This gives a high level overview of some of the important aspects of the status of a project. When the project manager needs more detailed information about time, cost, risk or resources, he can navigate to the respective pages. The project manager is able to 'drill-down' from the summary to detailed information about the project. The 'drill-down' functionality is expected to make the dashboard easy to use (Perceived Ease of Use).

The dashboard is realized in 6 screens, as mentioned before. Below is a table (Table 11) with the description of each page of the dashboard

Page	Description
Project list	This page displays all the projects assigned to a specific project manager. Per project it displays the stage, % complete and indicators about the health of a project.
Summary	This page displays all the relevant information about a project on a high level, on one page. It is intended to give an overview. Items from time, cost, risk and resources are presented here to give a summary.
Time	This page displays detailed time related project information, like the project plan, milestones and how much hours have been spend. The purpose is to have one screen where all the important information about this subject is gathered.
Cost	This page displays all the detailed information related to cost. The purchases are displayed as well as how much gross profit there is available for the work. Billing information is also given. The purpose of this page is to give the project manager a view on the financials.
Risk	This page displays the risks of a project with impact, opportunity and risk-number. The corrective measures are also given, and there is a historical overview of the status divided into time, cost and quality.
Resources	This page displays the resources used in a project. Since the main resource used at Sigmax is hours, it gives a detailed overview of all the hours spend, per person, per week. This page should have multiple views on this information, so that the project manager will not need to export the data to Excel to make his own view.

TABLE 11: DESCRIPTION OF THE DASHBOARDS PAGES

4.5 FEEDBACK FIRST VERSION

This first version of the prototype was validated through two feedback sessions in which multiple project managers were invited. Two parallel sessions were organized where the two groups did not have any contact with each other. Due to time and agenda constrains five of the nine project managers were invited. Last minute cancelations lead to the presence of three project managers, two project managers in one feedback session (three planned) and one project managers (two planned) in the other feedback session. It was deliberately chosen to keep the groups small; this provides the possibility for every project manager to participate.

Dominant persons are less likely to influence others. This way everybody has the ability to say something.

The purpose of these sessions was to get feedback on the usefulness and ease of use of the performance dashboard. The sessions started off by a short presentation. In this presentation the project managers were told about the design process, how the prototype was designed and which data sources were used. The focus in this feedback session was put on the usefulness and ease of use of the system, and the types of information presented on the different screens. The layout or the correctness of the displayed data were not considered important at this stage. After the presentation, the prototype was shown. At every screen the project managers were asked;

- their first reaction,
- whether information was missing,
- … or could be left out.

The audio was recorded during the sessions so no important feedback was missed. A summary of the feedback is listed in the next subsection, as well as Appendix B (in original language).

4.5.1 Feedback Summary

Summarized we can say the following feedback is considered most important for the improvement of our prototype;

Time screen;

- Focus time related items on three subjects; Budgeted, Actual, ToBeSpend. Preferably per task.
- This is probably the most useful screen in the system.

Cost screen;

- Cost is not a steering element for project managers.
- Project managers would like to know what the impact is of decisions they make on a projects profit (but the available data is not detailed enough)
- Status of purchases would be nice to know (although the source data is not uniform)
- More detailed information about client payments (installment). It is good to know if a client has paid their bills. If not, that might be a signal that the quality of the product is not as expected.

Risk screen;

- Sigmax does not have a proper functioning risk system in place; it is therefore advised to remove it.

General remarks;

- Focus on one thing at the time, implementing too much at once might lead to a half system which will not be used.
- Realized versus budgeted time is the most useful information at this time.
- Watch out for copying over standard functionality which is included in many off the shelve project management tools.

The feedback from the project managers are very valuable as they are the future users of the system. The acceptance of the dashboard is depending on the usefulness and the ease of use, as argued before. Implementing the feedback in a next version will improve the quality of the dashboard.

5 DASHBOARD DESIGN – VERSION 2

This chapter will provide a detailed view of the visual design of dashboard. This is the second version of the prototype. Based on the feedback of the first version of the prototype (see previous chapter), changes have been made to create the second version. These are discussed first. In the rest of this chapter we will show each page of the dashboard and describe its purpose.

5.1 CHANGES TO VERSION 2

Based on this feedback (see previous chapter) we have made some changes to the second version of the dashboard. These changes are displayed below, and listed per page.

Project list
- Remove risk indicator
- Remove resource indicator
- Remove stage column.

Overview
- Give an indication of current date in the project plan
- Remove risk
- Remove the milestones table
- Include some kind of cost overview, since that was missing in the overview.

Time
- Include the following information on task level;
    - Estimated
    - Spend
    - ToBeSpend
    - Percent complete
- Give an indication of current date in the project plan
- Remove all other information

Cost
- Installments; should include status, like invoice sent.
- Display the paid amounts of money.
- Provide more detailed calculation of the profit, include the hour-tariff for employees.
    - Leave the gross profit out.

Risk
- Remove this page.

Resources
- Hours spend per week should be displayed with bars instead of lines.

5.2 PROJECT LIST

This screen represents all projects currently in progress by the project manager. Relevant information on this screen are; name of the project, how much percent is complete, visual indication of time and cost, and start and end date of the project. When you click on the name of the project, you get transferred to the Summary page. The green circle means the Time or Cost is as planned, when there is a small difference it shows as a yellow triangle. A red square means the Time or Cost are differing a lot compared to the planned situation. With the distinctive shapes, we have taken into account that colorblind people can also read these signals. In this prototype the boundaries of when the signal will turn yellow or red are not determined yet.

