TDT4290 Customer Driven Project

Web-based Risk Management

Amin Ben Karroum, Arezoo Ghalichi, Bjørn Fevang, Habibollah Hosseinpoor, Nebojsa Sokolovic, Oddvar Standal

Preface

This report together with prototype presents the results of group 5 for the course TDT4290 - Customer Driven Project at Department of Computer and Information Science (IDI) at the Norwegian University of Science and Technology Autumn 2010.

The assignment was to make a risk management software prototype for an external company Extend AS, which would be used as a base for a new module in EQS system.

The projects goals was three folded. First of all, understand the problem topic. Next, create solid requirements for the problem topic. Finally, build a prototype as a proof of concept.

The team wants to thank our main supervisor Gustav Aagensen and assistant supervisor Tobias B. Iversen, for their valuable input and guidance throughout the course. We would also like to thank customer contact, Håkon Groven, for his cooperation and support throughout the project.

Trondheim, 25th November 2010

Habibollah Hosseinpoor

Amin Ben Karroum

Oddvar Standal

Bjørn Fevang

Nebojsa Sokolovic

Arezoo Ghalichi

Contents

Table of Figures

Table of Tables

Acronyms

- **IDI** Department of Computer and Information Science
- **RM** Risk Management
- **ISO** International Organization for Standardization
- **PHP** "PHP, Hypertext Preprocessor". a scripting language that produce dynamic web page.
- **SDK** "Software Development Kit". A set of development tools that help the creation of applications for a certain software.
- **CGI** "Common Gateway Interface", is a standard that defines how a web server can generate web pages to a text-based application.
- **NHS** "National Health Services", is the name that is used to refer to the four single-payer publicly funded health care systems in Great Britain
- **HRSA** **"**Health Resources and Services Administration **"** is an agency of the U.S. Department of Health and Human Services that is helping people who are uninsured to have access to health care.
- **DNV** "Det Norske Veritas", is an independent foundation with the purpose of safeguarding life, property, and the environment.
- **IMO** "International Maritime Organization ", is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.
- **STCW** "The Standards of Training, Certification & Watch-keeping", is located in London and is part of United Nations. It sets qualification standards for masters, officers and watch personnel on seagoing merchant ships.
- **VaR** "Value at Risk" is a risk measure on a specific portfolio of financial assets
- **MySQL** **i**s a database management system that runs a server which providing access to multi-user
- **PMA** "Post Morten Analysis", is a method to evaluate a project that has been done to discover the week points and the strong points of the project.
- **WbRM** "Web-based Risk Management", is the applications/module that we are going to build and is described in this report.
- **EQS** "Extend Quality System", described in the section x.x
- **COTS** "Commercial of-the-shelf", or simply of the shelf (OTS) is a term defining technology which is ready-made and available.
- **HTML** "Extended Markup Language". The standard language for web pages.
- **HTTP** "Hypertext Transfer Protocol". Communication protocol used for data-transfer between server and client.
- **HTTPS** "Hypertext Transfer Protocol Secure". Communication protocol used for encrypted data-transfer for web pages.
- **ISO** "International Organization for Standardization". We got and ISO-standard for guidelines when researching risk-management systems.

- **PDF** "Portable Document Format". We used it for our meeting reports, agendas, invitation and main report.
- **SVN** "Subversion", versioning software. We used it when writing code, so that one change doesn't overwrite another.
- **SQL** “Structured Query Language”.
- **URL** “Uniform Resource Locator”.
- **DB** Database.
- **Perl** is a high-level, general-purpose, interpreted, dynamic programming language.
- **API** "Application Programming Interface". An interface for 3rd. party applications, so it's possible to communicate with the software.

Glossary

- **Gantt chart** is a bar chart that is used for demonstrating a project schedule.
- **LATEX** Document Writing Language, meeting agendas and the first meeting reports were written in Latex.
- **Scrum** an agile software development method for project management.
- **Perl** is a high-level, general-purpose, interpreted, dynamic programming language.
- **Programme** in construction project programme phase is when the client has an idea of the project.
- **Force Majure** are risks that can't be avoided.
- **Google Docs** Online word processing software. We used it for sharing documents when more than one person is writing on it at the same time.
- **Ubuntu** Linux distribution. We got a virtual computer-image from Extend with EQS preinstalled for testing and coding.

Introduction

This report represents the implementation of the project that was given to group 5, students of the course TDT4290-customer driven project, by Extend AS company.

The group includes 6 computer science (Datateknikk) students on their fourth year at master course at IDI, Norwegian University of Science and Technology. The main aim of this project is to put the students in a realistic environment of team work and to deliver a project with a real customer during the allocated time.
The customer Extend AS is a Trondheim based IT company that delivers quality management systems. The purpose of the project was to implement risk management in their existing quality management software (EQS).

CHAPTER 1

1 Project Directive

1.1 Introduction

In this chapter we are presenting the project purpose, mandate, goal and external condition.

1.2 Project Purpose

The purpose of this project is to develop and deliver a prototype to our client, based on the initial problem handout and the feedback/ requirements from the customer during the project. It is also expected that we make a report which summarizes our work and will make sure our customer, Extend AS, can continue working on the results from our project. They will start developing a risk management module that they will integrate into their existing software.

1.3 Project Mandate

This section presents the project name, involved parties, background goal and external conditions that the project will go through.

1.3.1 Project Name

The name of our project is Web-based Risk Management, it was given to us by the external customer, and it is exactly what we are going to build, a web-based risk management module.

1.3.2 Involved Parties

The main stakeholders for this project is the customer representative, the staffs of the course TDT4290 and the project group

1.3.3 The Client

Our external customer is Extend AS. Extend AS is a Trondheim based IT company that delivers Quality management system.

Extend AS

Extend is a software company that was established in 1996 in Trondheim. They started with the goal to make web based administrative tool for private and government sectors. In 1999 they began develop a tool for quality management. This resulted to the Extend Quality System (EQS). The EQS has been their main product since then and their customers are mostly government companies that want to ensure quality management.

Extend has a great span in the customer base with over 60 customers as of today, with the smallest customer including 7 employees and the largest having 15 000. To ensure that the costumers are satisfied at all time, Extend has several business partners within quality, occupational safety, health, and process improvement. This is so Extend can provide costumers counseling service to all of their customers.

1.3.4 Project Background

Extend AS provides the EQS, its quality management software. They asked our group to make a new module to their existing system, see appendix A.3 the initial problem handout. This module makes their application more desirable for their existing and new customers. Since the EQS is web based, our module must also be web based.

Our module, when completed, will assist an organization to do risk management. Risk management is usually referred to the systematic process of identifying, analyzing, evaluating, and treating risk, see chapter 3. This means the customers will be able to identify, assess and then treat risks. All these functions will be available through a web browser.

One thing the reader should be clear about is that we are not proposing/ creating a software solution that does RM, but rather a software module that helps an organization to do RM. This means the software module should support the RM process as a knowledge base. For more specific requirement, see chapter 4 Requirement specification.

1.3.5 Project Goal

The main objective of the project is to research and build a risk management module for EQS. More specific goals of this project are to do three things:

Research about risk management: This includes understanding of risk management, and to develop a good understanding of the ISO 31000 and ISO 31010. Then do research on implementation of risk management on different industry/ fields, research on risk management on the Norwegian companies and finally creating/ finding a list of existing software for managing risks, compare them with each other in order to extract their key features.

Requirements for web-based Risk Management system: This includes creating a requirement specification for a web-based risk management system. Requirement specification should be in a good quality, so that Extend can use this for further work. When creating/ collecting requirements we must consider the ISO 31000 and the COTS - EQS, where the risk management system is going to be a module.

Prototype: This includes designing and implementing a fully functioning system for managing risks as a proof of concept

1.3.6 External Conditions

The involved parties

The client: The project manager is responsible for communication with the client, primarily by e-mail, and by phone if it is urgent. There should be weekly or bi-weekly meetings with the client throughout the project.
The supervisors: There should be weekly supervisor meetings, and assistance by the assistant supervisor.

Resources

Computers

- Team members will use their personal laptops for the project.
- The code will be stored in servers of the customer

• The finished product will run on the server of the client

Other Resources

- Computer room in the 4th floor in P-15
- Group room in 4th floor in IT-building

1.3.7 Duration

The estimated workload is 24 hours every week, this makes 312 hours per person for the entire semester. The group consists of six students, which gives a total amount of 1872 hours for the project.

- Project start: 25th of August, 2010.
- Project end and final presentation: 25th of November, 2010.

Part I

Planning & Requirements

CHAPTER 2

2 Planning

2.1 Introduction

This section contains the following:

- Project planning, present our estimated time workload.
- Project organization, presents how we organized our project, roles and responsibilities
- Risk management, present our main risks during the project, and how we treat them.
- Quality assurance, present some protocols to ensure good quality and result.
- Development method, where we present our development model and reasoning why we chose it.

2.2 Project Plan

In this section the overall project is described. It includes the phases of the project, and what they will contain.

2.2.1 Phases

The Table 2-1 shows the overall phases of our project. This project basically starts off in a similar way to a waterfall project, with an overall project plan and preliminary study, where the task, product, understanding, and study are done. Due to the nature of our task, we have to spend a lot of time in the preliminary study, and because of this we decided on using scrum, mainly because of its agility to fit our projects nature. More about scrum and the reasons for why it was chosen are described in this chapter.

Table 2-1 - Project Phases

Phases	Time in week	Time in hours
Planning and preliminary study	Week 35 to week 38	576
Sprint 1	Week 39 and 40	288
Sprint 2	Week 41 and 42	288
Sprint 3	Week 43 and 44	288
Project evaluation	Week 45 and 46	288
Presentation	Week 47	100

Planning and preliminary study

The preliminary study phase contains all the initial activities related to the gathering of information and knowledge. In this phase the group will research on the existing risk management systems, in order to specify/ understand what we should build.

All the preparation needed to launch the project is included in this phase, including the creation of the initial requirements.

The preliminary study phase is rather large in this project, due to several reasons: The fact that we not only have to research the existing solution in order to specify the requirements, but also because the team has to study the EQS system, since we are building our module on top of it. The EQS system is written in Perl, which no one of the group members have any experience with.

Sprints

Common for all the sprints are that every sprint consist of six activities;

1. **Sprint planning meeting**
2. **Sprint backlog**
3. **Implementation**
4. **Testing**
5. **Documentation**
6. **Sprint review meeting**

Sprint 1

Here we have planned to build the basis for our solution. But since we have difficulty understanding the architecture of EQS, we might build a prototype with PHP on our local machine. Also, we need to accustom ourselves to manipulating sprints and Scrum in general. For more details on Sprint 1 look at Chapter 5.

Sprint 2

In the second sprint we plan to refine and add most of the features to our solution. See Chapter 6 for more details.

Sprint 3

In the last sprint we plan to refine and polish our solution and make sure everything is working as intended. Hopefully no major changes to our solution will be needed in this sprint.

Project Evaluation

Project Evaluation contains the evaluation of the project as a whole. We will evaluate most parts of the project; the process, results, course, customer, task, prototype, and future work. For more details see Chapter 8.

Presentation

Presenting the final prototype with the customer.

2.2.2 Phases workload

Figure 2.1, shows an overview of the estimated work hours for the project. This is based on the groups initial planning in the early phase of the project. The chart is again based on the initial work break down structure that is included in appendix A.2.

ITEMS	Hours work
Lecture	264
Selfstudy	132
Meeting and work-session	396
Requirements	180
Design	142
Development	480
Testing	144
Deployment	56
Total	**1794**

Table 2-2 - Phases and it's workload

	Planning and preliminary study				Sprint1		Sprint2		Sprint3		Project Compilation		Present		
Activity / Week	35	36	37	38	39	40	41	42	43	44	45	46	47	Total	%
Lecture	24	24	24	24	24	24	24	24	24	24	24		0	264	14,699
Self-study	30	30	30	30	0	0	0	0	0	0	6	6	0	132	7,3497
Meeting and work session	36	36	36	36	36	36	36	36	36	36	36	0	0	396	22,049
Requirements	45	45	45	45	0	0	0	0	0	0	0	0	0	180	10,022
Design	0	0	0	0	36	12	36	12	36	12	0	0	0	144	8,0178
Development	0	0	0	0	80	80	80	80	80	80	0	0	0	480	26,726
Testing	0	0	0	0	12	36	12	36	12	36	0	0	0	144	8,0178
Deployment	0	0	0	0	0	0	0	0	0	0	28	28	0	56	3,118
All activities	135	135	135	135	188	188	188	188	188	188	94	34	0	1796	

Estimated work hours for the week
Total work hours for the week
Estimate workload % for each activity
Total estimates for work hours for each of the activities

Figure 2.1 - Estimated workload

The Gantt chart; which is giving an overview of the phase sizes in relation to each other, can be found in Figure 2.3.

	September					October				November			
Activity / Week	35	36	37	38	39	40	41	42	43	44	45	46	47
Project Management													
Pre-study													
Planning/product backlog													
Sprint1													
Sprint2													
Sprint3													
Project Complitation													
Project Presentation													

Figure 2.2 - Gantt Chart

2.3 Organization

2.3.1 Roles

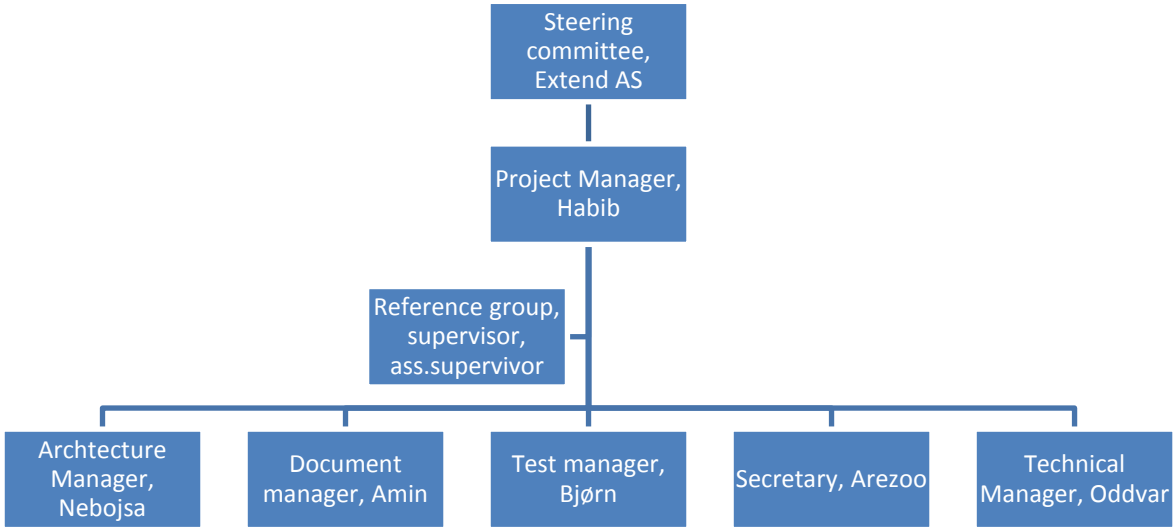


Figure 2.3 - Organization Chart

Steering committee

Extend AS

Reference group

Main supervisor and assistant supervisor

Project Manager

The project manager should have an in-depth knowledge of the project on all-time. More specific the role includes:

- Communication between the customer and the group must go through this role, in order to reduce the redundancy and the risk of not sending important information.
- Communication between the supervisors and the group must go through this role, in order to reduce the redundancy and the risk of not sending important information.
- Must coordinate tasks to other group members.
- Main responsible for the project plan.
- Responsible for project progress, if it is progressing according to plan
- Last periods activity

- Next periods activity
- Important unsolved issues
- Resources issues, if someone is sick, this role assigns redistribution of tasks to other group members.

Secretary

- Take meeting notes
- Write meeting reports
- Create status reports

Document Manager

The document manager is responsible of having an overview over the main report:

- Update the main report
- Make sure that there are no spelling errors in the document
- Make sure everything is in its right place
- Update the table of Figure, table and content

Test Manager

The test manager is responsible for the systematic testing of the product. More specific these roles entail:

- Define how to test the solution.
- Have an overview of the bugs and errors
- Responsible that the solution is properly tested.
- Make a plan for systematic testing.

Technical Manager

The technical manager is responsible for coordinating technical tasks during this project. He should have knowledge in:

- SVN
- Linux, Ubuntu image, Eclipse, SDK, development environments etc.
- Perl
- Database

Architecture Manager

The architecture manager is responsible for the software architecture. More specific this role entails:

- Have a good overview of the software requirements.
- Specifications of requirements
- Breaks the tasks to sub-tasks, and assign to different group members, during the implementation.
- He has a good overview of the existing system.

2.4 Risk Management

This part will cover risks that are linked to this project and their treatment. We performed a risk evaluation because there are always risk connected to group work, especially in our group there are problems/ risk connected to this area because the members did not know each other before the project started. We did the assessment by using previous experience with group work.

2.4.1 Risk Assessment

Risk assessment consists of risk identification, risk analysis, and risk evaluation. More details of the risk assessments are in appendix F.

Risk Identification

Explanation and properties of the identified risks

Name: Lack of experience

Source: Group members

Exposure: May not be able to do the assignments properly and may not finish the project before the deadline.

Description: This project consists of a lot of new concepts that we do not have any previous knowledge with.

Name: Incorrect requirement

Source: Document manager and architectural manager

Exposure: Has negative effect on the prototype, it can also have negative effect on the grade.

Description: Important to understand the requirements, since this build the foundation for the prototype.

Name: Sickness

Source: Substitute a group member for the sick member

Exposure: Effect the workload of the different members.

Description: Sickness during the project can cause a great deal of problem.

Name: Team conflict

Source: Group members

Exposure: Effects negatively on the final result

Description: There is a chance that the members might not agree with each other under circumstances which will not be solved. This can lead to a team conflict, which has a bad impact on all the team members

Name: Deadline

Source: Group members

Exposure: Effects negatively on the final delivery, and also may cause conflict between members.

Description: The possibility of reaching the deadline without finishing the tasks or not being able to deliver the project on time

Name: Lack of feedback

Source: Project manager

Exposure: Not be able to obtain correct information and do not understand the customer requirements

Description: Obtaining sufficient and accurate documents from customer.

Name: Communication

Source: Project Manager and Group members

Exposure: Not be able to obtain correct information and do not understand the customer requirements

Description: Ability to communicate with the customer.

Name: Correctness of project plan

Source: Project plan which is defined by the group members

Exposure: May presents obstacles towards final report

Description: The project might not go the way we planned it.

Name: Assignments

Source: Assignments in the project

Exposure: Could not finish before deadline

Description: The small tasks which have been given to each group members during every sprint

Name: Lack of meeting time

Source: Group members

Exposure: The quality of the project result will be decreased

Description: The meeting times are essential in project management. If there are not any solid schedules or proper meeting time then that would affect negatively on the project

Name: Priorities

Source: Group members that are not able to priorities this course.

Exposure: The effects are negative, and there is possibility that the project could not be finished before the deadline.

Description: If this course and its assignments are important for the group members and how much time and effort they put on them.

Name: Drop out of course

Source: Group members

Exposure: Gives higher workload on other members

Description: If one or more group members drop out of the course

Name: Technical issues

Exposure: Deadline will become delayed

Description: If some technical equipment becomes unavailable.

Name: Laziness

Source: Group members

Exposure: Work gets delayed, and may cause conflict between the group members

Description: This one is considered as possibility that someone despite of his or her condition of health ignores to do his or her own tasks

Name: Roles

Source: Project manager and the group members

Exposure: No one would do a specific task.

Description: Some roles have been defined in order to cover different parts of project plan to make the project go smoothly

Risk Analysis

Here we have analyzed risks and ranked risks according to the highest risk factor which is probability * impact.

Risk ID	Name	Probability	Impact	Risk Factor
R7	**Lack of experience**	4	5	20
R6	**Incorrect requirement**	4	5	20
R2	**Sickness**	4	4	16
R4	**Team conflict**	3	5	15
R5	**Deadline**	3	5	15

R8	**Lack of feedback**	3	5	15
R9	**Communication**	3	5	15
R10	**Correctness of project plan**	5	3	15
R12	**Assignments**	3	5	15
R1	**Lack of meeting time**	3	4	12
R14	**Priorities**	4	3	12
R15	**Drop the course**	2	5	10
R13	**Technical issues**	2	5	10
R3	**Laziness**	3	3	9
R11	**Roles**	3	3	9

Table 2-3 - Risk evaluation table

Risk Evaluation

Risk id is mapped into this two dimensional matrix [Probability, Impact]

5			**R10**		
4			**R14**	**R2**	**R6, R7**
3			**R3, R11**	**R1**	**R4, R5, R8, R9, R12**
2					**R15, R13**
1					
Likelihood /Impact	**1**	**2**	**3**	**4**	**5**

Table 2-4 - Risk evaluation

2.4.2 Risk Treatment

We are going to handle risk in these four ways of handling the risk, which is according to the ISO 31 000:

- Avoidance: elimination of the risk

- Reduction: reduce the negative effect of the risk
- Transfer : outsourcing or transfer the risk to third party.
- Retention: accepting some or all the consequences of a risk.

In appendix F, we have provided a more detailed information, and concrete strategies to handle these risk items that we have identified.

2.5 Quality Assurance

To ensure good quality and results, the group and our contacts agreed on some protocols. Meetings will be necessary to find out how the project is coming along and to get feedback from our supervisors and customer. During this project, the group will create several reports every week, including a status report for the week, supervisor meeting report, customer meeting report, and group meeting reports. These reports are created to make sure that we document the work done in this project.

2.5.1 Routines

The group agreed on:

- The group should have at least two group meetings every week.
- Group members that cannot come to a group meeting, has to inform the project manager.
- E-mail should be the main means of communication.

The customer agreed that:

- E-mail should be the main means of communication, but for urgent issues telephone can be used.
- There has to be a customer meeting every second week.

The supervisor agreed that:

- Invitation to meeting delivered by 12:00 every Monday.
- Weekly report will be delivered by 12:00 every Monday.
- There has to be a supervisor meeting every week.

Meetings

Internal meetings

Every week the group will have internal group meeting on Monday from 10:15 -12:00. An agenda for the meeting is created by the project manager. Tasks for the rest of the week will be assigned. The group will also have an internal meeting after the supervisor meeting on Tuesdays from 10:00- 11:00, to assess the issues that came up in the supervisor meeting. The group will also have an internal meeting after the customer meeting on every second week from 10:15-11:00, to assess the issues that come up in the supervisor meeting.

Team work session

The group will have work sessions on Monday from 12:00 -16:00 and also on Saturday from 10:00 - 16:00 if necessary. During these sessions the team members work, with his/ her tasks. And can ask other team members for help. These sessions are also used to do tasks that requires the whole group, or works that need more than one group members.

Supervisor meetings

The group attends a supervisor meeting every Tuesday at 09 a.m. in room 464 in the IT building. Before the meeting the group has to send an invitation for the meeting containing minutes from the last customer meeting, minutes from the last customer meeting, and status report before 12 a.m. at Monday. In the meetings we discuss our progress and difficulties and advices of the supervisors.

Customer meetings

The group attends a costumer meeting every second week at Thursday at 09 a.m. at the Extend office. Before the meeting the group sends an invitation with minutes from last customer meeting 24 hours before the meeting. In the meetings the group presents the progress and receives feedback, the customer contact gives us advice and comments on our pace of progress and results.

Scrum meetings

See section 2.6.2

Reports

Weekly status report

The group will create a weekly status report, where the work done, problems that occurred in the week and the work plan for the next week is documented.
The weekly status report is updated by the group members during the week. One group member is assigned the responsibility to make sure that the report is created in time.

Supervisor meeting report

The group will create a weekly supervisor meeting report, where the discussions, decisions and assignments are discussed will be documented. This report/ minutes are created the same day as the meeting is held. In this way all the group members (including those that where absent) knows that what was discussed at the meeting.

Customer meeting report

The group will create a report from the meeting with the customer, where the discussions and decisions during the meeting are documented. These report/ minutes are created the same day as the meeting is held. In this way all the group members (including those that were absent) knows what was discussed at the meeting.

Group meeting report

The group will create a report from the internal group meetings, where the discussions and decisions during the meeting are documented. These report/ minutes are created the same day as the meeting is

held. In this way all the group members (including those that were absent) knows what was discussed at the meeting.

Timekeeping

The group has created a simple excel sheet, where each group member can update how much work he/ she has done during the week.

Templates

This section describes the templates and standards that are used in the project documents. All documentation that we produce during the project will be written in English.

Invitation to customer meeting

See appendix A.1.1 Meeting invitation template.

Minutes of Costumer meeting

See appendix A.1.2 Meeting report template.

Invitation to supervisor meeting

See appendix A.1 Meeting invitation template.

Minutes of supervisor meeting

See appendix A.1 Meeting report template.

Minutes of Costumer meeting

See appendix A.1 Meeting report template.

Status report

See appendix A.1 Status report template.

Organization of files

The group will use Dropbox for document management. Every document that are used or produces in this project is in one place and available in the Internet.

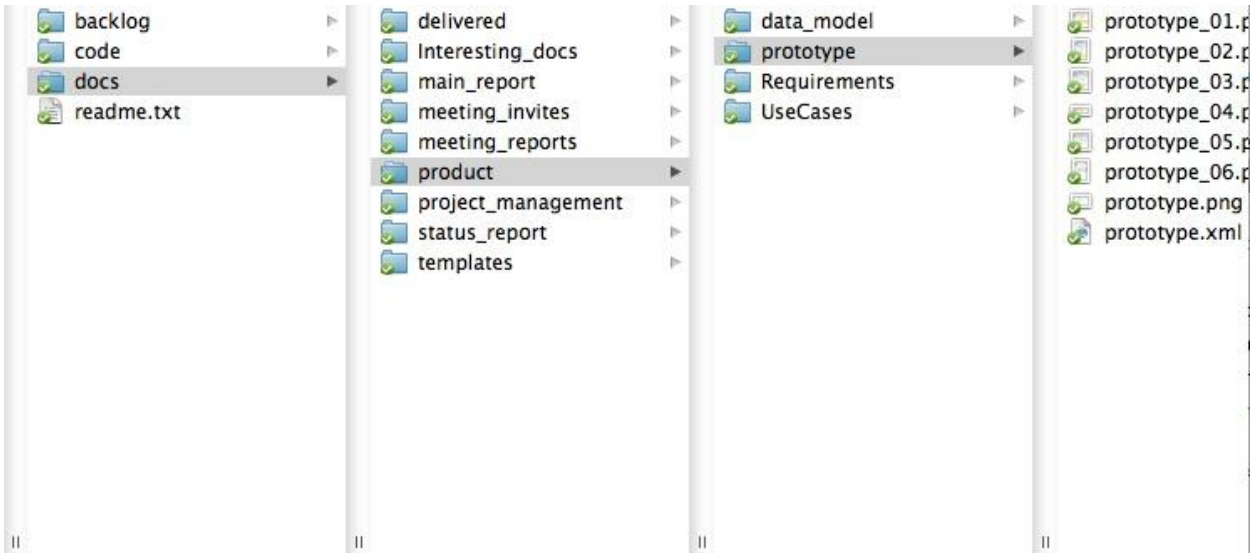


Figure 2.4 - Organization of files

Formats

Google docs

The group use Google docs if the document requires more than one group member to write it. This is because Google docs allow more than one to write on the same document at the same time. And the documents are online and everyone has the newest version at hand when they write on it. Status report, work timesheet and product backlog are the documents the group work together.

Microsoft Word

Microsoft word is known by everyone in the group, this is why the group chose to use word to write our main report. Word makes it easy to edit documents, add tables and pictures and has functions like table of content. Word is also used on meeting reports.

2.5.2 Customer Interaction

The group attends a costumer meeting every second week at Thursday at 09am at the Extend office. Before the meeting the group send an invite together with minutes from last customer meeting 24 hours before the meeting. In the meetings we the group presents our progress and receive feedback, the costumer contact gives us advice and comments on our pace of progress and results.

Invitation to customer meeting

See section A1 Meeting invitation template.

Minutes of Costumer meeting

See section A1 Meeting report template.

2.5.3 Supervisor Interaction

The group attends a supervisor meeting every Tuesday at 09am in room 464 in the IT building. Before the meeting the group has to send an invite for the meeting containing minutes from the last customer

meeting, minutes from the last customer meeting and status report before 12 am at Monday. In the meetings we discuss our progress and difficulties and our supervisors give us advice.

Invitation to supervisor meeting
See section A1 Meeting invitation template.

Minutes of supervisor meeting
See section A1 Meeting report template.

Minutes of Costumer meeting
See section A1 Meeting report template.

Status report
See section A1 Status report template.

2.6 Development model - Scrum

Scrum is an agile process for system development, with the main point being the use of sprints. Sprints are short working periods with a set of goals to complete within each period. The goals are documented in something called the sprint backlog. After each sprint is done the work will be shown to the customer for feedback, in case it is something the customer wants to change, before too much work is put into it. As with the sprint backlog, the overall goals in the project are kept in a product backlog. With scrum it is normal to have a meeting every day to keep everyone updated on the sprint progress, however it is hard for the members on this project to meet every day so we are trying to meet every second day instead. The meetings should be short, but everyone should answer 3 questions within this time.

- What have you done since last time?
- What will you do before the next meeting?
- What problems did you face?

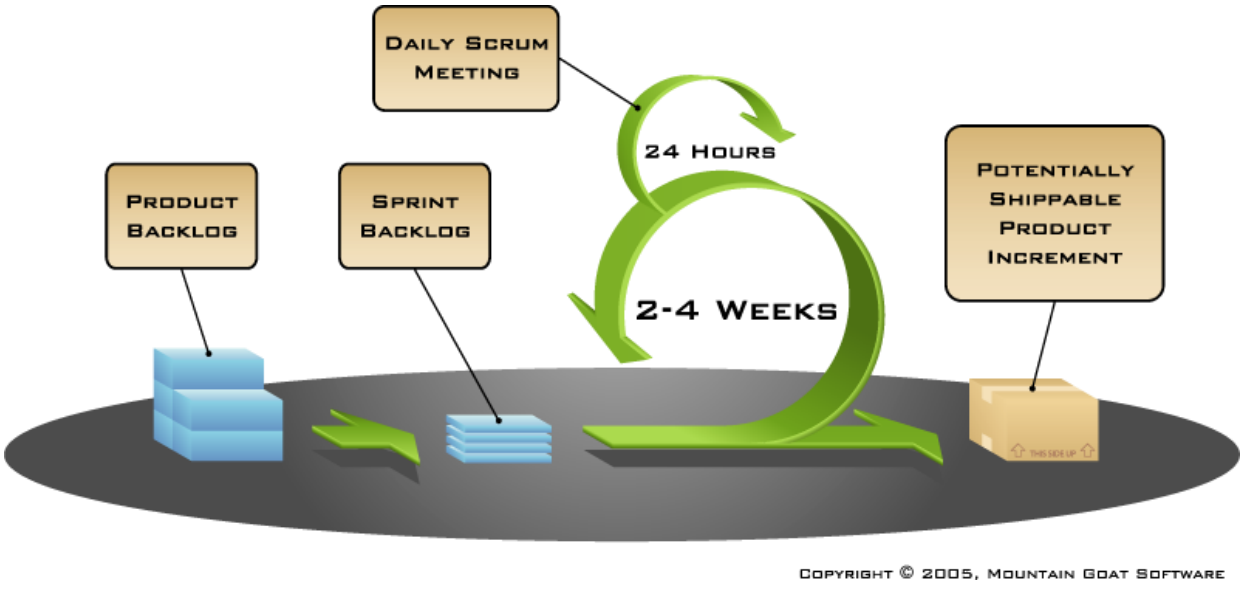


Figure 2.5 - Scrum

2.6.1 Scrum roles

Product owner

Extend AS

Scrum Master

Habibollah Hosseinpoor

Team members

Amin Ben Karroum, Arezoo Ghalichi, Nebojsa Sokolovic, Oddvar Standal and Bjørn Fevang

2.6.2 Why Scrum

Since we are working with a customer with no strict requirements, we chose to use scrum as a working method, since it is easier to make changes if the customer is not quite happy with the way the project is going. Even if scrum is more time consuming than say, the waterfall method, to get a finished product done, with no strict requirements, the customer is likely to not be as happy with the product. This is again because she/ he/ it is not involved so much with the development of the product.

Meetings

Sprint planning meeting
Daily Scrum meeting
Sprint review meeting
Sprint retrospective meeting

2.7 Version Control

2.7.1 SVN

Through the use of an ubuntu-image we have been delivered, we have access to an EQS system. This is why it will be the ground base for our programming. The server has preinstalled eclipse as text editor with the SVN add-on. SVN makes it easier for everyone to work on the same code, saving code changes of each submission. Each submission will have its own timestamp and creator name. It is also possible to merge the different submissions to make a new code base to continue working on. Earlier submissions will be kept within the SVN system.

2.8 Perl

Even though we were permitted to choose whatever programming languages we wanted to, the existing system was already running through using Perl code. So to easier integrate with the existing system, we initially chose to stick with Perl. And Perl also has its advantages. One of the main focuses of Perl is the ability to manipulate text files, which is a core feature in the EQS system.

Perl is one of the most popular dynamic languages for writing web applications through the use of Common Gateway Interface (CGI) scripts, which is a method to exchange data between a server and a browser.

The design of Perl is focused about readability, and around the focus that a computer engineer is more expensive than hardware. That means they have a lot of built in methods to make things easier for the engineer, like hashing, lists and automatic garbage collection through use of a reference counter. [1]

Problems encountered with using perl

Firstly none of the group members had previously had any experience with using perl. So a lot of effort had to be put into learning the basics of perl. Another problem was the use of the ubuntu-image. While SVN and eclipse were preinstalled as expected, eclipse itself had no SVN add-on nor had any support for writing in perl installed. This had to be fixed for every image environment created. The image itself was also very slow for our standards so we decided to skip the image and implement on our own computer instead, however we got a problem using the EQS code at our own environment and the need to return to the image was present.

To integrate our solution with their system we also had to understand some areas of their code, which proved to be a lot harder than initially thought. With limited knowledge of perl, a lot of similar class names and a good variety of description of their implementation used, our progress on deciphering their code went slow. This and taking into account that Extend were probably not going to use our code anyways, just have it as a prototype; we felt the need to re-discuss our goals with Extend. At the following meeting we agreed upon to loosen the bounds of integrating it to EQS and later abandoning it all, we swapped from using perl towards using PHP, which we already had some experience with.