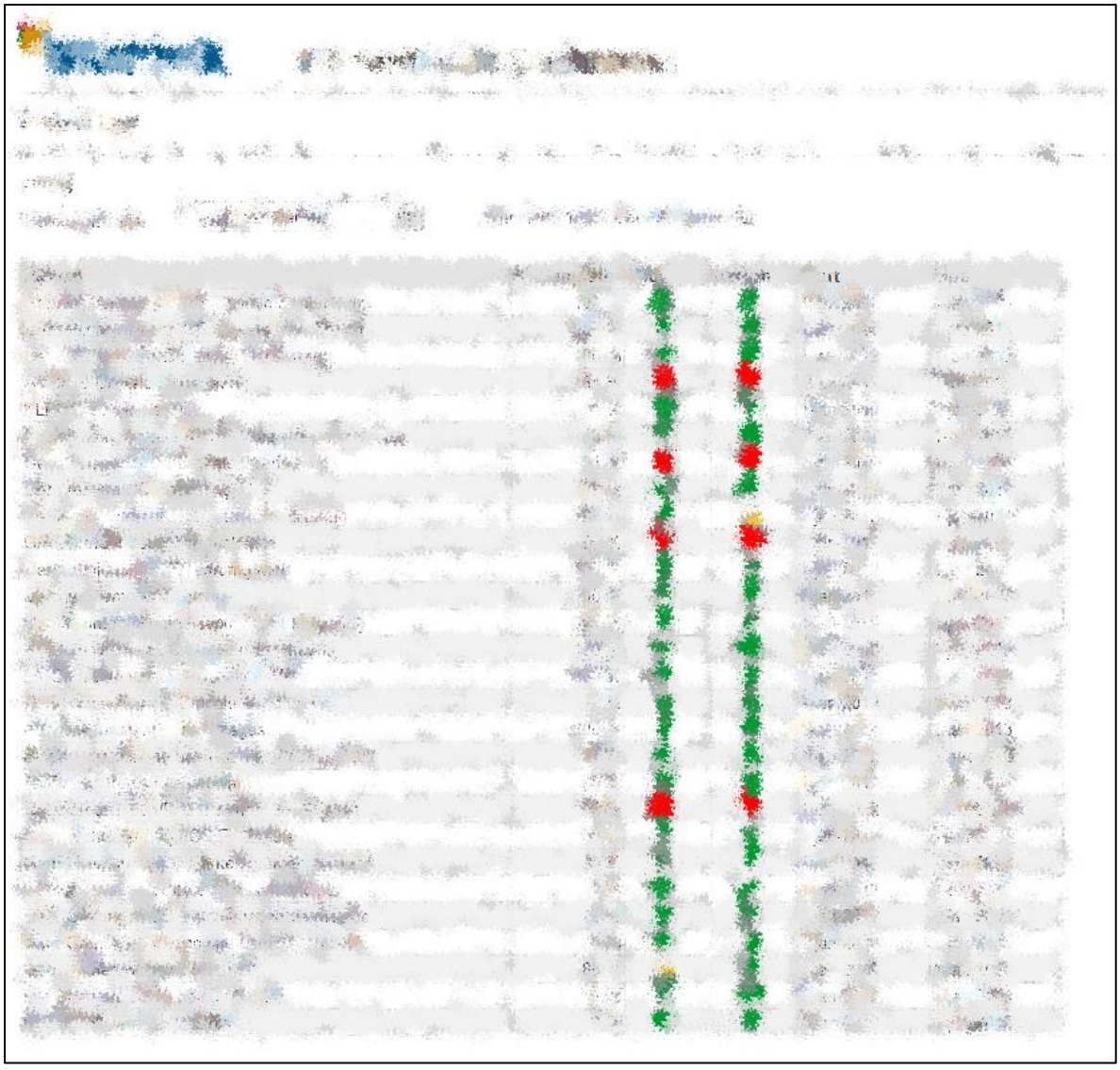

FIGURE 10: PROJECT LIST (CONFIDENTIAL)

5.3 SUMMARY

This page is an overview page of relevant information. Its purpose is to provide an overview in one glance of the progress of the project. The elements displayed are related to hour-spending, project plan, hours spend per week and a financial project status. Each element has the ability to click through to the next page.

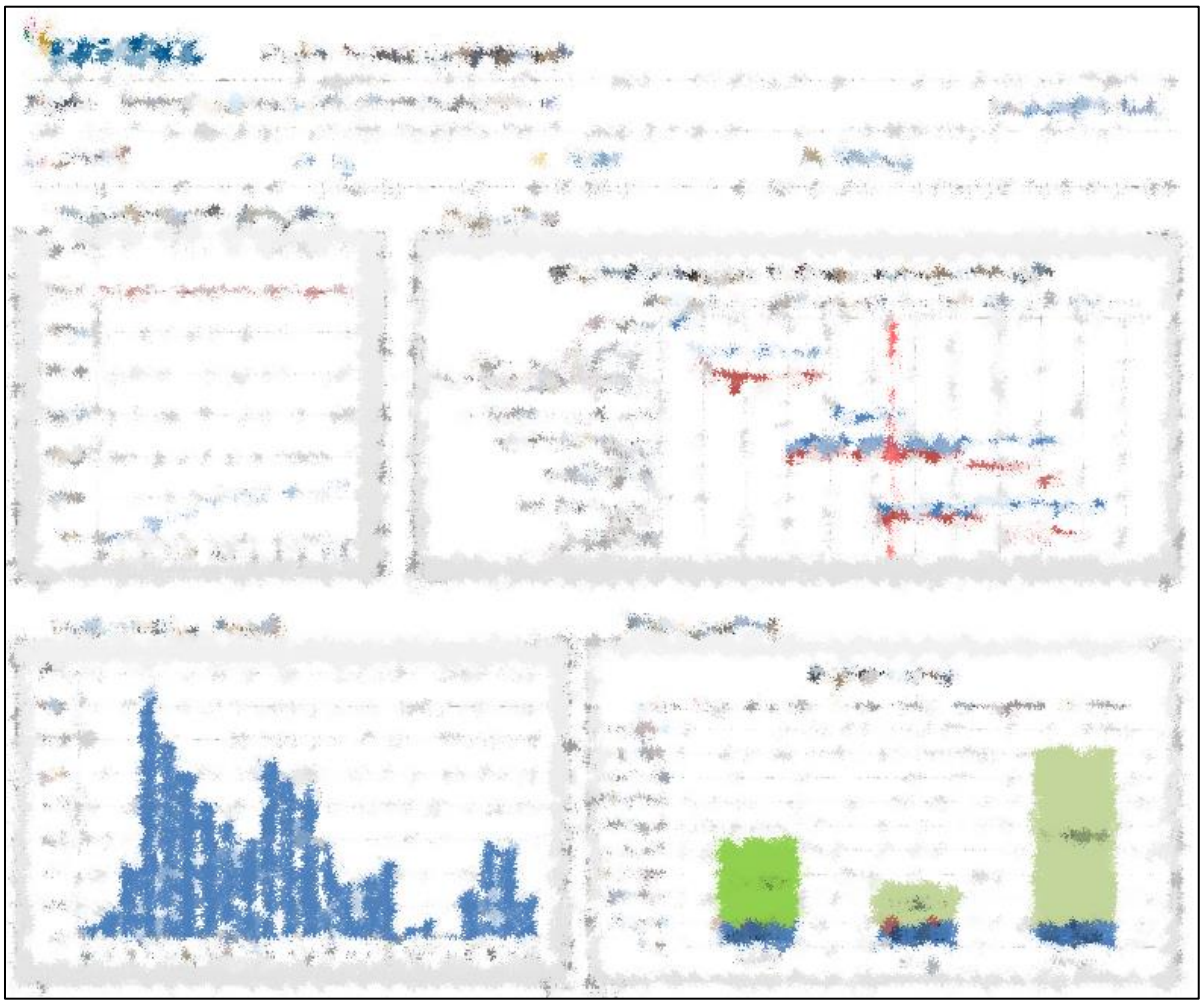

FIGURE 11: SUMMARY (CONFIDENTIAL)