2.9 PHP

PHP is a high-level, general-purpose, interpreted, dynamic programming language, which is mainly used creating web-applications. The main strength of PHP is the following, first of all, the syntax is easy to learn for a programmer with Java or C/C++ background. Secondly, PHP is very good documented and there is tons of functions and example codes on the Internet which makes jumping to this programming language pretty easy.
We chose to use this programming language because of the mentioned futures and also because that some of us had experience with this programming language, in contrary to Perl, which none of us had any experience writing code.

3 Preliminary Studies

3.1 Introduction

This chapter present our research result about risk management, it contains the following sub-chapters:

- **Definitions**, where we present our definition of understanding different terms, like risk, risk management etc.
- **Generic risk management process**, presenting the process of the generic risk management, which is presented in ISO 31000
- **A basic implementation of risk management**, where we present a very simple risk implementation of risk management and its processes, this will help understanding risk management much easier.
- **Risk management implementation in different fields,** to see how risk management can be implemented, or is implemented in different fields, using ISO 31000. The motivation for doing this was simply to discover that the methods of risk assessment are very dependent on the context. Here we have done research on four fields, namely in Health care, Maritime, Finances and Construction Industry.

3.2 Definitions

3.2.1 Risk

The word risk is used to describe a situation that involves a possibility of something to happen and if it does, will have a positive or negative impact.

3.2.2 Risk Measures

The risk definitions are of little use when comparing and measuring risks. Therefore, several risk measures have been developed, most of them being a function of a probability measure and a loss measure.

3.2.3 Qualitative measures

The severity of a risk can be quantitatively assessed by mapping the risk on a risk matrix according to (i) the value of the negativity of the outcome and (ii) its probability (or frequency of occurrence), see Figure 3.1. The closer to the upper right corner the risk is situated, the more critical it is. This is a good tool in risk identification for a quick overview of risks and in order to determine which to focus on in further analyses. From this graphical point of view, risk management can be seen as striving to move risks towards the lower left corner by lowering the probability of the undesired outcomes and/or lowering the severity of heir consequences.

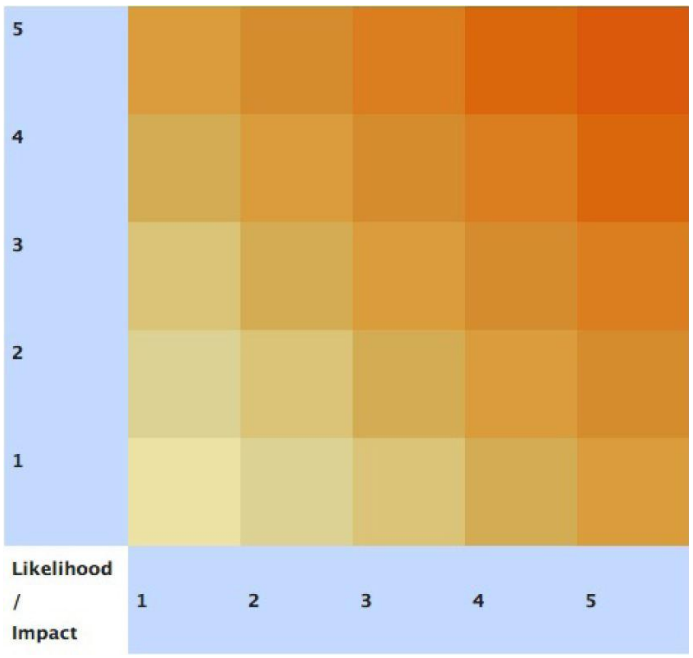


Figure 3.1 Risk [probability, impact] matrix

3.2.4 Risk Management

The systematic process of identifying, evaluating and reducing risks is usually referred to as risk management (RM). RM is very pervasive, RM has spread to every field, but the methods and their usage depend on the context. A generic RM model is presented in ISO-31000, which is designed to address any type organization and any type of risk, see Figure 3.2. And that is what we have taken the basis, when building a risk management module.

ISO 31000:2009(E)

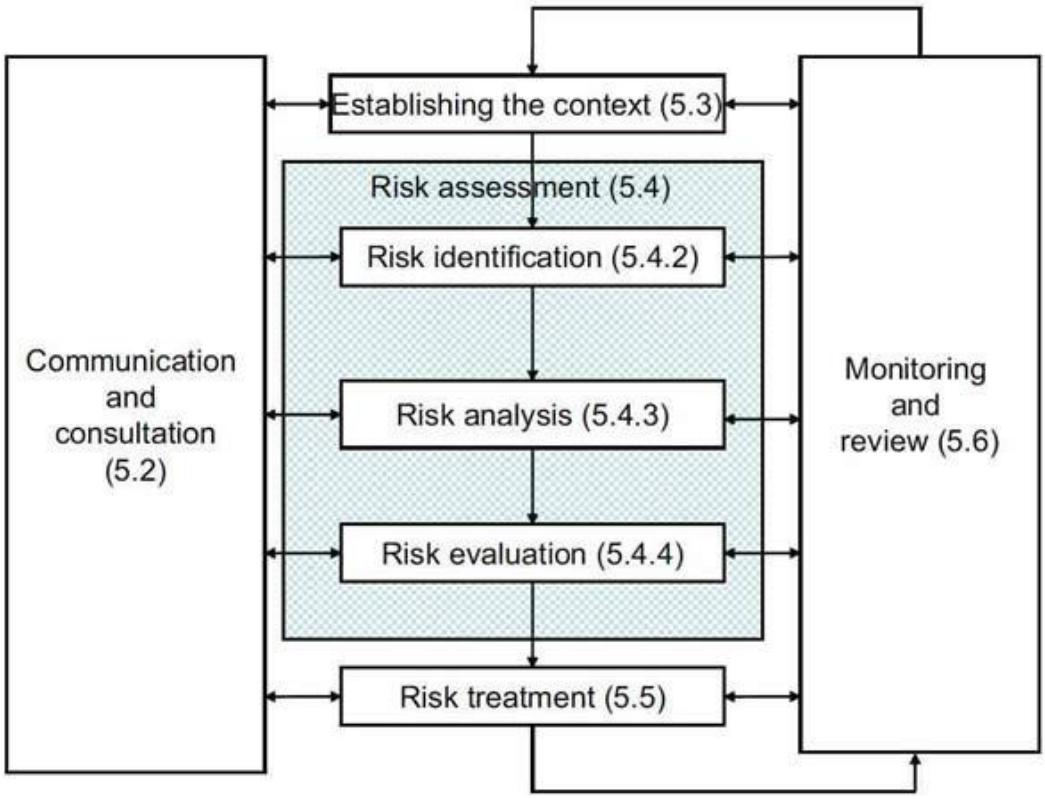


Figure 3 — Risk management process

Also terms that we are using throughout in this report is based on the understanding of this ISO, for instance, the term risk, is defined by ISO as “Effect of uncertainty on objectives”.

Figure 3.2 ISO 31000 Processes[1]

3.3 A Generic Risk Management Process

According to the ISO-31000, a risk management process consists of the following activities.

3.3.1 Communication and Consultation

During all of risk management processes appropriate communication and consultation should be made. The communication and consultation is done with external and internal stakeholders. Communication and consultation is done in order to provide information essential for deciding risk’s attributes. Proper communication and consultation will provide:

- Appropriate context definition

- Adequate identification of risks
- Taking into account related stakeholders and their interests
- Accountability in risk management processes, i.e. expertise for risk analysis
- Consideration of different views in risk evaluation
- Endorsement for treatment tactics

Internal communication ensures that framework supports correct flow of relevant information among organization. The information refers incomes and outcomes of risk assessment and treatment processes as well as changes in context.

External communication is connected with reporting mechanism. The reporting is related to legal, regulatory, corporate governance requirements. It may provide feedback from some other external stakeholders. This also raises confidence in the organization.

3.3.2 Establishing the context

To establish context in risk management one should articulate objectives of the activities of the organization, define external and internal parameters and set scope and risk criteria. Communication with internal and external stakeholders is very important to be established during all stages of risk management process. In risk management process the resources that are used must be specified as well as responsibilities and authorities. Defining the risk criteria is used to evaluate importance of the risk.

3.3.3 Risk assessment

Risk assessment process consists of Risk identification, risk analysis and risk evaluation processes

Risk identification

While identifying risk, source of the risk must be specified. Important part is identifying area on which the risk has impact. Events that have probability to happen which will trigger the risk and consequences of that events should also be considered.

Risk analysis

At the end of risk analysis the risk must be understood. In this process sources and causes are considered. The consequences that may be positive or negative as well as likelihood factor should be decided in this process. At the end, combining consequences and likelihood, the level of the risk should be determined. The dependence between the risks is also important to be considered in this process.

Risk evaluation

The outcome of risk analysis is input in risk evaluation. The result of it is decision about which risks need treatment and what are the priorities of implementation of this treatment. This is done by comparison of risk levels provided in risk analysis process.

3.3.4 Risk treatment

Risk treatment involves selection of one or more options for modifying risk. The risk may be avoided by deciding not to start or continue the activity that triggers the risk. In addition the risk source may be removed, likelihood and consequences can be changed or risk may be retained by informed decision.

3.3.5 Risk monitoring and review

In the process of monitoring and reviewing the risk the effectiveness and efficiency of the risk management process are derived. It is used to improve risk assessment by logging risk management and reviewing it. Some changes in establishing context may come up. During this process some new risk may emerge.

3.4 A Basic implementation of RM

A basic implementation of RM may look something like this:

1. **Analysis of domain.** In this step the organization analysis the domain for which the risk management is done for.
2. **Risk Identification.** Conduct Risk brainstorming sessions with staff. At the end of this step a list of risk item is identified.
3. **Risk Analysis and Evaluation.** For each risk item in step 2 do the following:
    a. What is the Nature of the risk?
    b. What is the likelihood of occurrence?
    c. What is the impact if it occurs?
    d. Determine Exposure.
    e. What sill we lose if the risk occurs?
4. **Risk Treatment**. For each risk item in step 3 do the following:
    a. Avoidance/Mitigation Plans
    b. How can we Minimize the Risk?
    c. What Actions/Tactics should be taken to minimize the risk?
    d. Contingency Plans, What do we do if it occurs?
    e. What sill we lose if the risk occurs?

3.5 RM implementation in different fields

3.5.1 Background

In order to compare risk management in different fields and how are can they implemented using ISO-31000 our group did a research on this topic. The nature of any industries dictates different contexts of risk management as well as methods of risk assessment and risk treatment. Using the risk management implementation manual many of these concepts can be implemented in one general framework while for some concepts more specialized technologies have to be used.

In the text below, there is more detailed explanation about concepts in different fields. The fields, that may also be called industries, are next:

- Health care
- Maritime
- Finances
- Construction Industry

3.5.2 Health care risk management

Context

In general risk is considered as a combination of likelihood and consequences of a situation with a potential to cause harm. According to risk definition a clinical risk or healthcare risk is the chance of an adverse outcome from clinical investigation, treatment or patient care.

Risk management in health care organization consists of two main parts: the first one is the local and the government policies about the health care in the region and the country which the organization should be up dated and know how to implement these policies in the organization, the financial situation of the organization, and the second one is the patient safety and how to confront risks that are related to patient safety.

Stakeholders

According to George D. Pozgar [2], the health care risk management's stakeholders are defined as below:

Governing body:

Governing body is a board of directors or board of trustees; they main responsibility are operating and managing the organization, also they have power to establish and implement policies regarding the operation and management. The other responsibilities of governing body are:

- Appointing a chief executive officer (CEO)
- Providing a definite scheme and platform according to the local and government's policies which affect the organization and patient's safety.

- Considering the organization regulation and patient's right in order to establish policies and making sure that medical and nursing staffs, the administration and other employees follow them.

Bylaws Committee

The members of the bylaws committee are selected by governing body, and they are assigned to review and recommend bylaws changes to governing body.

Finance Committee

They are responsible for the budget s and major capital requests. They should control the financial situation of the organization and make recommendations to the governing body, for instance making suggestion for closing a ward because of the expenses or downsizing a group of employees. This committee includes the CEO and the chief financial officer.

Patient Care Committee

This committee is responsible for the quality of patient's care and making recommendation for its improvement. This committee's main task is to developing a process to identify patients and their families' expectations and demands. This process should include:

- Developing a tool to identifying the patients and their families' demands and expectation. Like preparing a form of questions that can be given to the patients and their families before leaving the hospital.
- A methodology for reviewing data
- Identification of patterns of concern
- A mechanism for forwarding information to those responsible for implementing change in the organization which is the governing body
- A continuing review, evaluation, and implementation of plans for improving organizational performance

An effective committee should contain membership from the governing body, medical staff, nursing, administration. Actions and recommendations are reported to the governing body.

Safety Committee

The safety committee is generally charged for observing the organization's risk management program, life safety program, equipment management program (a program for ensuring the staff's training and new equipment testing).

Risk manager is empowered by the governing body to implement activities of the risk management program with the assistance of the patient care committee and administrative staffs. The risk manager is a member of safety committee.

Vicarious Liability

Usually master respond to this task is for avoiding to direct contact with the medical staffs. They are responsible for observing the staffs' actions and reporting the wrongful acts of employees whereby an employer is under question for the torts committed by employees.

Establishing the context

Before identifying the risks in hospitals or health institutes, there are more concepts that should be cleared. For instance:

- Declaring the organization's environment and goals (the responsibility of the governing body),
- Describing the program's scope, components and methods (governing body and the safety committee are responsible),
- Delegating the crucial responsibilities to more people (governing body responsibility),
- Demonstrating commitment by the board (governing body responsibility for the high ranks and vicarious liability responsibility for the medical staff and other employees).

Risk Assessment:

NHS (National Health Service) of the United Kingdom has published an article about risk management in patient safety; in this article they have mentioned five steps to identifying, analyzing, evaluating and treating risks in health care industry. Here, ISO 31000 risk management and these five steps are going to be compared.

Five steps of NHS [3]:

Step1: Identifying the hazards (what can go wrong?)

Step 2: Decide who might be harmed and how (what can go wrong? who is exposed to the hazard?)

Step 3: Evaluate the risks (how bad? how often?) and decide on the precautions (is there a need for further action?)

Step 4: Record your findings, proposed action and identify who will lead on what action. Record the date of implementation.

Step 5: Review your assessment and update if necessary.

The first step of NHS is as same as risk identification in ISO 31000: 2009, the second step is risk analysis, third one is risk evaluation, the forth one is risk treatment and the last but not the least step is monitoring and review .

Identifying risks

For identifying risk, we create a form which has:

For identifying risk as the Figure 3.3 demonstrates patient care committee monitors all the events related to the patient safety and if something goes wrong, the committee documents type of event, time of happening and the unit or department that the event happened. Then the risk manager would

view the report and make a valuation part of the risk which the frequency of the event happened and the impact of it. Both of them, the patient care committee and the risk manager will give a report as a form for risk.

The safety committee observes the issues with the medical and the staffs' training, and the vicarious liability views the staffs' issues. They all will be collected as a report of surrounding circumstances, and will be added to the form for risk.

Then the safety committee will make suggestions on that report and give it to the governing body for the final decision on the risks in the organization.

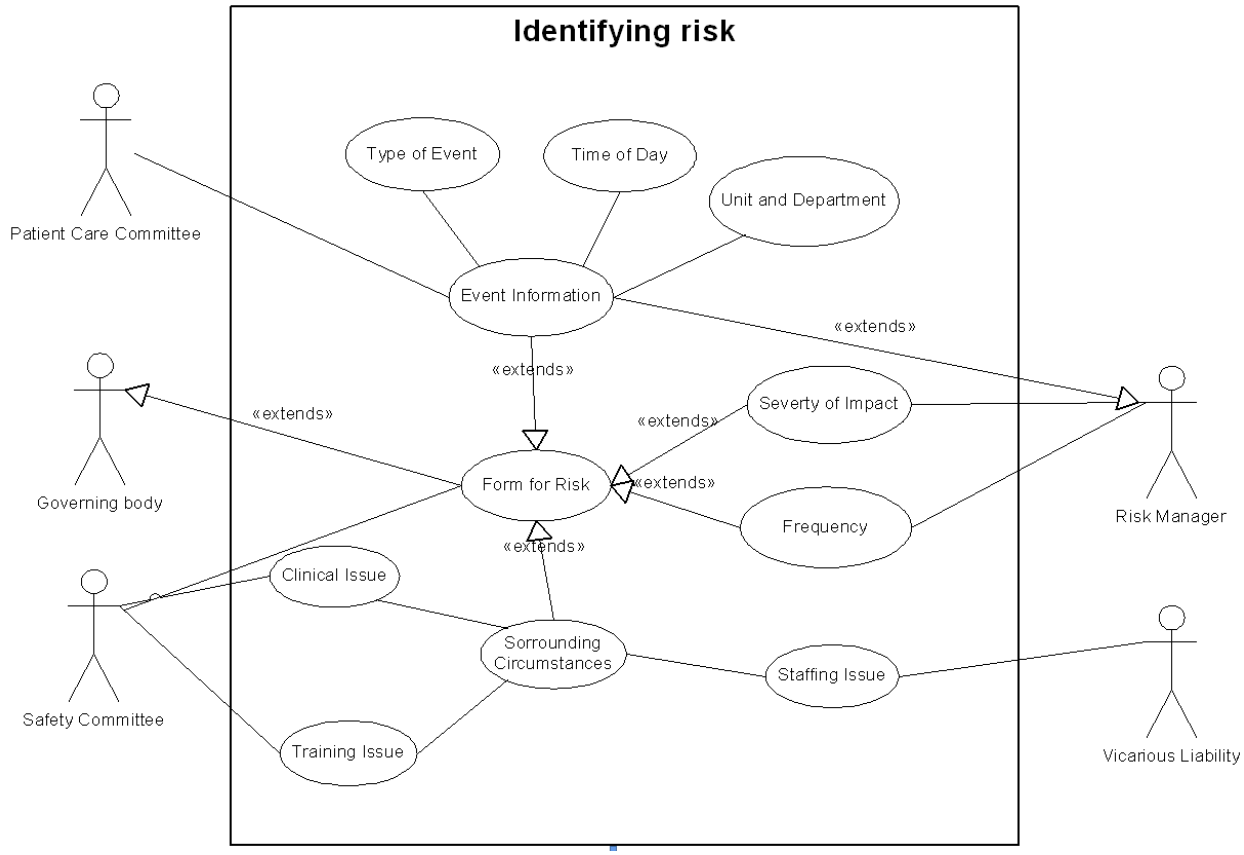


Figure 3.3 - Identifying risks

Why patient safety is important:

Patient safety is the most important aspect of the health organization. In recent years estimates show that in developed countries one in 10 patients is harmed while receiving hospital care, and in developing countries this number is higher. Therefore it is essential in risk management in heal care organizations.

In patient safety it is important to train your staff and lead them, to encourage the staff to report incidents and the reasons of incidents, to communicate with the patients and their families openly and to report their feedback and finally to implement solutions to prevent them.

In order to estimate the patients' satisfaction, a survey can be given to patient before leaving hospital. This survey can be helpful to improve the patient safety and finding a treatment for risks. It can be like the follow up survey which was given by Health Resources and Services Administration (HRSA)[4].

We would like to know how you feel about the services we provide so we can make sure we are meeting your needs. Your responses are directly responsible for improving these services. All responses will be kept confidential and anonymous. Thank you for your time.

Your Age: _____

Your Sex: ___Male ___Female

Your Race/Ethnicity:
___ Asian
___ Pacific Islander
___ Black/African American
___ American Indian/Alaska Native
___ White (Not Hispanic or Latino)
___ Hispanic or Latino (All Races)
___ Unknown

Please circle how well you think we are doing in the following areas:
GREAT: 5 GOOD: 4 OK: 3 FAIR: 2 POOR: 1

Ease of getting care:
Ability to get in to be seen: 5 4 3 2 1
Hours Center is open: 5 4 3 2 1
Convenience of Center's location: 5 4 3 2 1
Prompt return on calls: 5 4 3 2 1

Waiting:
Time in waiting room: 5 4 3 2 1
Time in exam room: 5 4 3 2 1
Waiting for tests to be performed: 5 4 3 2 1
Waiting for test results: 5 4 3 2 1

Staff:
Provider: (Physician, Dentist, Physician Assistant, Nurse Practitioner)
Listens to you: 5 4 3 2 1
Takes enough time with you: 5 4 3 2 1
Explains what you want to know: 5 4 3 2 1
Gives you good advice and treatment: 5 4 3 2 1
Nurses and Medical Assistants:
Friendly and helpful to you: 5 4 3 2 1
Answers your questions: 5 4 3 2 1

All Others:
Friendly and helpful to you: 5 4 3 2 1
Answers your questions: 5 4 3 2 1
Payment :
What you pay: 5 4 3 2 1
Explanation of charges: 5 4 3 2 1
Collection of payment/money: 5 4 3 2 1
Facility:
Neat and clean building: 5 4 3 2 1
Ease of finding where to go: 5 4 3 2 1
Comfort and Safety while waiting: 5 4 3 2 1
Privacy: 5 4 3 2 1

Confidentiality:
Keeping my personal information private: 5 4 3 2 1
The likelihood of referring your friends and relatives to us: 5 4 3 2 1

What do you like best about our center?

What do you like least about our Center?

Suggestions for improvement?

Thank you for completing our Survey!

Risk treatment:

In the clinical risk treatment cost always should be considered. For the treatment like ISO recommendation the risk can be avoided, be reduced the impact, be accepted the consequences of the risks because of their future benefits, be transferred to another organization or person like insurance company, be retained and control the risks. According to the above choices and financial situation an appropriate treatment should be collected and a plan be prepared.

3.5.3 Maritime Risk Management

Maritime industry include, in broadest terms, all enterprises engaged in the business of designing, constructing, manufacturing, acquiring, operating, supplying, repairing and/or maintaining vessels, or component parts thereof: of managing and/or operating shipping lines, and customs brokerage services, shipyards, dry docks, marine railways, marine repair shops, shipping and freight forwarding services and similar enterprises.

Context

In the text below there is an overview on risk management from a context of ship building, sea transport and traffic. The contexts represent following of certificates, standards and rules during processes in maritime industry, financial risks, risks in maritime transportation such as safety and polices for ship operators training. All contexts are compared with ISO-31000 standard.

In ship building there is a need to categorize the ships. To do that, the standardized classification is to be done. Classification is a special type of certification particularly applied to confirm that the maritime structures and facilities comply with requirements. Classification implies that requirements are set by the classification society, i.e. the same third party that performs the classification. The requirements may be for example specified in the DNV (Det Norske Veritas) Rules.

In the development of modern maritime industry, ship classification has emerged as an essential contributor to the safe-guarding of life, property and the environment.

Fundamentally classification is a very simple concept based on three main elements, applicable both to the new-build and operational phases:

1. Setting standards (Classification Rules)

2. Verification of compliance with standards (approval of specifications and drawings, surveys and testing)

3. Documenting compliance with standards (survey reports, Classification certificates)

As part of classification, all materials may be certified, as well as components and systems relevant to safe operation and quality of ships. The design assessment, type approvals and production assessments may ensure that systems and components are fit for their purpose, and fulfill the requirements. DNV has activities on Certification of Materials and Components.

Processes must be standardized in order not to be done according to rules. The rules can be both internal and external nature. In order to reach certain quality, it is usual that during the ship building, certain internal rules are followed. For example some polices about materials that are used in ship building. As external rules certain certificates must be acquired. For example Classification Rule described above.

According to ISO-31000 these rules can be represented in risk management framework as polices, objectives and strategies that can be represented as documents. In risk management system relations between risk and these rules may be made.

In the same way certain relations between risks and internal/external stakeholders can be made. As external stakeholders in maritime industry there can be Certification organizations as International Maritime Organization (IMO) [5] and Det Norske Veritas (DNV) [6] and qualified surveyors, approval engineers and experts. As internal stakeholders there can be persons responsible for quality of ships or persons that can somehow affect or be affected by risks or its consequences. The stakeholders are also identified in ISO-31000 and implemented in framework that is described in this manual.

In maritime, there are certain rules in maritime transportation provided by IMO that must be followed. Also, ship operators have to pass some certified trainings, i.e. trainings prescribed by STCW (The Standards of Training, Certification & Watch-keeping) [7] convention.

In maritime transportation certain statistics are being considered. The statistics about the frequency of casualties provide an overall view about the levels of safety involved in the shipping activity. They allow the quantification of the real safety levels for different ship types as well as the main modes of failure. There are certain risks that have to be taken into account such as risk of ship collision, grounding and foundering.

The analyses of historical records of ship casualties identify the major modes of ship losses as being fire, explosion, grounding, collision and foundering. There is also risk of structural failure. Reliability based methods have the potential to be used as a tool for the design of structures, allowing a quantitative approach to the allocation of safety to different components of a structure, or to different structures of a specific type. Reliability analysis is based on the calculated probability of failure, a concept that requires the answer to many difficult problems, such as what is the ultimate failure of the structure, in

which possible modes the structure can fail, how the extreme conditions under which failure occurs are defined, how accurate are current calculation methods, and so on.

Financial risk is the prospect of financial loss due to unforeseen changes in underlying “risk factors”. These risk factors are the key drivers affecting portfolio value and financial results. Such risk factors are equity prices, interest rates, exchange rates, commodity prices, freight rates, etc.

Financial risks in maritime industry may be categorized by next types:

- Business: The risk of loss due to unforeseen changes in demand, technology, competition, etc. affecting the fundamentals of a business activity.
- Market: The risk of loss arising from unexpected changes in market prices or market rates.
- Credit: The risk of loss arising from the failure of counter-party to make a promised payment.
- Operational: The risk of loss arising from the failures of internal systems or the people who operate in them.
- Other types: Legal, Liquidity, etc.

Financial risks in maritime requires special and more detailed risk analysis and more complex measuring of risk. This will be described more in the Assessment part below.

Assessment

After identifying and modeling the underlying financial risk factors, we must determine their significance and quantify their influence on portfolio value and financial results.

Modern applications of Financial Risk Management should cover the following:

- Exposure measurement and reporting
    - Market risk
    - Credit risk
    - Operational risk
- Economic capital estimation
- Allocation of capital
- Risk-based pricing
- Risk limits
- Risk-adjusted performance evaluation

An independent private company Freight Metrics [8] has recognized some financial risk measurement methods:

- Mean-Variance framework
- The Value-at-Risk (VaR) Approach

The Mean-Variance framework

Under the Mean-Variance framework, financial risk is modeled in terms of the mean and variance (or standard deviation, the square root of variance) of the Profit/Loss (P&L) or the returns of portfolio. The Mean-Variance framework often makes the assumption that returns obey a normal distribution (strictly speaking, the mean-variance framework does not require normality, but it is easier to understand its statistics). Portfolio theory starts with the premise that investors choose between portfolios on the basis of maximizing expected return for any given portfolio standard deviation or minimizing standard deviation for any given expected return. One of the key insights of portfolio theory is that the risk of any individual asset is measured by the extent to which that asset contributes to overall portfolio risk which depends on the correlation of its return with the returns to the other assets in the portfolio (a result known as diversification effect). Portfolio theory typically makes the assumption of normally distributed returns.

VaR

VaR Basics

VaR on a portfolio is the maximum loss that might be expected over a given holding or horizon period, at a given level of confidence (probability). VaR is less restrictive on the choice of the distribution of returns and the focus is on the tail of that distribution – the worst *p* percent of outcomes.

VaR in practice:

Estimating VaR: The various methodologies for estimating VaR actually differ on their particular technique for constructing the distribution of possible portfolio values from which VaR is inferred. The most common methodologies are:

- Analytical methods (Variance/Covariance)
- Historical simulation
- Monte-Carlo simulation

Attractions of VaR:

VaR is a single, summary, statistical measure of possible portfolio losses, providing a common and consistent measure of risk across different positions and risk factors. It takes account of the correlations between different risk factors. It is fairly straightforward to understand, even for non-technical people.

VaR variants

Following the same logic, other "at risk" measures have been proposed to quantify risk in various settings: Cash Flow at Risk (CaR), Earnings at Risk (EaR), etc.

To measure financial risk it is an expert's opinion is needed. Therefore as essential stakeholder in risk measurement an expert must be included. This can be both internal and external stakeholder and that matches the ISO-31000. However, there are more complex requirements for implementing risk measurement. A custom relations between various data need to be made. There are many methods that are used in measuring. Some of the solutions to this problem can be solved by including interactive and dynamic spreadsheets and charts.

Treatment

In part of maritime industry processes, where ship building, transportation, and operators training are taken into account, certain standards must be followed. The quality is influenced in a great manner if the actions are taken according to standardized processes. The treatment part of the risk in this case is done by continuing with planned actions but informing the actors, and stakeholders about standards and propositions that the standards are requiring. The system that is automating this treatment should track if everyone has been aware of rules.

When risks that include accidents in operating are taken into consideration, the risk probability is calculated through statistics based on previous events and experience. The risk can be treated in the way of reducing the probability of event that causes it. The probability should be reduced until acceptable.

Financial risks have to be monitored during whole risk life-cycle. Parameters are changing continuously so the risk probability is dynamic. Therefore, monitoring and recalculating risks parameters have to be done all the time. The actions that have to be taken may prevent risk probability rising or may reduce it.

3.5.4 Financial Risk Management

Financial risk management means that you handle risk in a way to gain economical benefits, mainly covering the area of market risk and credit risk, where credit risk is the risk involved with cash flow between two parties, with an investor and a borrower, while market risk takes care of the risks involved with portfolios, like how market factors can suddenly make a value of a portfolio increase or drop. Since good risk management within finance is something concerning most companies, and can hugely decide the economic growth of a company, it is one of the most researched parts within risk management and there have been a lot of different approaches of how to solve it throughout history.

Context and assessment

While it is hard to find some good automated methods in general risk management, there are plenty of methods found in the financial area of risk management. Especially if there is a good amount of collected data involved. As can be seen through of a study of how two different companies approached this problem, seen below. And with plenty of methods there are plenty ways to attack this problem but a common strategy is to have probability estimations of external and internal risks of a portfolio, with all

the respective probability estimations of risk avoidance and the new impacts. Also maximum loss calculations are also common. This way you can estimate the best approach considering buying or selling an item, and also to lure away risks that can potentially ruin the business.

Comarch [9]

Comarch has an asset management platform to help companies to integrate, among other things, financial risk management into their systems, with the targets being mainly in the area of banking, insurance and capital markets. They will have to tune solutions from the platform towards a user. The users will mainly have to do their own estimations but there are methods to aid them. [10] Some key features of *Comarch* asset management system is:

- that it adds support for calculating an investment before investing
- Having wide user configuration options when checking for risk exposure.
- it covers stress testing, that is it covers what happen to the system when set under extreme conditions
- Having methods to calculate maximum loss per portfolio can also used this on detailed items within a portfolio.
- Have back-testing, that is, checking the correctness of the estimation using historical data
- Can divide a portfolio risk into many sub-risks.
- Sensitivity analysis, how much impact a market change can have on the system
- Have support for What-if testing.

Listing of different solution *Comarch* is using:
Methods to calculate Value, Conditional value, Incremental value and marginal value of a risk

Simulations

- Historical simulation: Use of historical data to determine the future.
- Monte Carlo simulation[11] : Is a way to simulate how often an event occurs by simply testing a system. Given infinite time this testing will give an accurate description of probabilities within the system. In combination with *markov* chains, by setting up the *markov* states first, we can use the *monte carlo* simulation to find the probabilities within the *markov* chains.

Statistical estimations

- Variance-Covariance[12]: covariance is a measure of how much two variables change together. Variance is a special case of the covariance when the two variables are identical.
- Cornish-Fisher[13]: approximation method for variables used in the VaR method.

- Extreme Value Theory[14]: Finds extreme deviations from the normal probability distributions, which again can happen under extreme events.

- P/L vs. VaR[15]: See risk in maritime industry

- Kupiec tests[16]: An acceptance test of the VaR model, where it test the number of exceptions derivates from the VaR model. If it's higher than some confidential level the VaR test is not sufficient enough.

- Berkowitz test, another acceptance test[17].

Sensitivities

- Beta[18]: Beta is a parameter that tells how much the market value of a portfolio changes compared to the market changes overall. A negative beta says that the portfolio increases when the market has a down period, while a positive beta means that the portfolio follows the market. A beta of 0 means that the portfolio is independent of the market.

- Duration, MDuration, Convexit[19], BPV[20]: Sensitivities to calculate how a value of an asset or a financial instrument change compared to interest rate shifts.

- Greeks[21]: different Greek letters that calculate different variables a portfolio is dependent on.

Models

- Rate of return dynamics: Vasicek model[22], Cost/Income ratio, Ornstein-Uhlenbeck[23], Black-Scholes[24]: The Vasicek model maps and describes the evolution of interest rates. The Ornstein-Uhlenbeck is a stochastic process used to model interest rates, currency exchange rates and commodity prices. While the Black-Scholes is modelling using partial differential equations.

- Cox-Ross-Rubinstein model[25]: also called BOPM is binomial options pricing model. It is more accurate than the Black-Scholes method but computationally slower.

Stress testing

- What happens when you test the system under extreme conditions? Can be tested by predefined scenarios like 9/11, or the user can create its own.

- Contracts between parties

- Futures[26]: A standardized contract between that says how much of different items the parties will buy from each other, till what price and at which time. Future assets which you might not have yet or can't spend.

- Forward(FX, FRA)[27]: Same as futures except that is it not standardized, no agreement to use a counterparty for the exchange and there is no guarantee for margining, which is a way to take into account how the market price change compared to the agreed price.

- Swap(FX, CIRS, IRS)[28]: is a derivative in which counterparties exchange certain benefits of one party's financial instrument for those of the other party's financial instrument
- Vanilla option[29]: A contract that gives a party the rights to buy some assets of some other party at a reference price within a time period.
- Exotic option[30]: a more complex form of vanilla option

RiskMetrics Group[31]

The RiskMetrics group is a company started in 1994 with focus on helping people understand the risks of a portfolio of financial assets. Having almost 40% of their company to focus on research and development they have come up with solutions within research, models and data to cover more than 38.000 listed companies. To have a best possible risk estimation Risk Metrics group collects market data and client data every day, to be used for historical estimation, benchmarking etc. They got their own RiskManager web application that has what-if Scenarios, Stress Testing, Limits Testing and Margin Calculation as some main features. And also some more specialized risk applications for credit management, portfolio and reporting services, Web services, financial planning and monitoring.

Clients of RiskMetrics Group:

- Asset Managers
- Pension Plans
- Insurance Companies
- Central Banks
- Hedge Funds
- Fund-of-Funds
- Corporate Treasuries
- Investment Banks
- Commercial Banks
- Prime Brokers
- Private Banks
- Financial Advisory
- Retail Brokerage

A list of different models used in their market risks part is found at [32].