5.4 TIME

This time page represents the project plan. The project plan is displayed as a Gantt-chart. Each sub-project is listed, the bars width represent the time it is planned to take. Below the Gantt-chart is a detailed description on how much is budgeted, actually spend and ToBeSpend on each sub-project (high level tasks). Also a progress is displayed as percentage done.

FIGURE 12: TIME (CONFIDENTIAL)

5.5 COST

The costs screen displays the project result as initially planned, current, and at the end of the project. This provides the project manager a view of the results of the project as planned, and what consequences it has on the end result if the plan is executed. Calculations of the numbers are given. This page also includes installments information and invoices, and their respective statuses like 'invoice sent' or 'paid'.

FIGURE 13: COST (CONFIDENTIAL)

5.6 RESOURCES

The resources screen provides an overview on how of the resources are spend. The resources in projects at Sigmax are human of nature; hours spend by employees. The information from this screen have been adopted from a currently in use Microsoft Excel document. This document connects with ShERPa to retrieve the information and displays it in a summarized way with, for example, pivot tables. In our dashboard there is also a graphical representation displayed about the hour progress and spend hours per week.

FIGURE 14: RESOURCES (CONFIDENTIAL)

5.7 VALIDATION - SURVEY

We have conducted a survey to validate our second version of the performance dashboard. Online surveys have become an easy ways of conducting surveys. It provides the ability to quickly create a questionnaire and distribute this amongst the participants. While there are many choices for online survey tools, we have chosen to use SurveyGizmo (http://www.surveygizmo.com/). SurveyGizmo provides a clean interface which makes it easy to enter the different questions. Distribution of the survey through email campaign and an advanced reporting functionality makes this a very complete tool. SurveyGizmo provides almost all the functionalities to students for free, other tools might not provide all the functionalities to free users. This is why SurveyGizmo was used.

5.8 SURVEY QUESTIONS

The survey was set up in three parts. The first part is related to questions regarding Perceived Usefulness and Perceived Ease of Use, originating from the TAM model. In the second part, questions are asked about the different screens of the dashboard. In the last part, a few general questions are asked. The questions are listed in Appendix C.

5.8.1 TAM

As described in Section 4.1: Design Criteria, we have used the TAM model by Davis et al. (1989) as design criteria. The Perceived Usefulness and Perceived Ease of Use are considered important in the development of the performance dashboard. We have chosen for this framework because it is focused on the intended use of an information system. Our prototype fits into this philosophy. The performance dashboard we created is a prototype, not a full functioning application.

An extension of TAM is presented by Venkatesh et al. (2003) in the Unified theory of acceptance and use of technology (UTAUT) model. This UTAUT model combines different existing models into a unified view. The UTAUT model uses a theory that performance expectancy, effort expectancy, social influence, and facilitating conditions are directly related to usage intention and behavior. If we read UTAUT in detail we note that Performance expectancy and Effort expectancy is very largely based on the TAM model. The other two aspects, Social influence and the Facilitating conditions, are less important for the assessment of a prototype. This is why we use the TAM model for our validation.

We have asked the following questions related to the TAM model. These questions originate from the original paper of Davis et al. (1989) and have not been altered or translated to Dutch.

Perceived Usefulness

- *Q1. Using the Performance Dashboard in my job would enable me to accomplish tasks more quickly.*
- *Q2. Using the Performance Dashboard would improve my job performance.*
- *Q3. Using the Performance Dashboard in my job would increase my productivity*
- *Q4. Using the Performance Dashboard would enhance my effectiveness on the job.*
- *Q5. Using the Performance Dashboard would make it easier to do my job.*
- *Q6. I would find the Performance Dashboard useful in my job.*

Perceived Ease of Use

- *Q7. Learning to operate the Performance Dashboard would be easy for me.*
- *Q8. I would find it easy to get the Performance Dashboard to do what I want it to do.*
- *Q9. My interaction with the Performance Dashboard would be clear and understandable.*
- *Q10. I would find the Performance Dashboard to be flexible to interact with.*
- *Q11. It would be easy for me to become skillful at using the Performance Dashboard.*
- *Q12. I would find the Performance Dashboard easy to use.*

The possible answers are based on a 5 point Likert-scale, ranging from Strongly Disagree to Strongly Agree (with the possibility of answering Not Applicable).

5.8.2 DASHBOARD SCREENS

In this second part, we asked questions about the different pages of the dashboard. The purpose is to get extra requirements and to check if we did not miss any important information. We asked the following questions for each of the five pages (Project List, Overview, Time, Cost and Resources);

- *Q13. Missen er bepaalde elementen op deze pagina? Zo ja, welke?*
- *Q14. Staan er overbodige elementen op deze pagina? Zo ja, welke?*
- *Q15. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?*

Translated from Dutch;

- *Q13. Are there any elements missing on this page? If so, which?*
- *Q14. Are there any superfluous elements on this page? If so, which?*
- *Q15. Do you have any questions or remarks about this page of the prototype?*

The possible answers for these questions are open ended, and are not required to be answered.

5.8.3 GENERAL

The last part of the survey we asked some more general questions. One of the things we would like to know is which page will be used the most by the project managers. Maybe there are some pages which are not relevant and therefore will not be used. To find out we asked the following question;

Q 28. Welke pagina zou jij het meest gebruiken?

Translated from Dutch;

Q 28. Which page would you use the most?

The answer to this question is a bit different. The project managers are asked to divide 100 point over the five possible answers (Project List, Overview, Time, Cost and Resources). Giving 0 points to an answer means that the Project Manager will not use this page.

To conclude we ask several general questions about the project manager and if they have some questions or remarks about the prototype or survey.

- *Q 29. Wat is je leeftijd?*
- *Q 30. Hoeveel jaar werkervaring heb je als Project Manager?*

Q 31. Hoeveel jaar werk je als Project Manager bij Sigmax?
Q 32. Heb je naar aanleiding van het prototype of deze vragenlijst nog vragen en/of opmerkingen?

Translated from Dutch;

Q 29. What is your age?
Q 30. How many years of work experience do you have as Project Manager?
Q 31. How many years do you work as Project Manager at Sigmax?
Q 32. Do you have any questions and/or remarks on the occasion of the prototype or this questionnaire?

These questions in this part are all open-ended, and are not required to be answered.

5.9 CONDUCTING THE SURVEY

The survey was sent out to all the project managers of Sigmax via email. At the time of conducting the survey there were eight project managers working at Sigmax. The email with the invitation also contained instructions to download a zip-file containing the files of the performance dashboard prototype. The project managers all have enough technical knowledge to extract the zip-file and open the prototype. The prototype is generated with Axure RP to a number of HTML files. There is no need for server-side technology like PHP or ASP.NET, so running the HTML-files can be done on any computer.

5.10 SURVEY RESULTS

The number of responses of the survey is 8. This makes a 100% response-rate. This is not strange due to the low number of participants and the fact that all the respondents work at Sigmax. Asking the project managers in person to remind them to fill in the survey worked very well.

After filling in the survey three project managers approached me with questions and additional remarks. These were not filled in in the survey, but were interested enough to include them in the answers.

5.10.1 FIRST PART – TAM

The Technology Acceptance Model consists of two elements, Perceived Usefulness and Perceived Ease of Use. These two elements are spit to provide a clear overview of the results.

5.10.1.1 PERCEIVED USEFULNESS

Table 12 below displays the results of the element Perceived Usefulness. All Project Managers, besides R1 and R8, answered Agree (4) or Strongly Agree (5). R1 answered Disagree (2) to the first four questions, whereas R8 answered Neutral (3) to all questions related to Perceive Usefulness. It's possible that R8 entered Neutral to these questions because he works for Sigmax less than a year. The majority of the project managers find the Perceived Usefulness quite high (between 4 and 5).

	R1	R2	R3	R4	R5	R6	R7	R8	Avg.
Q1	2	4	4	4	5	5	4	3	3,88
Q2	2	4	4	5	5	4	4	3	3,88
Q3	2	4	4	5	5	5	4	3	4
Q4	2	4	4	5	5	4	5	3	4
Q5	4	4	4	5	4	5	4	3	4,13
Q6	4	4	4	5	5	5	4	3	4,25
Avg.	2,67	4	4	4,83	4,83	4,67	4,17	3	

TABLE 12: SURVEY RESULTS - PERCEIVED USEFULNESS

5.10.1.2 PERCEIVED EASE OF USE

Table 13 displays the answers to the element Perceived Ease of Use. Most project managers give a score of 4 or 5 (agree or strongly agree) to the questions related to Perceived Ease of Use. It's remarkable that R1 was quite negative about the Perceived Usefulness, but very positive about the Perceived Ease of Use. This could be related to the fact that he thinks that in order to get a proper dashboard, you need to have the ability to access all the right information, as he told us after he conducted the survey. The Mission Statement has been included in the introduction of the survey, which states that the changes in ShERPa are regarded as implemented. It is possible that he has misunderstood that part.

Furthermore R5 is not able to answer Q10 (*I would find the Performance Dashboard to be flexible to interact with*), which is understandable for this prototype; it is not very flexible at this time.

R8 is again Neutral towards the Perceived Ease of Use. He does not foresee difficulties learning the system. He does have questions about how easy it is to get the dashboard to do what he wants it to do (Q8), and how flexible it is to interact with (Q10). Which can be explained by the fact that this is a prototype in which not all the functionality is implemented yet.

Overall we can say that the majority of the project managers find the Perceived Ease of Use quite high (between 4 and 5).

	R1	R2	R3	R4	R5	R6	R7	R8	Avg
Q7	5	4	5	4	4	4	5	5	4,5
Q8	5	4	5	5	3	4	3	2	3,88
Q9	5	4	5	5	4	4	4	3	4,25
Q10	5	4	4	5	0	3	4	2	3,86
Q11	5	4	5	5	4	4	4	3	4,25
Q12	5	4	5	5	4	4	4	3	4,25
Avg	5	4	4,83	4,83	3,8	3,83	4	3	

TABLE 13: SURVEY RESULTS - PERCEIVED EASE OF USE

5.10.2 SECOND PART – DASHBOARD SCREENS

In the second part of the survey, the respondents have the ability to give answers to the following questions, per screen of the dashboard;

Q1. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q2. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q3. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Translated from Dutch;

Q1. Are there any elements missing on this page? If so, which?
Q2. Are there any superfluous elements on this page? If so, which?
Q3. Do you have any questions or remarks about this page of the prototype?

5.10.2.1 PROJECT LIST

Not all project managers have filled in the answers to this page, only four project mangers think something is missing;

- *"Project budget (uren / kosten) Opbrengsten (sales price) "*
- *"Subactiviteiten van projecten Kwaliteitsindicatie"*
- *"offertenummer "*
- *"Ik mis nog multivers projectnummer en klantnaam. Zodat je ook daarop kan zoeken/filteren. En ik mis onderdeel kwaliteit met rood, geel of groen symbool. "*

Quality has been deliberately left out of the prototype, two Project Managers think this is missing. These project managers have not participated in the previous feedback session.

All the project manager do not think anything is superfluous in the dashboard.

The following questions and remarks are given about the Project List page of the dashboard;

- *"Een tracking Gantt op projectniveau helpt sneller inzicht te krijgen in voortgang tov baseline. "*

A tracking Gantt on project level is a functionality of many project management planning tools. We should not be aiming at rebuilding that kind of functionalities. The prototype is clearly not intended as a replacement for such tools

- *"is het mogeljk om alle projecten van een BU te tonen? "*
- *"Wat betekent start en eind? Is dat start- en einddatum van rapportage periode? Of geplande start- einddatum van het project? In de huidige maandrapportage is er gelegenheid om per verslagperiode (per maand) een toelichting te geven: - belangrijke ontwikkeling afgelopen periode - belangrijke ontwikkeling komende periode - toelichting op status tijd - toelichting op status kwaliteit - toelichting op status kosten - corrigerende maatregelen"*

The performance dashboard is a tool that collects data and presents them in an aggregated way. Data about explanations given in current reports can be included, but they have to be stored somewhere. The performance dashboard is not intended to enter any information into.