Treatment

Financial risk treatment produced by computers is mostly suggestive, from calculated values. Though some predefined scenarios can occur that can make use for computer action. In an investment scenario the suggested treatment should be a list of the best possible value estimation given the limits that have been set, where limits can be maximum investment money, maximum level of loss etc. When it comes to credit risks there should have been calculated some sort of rank for a customer to determine the financial health of a customer, and give different treatment to each rank. For instance, a person with low financial health might have to put more properties on stake to be allowed to borrow money.

3.5.5 Risk Management in the Construction industry

Context

Its typical divide construction projects in to two aspects: process and organization. We can further divide these aspects into phases, the process aspect can be divided into two main phases project development and project implementation. According to Flanagan and Norman (1993) these two phases can further be divided into more phases, typically feasibility, programme, design, procurement, construction, commissioning, production, and operation. But we only need to take a look at programme, design, procurement and production because this is where risk management process is taking place.

Programme phase

In Programme phase the client has an idea about the project and its in this phase the analysis of the conditions for its execution.

Procurement phase

In the procurement phase the client has to appoint a contractor that will execute the project. And depending on the contract that the client and the contractor have drawn together after the procurement phase follows either.

Design phase

In this phase the architects and engineers will produce construction drawings according to the client's requirements.

Production phase

When all the phases above have started and\or is executed, than the contractor can start on executing the construction project.

Since construction projects depend greatly on what kind of contract the client signs with the constructor. And how the constructor party are made (subcontractor, consulates), the procurement phase follows either the after programme phase or after the design phase.

Figure 3.4 - Construction project phases

Stakeholders

In construction project the most important stakeholders are clients, contractors and consultants.

Client

A client is the person or party who wants a project to be carried out, they will assign this task to a professional contractor. We can categorize clients in two main groups: private and public. A public client will usually work for the government or local authorities and undertake project that will provide a service that will benefit the people. A privately owned company will undertake a project to expand so they can increase profit.

Contractor

A contractor is a group or individual that contracts with the client to provide a service for them like construction work or demolition. A general contractor usually is responsible for the supplying of all material, labor, equipment, (engineering vehicles and tools) and services necessary for the construction of the project. It is typical that a contraction organization provides a different range of services from ground work to telecommunication.

Consultant

Consultants are people who are hired to help the client and/or the contractor. They are advisors and can help with decisions regarding architectural and engineering issues.

Risk identification

Research shows that there is a trend on identifying risks at the early phases of the project before the production phase. The risk impact is not experienced before the production phase.

Successful contractors have a network with labors and different contractors (subcontractors). There's risks connected to having a network, experience and capability of project participants causes delays. The biggest risk in construction industry is delays the reason for this is mainly because of client interference, inadequate contractor experience, financing and payments, low moral that causes bad labor productivity, slow decision making, improper planning and subcontractors.

The most important risks in construction are the risks that are hard to control these can be weather and quality of material.

In the construction industry its ordinary to categorize risks in internal, external and force majeure risks.

Internal

The risks here are controllable through the stakeholders. It can be design, construction work, management and relationship that can be affected by these risks.

External

External risks are not controllable; these can be financial, economical, legal and environmental.

Force majure

Force majure are risks that are unique due to different countries and climate. These are ordinary caused by natural reasons like weather, an "act of god" if you want.

Assessment

The most common way to asses risks are to estimate risk probability and impact. After estimating risk, it has to be “analyzed” this can be done in probability-impact grid. By using the probability-impact grid it’s easy to detect high and low prioritized risks. It is typical to pay allot attention to the higher ranked risks. But since construction projects are very complex it is easy to forget about them, this happens usually because there are not enough resources. Then why it is not easy to assess risks in construction project? This is because risks are typically linked together; a small risk in the programme phase can affect another risk in the production phase. This is a big problem when handling risks in construction projects.

Treatment

When treating a risk we can choose to implement either of these strategies avoid, transfer, migrate or accept.

Risk avoidance: Changes in the project plan so that the identified risk is not able to cause any threat.

Risk transfer: Transfer to another party either by contracts or insurances.

Risk migration: Reducing the probability and/or consequences of a risk.

Risk acceptance: Take action after the risk happens, and take no action beforehand.

3.5.6 Conclusion of risk management in different fields

The solution that our group has to provide should be generic. During our research on the topic of risk management in different fields we have extracted concepts that are common for every field:

- Every industry in which risk management may be implemented have risks that can be characterized by common attributes.
- Every risk has some source that may be an event that triggers that risk.
- In every industry these events happen in different environment and may be of a different type.
- Every risk has an impact on some area in company. This impact may influence in different scales.
- For every risk triggering event there is the probability for that event to occur.
- The importance of awareness of some risk can be calculated from impact and probability. In some cases it can be calculated after analysis of dependencies between risks.
- Usually in order to achieve some goal (e.g. make some product according to some standard) the organization internal stakeholders have to be aware of this as a risk. The probability of the risk consequences is calculated based on the level of awareness. So in this case internal stakeholders are the ones that can contribute to achieve the goal. This scenario is very common in any industry.
- In some industries analysis and evaluation of the risks is simple. In others, e.g. finances, there are many methods for analysis and evaluation.
- Risk treatment can be implemented as well defined communication sequence and continue as new process which implementation is based on project management environment.

In ISO 31000 most of these concepts are covered. To build risk management system for a specific industry, the risk management framework must be integrated with communication module of the project managements system. By following the advices for the implementation in ISO 31000 this can be achieved. The parts of risk management that are specific can be done manually (e.g. complex methods of analysis and evaluation of financial risks). In order to build a generic risk management system a generic environment is necessary and that is exactly what EQS is.

3.6 Existing software for RM

The risk management software is often implemented as module in project management systems. Therefore, we have researched not just about existing risk management software, but project management software also.

We have researched about existing risk management and project management software and found next systems:

- Capital IQ (ClariFI)[33]
- RMS RiskManager[34]
- STG Active Risk Manager[35]
- Allegro Simulation 8.0[36]
- Citicus ONE[37]
- Enablon[38]
- Capacent[39]
- Patsystems' Risk Informer[40]
- Aon e-Solutions[41]
- Envision Technology Solutions LLC, RiskEnvision[42]
- Mountain View Software Corp[43]
- NOWECO, RiskDecision Risk Management Software[44]
- open source projects[45]
- Riskonnect[46]
- SAP BUSINESSOBJECTS GRC SOLUTIONS[47]

- Clearrisk[48]
- Palisade, @Risk [49]
- Risk Reasoning, RiskAid [50]

Next risk management solutions we have used to derive requirements in chapter 4:

- Citius[51]
- Capacent [52]
- Lumension Risk Manager [53]

Table 3-1 - Overview table of existing risk management systems that are used as source of requirements

Name	documentation availability	Main focus	Type of application	importance	comment
Clearrisk	good	General risk management	Web-based	medium	Good overview on general risk management
Capacent	poor, no videos	Financial risks management	web-based	medium	They only focused on finance
Lumension Risk Manager	poor, video	Risk analysis and evaluation	desktop	medium	Good organization of tasks

3.6.1 RM Systems on Norwegian Market

There are two different sources from which Norwegian risk management systems could be analyzed. The first one is Norwegian software development companies and their products that are related to risk management. The second one is Norwegian customers that and the products they are using. [54]

In Norway there are companies that develop project management systems. Risk management module is integrated in such systems.

The solutions that do not have an explicit risk management module are managing risk indirectly. Such solutions are reducing risk threat by using proper project management system. In these solutions risk management is not a separate module.

In further analysis the products will be attributed as the ones that got separate risk management module and others that apply risk management indirectly.

Some of Norwegian software development companies specializes their software to suit some specific field of work. A few of them develop more general risk management systems that can be used by different types of companies from many different fields of work.

24SevenOffice[55]

24SevenOffice is developing and marketing Software as a Service (SaaS) products. Headquartered in Oslo, Norway, the company is currently present in Scandinavia in addition to the UK.

24SevenOce main product is an integrated CRM and ERP system. The products are module based which enables customers to select modules based on individual need. The Project management module is implemented in their product 24SevenOce Project.

No separate risk management module is developed. Instead the risk management is done through efficient work and sharing of project information. It is a web-based application based on based on cloud computing and SaaS.

Corporater[56]

Corporater is a Stavanger, Norway based company which makes Performance Management software.

Corporater Enterprise Performance Management Suite, v3.0 was released in October 2008. This product has risk management module. It offers designing and modeling of risk matrices.

In this product risk elements help visualize the probability and consequences of potential risk factors. Risk plans may be linked to address risk areas by minimizing risk factors. Risk elements can be used anywhere where a customer needs them to help assess factors which may a effect performance. Risk can be assigned to users and will appear on user's personal page for quick reference.

Corporater Enterprise Performance Management Suite can be used customers from all industries.

Mamut ASA[57]

Mamut ASA is a Norwegian IT company that delivers administrative software solutions and Internet based services. The company's headquarters are located in Oslo, Norway.

Mamut Software Limited is a subsidiary of Mamut ASA, and is based in London, England and is a European vendor of integrated business solutions for the SME market.

Mamut solutions include integrated business software with functionality including accounting and financial management, CRM, logistics and stock control, time and project management, e-commerce, payroll /, Point of Sale solutions, domains, e-mail, web hosting and security.

Among business products of Mamut there is a product named Mamut Validis that integrates accounting tests and advanced data analysis techniques which check all transactions within user's accounts. It presents results in an easy to understand format and contains extensive help and explanations so that people with only basic accounting abilities can benefit from the solution. The system highlights potential problems and reduces the risk of errors.

Software Innovation[58]

Software Innovation is a Norwegian software company with locations in Norway, Sweden, Denmark and Finland. The company was founded in Oslo. It delivers solutions for Document management system.

ProArc provides total control of all information in all phases of technical projects.

It is a solution that is used for handling technical and administrative documentation in complex and simple, projects and organizations. The ProArc solution is based on the needs of technical and project related organizations.

A complete audit trail is a part of the solution, and all operations related to documents and distributions are logged. The redundancy of risk of legal issues in the project is accomplished by logging the information about who received what and when.

All of this could improve customer's business results through reducing of business risks and better support for business processes. It gives better control of customer deliveries in the supply information chain are reducing conflicts and the risk of legal claims.

Visma AS[59]

Visma AS is a Norwegian company headquartered in Oslo providing ERP and CRM software and services around those products for SME (small and medium enterprises) customers. Among their products there is a project management solution. The solution does not have explicit risk management module. This company is interesting because of their clients that are form SME.

The second source from which Norwegian risk management systems can be analyzed is a customer that uses risk management related product. There are many Norwegian companies that are using risk management systems that may or may not be made by Norwegian software development companies.

Det Norske Veritas (DNV)[60]

DNV is an independent foundation with the purpose of safeguarding life, property, and the environment. Its history goes back to 1864, when the foundation was established in Norway to inspect and evaluate the technical condition of Norwegian merchant vessels.

Many Norwegian companies use DNV's services. While many of DNV's services, such as management system certification and corporate responsibility, can be applied successfully in any industry. DNV's main focus industries are: maritime, oil, gas and energy, food and beverage, health care. DNV's services include software products.

DNV provides engineering software for managing risk for customers involved in building and operation of assets in the maritime, oil and gas, and refining and petrochemical industries:

- Nauticus - For ship design and operation. Software products for hull strength calculations and analysis of machinery and propulsion systems.

- Sesam - For strength assessment. It is a complete strength assessment system for engineering of ships, o
  shore structures and risers based on the finite element methodology.

- Safeti - For risk and reliability. It is the one that is most related to risk management. Software for managing customer's renery or petrochemical process plant safely and reliably to maximize asset performance and minimize risk.

- DNV Software realizes that companies have different work processes and work procedures and their vision is to deliver solutions that are tailored to the individual companies, through configuration, thus supporting the best practices of the individual companies. Orbit + EAM (Engineering Asset Management) is a comprehensive management tool to allow Asset Integrity Management, focusing on maintenance, parts, inspection and risk management.

Synergi Solutions AS[61]

Synergi Solutions AS [9] develops and implements the Enterprise Risk and HSEQ (Quality, Health, Safety and Environment) management system Synergi®. Company is headquartered in Stavanger, Norway's oil and gas capital. Synergi® is a business solution for risk and QHSE management, managing all non-coformances, incidents, risk, risk analyses, audits, assessments and improvement suggestions.

Clients of Synergy® are from all over the world and from different sectors like: energy, transport, health-care, industry, local government.

Modules of Synergy® are optional modules for different business needs. They can be used as standalone solutions or in combination with one another. The modules that are related to risk management are:

- Synergi® Incident Management™
- Synergi® Quality Management™
- Synergi® Risk Management™
    - Plan and handle risk assessments
    - Reduce the risk level by preventive action management.
    - Analyze trends from the risk register and calculate the overall risk factor.
    - Analyze and understand effect of the risk management process in the visualization of initial and residual risk.
- Synergi® Improvement Management™
- Synergi® Behaviour Based Safety (BBS)™
- Synergi® Anonymous Incident Management™

    - Allow all employees, clients or other stakeholders to report of critical conditions, complaints, illegal issues etc through an anonymous reporting channel.
    - Secure follow up, investigations, collection of additional information.
    - Secure anonymous witness communication and information verification.
    - Communication through secure and unique user id and password.
- Synergi® Deviation Management™
    - Coordinate and manage your planned deviations and permits.
- Synergi® Hospital Infection Management™
    - Developed to report and manage Hospital Acquired Infections.
- Synergi® Adverse Drug Reaction Management (ADR)™
    - Developed to report and manage side effects of medication.
- Synergi® Laboratory Medicine Management™
    - Manages all unexpected events and accidents within Laboratory Medicine.

Conclusion to RM Systems on Norwegian Market

There are tips and conclusions for features EQS Risk Management System. The features are derived based on status of Norwegian Software Market that relates risk management.

One must note that most of Norwegian software development companies develop solutions that are specialized for particular industry or sector. The cost of development of these solutions is great. Advantage of these solutions is that they have risk management module as a separate component, the solutions that pay more attention to risk management among project management. Extend AS would be in advantage if it develops risk management software that can be used by any industry or sector. Also, most of these solutions are used by large organizations. The solutions are specialized, more expensive to develop and thus customer will pay more. This may not be the problem for large organizations. But small and medium organizations may decide not to spend their resources on risk management system that is made as separate module among project management system. The system that is made to be generic and configurable for organization needs, may cost less because the same product can be reconfigured and sold to organizations form different industries and sectors.

CHAPTER 4

4 Requirements specification

4.1 Introduction

This chapter presents our requirement specification for the system. It consists of following sub-chapters; non-functional requirements, functional requirements and use cases.

Gathering of requirements was done through our research on risk management field. We had to add requirements “on the go” when we found them. Since we used scrum we had to add requirements during every sprint. We will document the changes in our sprint report, see Sprint1, and Sprint2.

The requirements are divided into two groups, non-functional and functional. Every requirement has a identification code and a priority (HIGH, MEDIUM, LOW) that define how important the different requirements are.

4.2 Non-functional Requirements (NFR)

- **NFR-1: Written in Perl (LOW)**

The module should be written in Perl, since EQS uses Perl. This will make it easier to integrate.

- **NFR-2: Web-based (HIGH)**

The module must be web-based. Since the rest of EQS is web-based, this module should also be it.

- **NFR-3: EQS integration (HIGH)**

The module should be integrated in the already existing EQS. EQS contains valuable data when performing a risk assessment.

- **NFR-4: Communication with other modules (HIGH)**

The module should have an external interface which is available to other modules in EQS. This is necessary for future modules in EQS to communicate with the risk management module.

- **NFS-5: Read/store data from database (HIGH)**

The module must be able to read and store data from a database, either through the already implemented database in EQS, or with its own database-handler.

4.3 Functional Requirements

4.3.1 Risk Assessment (RAS)

- **RAS-1: Add new risk assessment (HIGH)**

The user must be able to create a new risk assessment. The assessment should include name, description and impact type.

- **RAS-2: View risk assessment (HIGH)**

The user must be able to view an existing risk assessment.

- **RAS-3: Modify risk assessment (HIGH)**

The user must be able to modify an existing risk assessment by changing name, description and impact type.

- **RAS-4: Delete risk assessment (HIGH)**

The user must be able to delete an existing risk assessment.

- **RAS-5: View a list of risk assessments (HIGH)**

The user must be able to get an overview of currently existing risk assessments in the system.

- **RAS-6: Input data (HIGH)**

The user must be able to link an assessment to specific data already existing in EQS (procedures, deviation reports, etc.). This helps identifying and analyzing risks.

4.3.2 Risk Identification (RI)

- **RI-1: Add new risk (HIGH)**

The user must be able to add a new risk. The risk should include name, description, source and impact consequences.

- **RI-2: View risk (HIGH)**

The user must be able to view an existing risk.

- **RI-3: Modify risk (HIGH)**

The user must be able to modify an existing risk. Change name, description, source and impact consequences.

- **RI-4: Delete risk (HIGH)**

The user must be able to delete an existing risk.

- **RI-5: View a list of risks (HIGH)**

The user must be able to get an overview of all risks in an assessment.

4.3.3 Risk Analysis (RAN)

- **RAN-1: View Probability (HIGH)**

The user must be able to view the probability of a risk to occur.

- **RAN-2: View Impact (HIGH)**

The user must be able to view the impact of a risk.

- **RAN-3: View Risk Factor (MEDIUM)**

The user should be able to see the risk factor, which means how critical the risk is, measured in probability * impact.

- **RAN-4: Modify Probability (HIGH)**

The user must be able to change the probability of a risk after the initial analysis.

- **RAN-5: Modify Impact (HIGH)**

The user must be able to change the impact of a risk after the initial analysis.

- **RAN-6: Choose positive-/negative-impact (LOW)**

The user should be able to choose if the impact is negative or positive. Since most risks are negative, this is priority LOW.

4.3.4 Risk Evaluation (RE)

- **RE-1: View list of risks (HIGH)**

The user must be able to view a list of all risks in an assessment

- **RE-2: View risks in matrix [probability, impact] (HIGH)**

The user must be able to view all the risks in an assessment in a matrix, showing the more critical risks in the red area. This will help getting an overview of the risks in the assessment, where they are compared to each other.

- **RE-3: Sort risks (MEDIUM)**

The user should be able to sort the risks according to ID, Name, Probability, Impact and Risk Factor.

4.3.5 Risk Treatment (RT)

- **RT-1: View list of all the treatment actions (HIGH)**

The user must be able to view a list of every action in the assessment, sorted by the risk it belongs to.

- **RT-2: View the actions connected to a specific risk (HIGH)**

The user must be able to view all the actions connected to a specific risk.

- **RT-3: Add treatment action to a risk (HIGH)**

The user must be able to add an action to a risk.

- **RT-4: Set status of risk (HIGH)**

The user must be able to set the status of a risk, if it should be treated or not.

- **RT-5: Set treatment type (LOW)**

The user could be able to set the treatment type (Avoidance, Reduction, Sharing, Retention).

4.3.6 Risk Monitoring (RM)

- **RM-1: View all risks in risk factor/time diagram (MEDIUM)**

User should be able to view the sum of all risk factors in a two-dimensional view, where the x-axis is the time, and the y-axis shows the total risk factor. This way, the user can keep an eye on how the total risk of an assessment develops during a project/time scope.

- **RM-2: View risk history (HIGH)**

The user must be able to view the history of a risk in an assessment. This shows any changes made to the risk, all measures done to reduce the risk, all deviation reports connected to the risk.

- **RM-3: View list of measures to do (HIGH)**

The user must be able to view a list of measures/actions that have to be done, sorted by priority. Like a to-do-list.

4.4 Implemented requirements

Requirements implemented in the prototype:

- RAS-1: Add new risk assessment (HIGH)
- RAS-2: View risk assessment (HIGH)
- RAS-3: Modify risk assessment (HIGH)
- RAS-4: Delete risk assessment (HIGH)
- RAS-5: View a list of risk assessments (HIGH)

- RI-1: Add new risk (HIGH)
- RI-2: View risk (HIGH)
- RI-3: Modify risk (HIGH)
- RI-4: Delete risk (HIGH)
- RI-5: View a list of risks (HIGH)
- RAN-1: View Probability (HIGH)
- RAN-2: View Impact (HIGH)
- RAN-3: View Risk Factor (MEDIUM)
- RAN-4: Modify Probability (HIGH)
- RAN-5: Modify Impact (HIGH)
- RAN-6: Choose positive-/negative-impact (LOW)
- RE-1: View list of risks (HIGH)
- RE-2: View risks in matrix [probability, impact] (HIGH)
- RE-3: Sort risks (MEDIUM)
- RT-1: View list of all the treatment actions (HIGH)
- RT-2: View the actions connected to a specific risk (HIGH)
- RT-3: Add treatment action to a risk (HIGH)

4.5 Use Cases

After documenting/collecting the functional requirement for the system, we developed some use cases to describe this system functionality in a more understandable way. Using the UML representation, we have developed the use cases, as well as a short description of each of the tasks.

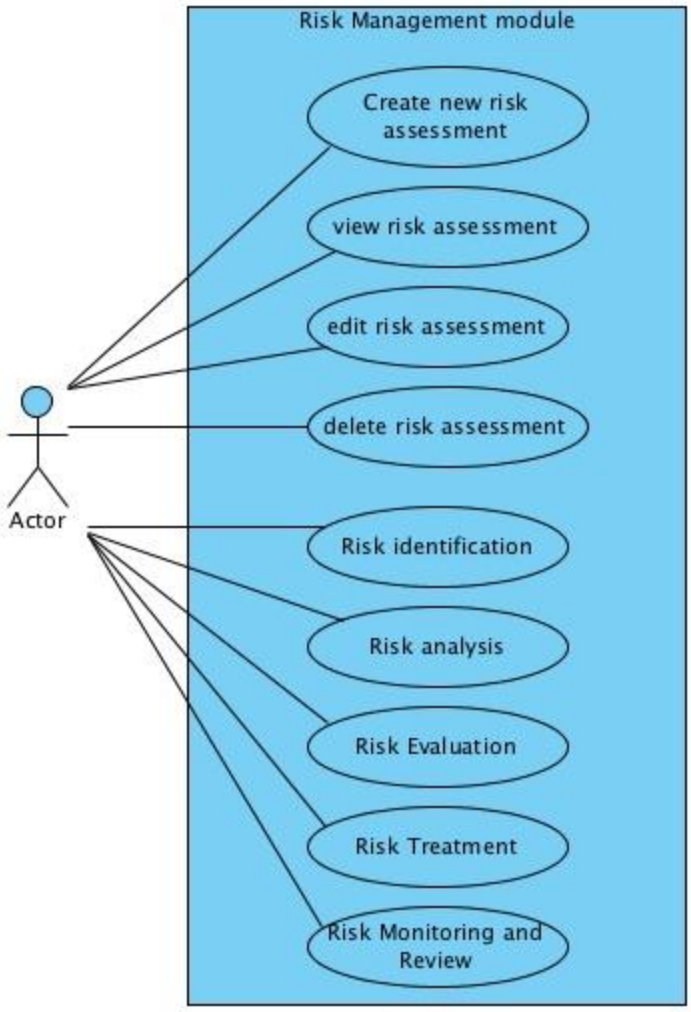


Figure 4.1 - Over all use case

Table 4-1 - UC-1 Risk Management use case

Use case ID	**UC-1**
Name	Risk Management
Description	Over all use case for Risk Management.
Actor	User
Pre-conditions	User is logged in, and the module is up and running

Post-conditions	A new Risk Assessment is created/edited/deleted
Basic Flow	1. User shall be able to create and add a new risk assessment in the system. User fills in the assessment form, which consist of 3 fields, name and description, choose impact type and select/import input data. Then she or he clicks “Create” button, which creates and saves the information in the database. The new risk assessment is created and is ready to be used. 2. User shall be able to view the newly created risk assessment. By clicking on the assessment name, then the user can view this assessment in more detail. She can also view all assessment by clicking on the “risk management”; there she can sort assessments by different assessment properties, like name. 3. User shall be able to edit a risk assessment by clicking on the edit icon. She can then change the assessment information and click on the “update” button in order to save the changes. 4. User shall be able to delete a risk assessment; if user clicks on the delete icon the system ask if the user really want to delete, if the user conforms it, the assessment is deleted, along with all of its risk items. 5. Use cases for Risk Identification, Analysis, Evaluation, Treatment and Monitoring and Review is further expanded on the next use cases.

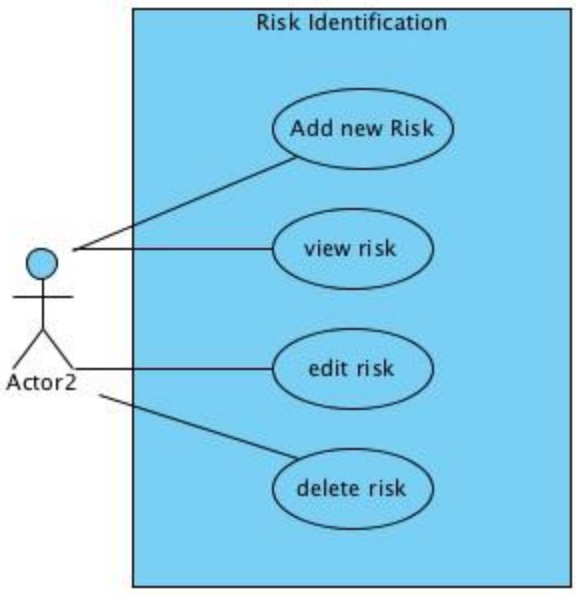


Figure 4.2 - Risk Identification use case

Table 4-2 - UC-2 Risk Identification use case

Use case ID	**UC-2**
Name	Risk Identification
Description	Identifying risks.
Actor	User
Pre-conditions	User is logged in, a risk assessment is created.
Post-conditions	A Risk item is added/edited/viewed/deleted.
Basic Flow	1. User wants to add a new risk item; User fills in the risk form, which consists of four fields, name, source, exposure and description. Then she or he clicks “add” button, which creates and saves the information in the database. A new risk is created and added to the system. 2. User views the newly created risk by clicking on the risk name; then she can view this risk in more detail. She can also view all risk; where she can sort risk by different risk properties, like risk factor. 3. User can edit a risk by clicking on the edit icon. She can then change the risk property and click on the “update” button in order to save the changes. 4. User can also delete a risk; if user clicks on the delete icon the system ask if the user really want to delete, if the user conforms it, the risk is deleted, along with all of its tactics.

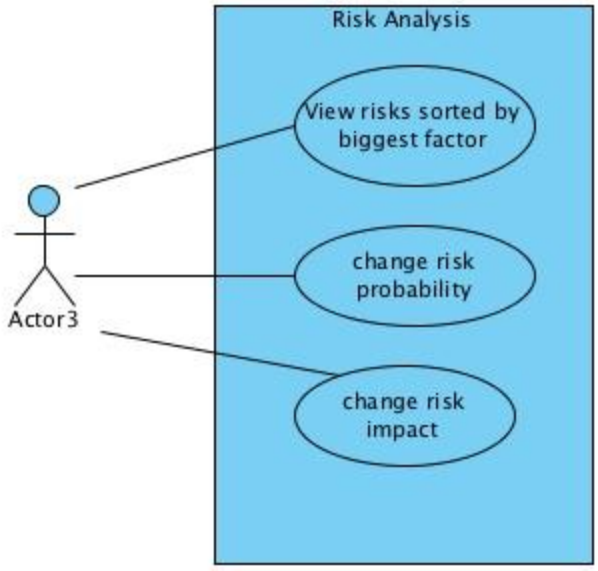


Figure 4.3 - Risk Analysis use case

Table 4-3 - UC-3 Risk Analysis use case

Use case ID	**UC-3**
Name	Risk Analysis
Description	Analyzing risks.
Actor	User
Pre-conditions	User is logged in, risk items are identified and added to the system.
Post-conditions	Risk impact / probability and factor is changed
Basic Flow	1. User can update the risk probability and impact after she has analyzed and decided what impact and probability a risk should have. Since the risk factor is dependent on the risk probability and impact, the risk factor is recalculated and updated as well.

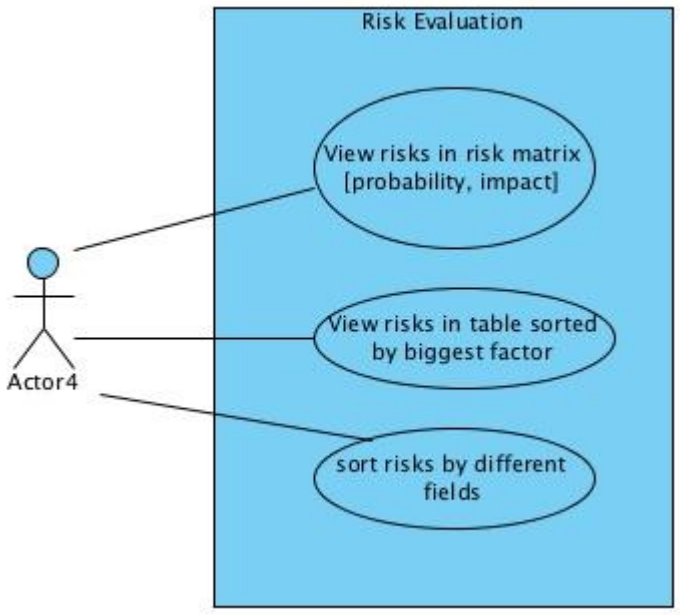


Figure 4.4- Risk Evaluation use case

Table 4-4 - UC-4 Risk Evaluation use case

Use case ID	**UC-4**
Name	Risk Evaluation
Description	Evaluation of risks.
Actor	User
Pre-conditions	User is logged in, risks are identified and added to the system and also risks are analyzed.
Post-conditions	Better understanding of risk items. User can see which risks are important so it can be handled first.
Basic Flow	1. User shall be able to view all risks in a two dimensional matrix, where the x-axes is the probability, and the y-axes indicate the impact. 2. User shall be able to view all risks in a table, where the user has can sort risks

	by different risk properties, like risk factor, which is the product of impact and probability.

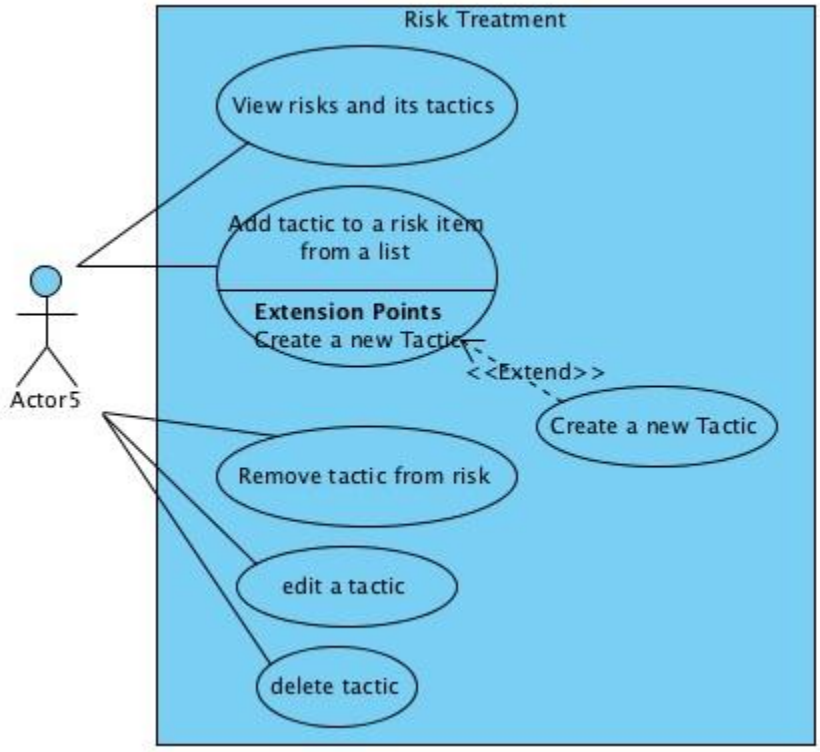


Figure 4.5 - Risk Treatment use case

Table 4-5 - UC-5 Risk Management use case

Use case ID	**UC-5**
Name	Risk Treatment
Description	Threat a risk
Actor	User
Pre-conditions	User is logged in, risks are identified and added to the system and also risks are analyzed.

Post-conditions	Counter measures are identified and created for each risk item, in terms of risk action. Each risk actions contains a document where the there is concrete proposals of TODOs to reduce the risk item.
Basic Flow	1. User shall be able to view a risk item in details, along with all its tactics. 2. User shall be able to add a tactic to a risk item from a tactic list. If there is not a appropriate tactic, the user shall be able to create a new tactic item. 3. User shall be able to edit a tactic 4. User shall be able to remove a tactic from a risk item. 5. User shall be able to delete a tactic from the system.