- *"Het zou handig zijn dat je met een mouse over meer inzicht krijgt in de cijfers, of via aparte kolommen"*
- *"De bruikbaarheid van het systeem is afhankelijk van het verzamelen en verwerken van de invoer gegevens. Het probleem bij Sigmax is niet dat we deze overzichten niet kunnen maken, het probleem is dat het heel veel werk kost om die informatie uit de systemen te halen -> Daar moet wat aan gedaan worden. "*

This last remark is addressed by the changes that are needed in ShERPa. Those changes will make it easier to retrieve information. For the problems at Sigmax see Chapter 3.

5.10.2.2 Overview

Three project managers have pointed out that there is something missing for them. These items are;

- *"Vrijval"*
- *"keuze voor periode. Vrijval mist. Overzicht gefactureerd, nog te factureren e.d. "*
- *"Baseline gegevens (oorspronkelijke planning / aantal uren per week) Urenbesteding / eindprognose zou uitgebreid kunnen worden met nog te verzetten uren in de tijd. Projectplan met tracking Gantt en critical path. "*

All the project manager do not think anything is superfluous in the dashboard.

The following questions and remarks are given about the Overview page of the dashboard;

- *"Overzicht is helder en logisch, maar waar komt alle info vandaan? "*
- *"Welke (initiële) input is benodigd voor de overzichten? Betekenis van kleuren (rood, blauw) van project plan is niet duidelijk. "*

In the introduction the sources of the data was explained. It is possible that the participant have not read this well enough, or that this was not clear enough.

5.10.2.3 Time

Three project managers have pointed out that there is something missing for them. These items are;

- *"%complete"*
- *"Geplande, gerealiseerde en nog te besteden uren uitgezet in de tijd. "*
- *"In uurbesteding per taak een column eindprognose (werkelijk + nog te besteden). Met rode en groene getallen het verschil tussen begroot en eindprognose. Aanname: werkelijk is actueel tot nu toe. "*

All the project manager do not think anything is superfluous in the dashboard.

The following questions and remarks are given about the Time page of the dashboard;

- *"De benodigde resources (capaciteit) om de planning te kunnen halen is onvoldoende inzichtelijk. "*

Sigmax currently does not have a detailed capacity planning system. This data would be useful for a project manager to help him plan his projects better.

- *"Vraag is in welk detail we uurbesteding per taak vooraf al incalculeren/helder hebben? "*

5.10.2.4 Cost

Three project managers have pointed out that there is something missing for them. These items are;

- *"Datum inkoop (cash out). Earned value"*
- *"Inzicht in het feit of klanten betaald hebben"*
- *"ik mis inkoopcomponenten. Te ontvangen inkoopfacturen en hun status (nog te ontvangen, ontvangen, betaald). "*

All the project manager do not think anything is superfluous in the dashboard.

The following questions and remarks are given about the Cost page of the dashboard;

- *"Termijnregels: goed idee! Ontvangen bedragen misschien in tabel termijnregels opnemen als status. Status kan dan bijv. zijn: open, gefactureerd, betaling ontvangen. Ik zou de volgende kolommen verwachten: - begroot, werkelijk (tot nu toe), nog nodig (verwacht), eindprognose, verschil begroot / eindprognose. "*
- *"Als er idd. zo makkelijk alle info inzichtelijk is, scheelt het heel veel werk. Waar komt alle info vandaan? "*
- *"welke input wordt gebruikt voor overzicht? werkelijke kosten tov eindprognose is onduidelijk in staafdiagram. "*

5.10.2.5 RESOURCES

Two project managers have pointed out that there is something missing for them. These items are;

- *"Geplande uren. "*
- *"ik mis de actuele geaccordeerde urenregels en de nog te accorderen urenregels (die je misschien vanaf hier eenvoudig kunt accorderen). En mogelijkheden om op die urenregels te kunnen filteren/zoeken. "*

All the project manager do not think anything is superfluous in the dashboard. None of the project managers have given a remark or question about the Resources page of the dashboard.

5.10.3 THIRD PART – GENERAL

An interesting thing to know is which page would be used the most by the project managers. The answer to that question can be seen in the table below (Table 14)

Q 28. Welke pagina zou jij het meest gebruiken?

Translated from Dutch;

Q 28. Which page would you use the most?

	R1	R2	R3	R4	R5	R6	R7	R8	StdDev	Avg.	Sum
Project List	20	50	50	10	30	20	10	10	15,81	25	200
Summary	20	25	25	18	20	30	15	10	5,89	20,38	163
Time	20	10	10	23	20	20	20	50	11,66	21,63	173
Cost	20	10	10	23	10	20	15	10	5,17	14,75	118
Resources	20	5	5	26	20	10	40	20	10,96	18,25	146

TABLE 14: SURVEY RESULTS - WHICH PAGE WOULD BE USED THE MOST

We can see different results from this question. R1, R5 and R6 have almost equally divided the points over the pages. R2 and R3 have a preference towards the Project List page. R4 is more interested in the details provided in the Time, Cost and Resources page. R7 is mostly interested in the Resources page, and R8 mostly in the Time page. We see there is a lot of difference in the answers. Overall we can say that the Cost page is of less importance than the other pages. But regarding the other pages, we cannot pinpoint a single page which will be use the most by all the Project Managers.

5.11 FINAL REQUIREMENTS

There are some issues with the individual screen which might need some additional attention before the system is built. Based on the feedback on each different screen, there are some issues which are open, these are;

Project list;

- Unsure what start and end means. Is it the start and end date of the report period, or planned start and end date of the project? In current reports it is possible to give feedback on each period on different issues.

Summary;

- Choice of period is missing, summary of billed and to be billed invoices is missing
- Which input is needed for the summary?
- Meaning of colors is not clear.

Time;

- In the spend hours per task, add a column end-forecast (actual+ToBeSpend). With red and green numbers representing the difference between budgeted and end-forecast.

Costs;

- Purchase elements are missing. To be received purchase invoices and their status.
- Put received funds in a table as status (of installments). That way status could be open, billed, received.
- Which input is used in this overview? Actual costs related to the end forecast are not clear in the bar chart.