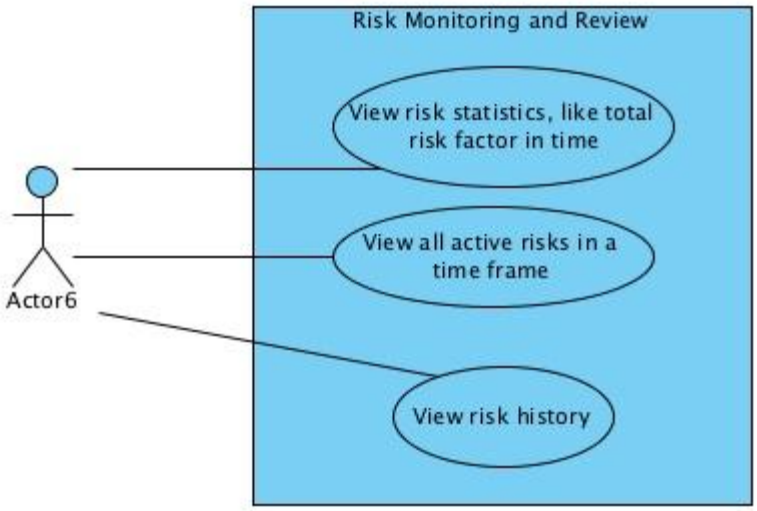


Figure 4.6 - Risk Monitoring and Review use case

Table 4-6 - UC-6 Risk Management use case

Use case ID	**US-6**
Name	Risk Monitoring and Review use case
Description	Monitoring risks in long term, see how a risk has changed when time passes.
Actor	User
Pre-conditions	User is logged in, risks are identified and added to the system and also risks are analyzed.
Post-	Get knowledge of risk history. The knowledge can be used in the next project/risk

conditions	assessment
Basic Flow	1. User shall be able to view risk factor in a two-dimensional view, where the x-axis is the time, and the y-axis shows the total risk factor. 2. User shall be able to view risk history. How a risk has developed during the project/ risk assessment

4.6 Class diagram

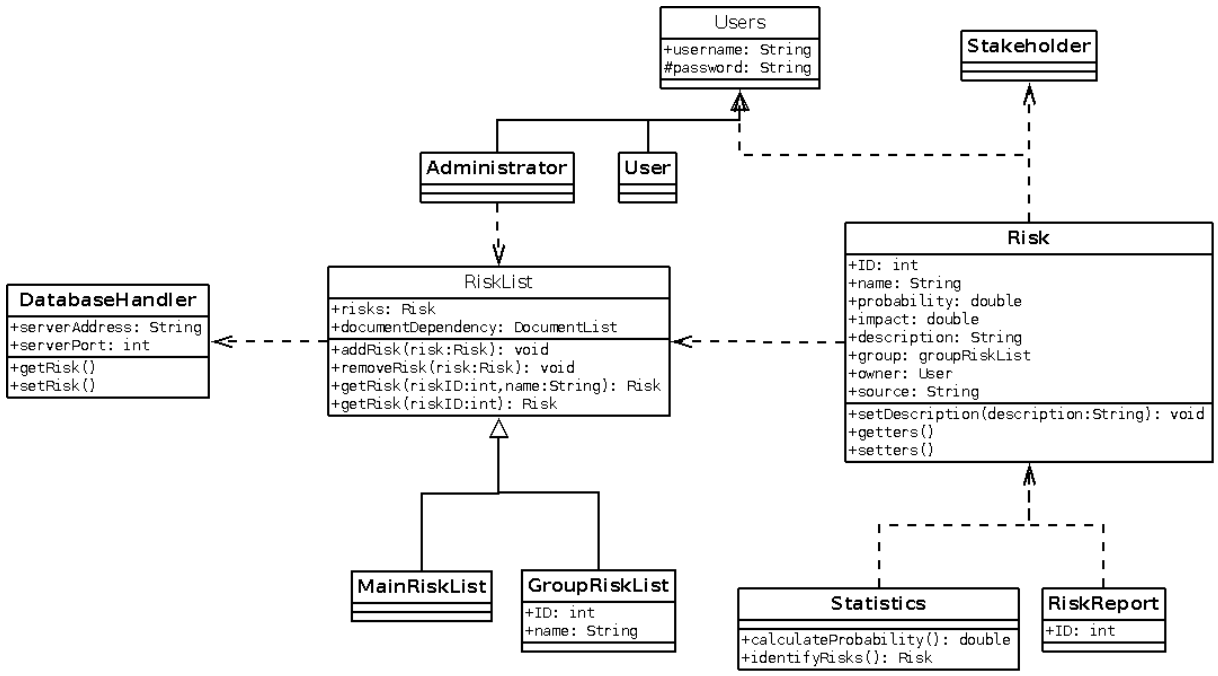


Figure 4.7 - Class diagram

Risk is the class that represents each risk, with all necessary information. RiskList is an abstract class which contains reference to many Risk-classes. MainRiskList and holds reference to all the risks in the system, while GroupRiskList is associated to a department or group which has a reference to the risks belonging to them. Both classes inherit RiskList. Stakeholder is a class which holds information about the stakeholders of a risk. The Statistics-class calculates probability for a risk based on statistics from EQS, like how many people have read a certain document associated to a process with a risk. It can also identify new risks based on the same statistic from EQS. RiskReport is a class that writes a summary of a report.

The Users-part is based on EQS' already existing user-system, this diagram only shows that the Risk Management Module needs admin-users and regular users. The administrator can add/edit/delete/read risks, while the regular users can read risks associated to them.

The DatabaseHandler is for connecting to an SQL-database, which contains all the risks and groups for preserving data.

4.7 Test Plan

We are planning to test everything continuously when we have enough code to test a particular test. This is because it's easier to fix an error right after you have written it, when you still got the written code fresh in your mind. Test runs that pass the criteria of the test will be given a date of the day it was successfully run. We are also planning to report the summary of the testing at the end of each sprint, this because it will give an overview of what we have completed, and what we need to focus on. Tests that have already passed, or tests that are too early to test will not be written in the summaries, unless there is some implemented bug that we can't find that mess up a passed test. Since it is a web application it's also important to write down the browsers that it was successfully run on.

Test identifiers

Each test will be given a unique number after the following criteria:

P-xxx - Performance tests

F-xxx - Functionality tests

Here we write xxx as unknown numbers not yet assigned.

4.7.1 Test template

See section A1 Test template

4.7.2 4.6.3 Test overview

The description of the tests will be found in appendix D.

F-000 - Adding risks into the system.

F-001 - Deleting risks from the system.

F-002 - Testing the fields in add and edit risks.

P-000 - Testing the different sorts we are offering.

F-003 - Editing risks

F-004 - Reading risks

Part II

Scrum

CHAPTER 5

5 Sprint 1

5.1 Introduction

This chapter contains the documentation for our first sprint, it contains sprint planning, sprint deliverable, customer feedback and sprint evaluation.

Duration for this sprint was set to two weeks, and it took place in week 39 and finished in week 40. We use a very agile sprint methodology. During this sprint the group continued researching risk management and made requirements of all the research. We used our requirements to make some mockups that our customer evaluated and gave us some pinpoint of which direction we should continue. The next step was to make a functioning prototype in Perl, but because of the limitation of the WMware image, and the fact that no one of the group members had any experience in writing code in Perl, we decided to write a very simple prototype in a known technology in this sprint and later write it in Perl. We chose to write our prototype in PHP, since two of our group members had good experience in PHP.

5.2 Sprint planning

Scrum methodology started a few weeks after the beginning of the term and that is why our first sprint was established late. It covered all of our preliminary study, pre-development research and development. During this sprint we attempted to consider all the research and preliminary study part in the sprint backlog. A prototype was also being implemented during it. This section contains aims and overview of this sprint as well as the sprint backlog.

5.3 Sprint goal

Our project goal is to develop risk management software for Extend, in order to achieve this we planned to put most of our effort on the research due to our lack of knowledge in risk management. In this sprint we were going to use ISO 31000 and 31010 standards as well as other existing risk management software to obtain requirements for our own project. We were further planning to use these requirements to make use-case diagrams, class diagram, ER diagram and a GUI mock-up. For getting familiar with the programming platform (Perl), we also signed some tasks regarding basic Perl programming. Because the pre-delivery deadline was getting close, we were also planning to focus a little on our main report.

Task	Estimated hours	Actual hours	Variance
Prototype	25	50	-25
preliminary study	85	80	5

Requirements	77	66	11
Finalize pre-delivery	40	25	15
Sum	227	221	6

**Hours were made up during reporting because there wasn't any estimate beforehand.*

5.4 Deliverables

This section will include what we had produced during sprint 1.

5.4.1 Requirements

Functional requirements

Risk Identification

Requirement Code	Priority	Task
FR01	High	Risk Owner must be able to identify risk by defining risk's source. Risk source can be tangible or intangible.
FR02	High	Risk Owner must be able to identify risk by defining risk's event. Occurrence or change. Can be something that did not happening. There can be one or more events.
FR03	High	Risk Owner must be able to identify risk by defining risk's consequences. Can be positive or negative. Can be expressed qualitatively or quantitatively.
FR04	High	Risk must be linked with external or internal context (stakeholders, objectives, impact area)
FR05	High	Risk Owner must be able to define probability/likelihood of happening.
FR06	Medium	Risk Owner should be able to write description.
FR07	High	Risk Owner must be able to edit risk he created.
FR08	High	Risk Owner must be able to delete risk he created.
FR09	Medium	Risk may be identified automatically for automated processes.
FR10	Medium	Risk Owner must be able to view risk's profile that contains risk attributes.

Risk Analysis

Requirement Code	Priority	Task

FR11	High	Users must be able to analyze risks. Risks may be represented as a list categorized by consequences and likelihood/probability.
FR12	High	Users must be able to set risk level /priority and describe way of setting that level /priority to risk. (Risk may have multiple consequences with different likelihoods)
FR13	High	Users must be able to edit risk consequences, likelihood/probability.
FR14	High	Users must be able to set dependences between risks.
FR15	Medium	Users may be able to analyze risks. Risks may be viewed graphically (matrix: [Consequence, Likelihood])

Risk Evaluation

Requirement Code	Priority	Task
FR16	High	Users must be able to view risks. Risks may be represented as a list categorized by source, event and context
FR17	High	Users may be able to analyse risks. Risks may be viewed graphically (matrix: [Context, Likelihood])
FR18	High	Users must be able to sat status of risk (it can be decided not to treat risk)

Risk Treatment

Requirement Code	Priority	Task
FR19	High	Users must be able to define risk treatment type. (Avoidance, Reduction, Sharing, Retention).
FR20	High	Users must be able to define actions for risk treatment.
FR21	Medium	New processes for treatment may be started automatically.

Risk Monitoring

Requirement Code	Priority	Task
FR22	High	Users must be able to view all the risks in a time frame, which shows when the risk first was identified and how it has changed in time, with aspect to

		consequence and likelihood.

Actors

Actor code	Actor name	Actor description
A1	Risk Owner	Person or entity with the accountability and authority to manage a risk
A2	Risk Stakeholder	Person or organization that can affect or be affected by risk (example: decision maker)
A3	Risk Viewer	Person or organization that perceive themselves to be affected by a decision or activity

Non-functional requirements

- The module must be written in Perl
- The module must be web based
- The module must be able to be integrated with existing EQS system
    - The module must be contactable with other future modules of EQS
- The module must be able to read/store data from a oracle database

New requirements

We chose to develop in PHP instead of Perl. So we had to change some of the requirements during the sprint. This resulted to that we had to change the non-functional requirements, to these requirements:

- The module must be written in PHP
- The module must be able to read/store data from a MySQL database

5.4.2 Prototype

Mock-ups

Before starting the development of the risk management module we made mock-ups, we made these with the free version of Balsamiq[62]. These were made to have something to show the customer before we started to develop, so we didn't waste time if we misunderstood the demands from the customer. We used these to have a kind of presentation for the customer

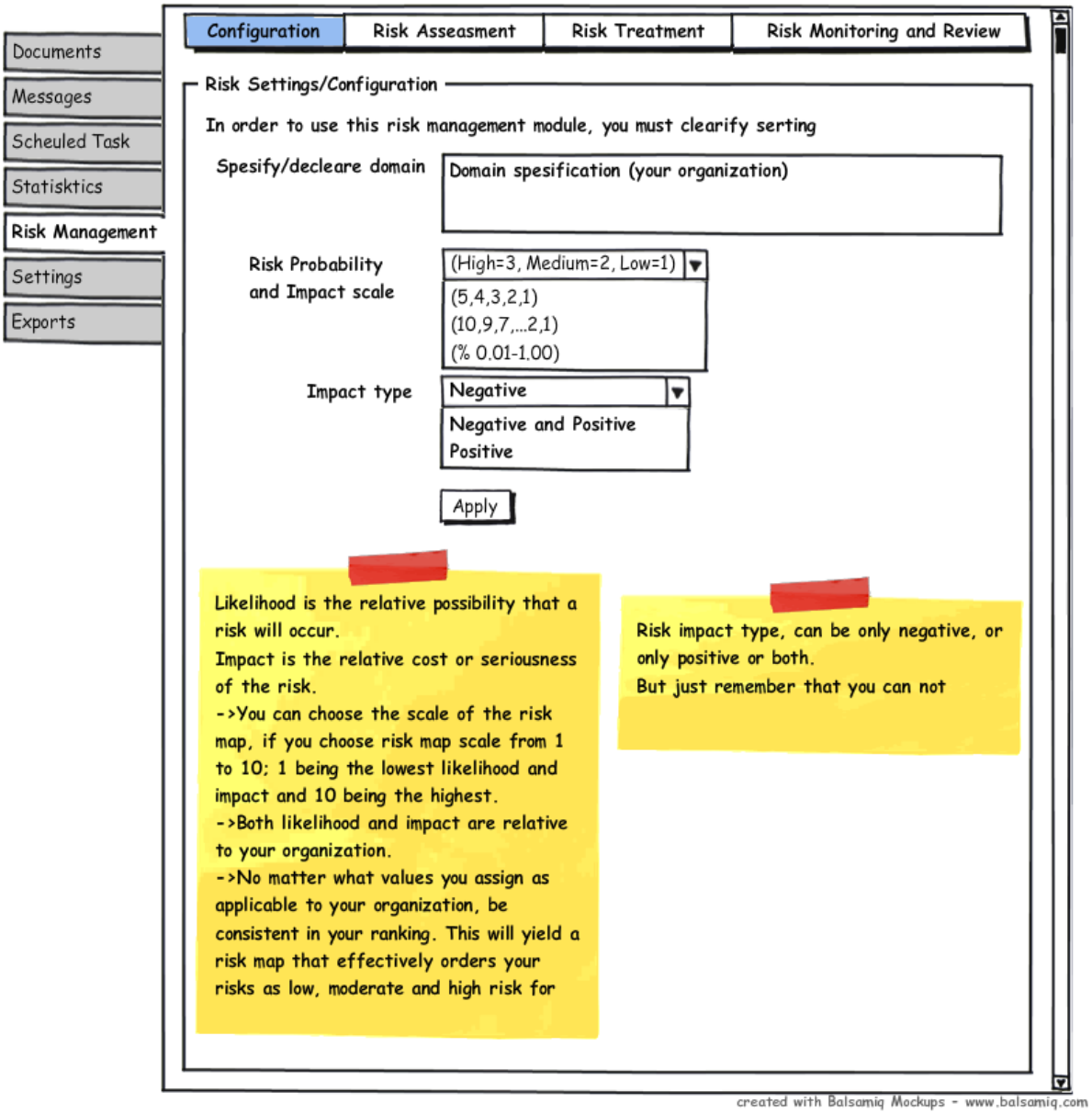


Figure 5.1 - Mock-up look

Figure 5.1 shows how the mock-ups look like, to view the others look at Appendix B.

Functioning prototype

The functional prototype was made in PHP, we used simple scripting to make this. The main reason for making this prototype was to show what kind of functionality we had implemented. The plan is to make a more functional prototype in object oriented PHP that covers more of our requirements. Along with PHP we used MySQL as our database this would handle the data that we stored.

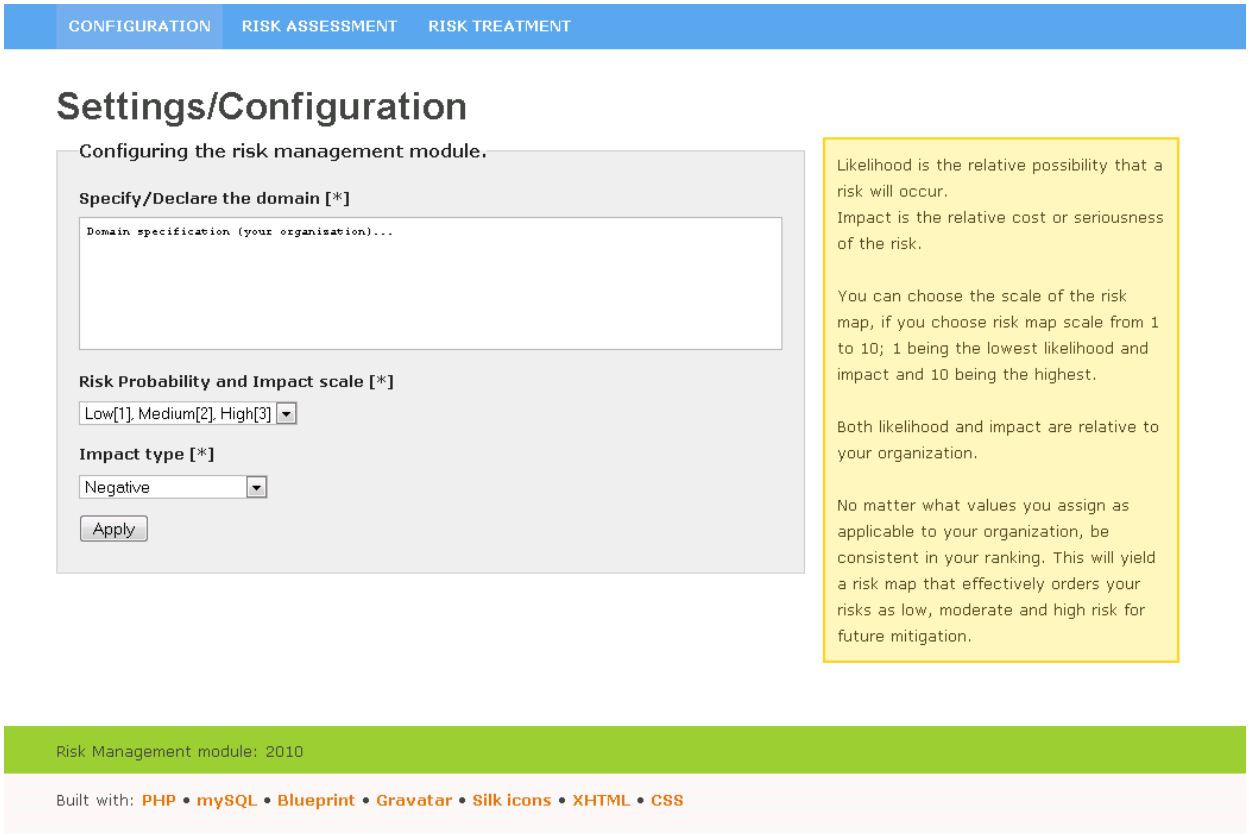


Figure 5.2 - Configuration page of the risk management

Figure 5.2 shows how the configuration page of the risk management, to see the other screenshots see **Appendix B**.

We managed to implement these requirements during this sprint:

- FR5
- FR6
- FR7
- FR8
- FR10
- FR13
- FR16
- NFR2

ER-diagram

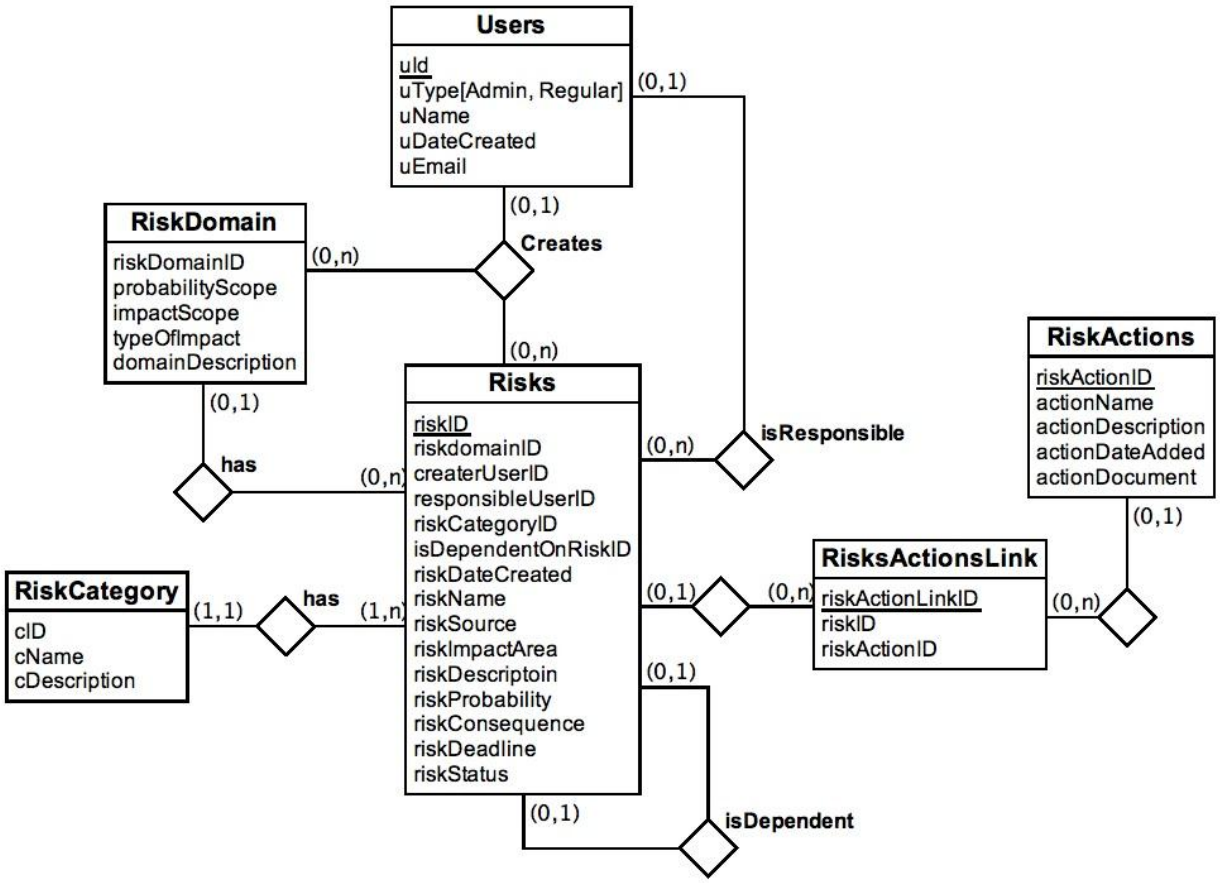


Figure 5.3 - ER-diagram, sprint 1

This is the ER diagram to our functional prototype database.

Site Map

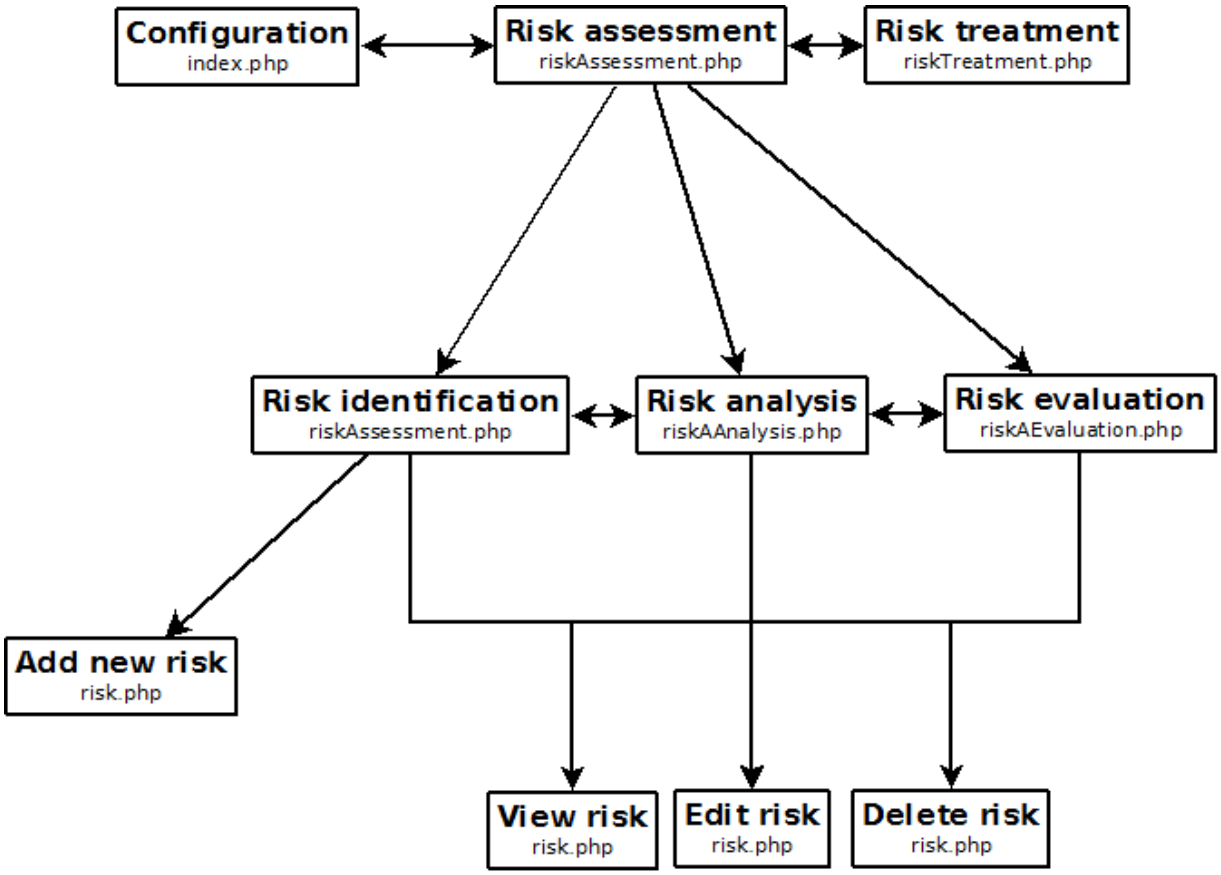


Figure 5.4 - Site map, sprint-1

This is the site map to our functional prototype.

5.5 Customer feedback

5.5.1 Feedback for the prototype

The customer wants a module that can handle many risk assessments, which each risk assessment contains a set of risks, and that each risk contains a set of tactics strategies to handle that risk item. Our system as it is now does not support this functionality, it can only handle one risk assessment.

Figure 5.5 - The system as it is in sprint 1.

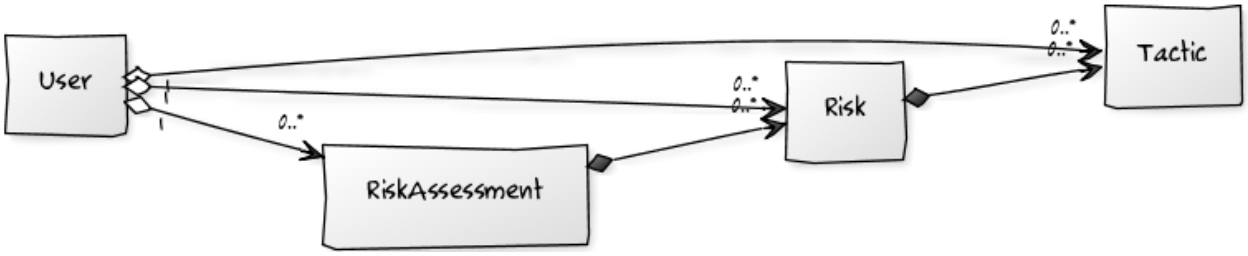


Figure 5.6 - This is what the customer wants.

Further more the customer wished that we should have the same functionality for handling risk tactics as what the EQS system supports today. And that is that in the process of risk treatment for each risk item these steps should be taken place: 1. create procedure, 2. execute procedure, 3. approve procedure. Which in this context, it means:

1. Creating a risk tactic, where there are concrete TODOs/procedures that handle a risk item.
2. The risk responsible should execute these procedures in time.
3. Someone else should approve that the procedure is executed in an approvable quality.

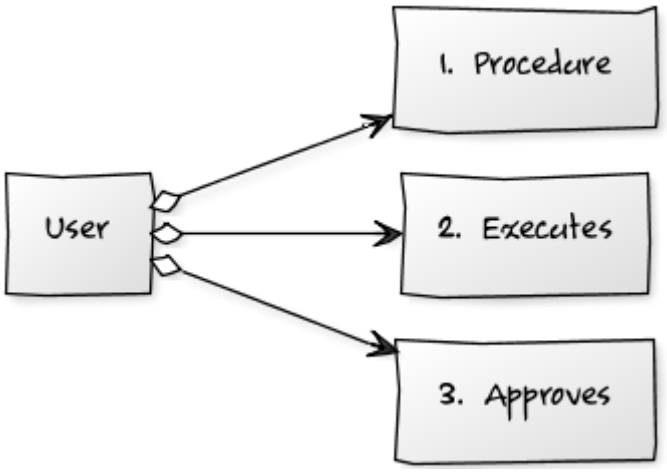


Figure 5.7 - Procedure is the same as a tactic in our system

We also got feedback from other employees of Extend AS, they wanted us to go through everything again, like an iterative motion. A new demand was that they wanted us to import data from their database, using an XML parser. The data would be used to estimate new risks in our module, manually and automatically.

5.5.2 Feedback for the preliminary study (research on risk management)

Our customer contacts felt that we had not documented enough on how the different industries use and need risk management. They suggested to us that we should do research in different fields where risk management is used. But most importantly they wanted us to do a more thorough research on risk management implementation in different fields.

This effectively changed our project plan, which led to spend two weeks improving the preliminary study, and not be able to do three sprints as planned.

5.6 Sprint Evaluation

This sprint lasted two weeks. During these two weeks we estimated that we would use 227 hours on research, preliminary study and development. The actual number was 221, that's a variance on 6 hours. This has something to do with our use of the scrum methodology, which in our case was more like a agile form of scrum. This was the only way we could use scrum since the members in the group have a diverse school schedule. Another thing that could affect the variance is that some of the estimation of hours was not made in advance, so we wrote the estimations of what we thought we would use in the estimation. The group understands that this is something we have to improve. There were also some hitches when writing hours used. Not everyone wrote down the time that was used on the different tasks.

During this sprint we had to remove some tasks, this was done when we found out that these tasks were unnecessary. We also had to add new tasks. This was our use of the “agile” sprint.

We had problems sticking to our main roles that was established in the beginning, see section 2.3.1 Roles. So we made main and secondary roles, in case the main person didn't or couldn't complete his\her task.

6 Sprint 2

6.1 Introduction

This chapter contains documentation for our second sprint, it contains sprint planning, sprint deliverable, testing, customer feedback and sprint evaluation.

In sprint 1, we tried to implement a very simplified version of risk management in PHP to see if we had understood risk management and the customer requirements. And in this sprint we planned to implement the prototype in Perl, and also implement most of the missing functionality and features in our prototype. But based on the feedback from the customer on sprint one, we completely threw away Perl, and continued with the PHP. We also acknowledged the customers second feedback, which was to do one more iterative, and do everything one more time, which meant doing preliminary study, requirement collection and finally improve our prototype based on preliminary study and the new features and requirements.

6.2 Sprint Planning

This section will explain the overall goals we have for this sprint, and the backlog items we will implement.

6.2.1 Sprint Goal

After the first sprint, we have a solid foundation for a new iteration, and improving both the preliminary study, requirements and the prototype.

Table 6-1 shows our overall sprint plan along with its estimated and actual time spent on.

Table 6-1 - Sprint 2 log

Task	Estimated hours	Actual hours	Variance
Study on risk management implementation in different industry/field	80	102	-22
Prototype	104	87	17
Documenting	78	72	6
Sum	262	261	1

6.2.2 A more detailed sprint plan

1. Do more research, particularly on risk management implementation in different fields, and use the founding to improve our requirements and the prototype.
2. Implement the prototype in an object oriented way, since this is going to make our job much easier to change and modify. (Since in our first sprint we didn't have any database class etc.)
3. Change the database to reflect the new features/ changes.
4. Implement the features
5. Document the changes and features

6.3 Deliverable

6.3.1 Research on risk management

During sprint 2 we have improved risk management definition in more details as the customer requested. We have also written about risk management in different fields and how that is related to our solution. For more detailed information see chapter 4.

6.3.2 Prototype

In this sprint we improved our risk management system, and implemented unimplemented functionalities. One of the main functionalities implemented were our support for adding risk assessments. Our system now supports the creation of many risk assessments where each individual assessment can hold several risks. When a risk assessment is deleted, all its content will also be removed from our system. Another important feature implemented were the risk matrix view, a two dimensional graph with impact and probability at its x and y graph respectively. It is a nice tool to see which risks to focus on in further analysis. All risks of a particular risk assessment are mapped in this risk matrix.

Here is a list of requirements that was implemented in our prototype in this sprint:

- RAS-1: Add new risk assessment (HIGH)
- RAS-2: View risk assessment (HIGH)
- RAS-3: Modify risk assessment (HIGH)
- RAS-4: Delete risk assessment (HIGH)
- RAS-5: View a list of risk assessments (HIGH)
- RI-1: Add new risk (HIGH)
- RI-2: View risk (HIGH)
- RI-3: Modify risk (HIGH)
- RI-4: Delete risk (HIGH)
- RI-5: View a list of risks (HIGH)
- RAN-1: View Probability (HIGH)
- RAN-2: View Impact (HIGH)
- RAN-3: View Risk Factor (MEDIUM)
- RAN-4: Modify Probability (HIGH)

- RAN-5: Modify Impact (HIGH)
- RE-1: View list of risks (HIGH)
- RE-2: View risks in matrix [probability, impact] (HIGH)
- RE-3: Sort risks (MEDIUM)
- RT-1: View list of all the treatment actions (HIGH)
- RT-2: View the actions connected to a specific risk (HIGH)
- RT-3: Add treatment action to a risk (HIGH)

6.4 ER-diagram

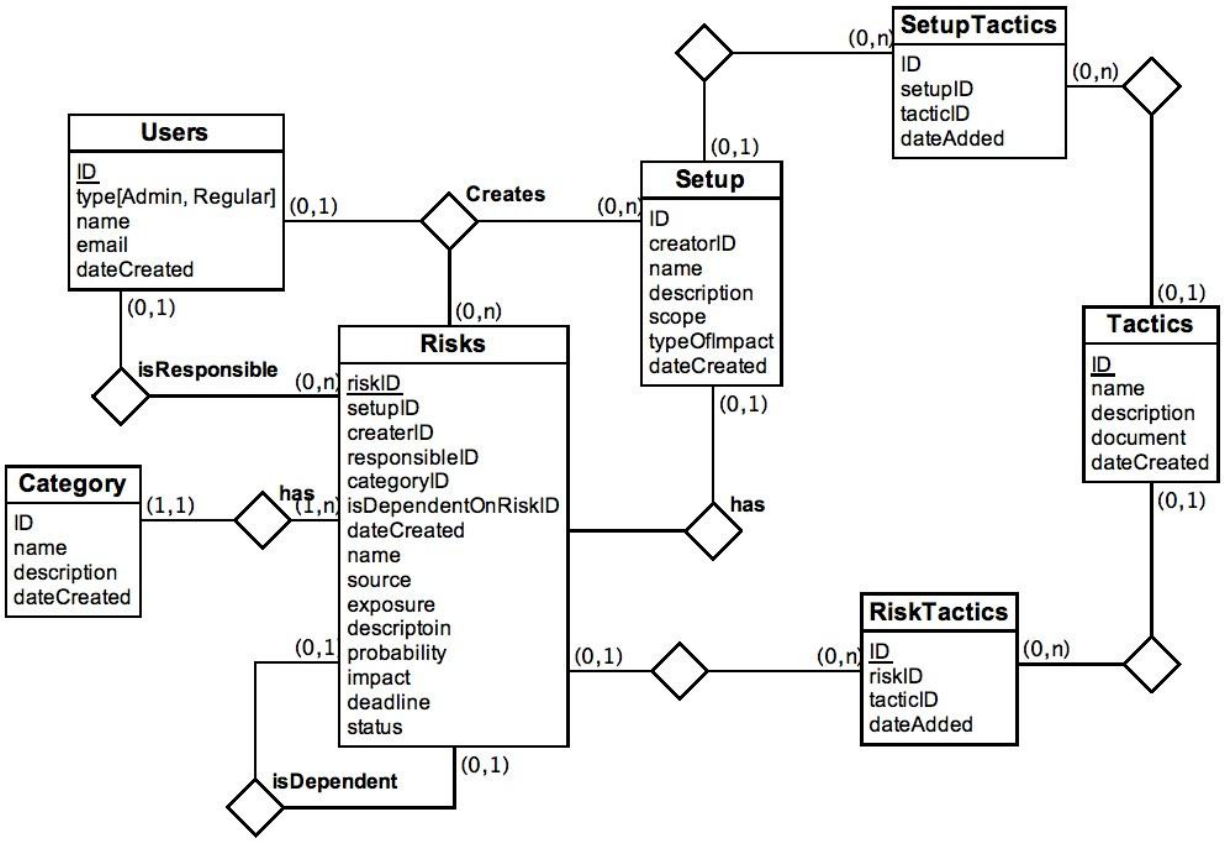


Figure 6.1 - Data model

This is the ER diagram to our functional prototype database. The setup table corresponds to risk assessment.