Resources;

- The actual approved hours are missing, and the to be approved hours. (maybe it is even possible to approve hours from this screen?)
- Add the possibility to filter or search on these hours?

6 CONCLUSIONS

In this chapter the results of the research are presented. In this research we started off with a problem analysis regarding project management at Sigmax. Based on the results of this problem analysis, we have designed a performance dashboard. Two versions of a prototype were made of this performance dashboard. After we made the first version we held a feedback session, based on this feedback a second version was made. The last part of our research was conducting a validation of the second version of the performance dashboard prototype. The findings of this study are presented in this chapter.

6.1 RESULTS

RQ1 What are the characteristics of a performance dashboard when it is used in the context of project management?

We explored the literature on two subjects, performance dashboards and project management. Performance dashboards are gaining a lot of popularity in businesses and a lot of software vendors create their own type of dashboard. Academic literature has not kept in pace with this development, resulting in different scientific gaps. The lack of a general accepted definition of a performance dashboard is maybe the most significant. However multiple author do have a definition which gave us enough guidance to come up with general characteristics of a dashboard. A performance dashboard is "*a visual and interactive performance management tool that displays on a single screen the most important information to achieve one or several individual and/or organizational objectives, allowing the user to identify, explore, and communicate problem areas that need corrective action*" (Yigitbasioglu & Velcu, 2012). It presents metrics relevant for the user in his decision making process, based on multiple sources, in a single screen. In the presentation graphical elements like colored graphs and stoplights are commonly used. To get more detailed information, the ability to drill down should be present. That way, one system can be used to monitor, analyze and manage the performance.

The topic of project management has been described on a general level. The PMBOK Guide has been used to describe the aspects which influence the performance of a project. These aspects are called project management constraints. The Iron Triangle of time, cost and quality have long been seen as the most important constraints. We have complemented those three to the following six constraints; scope, time, cost, quality, resources and risk. When these six constraints are managed in a proper way, the end result of a project will be successful.

RQ2 What are the current problems at Sigmax related to the status information of projects?

A thorough problem analysis has been executed. By conducting semi-structured interviews, based on the USE IT method, we have identified various problems. The USE IT method was created in the healthcare domain, but the authors encouraged researchers to use their method in other environments as well. The interview protocol was clear, and needed little alterations to be

applied in our context. The way the USE IT method is structured provided proper guidance to conduct a problem analysis. The problems that have emerged during our investigation were diverse, not all of them could be related to the solution of a performance dashboard. We used a solution matrix to score the effectiveness and feasibility of the proposed solutions. The following problems are expected to be solved by designing a performance dashboard (not ordered by problem size, or order of importance);

- reports not suited for comparison,
- many (unlinked) sources of information,
- takes a lot of manual work to create reports,
- cannot act quickly because of lack of signals.

RQ3 How can the identified problems be mitigated by a performance dashboard?

Based on the literature findings and the problem investigation, we have designed a first prototype version of a performance dashboard. We used the TAM model as guidance, as the Perceived Usefulness and Perceived Ease of Use are important aspects in the acceptance of a new information system. In this first design we have taken into account the six project management aspects of; scope, cost, time, quality, risk and resources. These aspects were placed on a single page. Combined with a project list page and an overview page this resulted in prototype with drill-down functionality. While constructing the pages, we found that risk and quality were more subjective and thus hard to measure in numbers. The quality of the time related data was not adequate to be useful in a full functioning performance dashboard. This information is mostly stored on project level; all hours are booked on one entry in the system. Recording time on the right level of detail is a hard requirement for a performance dashboard to work. Furthermore the ability for different data sources to be linked to each other, would greatly simplify the creation of a performance dashboard. This could be done by using a common 'Project ID' in all information systems. This might seems trivial in the first place, but our experience at Sigmax has learnt us that when different systems are made by different vendors, this is not always the case.

RQ4 How will the performance dashboard be received by Sigmax?

The prototype has been validated twice. First with a small number of project managers in a feedback session, the second version was validated through a survey. The first feedback session was set up to retrieve first reactions to the prototype's functionalities. Not all project managers were involved in the feedback sessions, but nonetheless there was enough feedback to record substantial improvements. The information presented on the different screens were discussed, which resulted in removing the quality and risk page. Also some metrics were added or removed from the different pages based on the results of the feedback.

The second version, which included changes based on the feedback, was validated through a survey. All project managers of Sigmax have completed the survey. The survey was set up using question from the TAM model. Although some project managers gave low points to the Perceived Usefulness and Perceived Ease of Use, we have strong motives that the performance dashboard will be accepted by the project managers. The project managers that gave low points gave additional remarks; in order to succeed in creating a performance dashboard, its basis should be right. With the basis, they mean that the information used in the performance dashboard need to be present in the information systems. For example, ShERPa currently only

supports one level where all the time registration of a project takes place on. When the changes in ShERPa are implemented, it should be possible to register time at sub-project level. This is required for the performance dashboard to work.

Concluding we can say that there are good chances of creating a performance dashboard that is very valuable for Sigmax. The involvement of the project managers in the design process has provided us with helpful feedback. Before the system can be built, there are some requirements that have to be met. The most important one is the changes to ShERPa, especially the support of time registration on sub-project level. These changes to ShERPa are being implemented at the time this research has ended.

6.2 RESULTS RELATED TO THE PROBLEMS

While multiple problems emerged during the problem investigation, only a few are solved by creating a performance dashboard. We elaborate more on these problems in this section.

Reports not suited for comparison

The performance dashboard provides an overview of the status of current projects to project managers, but this can also be interesting to others as well. Other roles within the organization, like product managers and business unit managers (maybe even the directors), now have an overview of current work in progress. It will create a sort of project portfolio overview for them. By utilizing the drill down functionality every user can have his appropriate views. Executives usually are more interested in the big picture, compared to project managers who want detailed information. The performance dashboard will provide the organization with a tool to make the information visible, by collecting and aggregating the information in one place, and to communicate this with all interested members of the organization. This will make a performance dashboard even more valuable tool for the organization.

Many (unlinked) sources of information.