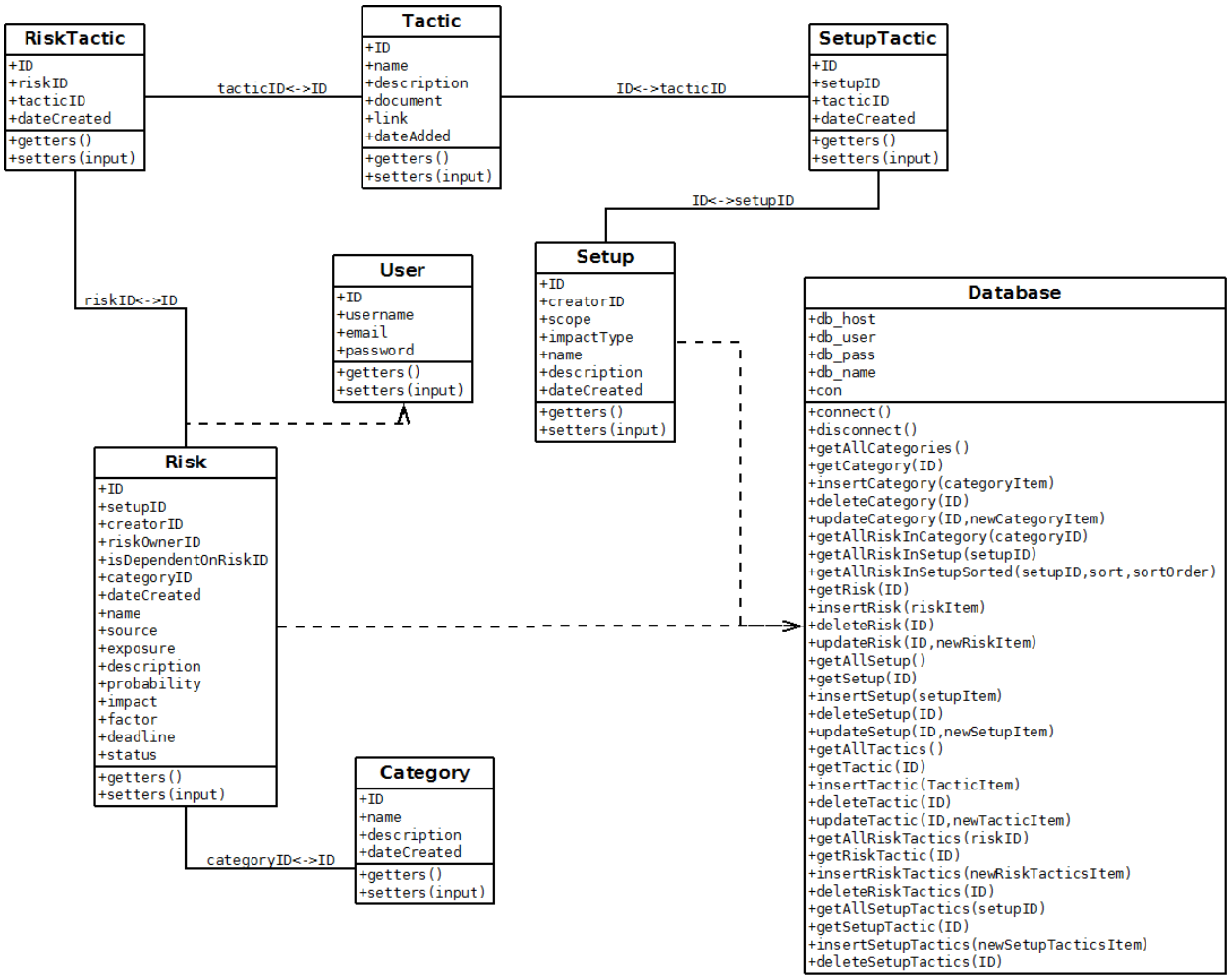


Figure 6.2 - Class diagram

This is the site map to our functional prototype.

6.5 Site map

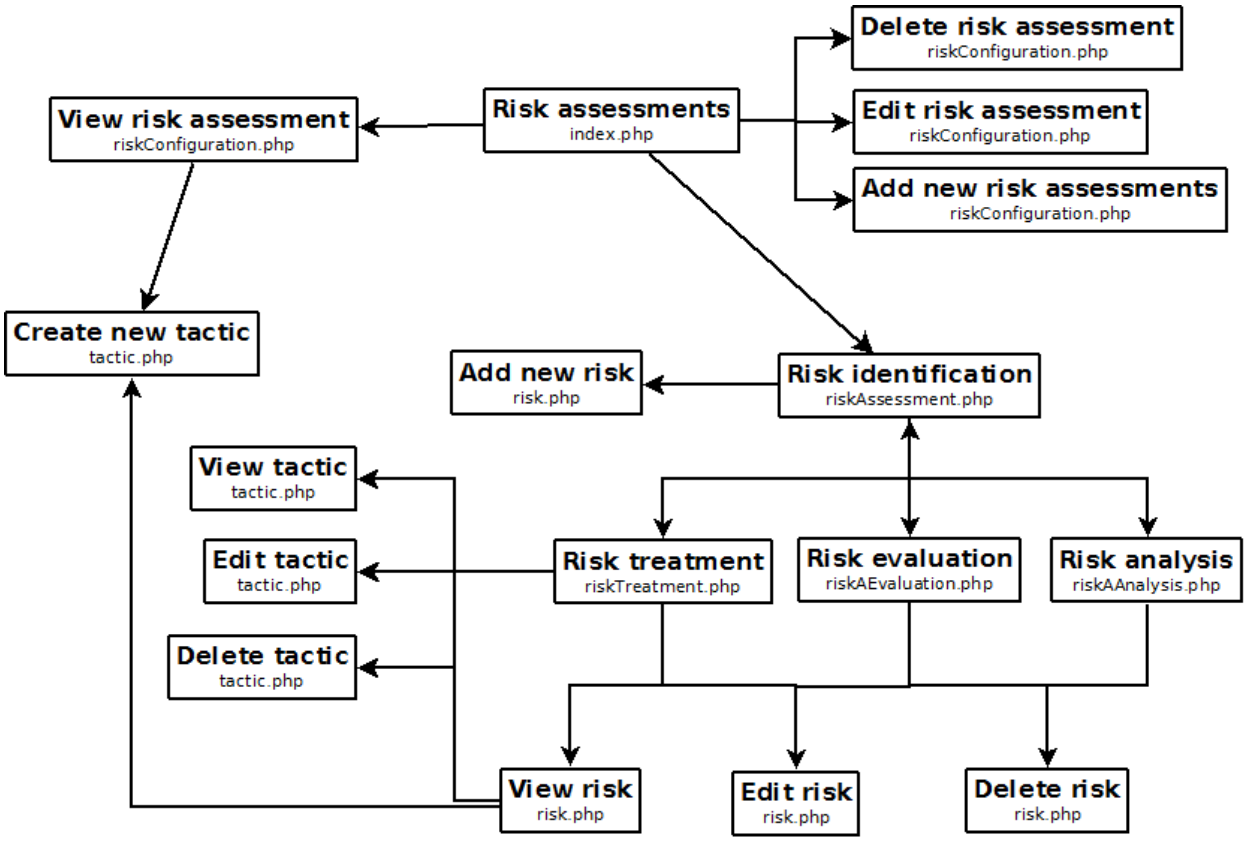


Figure 6.3 - Site map

This is the site map to our functional prototype.

6.6 Screenshots

The results of this sprint as screenshots can be found in appendix C.

6.7 Testing

This chapter will give a summary of the different tests being run in sprint 2 with its results. Details on how we are performing the testing will be found in chapter 4.6 while the respective test cases are to be found in appendix D.

Title	Adding list group
Identifier	F-000
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run was successful

Title	Removing, editing and reading list group contents.
Identifier	F-001
Responsible	Bjørn Fevang
Date	02.11.10
Results	This was divided into 5 points: 1. Test run successful 2. There were made no confirmation message, however writing into the fields and moving without pressing the edit field did not alter the contents. 3. Pressing edit button made it update the field values 4. There was no cancel button in the following confirmation message, this need to be fixed. 5. Test run successful

Title	Adding risks
Identifier	F-002
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run was successful. However every field couldn't be added in the Add risk function

Title	Deleting risks
Identifier	F-003
Responsible	Bjørn Fevang
Date	02.11.10
Results	Lack of cancel in confirmation message, else ok.

Title	The fields concerning add and edit
Identifier	F-004

Responsible	Bjørn Fevang
Date	02.11.10
Results	No restriction on the fields was followed. You could add empty strings in fields which demanded at least one character. You could enter weird characters. Could enter strings in number fields. And changing impact option didn't change the appearance of the evaluation graph

Title	**Editing risks**
Identifier	F-005
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Reading risks**
Identifier	F-006
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Checking the risk tab**
Identifier	F-007
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Setting risk probability and impact**
Identifier	F-008

Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Risk evaluation tab**
Identifier	F-009
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Sort test**
Identifier	F-010
Responsible	Bjørn Fevang
Date	02.11.10
Results	The sort of risks worked as intended, however sorting weren't implemented at the overview of risk groups.

Title	**Creating tactic**
Identifier	F-011
Responsible	Bjørn Fevang
Date	02.11.10
Results	The tactic was created with links and documents working as intended, however there was a lack of description of where the link actually takes you.

Title	**Edit, view and delete tactics**
Identifier	F-012

Responsible	Bjørn Fevang
Date	02.11.10
Results	There is a lack of ability to view and edit tactics unless you have added it to a risk, but at that point you can enter the specific risk and edit and view the tactic as wanted. For the deletion part there is no deletion button implemented, which should be fixed.

Title	**Linking tactics to a risk**
Identifier	F-013
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Treatment tab**
Identifier	F-014
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Removing tactics from a risk**
Identifier	F-015
Responsible	Bjørn Fevang
Date	02.11.10
Results	Test run successful

Title	**Server response time**
Identifier	P-000

Responsible	Bjørn Fevang
Date	02.11.10
Results	With low amounts of data this test run was successful, however testing it huge amounts of data is beyond the scope of today's test.

Title	**Timing the sorting**
Identifier	P-001
Responsible	Bjørn Fevang
Date	02.11.10
Results	With low amounts of data this test run was successful, however testing it huge amounts of data is beyond the scope of today's test.

Title	**Usability test**
Identifier	U-000
Responsible	Bjørn Fevang
Date	16.11.10
Results	Tested a test subject with the name Jan Eriksson and gave him the tasks for him to work on, with no guides on the system beforehand. The task solving itself went like this: 1. Had some problems with the go back functionality, else it went fine. 2. Used quite some time to enter the specific risk assessment, once entered it went fine. 3. Went fine 4. Went fine 5. Managed to find an infinite loop through our go back functionality when deleting this assessment 6. Trouble finding the proper tab made for this purpose, so he went through all tabs manually, which made him use a lot more time than anticipated. 7. Went fine. Total time usage was 9 minutes to solve the tasks which is 4 more minutes than our maximum limit and is therefore unacceptable. Jan himself had these comments on the

system after the test was complete:

1. There was a lack of tooltips at the clickable pictures which made him wonder what they actually did
2. The menu tab looked like a step guide, which lets you know how far you have come in a process, and not actually a tab you can select your wanted area yourself. This explain a lot of the time usage on task 6.
3. The go back functionality were more confusing than helpful.

   Point 1 and 3 where addressed and fixed shortly after.

6.8 Client Feedback

In the end of the sprint we had a small presentation of what we had done so far. The section is split into the prototype, and the research on risk management.

6.8.1 Prototype

The customer said that the prototype looked like what he imagined, and it was good enough, but we had missed an important functionality, and that was risk monitoring and reporting. We should have implemented something that tracked/logged history of each individual risk item.

6.9 Sprint Evaluation

We originally planned to perform three sprints, and we estimated two weeks for each sprint, see chapter 2 planning, but after finishing sprint one we realized that we didn't had developed the product concept as good as we should have, this is reflected in the feedback from the customer. This changed our plan, and we decided to do more research on risk management, particularly risk management implementation in different fields. So we spent two weeks researching on risk management and to improve our product concept, then we spent two more weeks to improve our requirements based on this research and implement it into our prototype.

Since we had to redo most of our work, we didn't spent a lot of time estimating and planning, but rather doing the work. That's way we get so big variances between the planned and the actual workload. The biggest variance we got was on the research on risk management and the implementation of risk management on different fields.

Part III

Conclusion & Evaluation

7 Design

7.1 Introduction

This chapter presents the system in general, it explains how it should work within the EQS system. It also gives an overview of the limitations of our prototype and possible future improvements.

7.2 Architecture

7.2.1 Component diagram

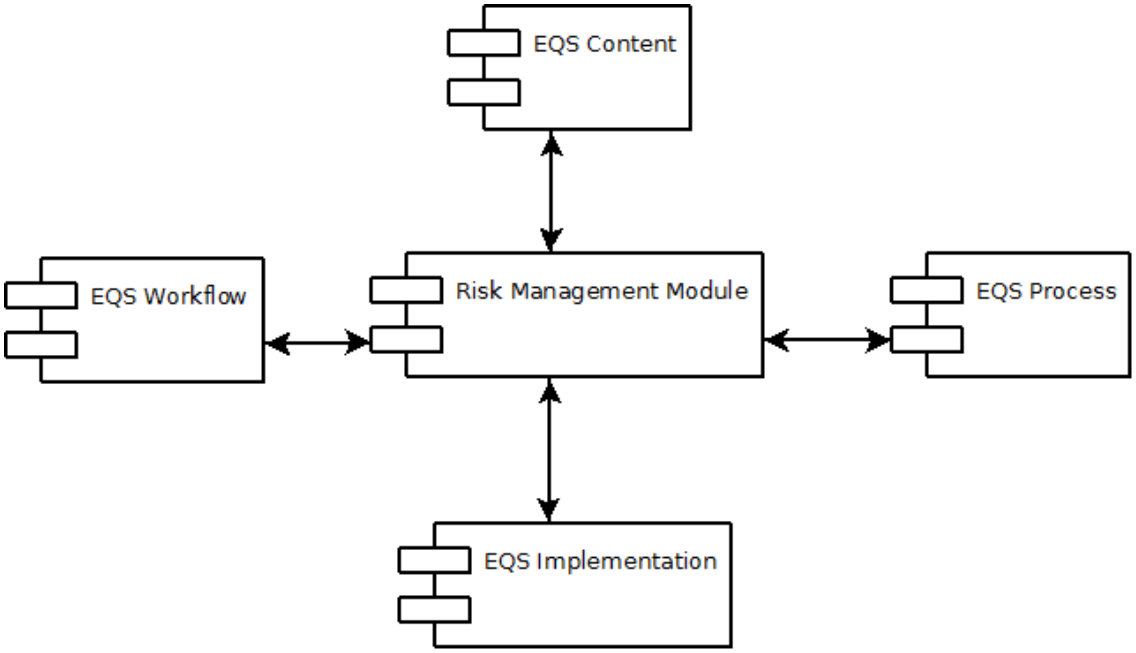


Figure 7.1 - Component diagram

Risk Management Module is the module we are researching about and created a prototype of in this project. The component diagram show how it is connected to other modules in EQS. It uses the different modules both to collect data for risk assessment, analyzing risks and creating tactics to handle the risks. The other modules can also get information from this module if needed.

EQS Content is the main module of EQS. It lets the user find a valid and approved version of the right document easily. The Risk Management Module can utilize this when creating a risk assessment. Many documents in EQS contain valuable data when analyzing risks. When creating an assessment the user should be able to link to these documents, and then it is easy to use the already existing EQS Content module.

EQS Workflow is a module which handles events, deviations and statistics. The statistics is valuable as input when analyzing risks. If it has been many deviation reports on a specific procedure, then it should affect the probability of the risk which is linked to that procedure. It also provides the functionality to create, execute and approve tasks.

EQS Process is a module which visualizes processes and links these to relevant documents. This can be a part of the tactics in risk treatment, but also as input to an assessment.

EQS Implementation is a module which gives statistics over what document is read or not, and how many that have read it. This is useful when analyzing risks in an assessment. If a document should be read by many users in a department, but is only read by a few, then it should have an influence on the probability or impact of a risk.

EQS is more than four modules, but most of the functionality the Risk Management Module needs is covered in these four.

7.2.2 Activity diagram

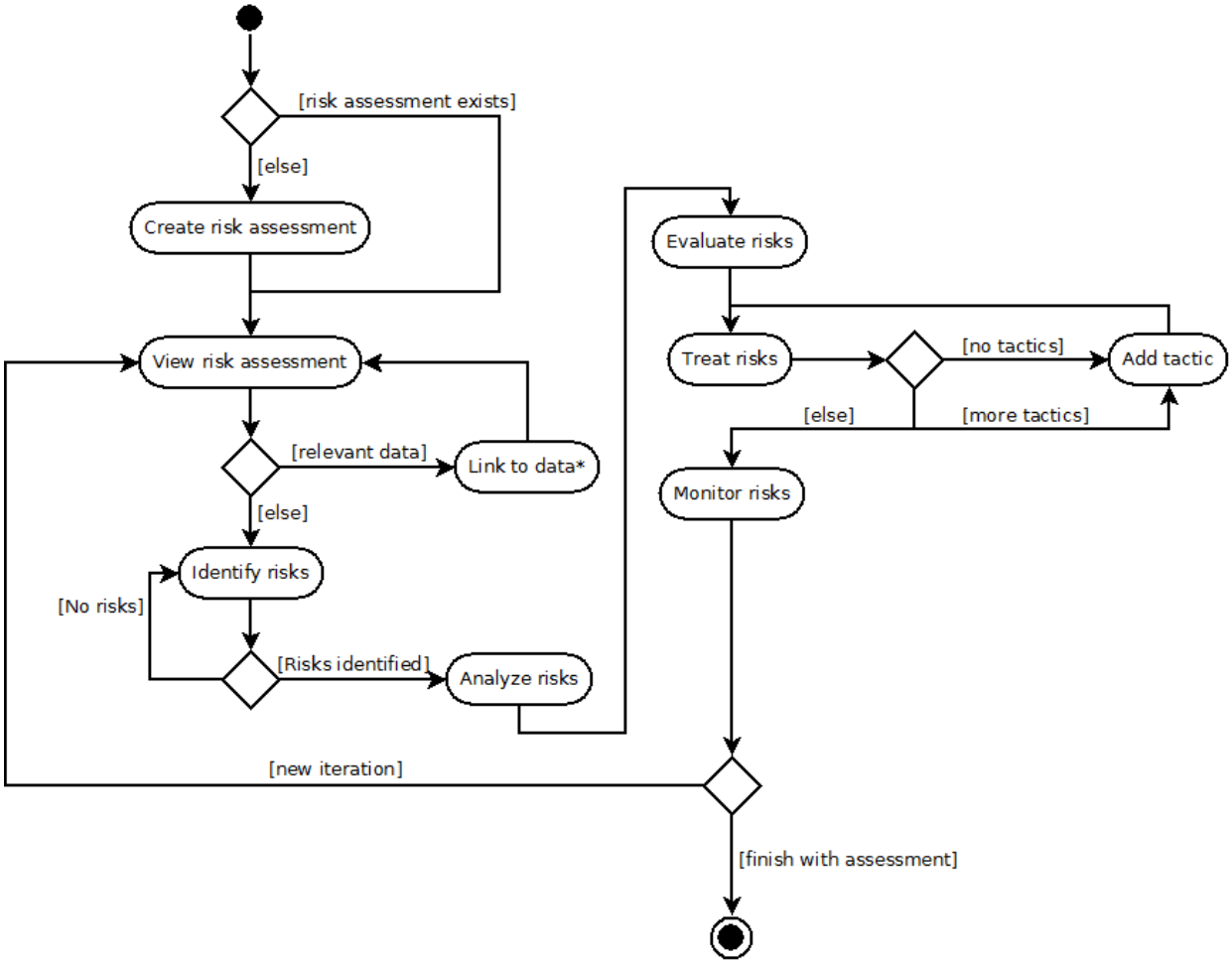


Figure 7.2 - Activity diagram

This activity diagram shows the process of running risk management with our module. In most cases, risk managing is a never-ending process, which means that it is running many iterations. Each iteration goes through every step. If it is used for instance in a project, it can be finished when the project is done. *Link to data: This opens a new window in EQS showing all documents. The user then can select the relevant document and link it to the assessment. When analyzing the risks, these documents are providing valuable information. It can also be a web-page or an image, in other words, all items which are relevant to the risk assessment.

7.3 Further Development

7.3.1 Limitations

Since we have only made a prototype, there are certain features which are not implemented yet. These features are mostly limited by the lack of connection with EQS. This part will explain these features we think would be useful in the final risk management module. We made a standalone prototype, which is not integrated with EQS. That is why we are lacking the functionality to make these features work, and the reason we skipped these in the prototype.

7.3.2 Risk monitoring

A functionality that remains to implement is risk monitoring. However, we have created the requirement for this functionality, see chapter 4.3, functional requirements, we also have made a mock-up (see Figure 7.3), that shows our suggestion of how it could be once it is implemented.

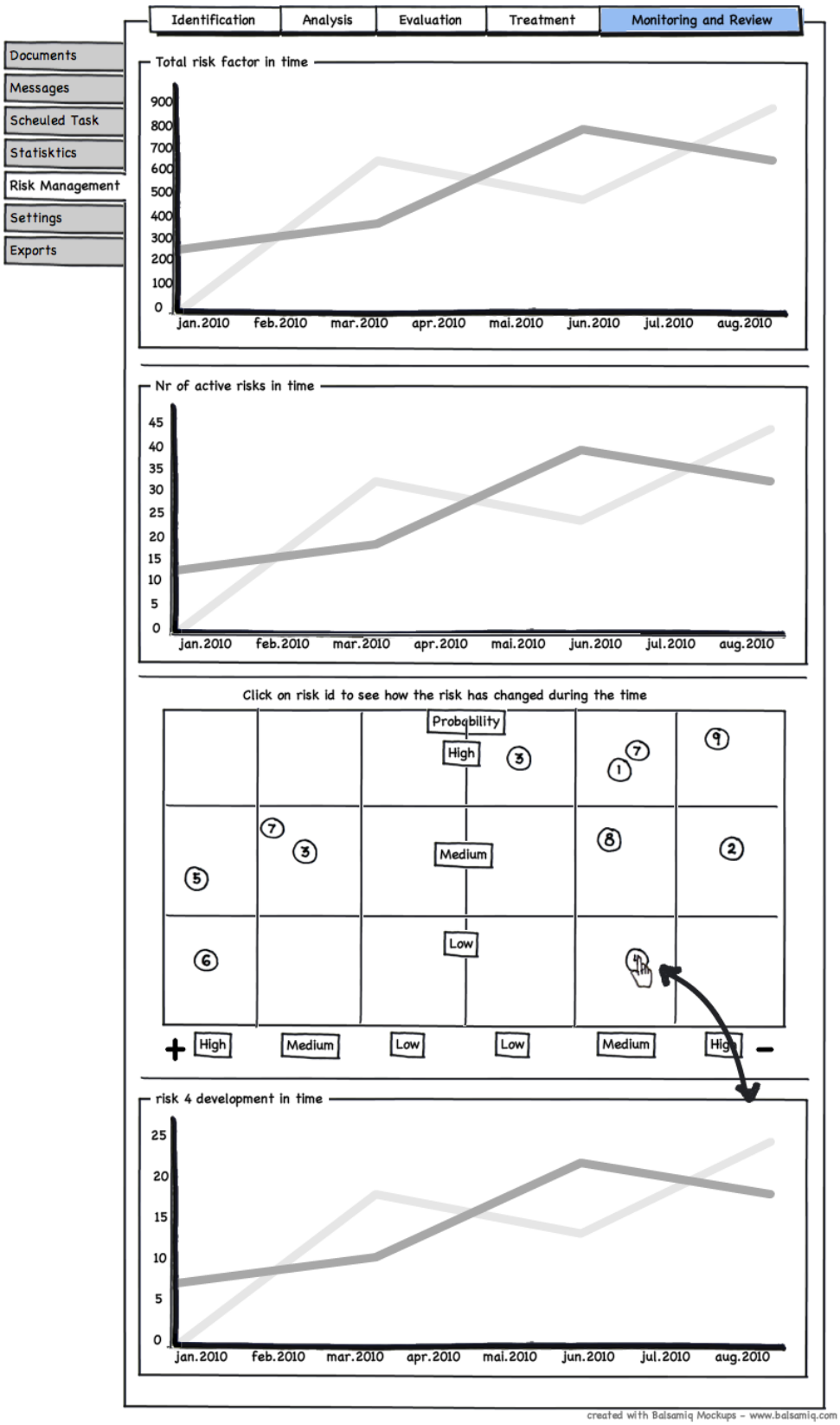


Figure 7.3 - Risk Monitoring and Review

This diagram shows how the total risk factor develops over time in a given time scope. Total risk factor is the sum of all individual risk factor in an assessment. It also shows the number of active risks through time. We also have the probability/impact matrix showing both positive and negative risks. If we click on a risk ID in the matrix, we get a risk factor history-diagram, showing the development of the specific risk.

7.3.3 Long-term risk treatment

Long-term risk treatment should show the status of the risks in an assessment. When a user clicks on a risk he should be able to see the history, what has been done, all tactics and all documents, links, procedures used as input. It should also show checklists whether the tactics have been performed or not if a risk occurs.

A list of tactics remaining to do should also be displayed, so the user always has an overview of what to do, either to prevent risks from happening or how to deal with them if they occur. Risk management is done in many iterations. When dealing with long-term risk treatment, the user should be able to see all changes in the assessment since the last iteration. This makes it easy to see what is new, what is changed and if there is anything more to do.

7.3.4 Version control

Version control is keeping a revision history, which means that when making changes to a document, the old document is not overwritten, any changes is just stored as a new revision. This way it is easy to both undo changes, and see the history of a document. EQS already has this functionality and it could be useful for the risk management module. When a user creates a risk assessment, the first revision is made. If the user then makes any changes, a new revision is made. For each revision, an admin user needs to approve it before it can be displayed. It is an easy way to have quality insurance of the risk assessment. The system automatically shows the latest approved revision.

7.3.5 Connection to EQS

Data collection

When integrating a risk management module in EQS, the existing data in EQS is very valuable. To illustrate this, we can give an example:

A company is using EQS, and has been using it for many years. All deviation reports in relation to certain procedures have been stored in the system. The procedures could for instance be about how to handle fire alerts. Every time the fire alert sounds, most people will follow the procedure. But if one or more person is doing something wrong, a deviation report is registered. When creating a risk assessment which includes risks about fire alerts, the information from the deviation reports is valuable. This could affect the probability/impact when analyzing the risks. Another factor is the statistics from how many users have read and understood the procedures. This can be useful to see why some people are not following the procedures. If only a few persons have read the procedure, the probability or impact of a risk should be affected.

To implement this feature, the user which creates a risk assessment should have an option to link the assessment to the procedures, deviation reports and other relevant documents.

Tactics

Tactics is a way to handle risks if they occur, or to prevent them to occurring. Creating tactics for a risk can be divided into three parts. The first part is creating tasks, describing what to do or what to make. This can be done by an administrator, and then be assigned to different users. The second part is the actual implementation of the tasks. Here the user is doing the task, which can be creating procedures, documents, processes etc. The third and last part is approving the task after it has been done. This is done by the administrator again.

These three steps already exist in EQS, which means that it should be easy to integrate this functionality when creating the Risk Management Module in the system.
A tactic can also be a link to an existing procedure or document.

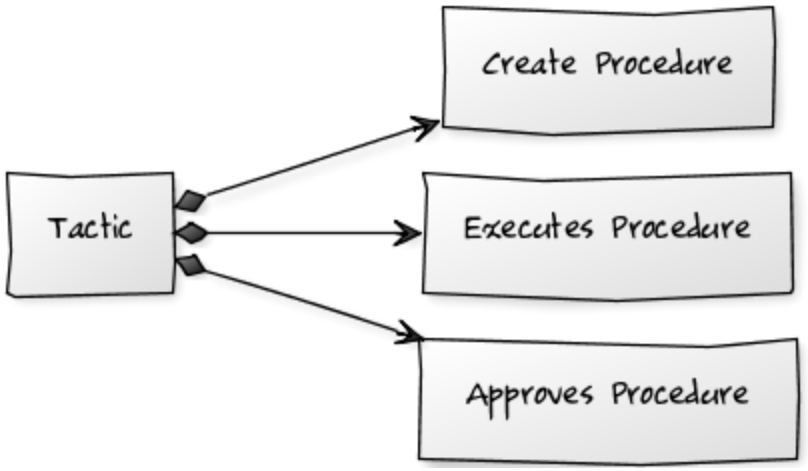


Figure 7.4 - Three-part tactic creation

CHAPTER 8

8 Project evaluation

Introduction

In this chapter we present the evaluation for the whole project, it covers the following: TDT4290 customer driven project, group dynamic, group organization, project planning, communication, tools, risks, and more.

8.1 Post-Mortem Analysis

We choose to evaluate the project with a technique called Post-Mortem-Analysis (PMA). The main reasons for choosing PMA is that it covers both the positive and negative aspect of evaluating a development project, like this one. Further, PMA helps learning from finished projects by collecting the experience in a compact way to improve future projects.

There are four steps in performing a PMA:

1. Brainstorm on the positive aspects of the project using KJ-diagram.
2. Brainstorm on the negative aspects of the project using KJ- diagram.
3. Create Causal maps. They provide root-cause analysis for a positive main element found in the KJ analysis.
4. Create Causal maps. They provide root-cause analysis for a negative main element found in the KJ analysis.

Performing the PMA:

- All the participants get yellow post-its, writes an element/issue from the project on every post-it.
- The post-its are then placed on a black-board/big piece of paper and every participant presents her/his element/issue
- The post-its are then grouped and every group gets a descriptive name
- Possible relations between groups are drawn using arrows.

A PMA tries to discover:

1. What happened in the project?
2. Why did it happen?
3. What can we do to make it or not make it happen again?

8.2 Positive Brainstorming

Figure 8.0.1 - Positive post-it issues in brainstorming

8.2.1 Positive Causal map

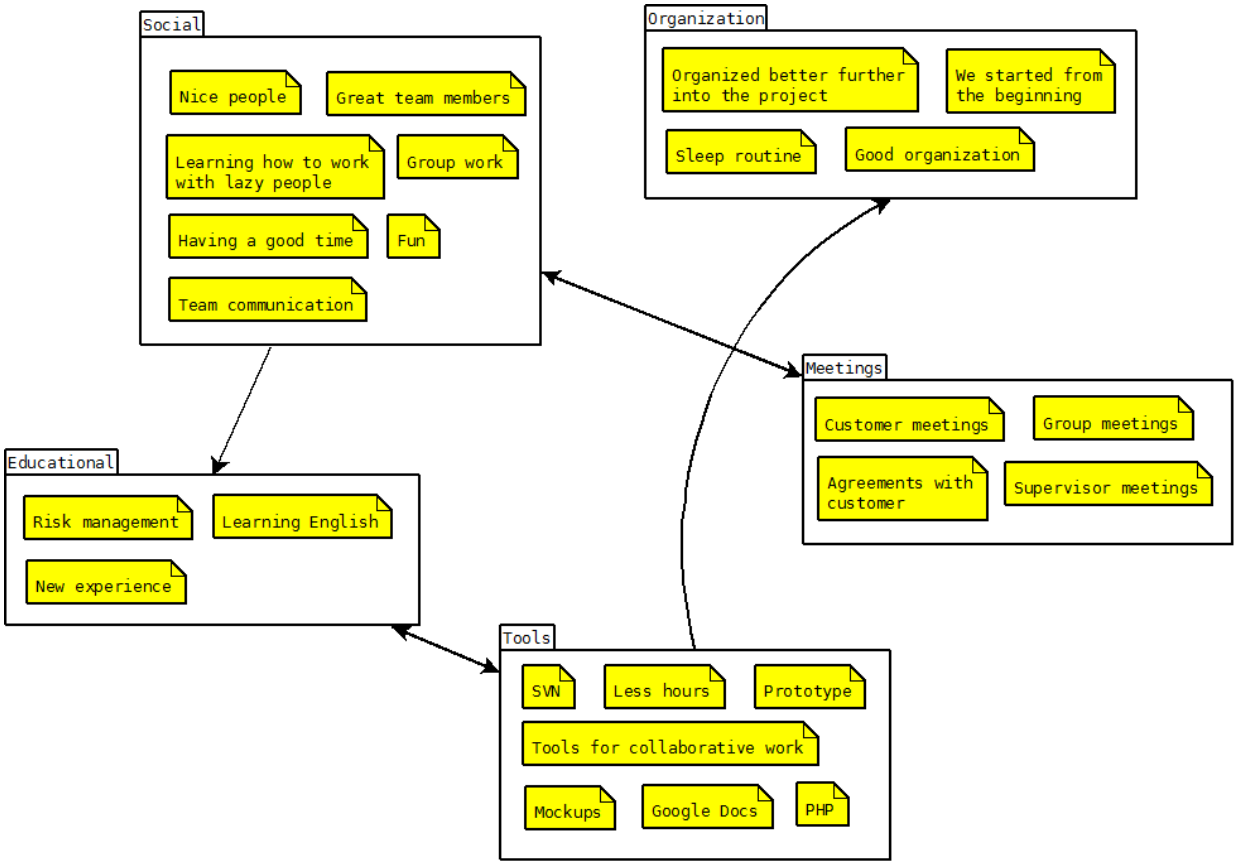


Figure 0.2 - Positive causal map

The positive aspect of the organization of our group has reflected at the beginning of the project. We started working early so we got enough time to finish most of the parts of our project with less stress. In contrast to that we had constant feeling that our organization was poor, so we have kept improving planning and organization as the project was running. As a result of the thought of poor organization and constant improving, the organization of our group at the end of the project was significantly better than at the beginning.

Different technologies as Google Docs and Dropbox helped us doing collaborative work. We are very satisfied about these technologies because they have speed-up the process of working on most of the documents and improved the mobility and accessibility of our shared repository. The most positive effect of these technologies on our project was reduced redundancy that was a big problem at the beginning. We rather make automatic some processes of writing documentation that requires cooperation.

During our work on this project, we learned to work with many different tools and technologies. We enjoyed the most working with PHP and mockup tool while working on our prototype. The mockup tool helped us visualizing the solution of project. It has improved the communication between group members so that we have understood better the way everyone sees the solution. And we were able to

visualize our ideas to the customer before starting on a functional prototype. As the result of this, we are all very satisfied with our prototype and its evolution.

The group has learned a lot about risk management. We have understood the steps in risk management and more important, the reasons and benefits of doing a systematic risk assessment. That helped us realizing the purpose of the system we were making. Knowing the purpose was important for improving group motivation.

Since we had non-Norwegian speaking project members, everything was done in English, which has helped us improve our English skills. But the most important experience that the group members have made is the ability to work with different people, that have different goals, work habits, past experiences, and set of skills. During the project the group members recognized different habits of each other and instead of trying to change a particular group member the group tried its best to use and courage the positive/strong side of each group members, which helped finishing this project.

The positive aspects of group work were getting to know the group members with diverse cultures and backgrounds, while having fun executing the project. During this experience we learned how we should work together as a team and how to get along with a group member who did not accomplish his or her task properly. Also, it helped us to improve our communication skills and being social.

One of the necessity for this course were arranging different types of meetings, meetings with the customer, the supervisor, and the internal meetings. We improved our ability to handle the meetings more sufficient each time that we had a meeting and this has assisted us to reach an understanding with the customer during our meetings, because we grasped deeper knowledge of our project and were able to produce better documents for the customer. Also we have improved our skills in writing more proper status reports for the supervisor meetings.

8.3 Negative Brainstorming

Figure 8.0.3 - Negative post-it issues in brainstorming

8.3.1 Negative Causal-map

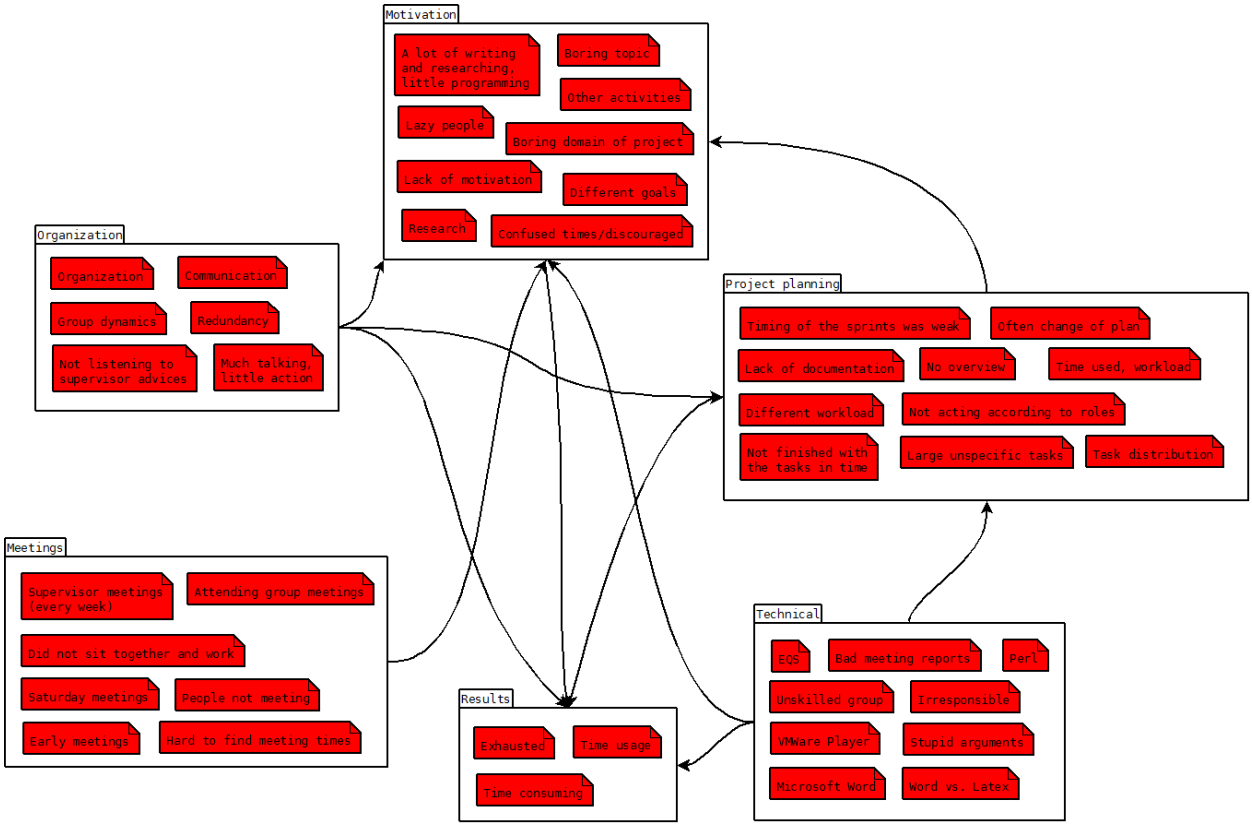


Figure 8.0.4 - Negative causal-map

After grouping the negative experiences of the project work, we made connections to the different "groups". We found out that motivation was our main problem, this include many sub problems that we experienced throughout the duration of the project. The main problem for the motivational issues was poor communication, that effected different goals for the project. During the start of our project, there was little knowledge to what actually risk management involved, what the domain of our subject was and the actual work that had to be done. This contributed further to our communications problems since we did not attack this problem at the beginning of the semester. There were a lot of research that had to be done on our subject and the group had a problem grasping the subject. Going in to this project, the group thought that there were going to be a lot of programming, but there wasn't need of it, since the subject we were assigned needed more research than development, since they were going to develop a "product" them self next year.

At first the tasks were assigned to every individuals in the group , but after the group awareness of that the tasks being time consuming, the group had decided to divide tasks to among more group members. Also the tasks were defined with a considerable amount of work to do, which was assigned to only one of the group members. All of these factors were due to lack of understanding of the next step in the project. According to these reasons some tasks were done more than once with different approaches, and some times in the middle of a time consuming task the group had decided to change the plan and define a new task. After taking some decisions, getting better idea about domain of our problem and

identifying weaknesses of our team we managed to tasks that will fit group member better. With this we have also reduced redundancy of the work.

The group were exited on actually developing the prototype, but we met issues that slowed us down. Firstly none of the group members had previously any experience with using Perl. So a lot of effort had to be put into learning the basics of Perl. We also had the problem with the use of the Ubuntu-image.

To integrate our solution with EQS we also had to understand some areas of EQS code, which proved to be a lot harder than initially thought. With limited knowledge of Perl, a lot of similar class names and a good variety of description of their implementation used, our progress on deciphering their code went slow. This and taking into account that Extend were probably not going to use our code anyways, just have it as a prototype, we felt the need to re-discuss our goals with Extend. At the following meeting we agreed upon to loosen the bounds of integrating it to EQS and later abandoning it all, we swapped from using Perl towards using PHP, which we already had some experience with. These decisions improved our productivity and at the end customer was satisfied with prototype. The fact we learned from this problem is that we have to make decisions earlier, act immediately when we identify the problem and that sometimes it is better to “let it go” than to spend a lot of energy trying to “stick it out”.

Another issue was choosing the main tools for documenting. The group had a lot of arguments about using Microsoft word or Latex, because most of the group members knew word, therefore the group decided to use Microsoft word instead of Latex. But in practice we noticed it is hard to work with Microsoft word as tools for team work because there isn't revision control so two persons were cant working on a same document. Thus we decided to use Google Docs for documenting and then transfer the text to Microsoft or Latex later.

Internal meetings were scheduled only on Mondays after the customer meeting and Thursdays (instead of the customer meeting) from the starting point of our project. At first it sounded sufficient meeting time, but after a while we noticed that it wasn't going the way we thought, this is because our productivity decreased drastically when task were distributed to do at home, this resulted that people didn't complete their tasks on time. Therefore we reached the conclusion to arrange extra meetings as work sessions in order that make the group members to finish their tasks on time and be able to help each other for this matter.

We had also some issues with members getting sick, but this did not effect the group severely since the sickness did not last more than some days. Other issues we had, were that people did not understand their task or could not grasp the issues of the task. So we fixed this by when attending the meetings we used some time to explain the tasks then do them, this was to ensure that the tasks were done properly and right.

The meetings with the supervisors were in the beginning helpful for finding our path for approaching the main goal and being able to bind with the group members. Despite the beginning weeks, we felt attending every week in one hour meeting was a bit redundant since in many of the meeting there were not much to talk about since there were not any issues the supervisors could help us with. The meeting time could have been spending working. If the supervisor meetings could be held once in two weeks

could be a better schedule. In that condition we could have more cases to discuss with the supervisor and could have enough time to apply his advices in our project.

The last and essential part of every project is its result. Therefore this part deeply depends on group motivation, the project planning, technical cases, and the way the tasks and roles were organized other key factors in the project processing. We faced many problems during our project, both small and big ones. Some problems we have solved easily others we have not solved completely or we have not solved it quick enough, but experience that we have gained will be of great value for our future team projects.

8.4 Scrum

At the start of the project we decided on using scrum. Everyone had heard of scrum, and some had earlier tried to implement it in some project they had before. But no one had used it to the fullest, with backlogs and meetings. But we decided either way we would go for it. After a while we discovered that we were not following the scrum development model, we did not always have time for daily scrum meetings, due to different schedule of the group members. And we did not always follow what we had to do in the sprint backlog. This is mainly because we had to remove and add tasks during every sprint. This means our use of scrum was very agile. The way we used scrum was good hence we didn't always sit together and work, this makes it hard to use scrum to the fullest. Scrum seems to work better under “controlled” environment, where the members meet each-other everyday and work together under the same roof. But we managed to use the scrum ideology by using sprints and having a product backlog (requirements).

8.5 Workload

In the start of this project we used a work breakdown structure to estimate our time usage, which was estimated to 1796 hours. Table 8-1 shows our time estimations and actual time usage. As can be seen our estimations in the start of the project did not really hold compared to what we actually did. The main reason is that the project developed into a more research oriented one than our first anticipation, where the need for research was high and development was low. This made a lot of estimations like design and development is overestimated while requirements were underestimated. Another reason is that the administrative work and the work with the main report and the presentation were neglected also, so this was also quite underestimated.

As for the weeks we were a bit optimistic with our estimations that we would work a lot once we heavily started development, which turned out this was not the case. From the table we can also see that we were having more work hours near the end, which is natural considering its time to wrap the project up.

All in all we ended up spending 1494 hours which means 20.75 hours per week per person. Note that the final week was not calculated. This is a bit lower than the 24 hours we had hoped to spend and the reason for this was probably some lack of motivation described in earlier evaluation part. However we do not feel there are a lot more work we should do, even though there are always more work if you look for it, so perhaps time usage were fine.

Table 8-1 - Actual/Estimated Workload

	Planning and preliminary study								Sprint1				Sprint2				Sprint3				Project Compilation				Present					
Activity / Week	35		36		37		38		39		40		41		42		43		44		45		46		47		Total		%	
Lecture	24	28	24	16,5	24	8,75	24	7	24	15	24	0	24	15	24	0	24	0	24	0	24	0	0	0	0	0	264	90,25	14,6993	6,04083
Self-study	30	23,75	30	20,25	30	14,75	30	17	0	3	0	17	0	13	0	16	0	5	0	0	6	0	6	0	0	0	132	129,75	7,34967	8,68474
Meeting and work session	36	49	36	72	36	42	36	27	36	39	36	51	36	30	36	24	36	42	36	34	36	15	0	52	0	0	396	477	22,049	31,9277
Requirements	45	0	45	27	45	28	45	26	0	35	0	21	0	0	0	26	0	65	0	30,5	0	8	0	2	0	0	180	268,5	10,0223	17,9719
Design	0	0	0	0	0	4	0	0	36	17	12	0	36	9	12	0	36	0	12	6	0	3	0	2	0	0	144	41	8,01782	2,74431
Development	0	0	0	1	0	4	0	4	80	9	80	20	80	22	80	0	80	33	80	11	0	6	0	12	0	0	480	122	26,7261	8,166
Other	0	10	0	6	0	12,5	0	14	0	10	0	15	0	13	0	6	0	5	0	25	0	124	0	104	0	0	0	344,5	0	23,0589
Testing	0	0	0	0	0	0	0	3	12	2	36	2	12	0	36	0	12	0	36	6	0	2	0	2	0	0	144	17	8,01782	1,13788
Deployment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	28	4	0	0	56	4	3,11804	0,26774
All activities	135	110,8	135	142,8	135	114	135	98	188	130	188	126	188	102	188	72	188	150	188	112,5	94	158	34	178	0	0	1796	1494		

Estimated work hours for the week

Actual work hours for the week

Total work hours for the week

Total estimates for work hours for each of the activities

Estimate workload % for each activity

Total work hours for each of the activities

Actual Workload % for each activity

*Other field is mainly work regarding main report and other documentation

8.6 The Assignment and the solution

The task from our customer was quite open and contained intensive research, see Appendix A.3. We had to spend a lot of time on understanding the assignment topic and to develop a product. In fact our task seemed more like a product development project, than a software development project, this can be seen through the amount of time spent on the research vs. the actual time spent programming.

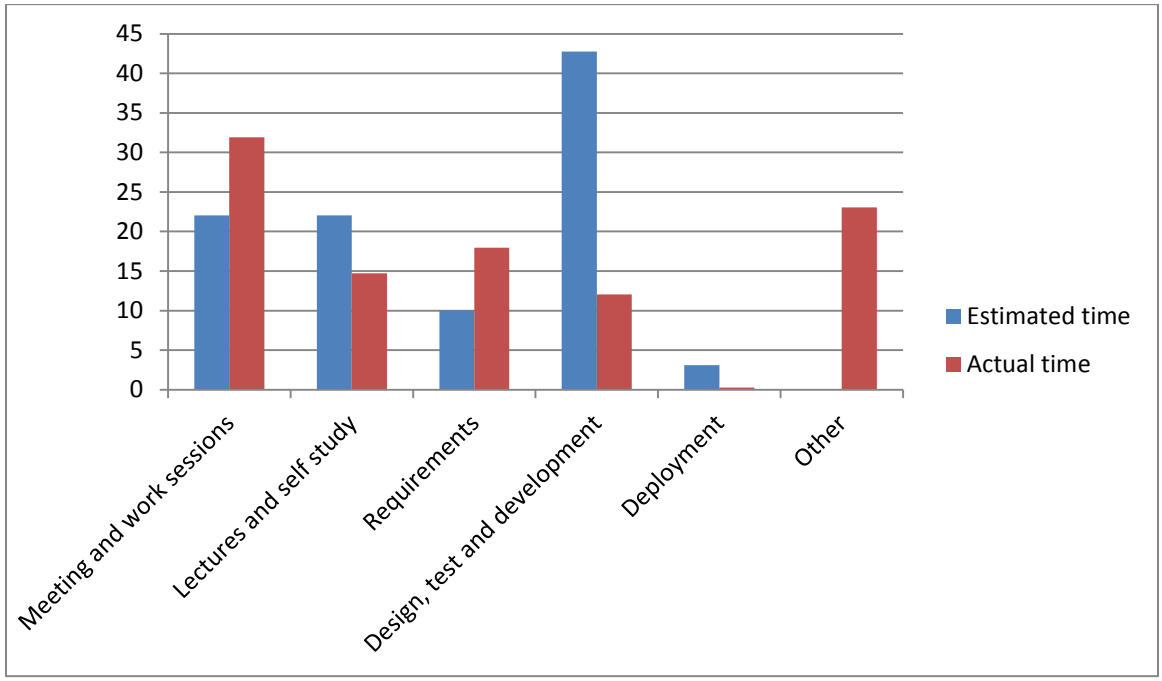


Figure 8.5 - Actual vs. estimated time

***Other field is mainly work regarding main report and other documentation**

During the project we had very good communication with the customer, which was very important in the process. We got new requirements as we gained more knowledge of the problem domain/topic and shared it with the customer, allowing them to change the direction of the development, the product result, during this steps we continually got new requirements.

The final product was a combination of the customer's requirements and the ideas our group came up with while studying the topic of risk management. We built a simple and generic prototype for a risk management system, as a proof of concept, which can be used in any organization and in any type of risk, whatever its nature. However the application is not finished, we weren't able to implement all the functional requirements in time, never the less we have created/collected solid requirements for a web-based Risk Management system. One of the main functionality that we did not had time to implement, is the monitoring and review part, see chapter 7, further development.

8.7 Conclusion

Afterword seeing the result and how we worked together, we feel that we learned a lot by executing this project. This project is new for everyone in the group, no one had ever worked on a project of this caliber, so everyone gained valuable experience.

To reach our goal we had to struggle as a group but slowly we understood how we could make it to the goal. It was a slow process understanding how we could utilize the different members in the team, but after a while everyone found their place in the group. The problems we had in the beginning were mostly solved in the end. The supervisors were a big advantage in many areas, trough tips of the supervisors and their advices we managed to make progress in our project. The costumer gave us a lot of tips on how we should go forward with the work that we were doing, this helped our pacing. And the group made great effort, so we as a team could deliver this report and the product (prototype).

CHAPTER 9

9 Project Conclusion

We achieved valuable experience during the project, we learned how to work with new people in a very realistic setting, and since our group was diverse through having people from different countries we gained a lot form this. We gained experience in communicating with a real customer and development on a larger scale than earlier courses.

The task from our customer was quite open and research intensive, so we had to spend a lot of time to understand the assignment topic and to develop a product. We got new requirements from the customer during the project and shared our ideas for functionality with the customer.

The final product was a combination of the customer's requirements and the ideas our group made, while studying the topic of risk management. We built a simple and generic prototype for a risk management system, as the proof of concept, which can be used in any organization and in any type of risk, whatever its nature. However the application is not finished, that way we call it a prototype, we weren't able to implement all the functional requirements in time, nevertheless we have created/collected solid requirements for a web-based Risk Management system.

Intentionally inserted blank page.

Part IV
Appendices

Appendix A

A Project Directive

A.1 Templates

A.1.1 Meeting invitation template

Meeting invitation

Time and location

Date: xx.xx.xxxx
Time: 09:00-10:00
Place: Room 464

Invited

Gustav Aagesen (Main supervisor)
Tobias B. Iversen (Assistant supervisor)

Agenda

1. Approval of agenda
2. Approval of minutes from last meeting
3. Comments to minutes from last meeting
4. Approval of the status report
6. Other issue

Preparations

A.1.2 Meeting report template

Meeting report

Author: Xxxx xxx
Place: Office of Extend AS
Date: xx.xx.xxxx

Attendee:

Xxxx xxxx
Xxxx xxxx

Absent:

Xxxx xxxx
Xxxx xxxx

Discussions and Decisions:

....

Assignments:

....

A.1.3 Status report template

Status report

Date: xx.xx.xxxx

Period:

This Status Report is for the period week x: xx.xx.xxxx - xx.xx.xxxx.

Summary of this week

...

Work done on this week

...

Problems

...

Planning of work for the next period

...

Others

...

A.1.4 Test Template

Test template

Title: name of the test
Test Identifier: unique code given to the test, code is signaling what area we are testing within.
Dependencies: which other tests will influence this test.
Description: what we are testing
Input: how we are testing it
Expected results: How we are expecting the results to become.

A.2 Work break down structure

When we used work break down structure, we had to estimate time usage in man-hours.

A.2.1 WBS and estimates

[1002] : Total number of hours estimated

1. Requirements [180]
    - Research [150]
        – Existing software for risk management (both desktop and web based application) [24]
    - ∗ Compare and extract features of existing system [2x12]
        – Technologies [112]
    - ∗ Perl [4x24]
    - ∗ SVN [3x1]
    - ∗ Platform (Ubuntu image, SDK - Eclipse or NetBeans) [6x2]
        – EQS [24]
    - ∗ EQS architecture overview [6x2]
    - ∗ Basic overview of EQS modules [6x2]
    - ISO Standard
        - Drive requirements from the ISO [8]
    - Interview [12]
2. Design [142]
    - Requirement Specification [48]
        – Functional requirements [4x10]
        – Non-functional requirements [2x4]
    - Architecture Design [70]
        – Class diagrams [2x10]
        – Component diagrams [2x3]
        – Sequence diagrams [4x6]
        – DB schema [2x6]
        – Detailed architectural Plan Document [2x4]
    - Test Specification [24]
3. Development [480]
    - GUI [2x24]
    - Logic [4x72]
    - Database [2x24]
    - Integration [4x24]
4. Testing [144]
    - Test plan [4x6]
    - Functional testing [4x24]
    - Non-functional testing [2x12]
5. Deployment [56]
    - Integration with EQS [4x12]
    - User manuals [2x4]

A.3 Initial task from the customer

Here is the initial problem handout from the customer word for word.

Web-based risk management

Extend delivers a quality and process management system, EQS, which is a web-based application for quality management and improvement, in all types of organizations.
EQS consists of several modules, including a module for deviations registration and other date\a entry, with a corresponding statistics indicators module.
In a module for risk management, a systematic approach for describing and/ or calculating risk should be supported. Risk analysis must be possible based on the likelihood and cause of events and their consequences.
The thesis' goal is to specify requirements for a risk management module, in the context of what is described above. A web-based prototype, based on the specified requirements should also be implemented.

Thesis' key issues

- ISO 31000:2009 Risk management
- List of existing (web based) Risk Management System with key features
- Requirement specifications for (web based) Risk Management System, in EQS context

Project meetings

Extend suggests project meetings at their office every second week.

Source code & applications (EQS)

The project team will get access to their own virtual development server with EQS pre-installed. You will also get your own branch in SVN.
Documentation & manuals available online, via EQS (in Norwegian only)

ISO 31000:2009

ISO 31000:2009 provides principles and generic guidelines on risk management.
ISO 31000:2009 can be used by any public, private or community enterprise, association, group or individual. Therefore, ISO 31000:2009 is not specific to any industry or sector.
ISO 31000:2009 can be applied to any type of risk, whatever its nature, whether having positive or negative consequences.
Although ISO 31000:2009 provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed.

It is intended that ISO 31000:2009 be utilized to harmonize risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/ or sectors, and does not replace those standards.
ISO 31000:2009 is not intended for the purpose of certification.

Additional resource on Risk Management
https://www.nsm.stat.no/Documents/Veiledninger/ROS_2004_veiledning.pdf (in Norwegian)

Extend AS
Visiting address: Pirsenteret, oppgang C, 5. etg
Phone: 73 54 61 00
http://www.extend.no

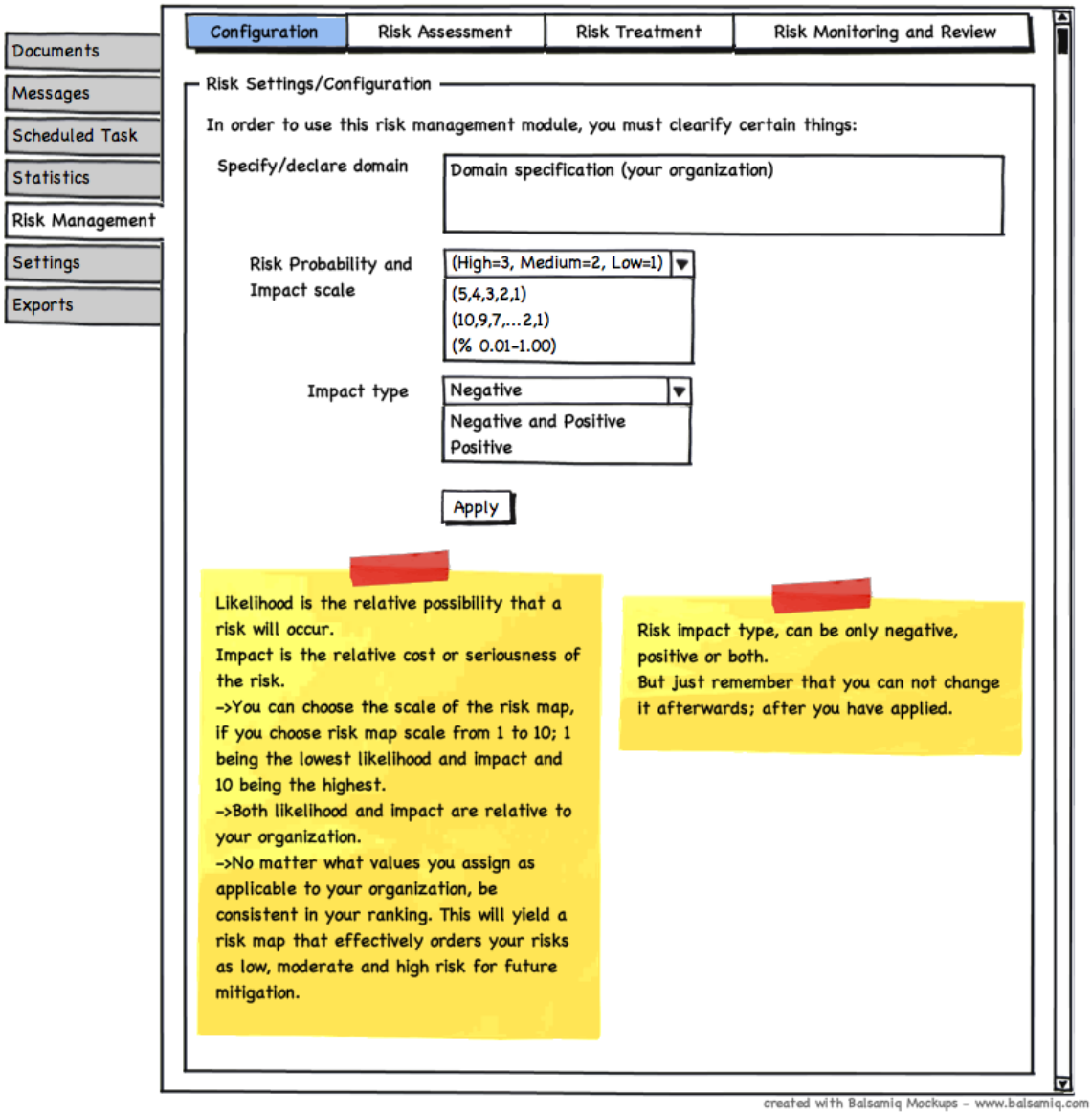
Your main contact:
Håkon Groven
Manager of development
hakon@extend.no
Phone: 90 72 00 65

B Screenshots

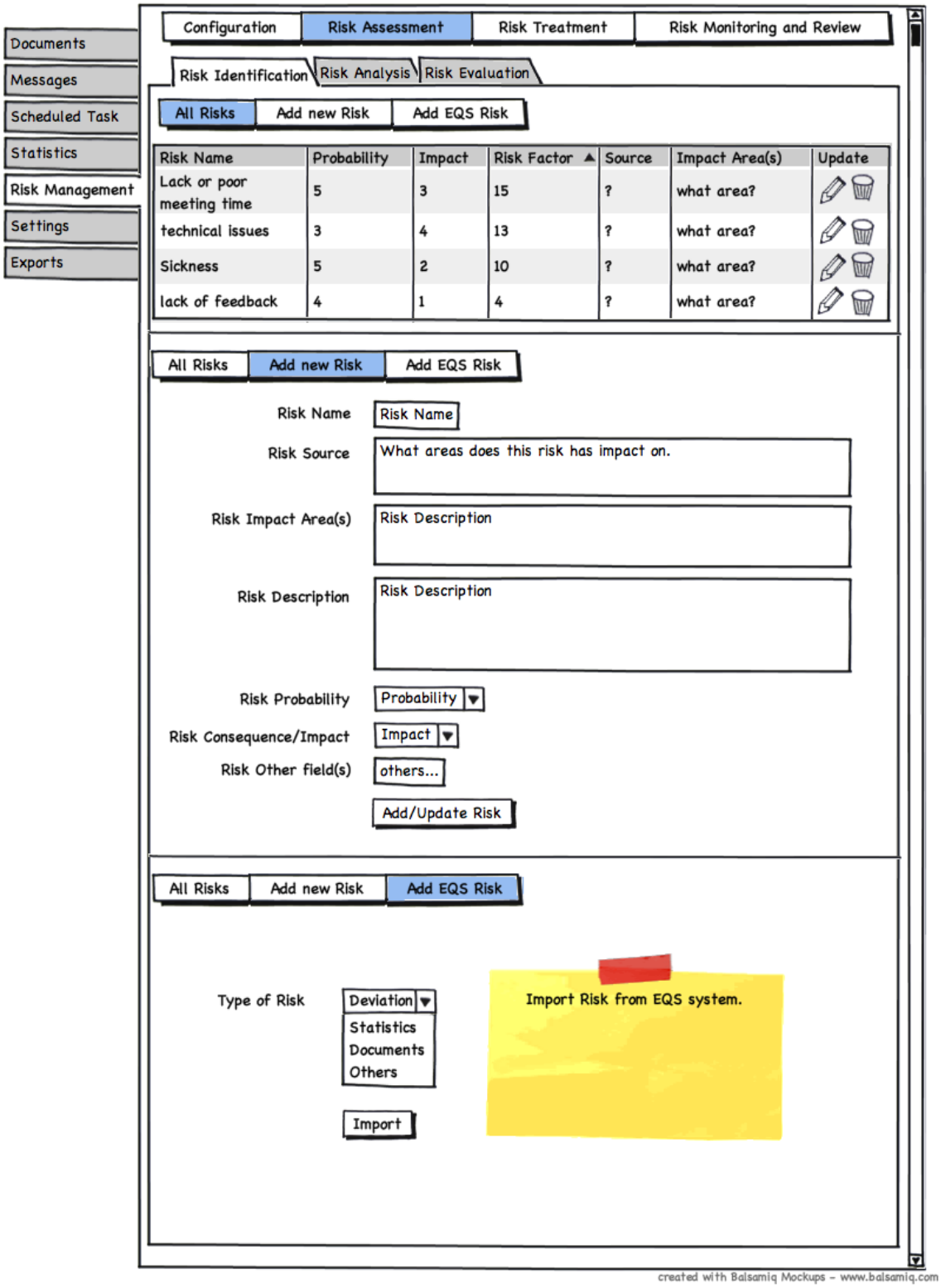
This appendix contains the screen shots of the finished design of Sprint 1.

B.1 Mockups

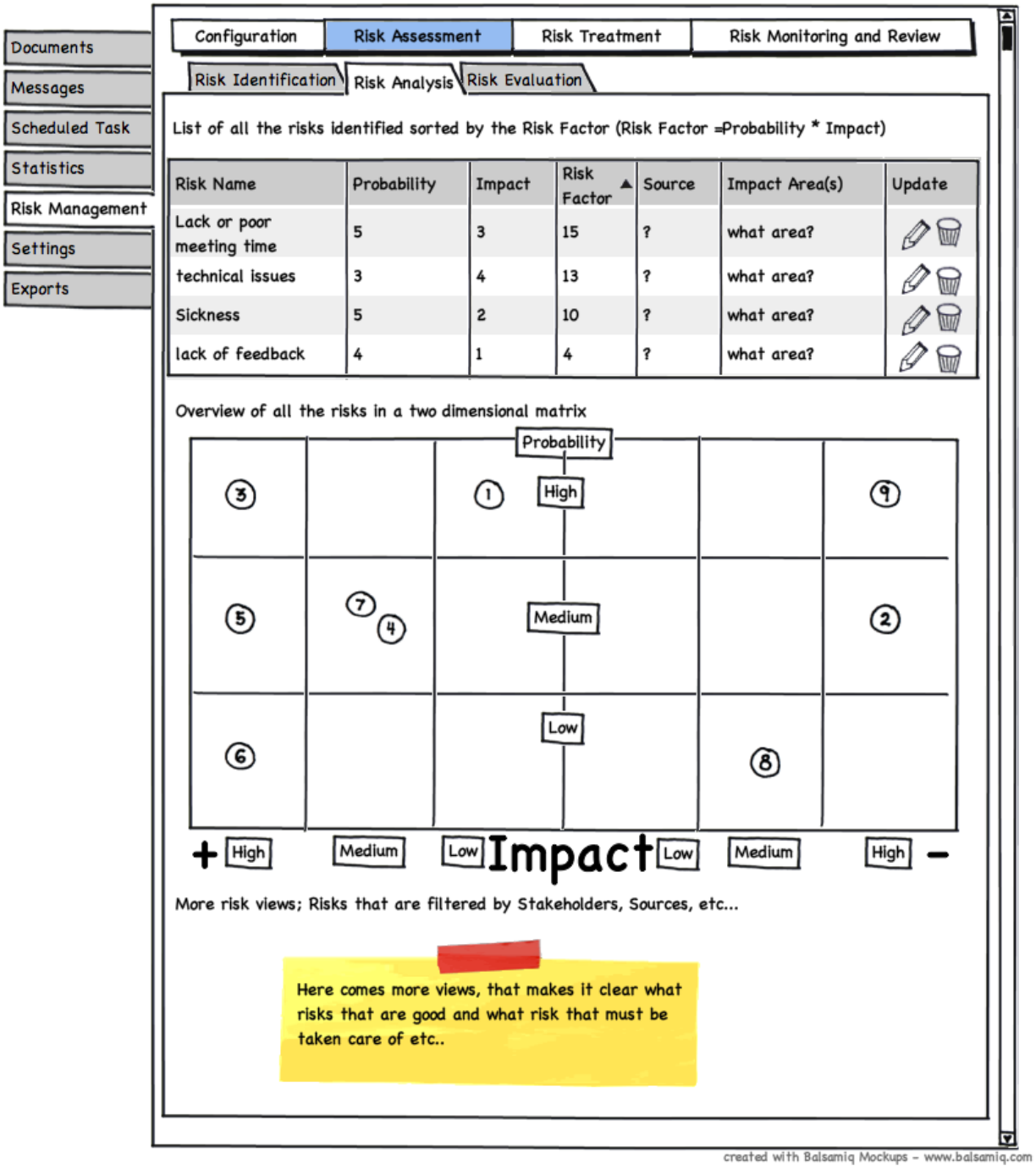
Before starting the development of the risk management module we made mockups, we made these with balsamiq mockups. These were made to have something to show the customer before we started to develop, so we don't waste time if we didn't understand the demands from the customer.