One of the main requirements of a performance dashboard is that the data, which will be used in the dashboard, is of high quality. Data quality (or information quality) contains a lot of aspects, like timeliness, completeness, accessibility, etc. Many of these aspects are important to, eventually, get the right view on this information in a form of a dashboard. One can only extract meaningful information out of a large set of data, if the data is available in such a way that it is possible to use. If employees are not using the time registration tools appropriately, then it would not be possible to get meaningful management information out of it. Registering at the end of the month does not give you a correct weekly overview. Also the recorded time should be registered to a dedicated project. Saving it under some kind of general work project, and providing the project information in the comments section, makes it difficult or nearly impossible to extract meaningful information out of it. This also applies to writing all the hours to one entry in the system (e.g. the overall project), then there is no easy way to know to which activity or task those hours belong. Furthermore it is important that the different sources of data can be linked to each other. If there are multiple information systems in use, the data inside should not exclusively be available to that system. To construct a performance dashboard, it should be possible to link information of one system to information of the other. Common (project) IDs should be in place which makes this possible.

Takes a lot of manual work to create reports

When a performance dashboard is used for reporting purposes, the project managers will spent less time to generates reports, hence the performance dashboard will provide these. This will result in the project manager being able to spend more time to his job; managing projects. Spending a few hours each month to create reports are often seen as a burden, something to please the financial department. It has little impact on the work of a project manager. Creating reports and discussing them in meetings makes a project manager less effective in their jobs.

Cannot act quickly because of lack of signals.

With the use of a performance dashboard the financial department would be able to determine which part of the profit should be allocated to the current month. The performance dashboard collects the right information and combines then in a single view. This way the financial department always has a view of how the projects are performing. When the project managers keep the forecasts of their projects up to date, the system will be able to give the financial department the right information to allocate (part of the) profit for that month.

6.3 RECOMMENDATIONS

The proposed changes to ShERPa have remained unnoticed by the management of Sigmax, or at least no action was given to it. By diving into the subject of performance dashboards, we found out that this was actually the missing link to operationalize the dashboard at Sigmax. This research has given these proposed changes a positive push in the right direction. By the end of this research, Sigmax has given a 'go' to the changes in ShERPa. When the new version of ShERPa is ready, there is little that stands in the way of building a performance dashboard.

It would be very interesting to actually build a working version of the performance dashboard. Not much has been written in literature about the successful implementation of a performance dashboard in the context of project management. This research has pointed out that a performance dashboard will have a high chance of success at Sigmax. It would therefore be interesting to quantify the benefits of a real implementation of a performance dashboard. Data about nearly everything can be stored, and with more and more user-friendly techniques of Extract, Transform, Load functionality of products like Microsoft SQL Server, this would be very realistic to build. Like said before, there is a hard requirement; available data. The data in all information systems to be used need to be of a certain quality in order to easily link the data together.

Our recommendation to Sigmax is therefore as follows;

- Implement the changes to ShERPa, especially the ability to register time on sub-project level.
- Make sure all the required data is of the right quality, this will ease the linking of different sources of information.
- Involve the project managers (and possibly other stakeholders as well) in the design process. It is our experience that showing incomplete versions does lead to valuable feedback. More feedback will likely increase the acceptance.

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APPENDIX A

Mission statement

Introduction

Sigmax has a number of different information systems in use. Each system has its own unique functionality. They follow the best of breed philosophy. Because of the different information systems in use, it can be hard for project managers to quickly extract the relevant information they need to make decisions about their projects from the different information systems.

Sigmax is willing to address this issue by designing a performance dashboard. This dashboard will present the relevant project information to the project manager so that this person does not have to look up this information manually. It is expected that this system will give project managers an accurate view of the current status of projects and by that, more time to act on the information instead of looking it up.

Type of system

In this thesis I will develop a prototype of a Performance Dashboard in a Rapid Prototyping way. This prototype will consist of mockups of the desired system.

Goals

The goal of this prototype is to serve as a proof of concept, aimed at showing the possibilities of a performance dashboard which makes use of existing data sources. In the case of ShERPa (in the hour registration system), the proposed changes will be taken into account. The performance dashboard will provide the project managers an accurate overview of current project status so that they will not need to manually retrieve all the project related information. The prototype will be used to gather relevant feedback from the users.

Exclusions

- Only available data (including the changes to ShERPa) is used, there will not be a possibility to enter data into the performance dashboard.
- There will not be any Earned Value Management calculations made in the status reports.
- There will not be a separation of project- and product-related work.
- The performance dashboard will not replace any existing project management tools, it should serve as an addition to the current systems.
- The prototype will not be fully functional. It is intended to show the possibilities and retrieve feedback.

Solution – how the problem will be solved

First, a good understanding of current literature is required. Especially in the fields of dashboards, performance measuring and project management.

Second, a thorough problem analysis should take place. It is important to understand the current problems and how the performance dashboard will mitigate these problems.

Third, the prototype will be designed. This is done in Axure RP, a rapid prototyping tool to create sketches of the system with a little bit of interaction (like clicking to a next page).

Last, the prototype will be validated through questioning the project managers. Project managers will be asked if the goals and quality criteria are met and if they have general remarks which could improve the system.

APPENDIX B

The results of the first feedback session (in original language);

Project List

PM3: "Ik vraag me af of die 4 kenmerken datgene is wat je wilt zien in het totaal overzicht. Tijd geld kwaliteit zijn de belangrijkste…"

Summary

PM3: "Je moet oppassen dat je ShERPa niet al een planningstool gaat gebruiken, dat is het namelijk niet."

Time

PM1: "3 kolommen zijn relevant; begroot, gespendeerd, verwacht."

PM2: "De tabblad waar je nu op staat halen wij de grootste winst mee uit. Als we dat op deze manier inzichtelijk hebben , met 1 druk op de knop. Maak je ons leven een stuk aangenamer en dan zijn wij veel beter in staat om per direct te zien, hoe zit ik met mijn uren en verwachtingen. Daar zit echt de allergrootste winst."

PM3: "Die zijn het meest belangrijk; urenbreakdown, dus die 3 eenheid. Per taak; begroot, besteed en nog te besteden."

PM3: "Ik zou me nog kunnen voorstellen, om voor bepaalde projecten een onderverdeling naar rol maakt, in urenbesteding. Als je bijvoorbeeld een team hebt met ontwikkelaar en tester en een architect, dan plan je een bepaalde verhouding tussen die taken. En als nu blijkt, je plant een ontwikkelaar voor 30 uur, een tester voor 20 uur en een architect voor 10 uur. En er blijkt dat de ontwikkelaar geen tijd besteed heeft, maar de tester en architect allebei 40 uur, dan zit je met je totale urenverdeling op lijn, maar klopt er toch iets niet."

Cost

PM3: "In de praktijk heb ik er bijna niks mee te maken (inkoop/brutowinst)."