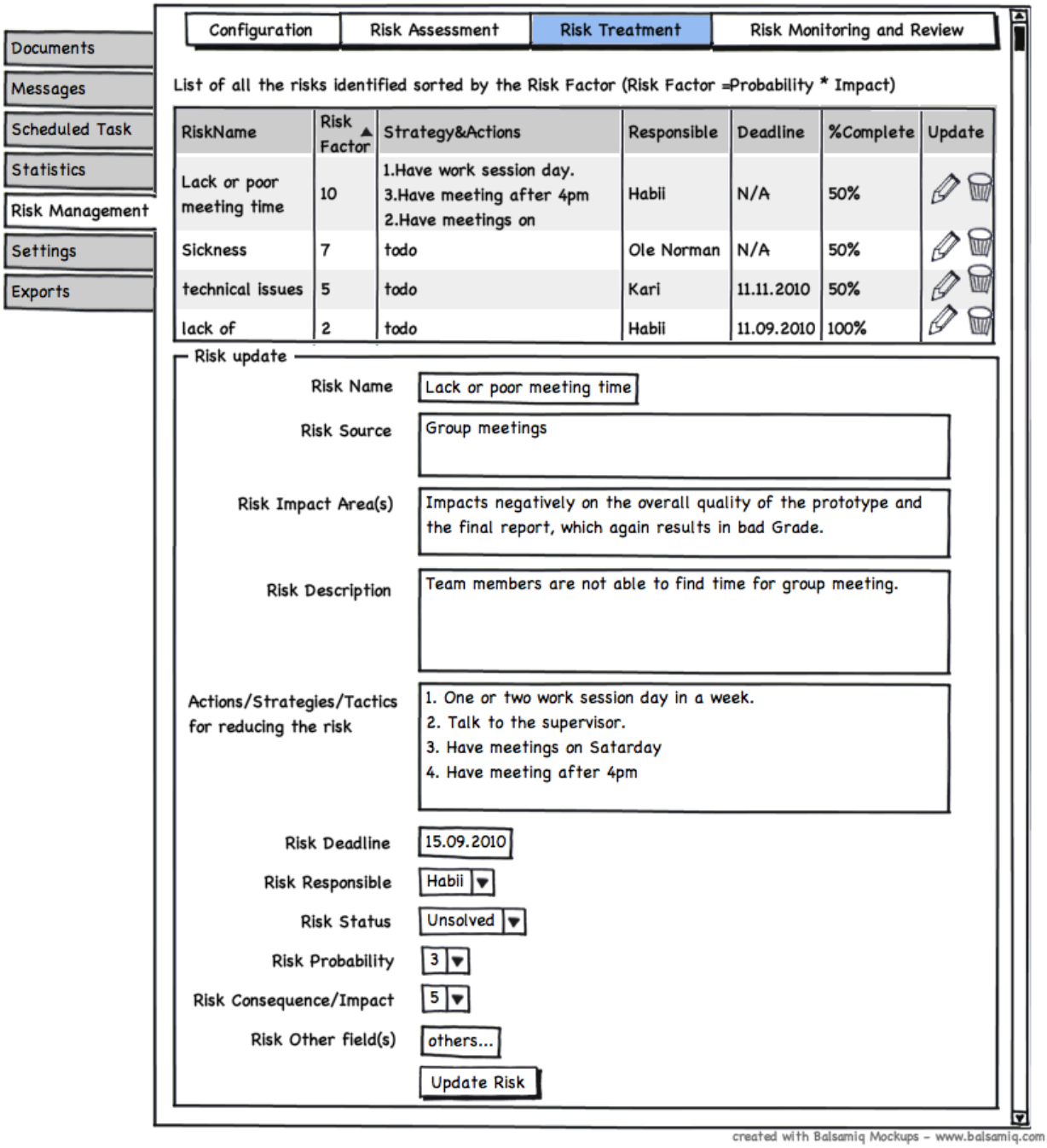
This is the configuration screen. Only the admin can access this area, the admin chooses the domain the risk are on, what kind of probability and impact scale, and if the users want to view positive , negative or positive and negative impact.



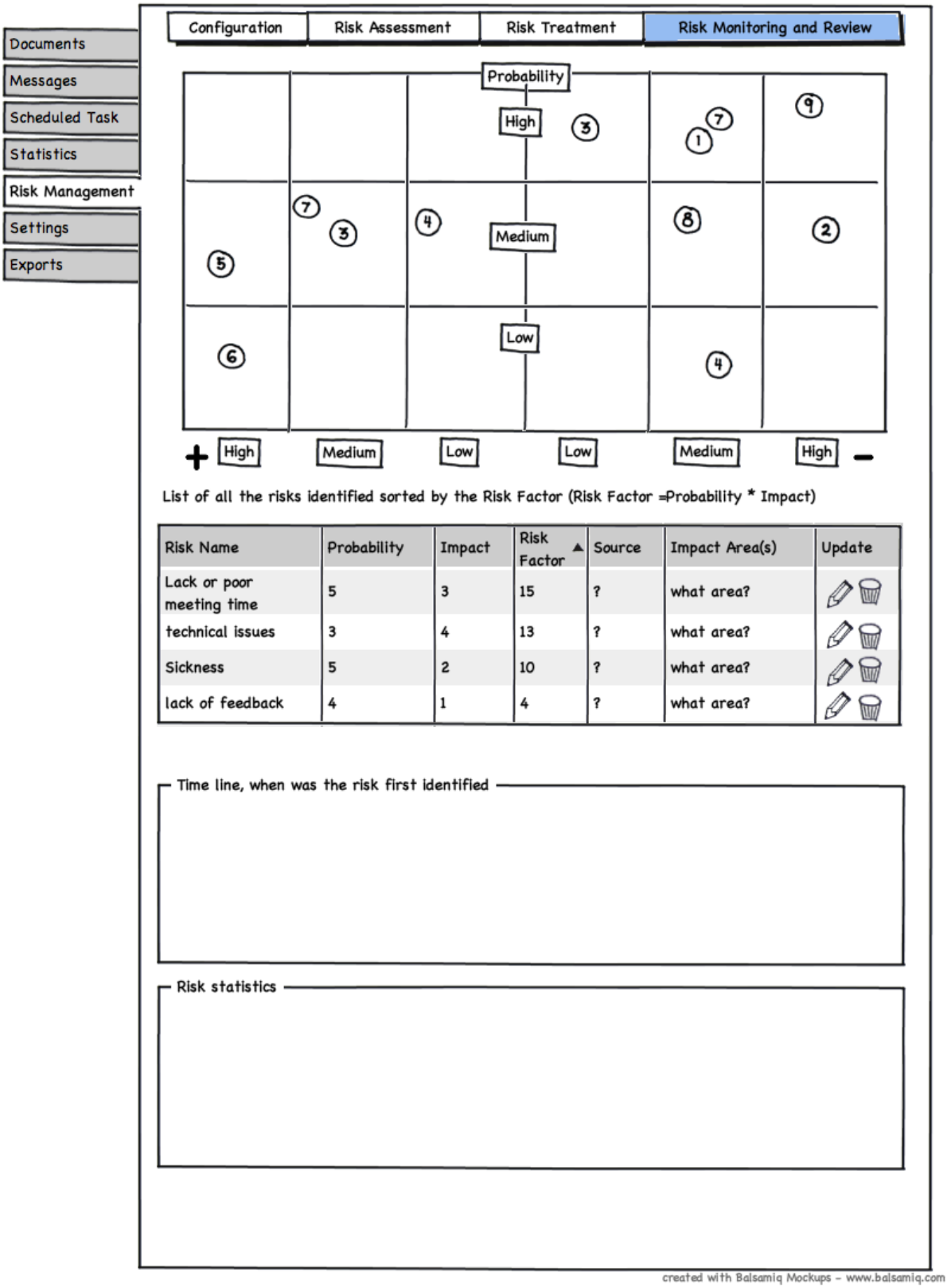
This is the identification screen, users can add, view and delete risks.



This is the risk analysis part, users can view risks in a matrix. This is so the can get an overview about which risk are high and must be treated first. And it is possible to delete and edit the risks.



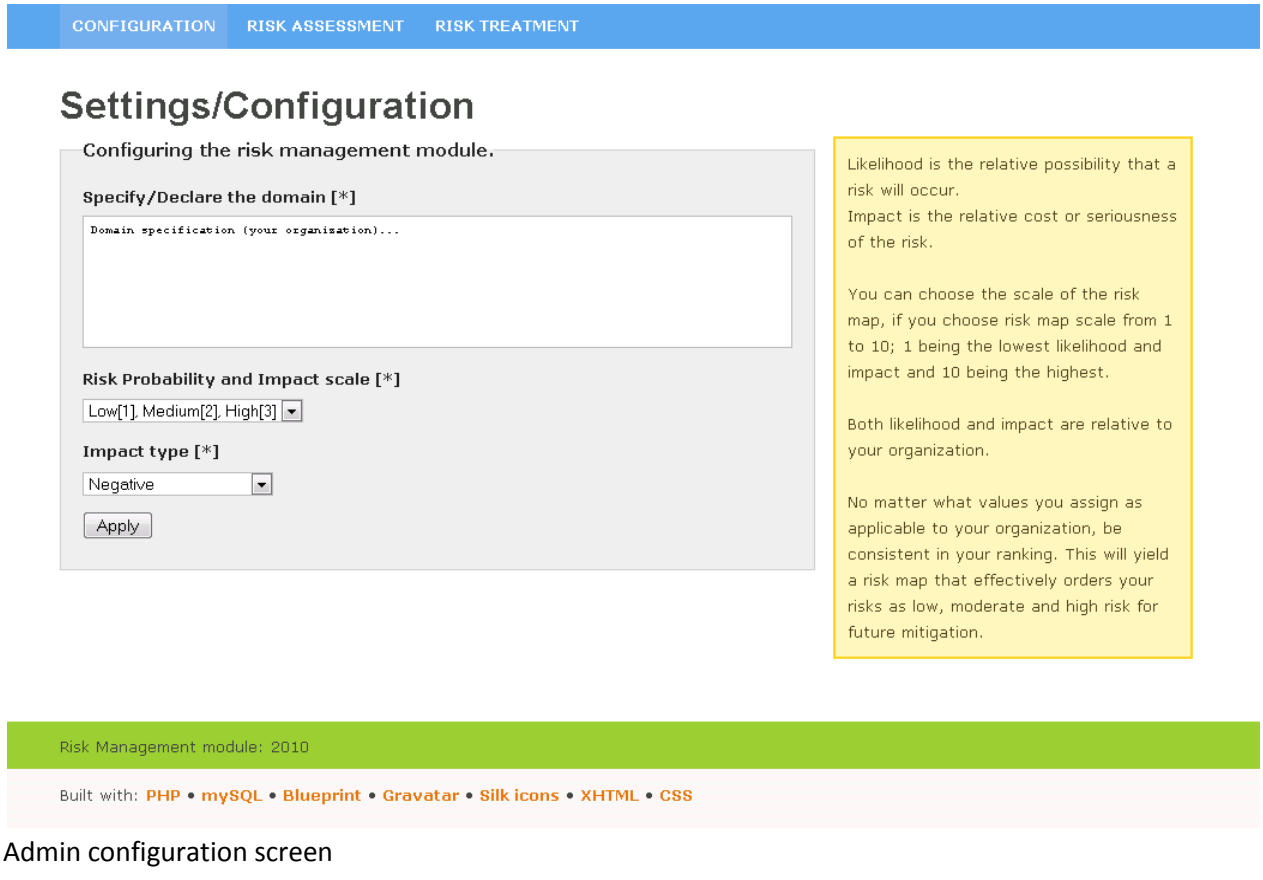
The treatment of the risks are written here, every risk has a status, this status can be updated by users and administrators.



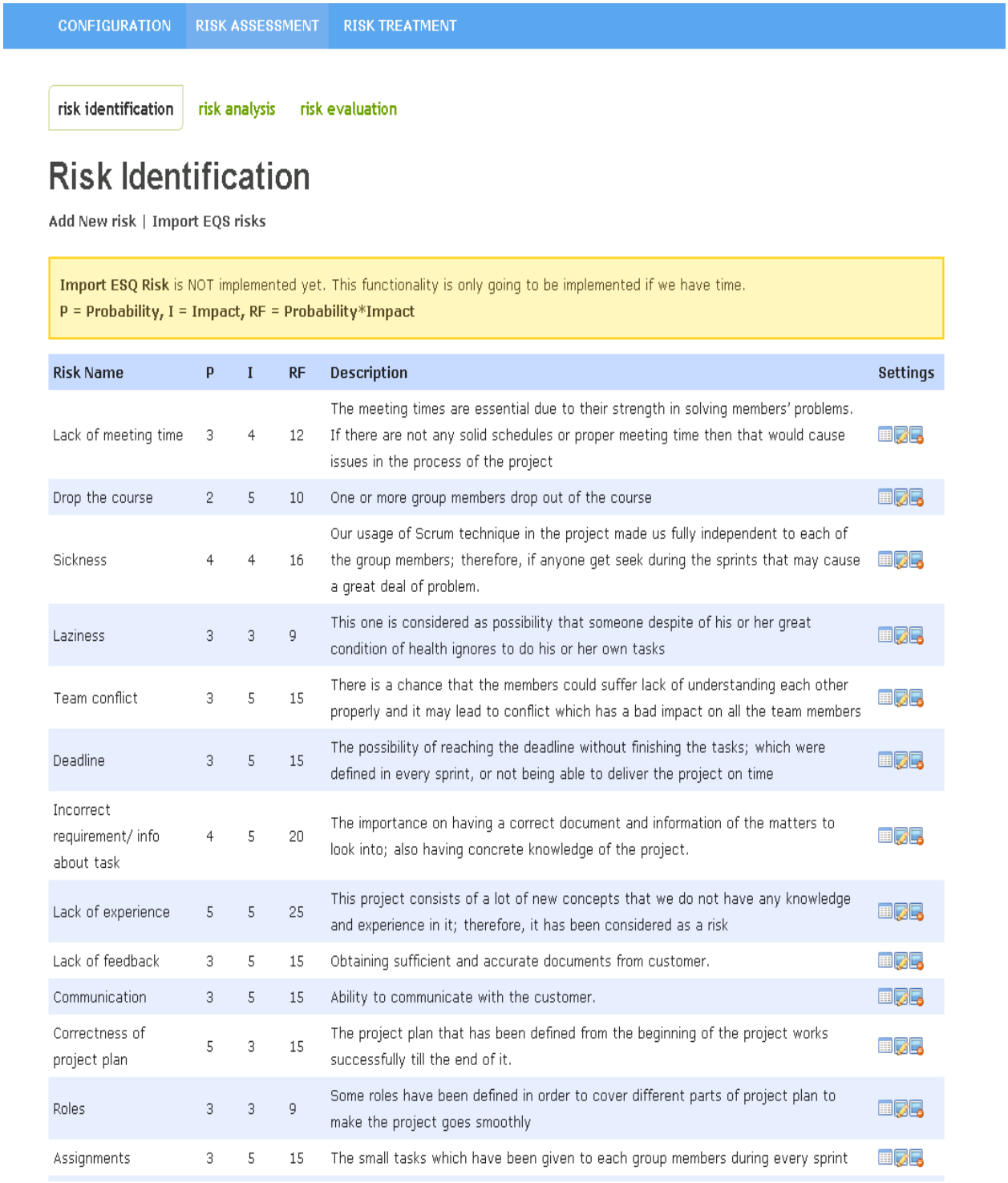
The users review risks, and have an overview about when the risks has been updated in a timeline.

B.2 PHP

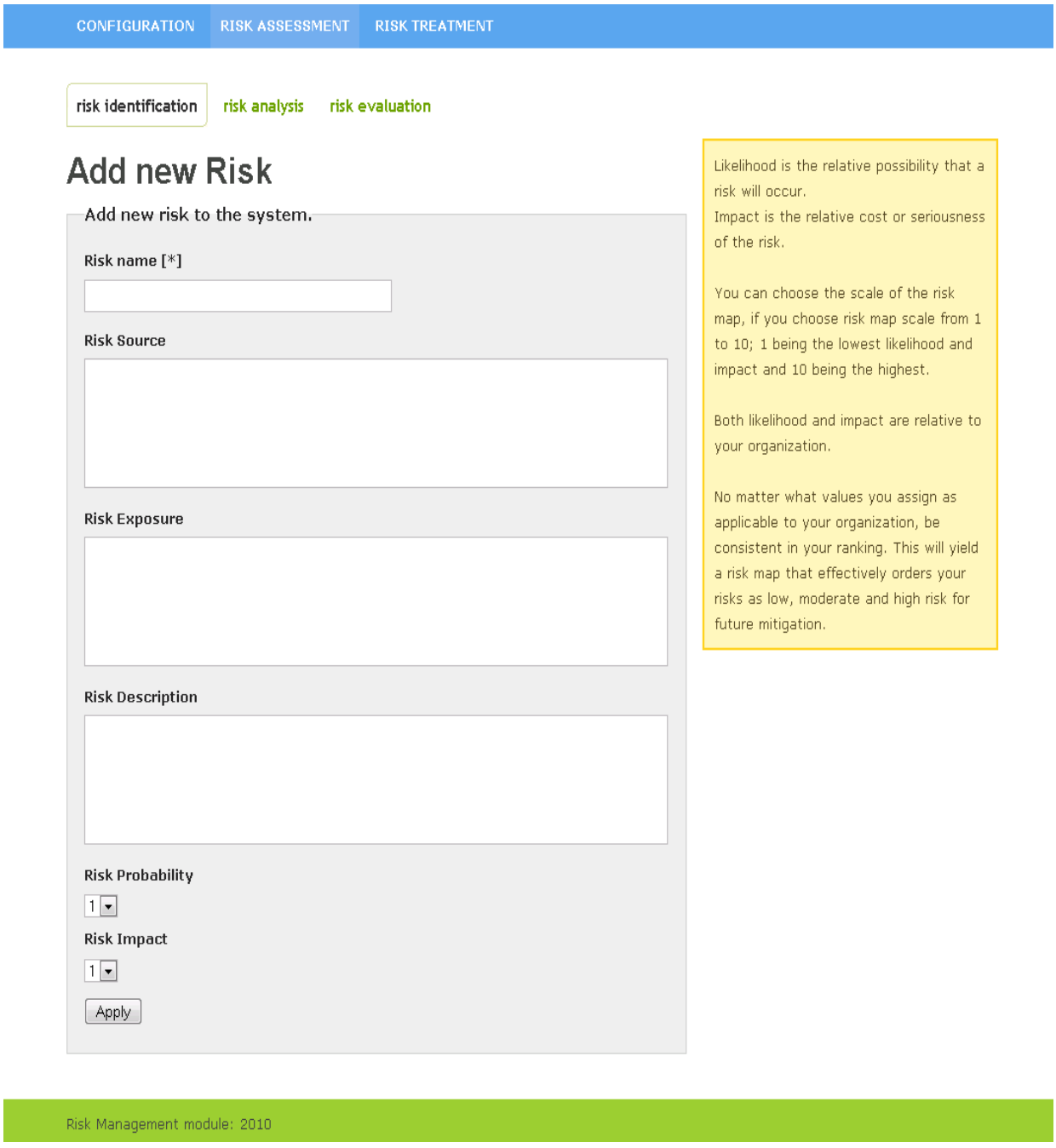
Before the development of the PHP prototype the group and the customer had a meeting. We presented the mockups to the customer. After the meeting we started the development of the prototype.



Admin configuration screen



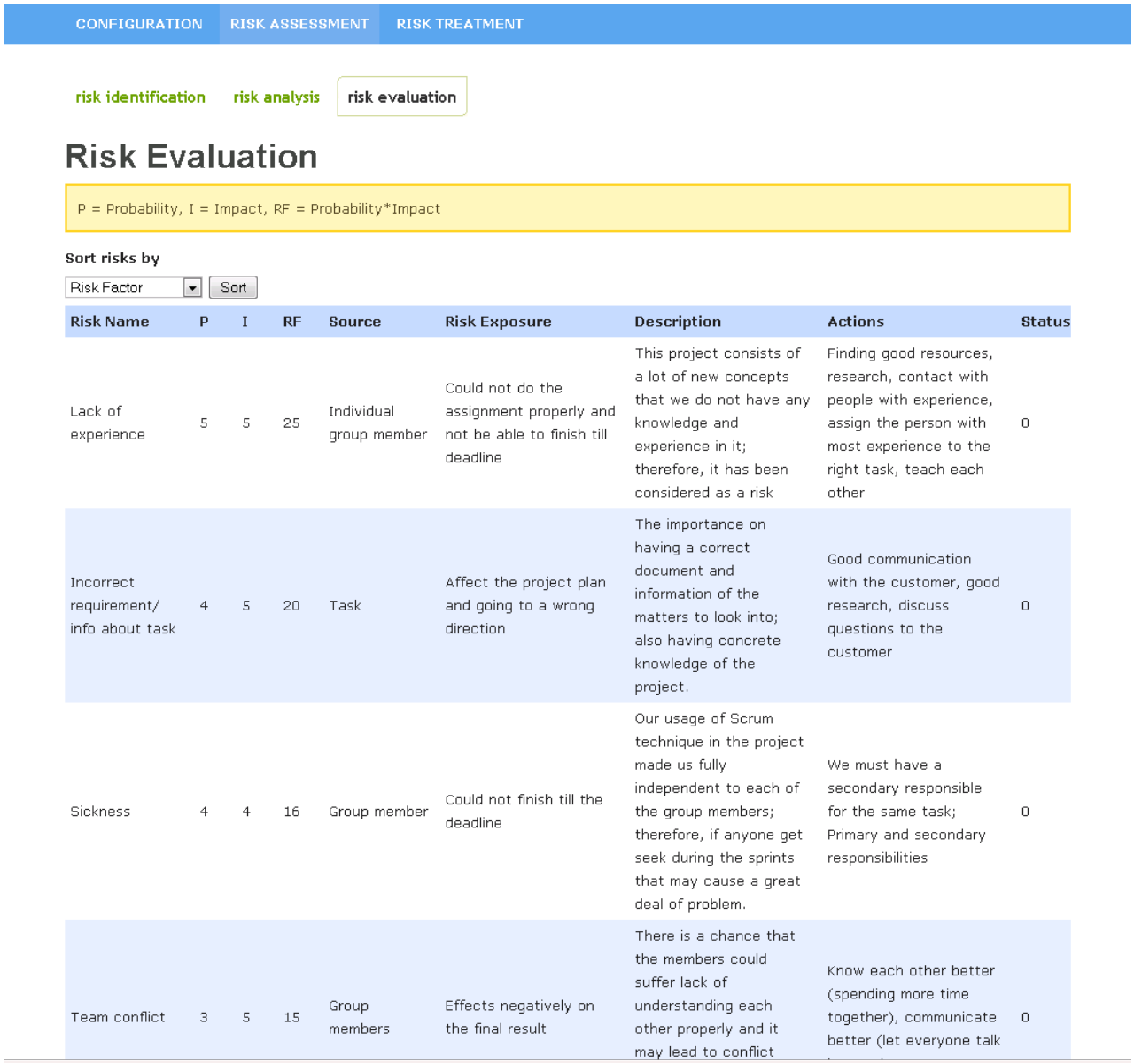
Risk identification screen



Add new risk screen

Risk analysis screen

Delete risk screen



Risk evaluation screen

CONFIGURATION | RISK ASSESSMENT | RISK TREATMENT

Risk Treadment

RiskID	Properties	Values
21	Risk Name	Lack of experience
	Risk ID	21
	Risk Category	Default
	Risk Creator	Habibollah Hosseinpoor
	Risk is dependent on	Independent
	Risk Date Created	2010-10-07 21:46:41
	Risk Source	Individual group member
	Risk Exposure	Could not do the assignment properly and not be able to finish till deadline
	Risk Description	This project consists of a lot of new concepts that we do not have any knowledge and experience in it; therefore, it has been considered as a risk
	Risk Actions	Finding good resources, research, contact with people with experience, assign the person with most experience to the right task, teach each other
	Risk Probability	5
	Risk Impact	5
	Risk Factor	25
	Risk Owner	Habibollah Hosseinpoor
	Risk Status	on going
	Risk Deadline	N/A

RiskID	Properties	Values
20	Risk Name	Incorrect requirement/ info about task
	Risk ID	20
	Risk Category	Default
	Risk Creator	Habibollah Hosseinpoor
	Risk is dependent on	Independent
	Risk Date Created	2010-10-07 21:46:22
	Risk Source	Task
	Risk Exposure	Affect the project plan and going to a wrong direction
	Risk Description	The importance on having a correct document and information of the matters to look into; also having concrete knowledge of the project.

Risk treatment screen

Appendix C

C Screenshots

This appendix contains the screen shots of the finished design of Sprint 2.

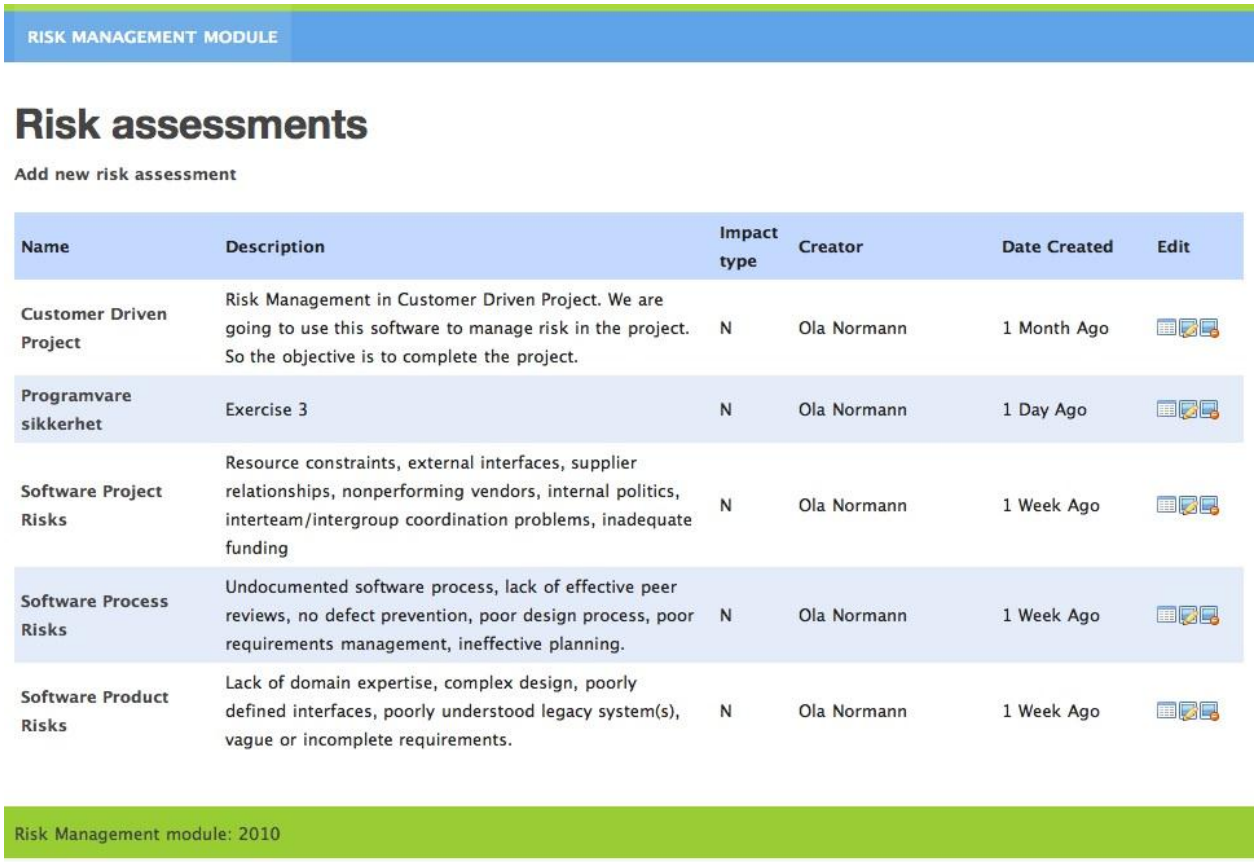


Figure C.1 - List of risk assessment, where each risk assessment contains a set of risk items.

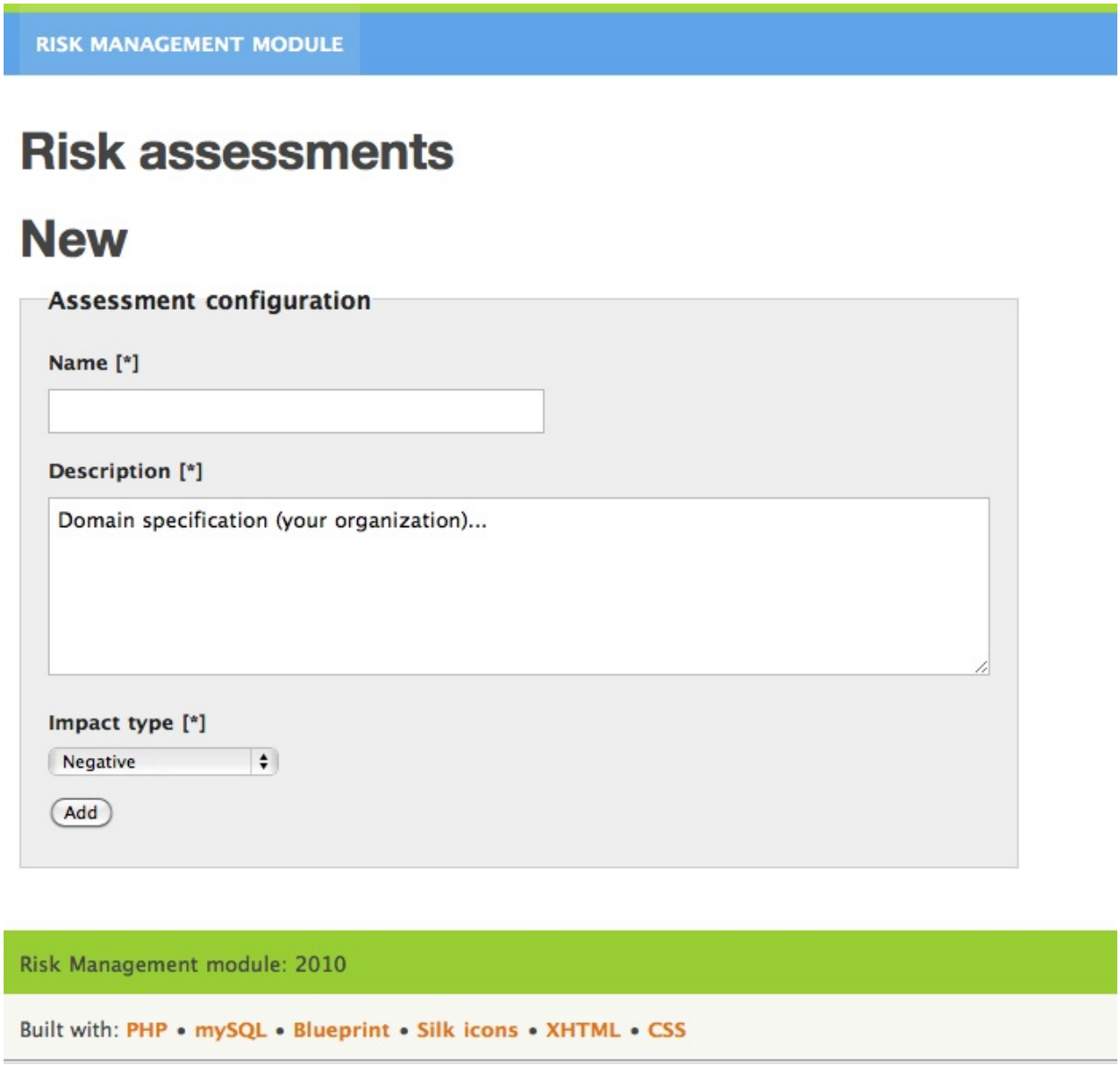
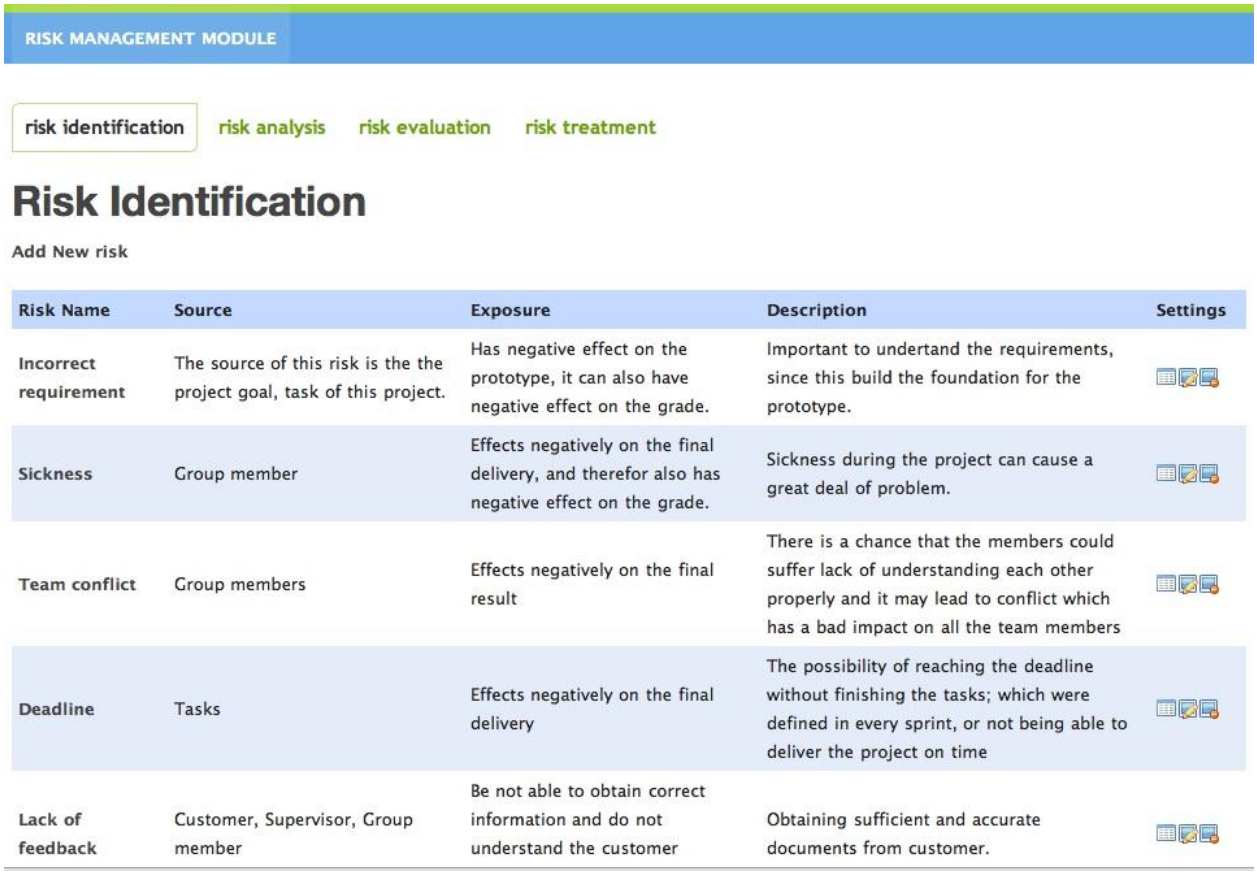


Figure C.2 - creating a new risk assessment



Risk Name	Source	Exposure	Description	Settings
Incorrect requirement	The source of this risk is the the project goal, task of this project.	Has negative effect on the prototype, it can also have negative effect on the grade.	Important to undertand the requirements, since this build the foundation for the prototype.	
Sickness	Group member	Effects negatively on the final delivery, and therefor also has negative effect on the grade.	Sickness during the project can cause a great deal of problem.	
Team conflict	Group members	Effects negatively on the final result	There is a chance that the members could suffer lack of understanding each other properly and it may lead to conflict which has a bad impact on all the team members	
Deadline	Tasks	Effects negatively on the final delivery	The possibility of reaching the deadline without finishing the tasks; which were defined in every sprint, or not being able to deliver the project on time	
Lack of feedback	Customer, Supervisor, Group member	Be not able to obtain correct information and do not understand the customer	Obtaining sufficient and accurate documents from customer.	