PM1: "Zo'n brutowinst berekening, daar doen wij eigenlijk niks mee. Dat is leuk voor de boekhouder, maar eigenlijk wil je weten; waar sta ik qua kosten op mijn project in relatie tot de opbrengsten?"

PM2: "Ja. En de vraag is, wat hanteer je qua kostprijs voor de uren? […] Ik vind het op zich wel interessant om te zien, als we nou uit gaan van een standaardkostprijs van 55 euro ofzo, maak ik dan überhaupt nog winst?"

PM2: "Feitelijk geef ik mijn budget af in uren en daar stuur ik op, en wat sales daar aan kosten of verkopen tegenover zet, dat is hun feestje."

PM2: “Ik heb daar geen invloed op, dus het zal mij een worst wezen. Voor de boekhouding en financieel is het interessant en voor sales is het interessant om te weten of ze het voor de goede prijs verkopen. Ik vind het ook interessant om te weten, omdat ik dan wellicht richting sales en inkoop kan sturen, maar ik stuur niet actief op kosten.”

PM1: “Wat wel aardig kan zijn, op dit moment weten wij niet altijd de stand van zaken of ten aanzien van hardware of die al binnen is of niet. […] heeft een Excel sheet met waar zij de inkoop bijhoudt, maar daar wordt niet altijd de actuele informatie weer gegeven.”

PM3: “En als er inkoop in zit, dan wil je daar wel van weten welke onderdelen daar van afgehandeld zijn en welke nog open staan.”

PM3: “Wat heb je als statussen voor de termijnregels? Gefactureerd, openstaand? Open zegt dus niet of het betaald is. Dat kan een signaal zijn. Vaak is een niet betaalde factuur of een teken van gebrek aan liquiditeit van de klant, of is een teken van ontevredenheid van het verloop van de werkzaamheden. Ik heb volgens mij wel toegang tot Multivers, maar ik heb er nog nooit gebruik van gemaakt. Dan ben ik afhankelijk van dat signaal van de administratie.”

Risk

PM1: “De vraag is alleen of we het veel zullen gaan gebruiken. Daar zou ik niet in eerste instantie de focus op leggen. Op risicomanagement vlak doen we vrij weinig op dit moment.”

PM3: “Als je een continue actuele status daarin hebt, wordt het een ander verhaal. Dan kan het van belang zijn om het risico wat zich vandaag voordoet dat er in op te nemen, net name als andere ook naar dat systeem kijken en willen weten hoe het met het project staat. Dan moet je een uniforme bron hebben om de risico’s in te beschrijven.”

Resources

PM2: “Nice. [..] Het hele principe van een dashboard en door kunnen zoomen op verschillende sub componenten, dat is perfect.”

PM3: “Gepland, hoeveel je hebt besteed en nog te besteden, dat zijn de 3 belangrijke. De laatste twee hoeven bij elkaar opgeteld niet de eerste te zijn.”

General remarks

PM2: “Gerealiseerd versus budget en de resources, dat zijn op dit moment de belangrijkste indicatoren.”

PM1: “Wat mij wel opvalt, dit is functionaliteit wat in een standaard planningspakket zit. Je kijkt naar een standaard pakket en je bouwt het na, maar dan voor onze systemen. En de vraag is dan vanuit het bedrijfsoogpunt, is dat een verstandige keuze om te zeggen, datgene wat niet onze core business is om dat na te gaan bouwen. Als het ook op de markt is met een standaard pakket.”

PM2: “Dashboard, totaalinzicht op mijn project. En daar horen status van uren bij, maar ook waar zijn mijn deliverables, waar zijn mijn documenten? Nogmaals, ik denk dat dit een latere stap is.”

PM1: “Je moet het behapbaar maken. Je moet kijken naar wat relevant is gezien de volwassenheid van Sigmax als organisatie.”

PM2: “En als je het daarbij hebt over risico’s en deliverables. Joh, dat komt wel. Die deliverables vind ik nu ook wel op het netwerk, ik weet wel waar ze staan..”

PM2: “Ik denk dat je dit stap voor stap moet gaan doen. Als je hier al mee begint, denk ik dat je al zo veel slagen maakt. Als je teveel in een keer wilt gaan doen, en te veel in een keer wilt gaan vastleggen dat het niet gebruikt gaat worden.”

PM3: “Als je het voor elkaar kan krijgen dat we die dynamisch en actueel kan vullen, dan hebben we al een hele mooie stap gemaakt.”

APPENDIX C

Survey questions

Perceived Usefulness

Q1. Using the Performance Dashboard in my job would enable me to accomplish tasks more quickly.
Q2. Using the Performance Dashboard would improve my job performance.
Q3. Using the Performance Dashboard in my job would increase my productivity
Q4. Using the Performance Dashboard would enhance my effectiveness on the job.
Q5. Using the Performance Dashboard would make it easier to do my job.
Q6. I would find the Performance Dashboard useful in my job.

Perceived Ease of Use

Q7. Learning to operate the Performance Dashboard would be easy for me.
Q8. I would find it easy to get the Performance Dashboard to do what I want it to do.
Q9. My interaction with the Performance Dashboard would be clear and understandable.
Q10. I would find the Performance Dashboard to be flexible to interact with.
Q11. It would be easy for me to become skillful at using the Performance Dashboard.
Q12. I would find the Performance Dashboard easy to use.

Possible answers, 5 point Likert:

Strongly Disagree Disagree Neutral Agree Strongly Agree

Project Lijst

Q13. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q14. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q15. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Overzicht

Q16. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q17. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q18. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Tijd

Q19. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q20. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q21. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Kosten

Q22. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q23. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q24. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Resources

Q25. Missen er bepaalde elementen op deze pagina? Zo ja, welke?
Q26. Staan er overbodige elementen op deze pagina? Zo ja, welke?
Q27. Heb je verder nog vragen of opmerkingen over deze pagina van het prototype?

Q 28. Welke pagina zou jij het meest gebruiken?

Verdeel 100 punten over de mogelijke pagina's. Als je een pagina 0 punten geeft, zal je deze pagina niet gebruiken.

Q 29. Wat is je leeftijd?

Q 30. Hoeveel jaar werkervaring heb je als Project Manager?

Q 31. Hoeveel jaar werk je als Project Manager bij Sigmax?

Q 32. Heb je naar aanleiding van het prototype of deze vragenlijst nog vragen en/of opmerkingen?