Figure C.3 - risk identification process. Adding a risk item into a risk assessment

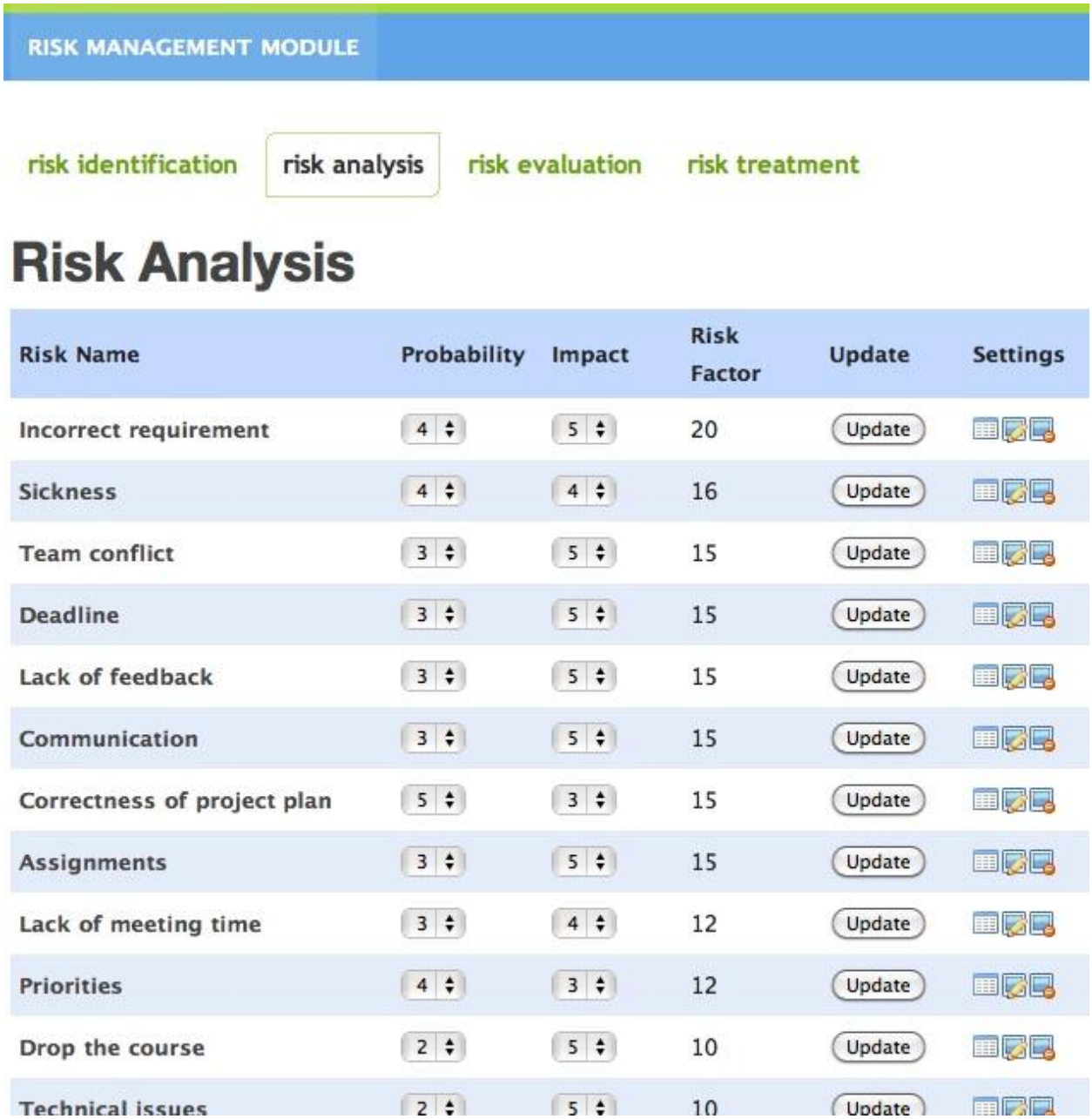


Figure C.4 - risk Analysis process. changing risk probability and impact.

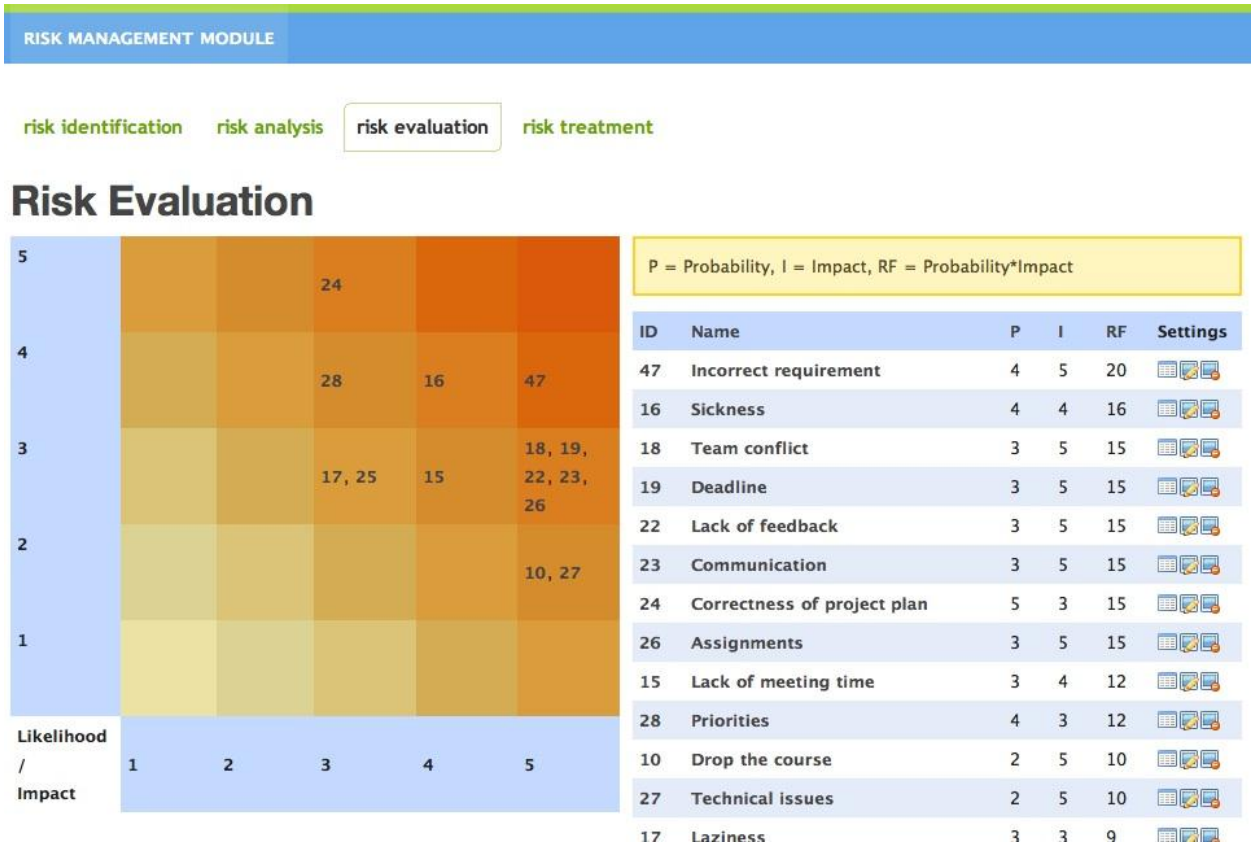


Figure C.5 - Risk analysis process, changing risk probability and impact.

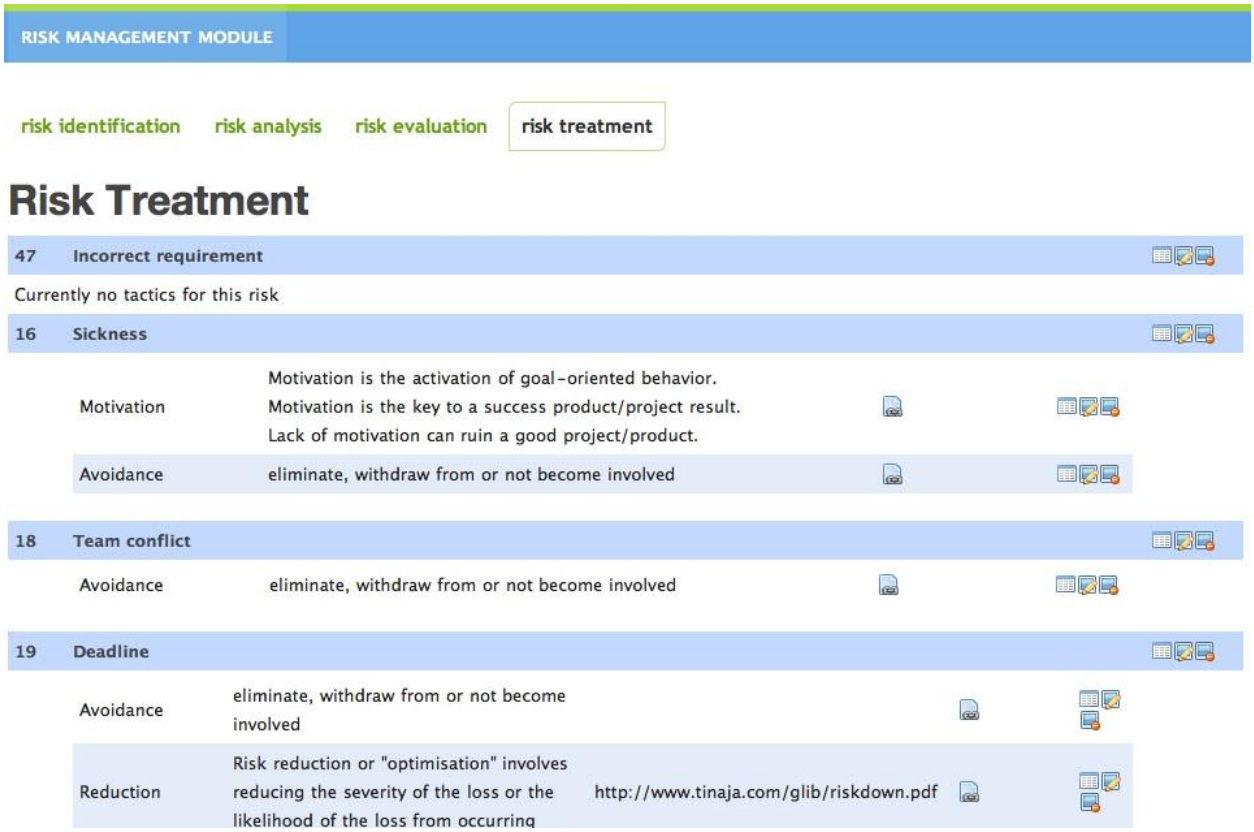


Figure C.6 - risk treatment process. Overview of all risks and its tactic in a particular risk assessment

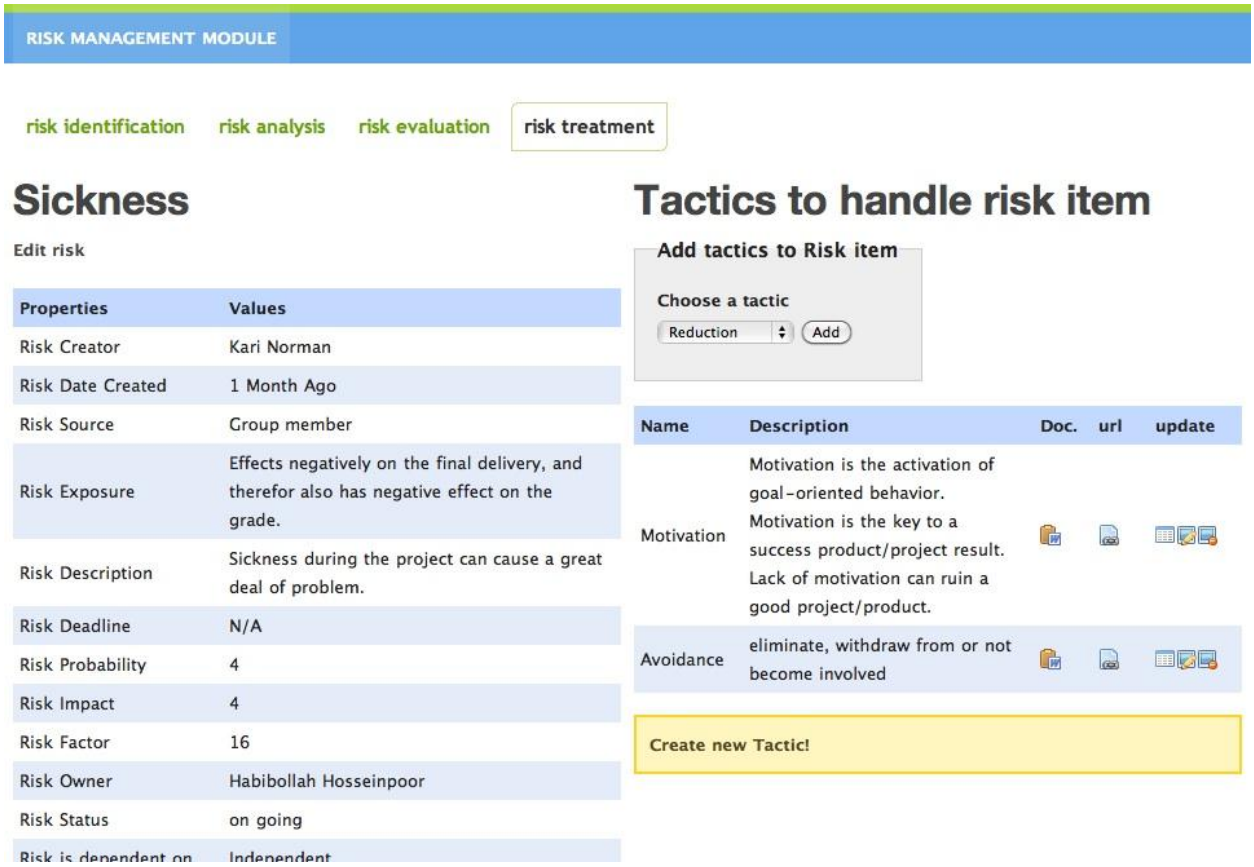


Figure C.7 - risk treatment process. Creating, adding or removing a tactic form a risk item.

Appendix D

D Test Case Descriptions

Title	Adding list group
Test Identifier	F-000
Dependencies	None
Description	The user should be able to create new list groups into the system
Input	Creating a list group with the name testList, testing List group as description and a negative impact
Expected results	Expected results: A new list group will be added with the name testList and appropriate values compared to our input.

Title	Removing, editing and reading list group contents.
Test Identifier	F-001
Dependencies	F-000
Description	Testing the read, edit and remove buttons which are connected with the risk group testList
Input	This test is split up in five parts 1. Checking the read button and checking if we can see all the respective fields 2. Checking the edit button and checking if writing something else in the fields and then cancel the operation 3. Same as 2 but now confirm the changes 4. Checking the delete button and cancel the following confirmation message. 5. Same as 4 but now confirm the message
Expected results	Cancelling of an operation is expected to make everything go back to normal, while confirming it is expected to save the changes being made. When reading a risk group it is important to not be able to alter its contents.

Title	Adding risks.
Test Identifier	F-002
Dependencies	F-000
Description	We are going to add a new risk called test into a random group and see what happens
Input	We click the add button, name the new risk for test, and give some random valid values into the risk description, risk source and risk exposure fields.
Expected results	We expect the risk test to be successfully added to the database, with a confirmation response to the user that it is added. It is also expected that the added risk is put into the correct group we chose.

Title	Deleting risks.
Test Identifier	F-003
Dependencies	F-002
Description	We are going to remove the risk test that we added in F-000
Input	We are choosing the risk test from the group we inserted test into, and clicking remove button, first we choose no from the following confirmation message, then we do it again and choose yes.
Expected results	At the first test we expect nothing to happen, at the second we expect test to be removed from database and the group list of risk will be updated.

Title	Testing the fields concerning add and edit.
Test Identifier	F-004
Dependencies	F-000, F-002
Description	We are testing if there is possible to add invalid input in the fields which add and edit, taken either from risk or risk group, will produce.
Input	testing with empty strings, strings in number fields and checking if there is only permitted letters in some special fields. Also testing every possible option in set impact field.
Expected results	There will be an error message with a pointer to where the user tried to enter some invalid inputs, with a message of what have been done wrong. The set impact field should produce different risk analysis graphs.

Title	Editing risks
Test Identifier	F-005
Dependencies	F-002
Description	Changing an already existing risk with some different information.
Input	Changing the name of the risk from test to test-2
Expected results	The database has been updated accordingly and the name of the risk will show as test-2 instead of test.

Title	Reading risks
Test Identifier	F-006
Dependencies	F-002
Description	Testing if a user can read a selected risk properly.
Input	Selecting a risk and click the read risk button.
Expected results	The user will be able to read the information of the selected risk, with no possibility to change the actual content.

Title	Checking the risk tab
Test Identifier	F-007
Dependencies	F-000
Description	Checking if all the tab elements will take the user to the intentional place
Input	Clicking every tab element
Expected results	The user is forwarded to the correct area. There should also be a clear view of which tab menu you have selected.

Title	Setting risk probability and impact
Test Identifier	F-008
Dependencies	F-002, F-007
Description	Will check if you can properly update the risk probability and impact in the risk analysis tab
Input	Setting risk probability 2 and risk impact 3 from a designed test risk and then click the update button
Expected results	The targeted risk will get an updated value of 2 in probability and 3 in impact. There will also be another value called risk factor which should be set to probability * impact, which in this case is 6. The risk will also get updated values in the risk evaluation tab.

Title	Risk evaluation tab
Test Identifier	F-009
Dependencies	F-002, F-007, F-008
Description	We will check that the graph and list shown in list evaluation parts is working as intended
Input	This testing requires several steps 1. enter a risk group and click the evaluation tab, check if every risk is seen in the list and the graph 2. add a new risk, and check evaluation tab again and look for the new risk 3. change the risk probability and impact
Expected results	Every risk should be listed with their spot in the graph. When a new list is added it should immediately be shown in risk evaluation with the default values 1, 1. When new values are added it should be moved in the graph to its correct area. Values in the list should also be changed.

Title	Sort test
Test Identifier	F-010
Dependencies	F-000, F-002, F-009
Description	We will check if we can sort every list we have by every description of an item within a list.
Input	Click the different descriptions both in the risk group list and the risk list.
Expected results	Sorting by numbers should make it sort by increasing order, or if it is already in this state it should be sorted by decreasing order. Strings should be sorted by lexicographical order, or reversed lexicographical order if it is already in this state.

Title	Creating tactic
Test Identifier	F-011
Dependencies	F-002
Description	A tactic is a way to handle a risk, to try and make sure it happens more often, less, become less costly etc. A user should be able to add new tactics as it pleases. A tactic should be able to make a link towards a risk treatment page, be able to upload a risk treatment document and have a description field
Input	Create a new tactic, write something in description, connect a link and upload a document
Expected results	The expected scenario is that we create a new tactic that can be chosen from a risk we are treating. The link should become a blue clickable link, the document should be uploaded and there should be some filled description of the tactic.

Title	Edit, view and delete tactics
Test Identifier	F-012
Dependencies	F-011
Description	Same as F-001 only with tactics instead
Input	See F-001
Expected results	See F-001

Title	Linking tactics to a risk
Test Identifier	F-013
Dependencies	F-011
Description	Should be able to link a created tactic with a specific risk
Input	Select a risk and then choose a tactic from a sorted drop down menu. Then click add tactic
Expected results	A new treatment tactic will be added to the selected risk, with updated values in the treatment tab

Title	Treatment tab
Test Identifier	F-014
Dependencies	F-007, F-013
Description	When selecting the treatment tab we expect to get an overview of the risks in the risk group with their tactics shown.
Input	enter a group list and select the treatment. Add a new risk and add treatment tactics to that risk.
Expected results	The treatment tab will first show an overview in the risk group and then show the same list + the newly created risk with its tactics.

Title	Removing tactics from a risk
Test Identifier	F-015
Dependencies	F-013
Description	We should be able to remove the unwanted treatments linked to a risk.
Input	Select a risk, create an unwanted treatment and then remove it again, first with a no in the following confirmation message, and then yes
Expected results	Nothing will happen at no and the selected treatment should be removed at yes.

Title	Serving response time
Test Identifier	P-000
Dependencies	all function tests
Description	Will test all the various pages within the system and check if the response time keeps within some given threshold
Input	Press every possible button within the system and observe.
Expected results	All the pages are expected to be updated within a second.

Title	Timing the sorting.
Test Identifier	P-001
Dependencies	F-010
Description	We will test the different sorting methods we have in the risk list overview. Like sort by name, date etc..
Input	Will click on the different options of sorting we can find in the risk list overview.
Expected results	As long as the number of elements stays fairly low, below 100000, it is expected to be done within 1 second.

Title	Usability test
Test Identifier	U-000
Dependencies	none
Description	We are testing if the system is easily understandable from an outsider point of view, one that doesn't have anything influencing the way of thinking about this program. We are going to make a list of task with appropriate time limits for what we think of reasonable for a first time user. It's important to just observe the tasks with no interference, with a later interview with questions to describe how it actually went and what thoughts being made, so we can continue to improve.
Input	What we want the user to do 1. Create a new risk assessment. 2. Create new risk within that assessment 3. Link a treatment to handle this risk. 4. Delete the new treatment 5. Delete the risk assessment 6. Enter risk in customer driven project and find the three least risky risks 7. Find detailed information about risk id 28. After these tests are completed we are going to ask the test person to answer these questions: 1. What were your problems solving the tasks 2. what did you think could have been done differently 3. Something you miss.
Expected results	How much time we expect the test person to maximum use on solving each task 1. 1 minute 2. 1 minute 3. 2 minutes 4. 30 seconds 5. 30 seconds 6. 2 minutes 7. 30 seconds We would also expect these tasks to be completed within 5 minutes.

Appendix E

E Manuals

This appendix covers the user manual for the system, and how to install the prototype. If you want to test the prototype on your own computer, you will need to either set up your own web-server (see Deploying the system), or install VMware Player and use the included VMware-image which is already configured (see Alternative method).

E.1 Deploying the system

E.1.1 Setting up the website

- *PHP*
- *mySQL*
- *Apache/IIS*
- *phpMyAdmin*

Extract all the files in *riskManagement.zip* to the document root of your web-server.

E.1.2 Setting up the database

Before the initial function of the prototype, you have to set up the database. This can be done with phpMyAdmin. Just login as root, import the *riskManagement.sql* file that came with the project. Then the database should be up and running.

In the file *Database.php*, update the following things:

- Database host
- Database username
- Database password

E.2 Alternative method

E.2.1 VMware Player

We made a VMware-image with Ubuntu 10.10 Server Edition installed. On this image, we have set up Apache web server with PHP, mySQL database with the preconfigured risk management database. It should be plug&play, no configuration needed by the user.
A short recipe to use the image:

- Download and install VMware Player (www.vmware.com/products/player)
- Extract the image, and start the .vmx-file.
- Find IP-address on the image (see section Ubuntu).
- Navigate to http://<ip-address> in a browser.

E.2.2 Ubuntu

Username: eqsadm
Password: eqsadm
The image is set up with bridged networking and DHCP client enabled. This means that the image will receive an IP-address in the same scope as the host running VMware Player. To find the IP-address, you have to log on to the image, using the provided username and password. Then you have to type in ifconfig, and see what IP-address the image has.

E.3 User manual

E.3.1 Demo:

A working demo of the application can be found at eqs.leiligheta.net [ID 53]

E.3.2 Create a new risk assessment

To create a new risk assessment click on the link "Add new risk assessment", and fill the form. You must provide a name, a description and must choose an impact type. Then click on "Add" button to create save it on the database. The newly created risk assessment is now listed on index.php

E.3.3 Edit a risk assessment

By clicking on the edit icon you can edit a risk assessment. Once you have edit it you must click the "Edit" button to save the changes.

E.3.4 Delete a risk assessment

By clicking on the delete icon you can delete a risk assessment. Once you have confirmed the delete question, the risk assessment is deleted.
NB! Deleting a risk assessment, means also deleting all of its risk items.

E.3.5 View a risk assessment

By clicking on the view icon you can view a risk assessment.

E.3.6 Viewing risks

By clicking on the risk assessments name you can view all risk items of this assessment.

E.3.7 Adding risk

To add a new risk item to a risk assessment, click on the name of a risk assessment, then click on "Add new risk", then fill the risk form and hit the "Add" button.

E.3.8 Editing risk

To edit a risk item, click on the risk items edit icon, then change the risk items property and hit the edit button to save the changes.

E.3.9 Deleting risk

To delete a risk item, click on the risk items delete icon, then confirm the operation to delete the risk form the system.
NB! Deleting a risk item includes also deleting all the risks items tactics.

E.3.10 Viewing risk item

To view a risk tactic in more detail, like risk items tactics, click on the risk items view icon.

E.3.11 Risk analyzing

Click on the menu “Risk analysis”, then change the probability and impact of a risk item and click on the update button.

E.3.12 Risk evaluation

Click on the menu “Risk Evaluation”.

E.3.13 Sorting risks

Click on the menu “Risk Evaluation”, then you can click on different properties of the risk table, like risk ID, name, Impact etc. to sort the risks in a particular way.

E.3.14 Treat a risk

To treat a risk, click on the menu “risk treatment”, then click on the name of a risk. Then choose a tactic from the tactic list and click the “add” button to add the tactic to the specified risk. Alternatively if there are no good tactics to choose from, you can create a tactic by clicking on the “Create new Tactic”, and then add it to the risk.

Appendix F

F Risks

Table 2 - Risk 1

ID	**R1**. Lack of meeting time: The meeting times are essential due to their strength in solving issues of the group members. If there are not any solid schedules or proper meeting time then that would affect negatively the process of the project.
Activity	R6, R10, R11 and R12
Risk factor	Lack of meeting time
Consequences	4 , The quality of the project will be decreased
Probability	3
Strategy and actions	Meet after school, create good agendas before every meeting, status report (what has been done), meet in weekends if it is necessary
Deadlines	Continuous
Responsible	Group members

Table 3 - Risk 2

ID	**R2**. Sickness: Since our project contains of 6 people a sick person that can not finish the work on time will halt our progress severely.
Activity	R5 and R12
Risk factor	Sickness
Consequences	4. Assignments might get delayed
Probability	4
Strategy and actions	Assigning primary and secondary assignments to each person
Deadline	Continuous
Responsible	The backup person

Table 4 - Risk 3

ID	**R3**. Laziness: This one is considered as possibility that someone despite of his or her great condition of health ignores to do his or her own tasks.
Activity	R4,R5,R11 and R12
Risk factor	Laziness
Consequence	3. Tougher schedule later in the project
Probability	3
Strategy and actions	Group pressure, talk with supervisor
Deadline	Continuous
Responsible	Group members

Table 5 - Risk 4

ID	**R4**. Team conflict: There is a chance that group members does not agree with each other, and instead of making a compromise they will start working independently.
Activity	R5 and R11
Risk factor	Team conflict
Consequence	5. Work might get delayed
Probability	3
Strategy and actions	Know each other better (spending more time together), communicate better (let everyone talk in turns)
Deadline	Continuous
Responsible	Group members

Table 6 - Risk 5

ID	**R5**. Deadline: The possibility of reaching the deadline without finishing the tasks; which were defined in every sprint backlog, or not being able to deliver the project on time.
Activity	R4
Risk factor	Deadline
Consequence	5
Probability	3
Strategy and actions	Good project plan, steady flow of work throughout the project
Deadline	At the end of term
Responsible	Group members

Table 7 - Risk 6

ID	**R6**. Incorrect requirement/ info about task: The importance of understanding our task correctly and also with the restrictions Extend gives us.
Activity	R5, R10 and R12
Risk factor	Correct requirement/info about task
Consequence	5. Might make us lose time where we are heading in the wrong direction
Probability	4
Strategy and actions	Good communication with the customer, good research, discuss questions with the customer
Deadline	Continuous
Responsible	Document manager and architectural manager

Table 8 - Risk 7

ID	**R7**. Lack of experience: This project consists of a lot of new concepts that we do not have any knowledge and experience in it, therefore, it has been considered as a risk.
Activity	R5, R12 and R13
Risk factor	Lack of experience
Consequence	5. Cannot do the assignment properly and work will be slowed
Probability	4
Strategy and actions	Finding good resources, research, contact with people with experience, assign the person with most experience to the right task, teach each other
Deadline	Continuous
Responsible	Group members

Table 9 - Risk 8

ID	**R8**. Lack of feedback: Obtaining sufficient and accurate documents from customer.
Activity	R5, R6, R9, R10 and R12
Risk factor	Lack of feedback
Consequence	5. Not able to obtain correct information and not understand the customer requirements
Probability	3
Strategy and actions	Make quality assurance documents, ask the customer, talk to the supervisor
Deadline	Continuous
Responsible	Project manager

Table 10 - Risk 9

ID	**R9**. Communication: Ability to communicate with the customer.
Activity	R5, R6, R10 and R12

Risk factor	Communication
Consequence	5. Not be able to obtain correct information and do not understand the customer requirements
Probability	3
Strategy and actions	Write an email with questions, ask anything
Deadline	Continuous
Responsible	Project manager and group members

Table 11 - Risk 10

ID	**R10**. Correctness of project plan: The project plan that has been defined from the beginning might not be how the project evolves
Activity	R4, R5,R6,R11 and R12
Risk factor	Correctness of project plan
Consequence	3. Need to make new plan that most likely will change time usage.
Probability	5
Strategy and actions	Continuously check if we're following the plan, and edit the project plan if changes occur
Deadline	Continuous
Responsible	Group members

Table 12 - Risk 11

ID	**R11**. Roles: Some roles have been defined in order to cover different parts of project plan to make the project go smoothly, these might not be followed as expected.
Activity	R4 and R6
Risk factor	Roles
Consequence	3. No one would accept responsibility

Probability	3
Strategy and actions	If uncertain, ask for help, change roles if necessary
Deadline	Continuous
Responsible	Project manager and group members

Table 13 - Risk 12

ID	**R12**. Assignments: The small tasks which have been given to each group members during every sprint.
Activity	R5 and R14
Risk factor	Assignments
Consequence	5. Cannot finish before deadline
Probability	3
Strategy and actions	Talk to the person, assign more people to the same task, make sure the person understands his task, ask questions
Deadline	Continuous
Responsible	Group members

Table 14 - Risk 13

ID	**R13**. Technical issues: This term indicates the different problems may occur due unavailability of technical tools.
Activity	R5 and R12
Risk factor	Technical issues
Consequence	5. Doing assignments improperly and will delay work
Probability	2
Strategy and actions	Ask technical manager, talk to the customer
Deadline	Continuous

Responsible	Technical manager, supervisor and backup person

Table 15 - Risk 14

ID	**R14**. Priorities: How important a person think this course is compared to other courses.
Activity	R12, R15
Risk factor	Priorities
Consequence	3. Work might be put on hold
Probability	4
Strategy and actions	Everyone should meet and do their assignments
Deadline	Continuous
Responsible	Group members

Table 16 - Risk 15

ID	**R15.** Drop the course: One or more group members drop the course
Activity	R5, R11
Risk factor	Drop the course
Consequence	5. More pressure on the other group members, which might cause low project quality
Probability	2
Strategy and actions	Try to encourage the group members, and assign more than one member in each task
Deadline	just the beginning of the course
Responsible	Group members

References

[1] ISO31000 International Organization For Standardization. 2009
[2] *Legal Aspects of Health Care Administration written,* by George D. Pozgar, 2004.
[3] www.nrls.npsa.nhs.uk/EasySiteWeb/GatewayLink.aspx?alId=60138 last accessed: 24.11.2010
[4]Healt Reasource http://bphc.hrsa.gov/patientsurvey/samplesurvey.htm last accessed: 24.11.2010
[5] International Maritime Organization: http://www.imo.org last accessed: 24.11.2010
[6]Det Norske Veritas http://www.dnv.com last accessed: 24.11.2010
[7]Standards of Training, Certification & Watchkeeping: http://www.stcw.org last accessed: 24.11.2010
[8]FreightMetrics: http://freightmetrics.com last accessed: 24.11.2010
[9]COMARCH: http://www.comarch.com/ last accessed: 24.11.2010
[10]COMARCH: http://www.comarch.com/files_eu/file_454/Comarch-Asset-Management-Risk-Management-EN-leaflet.pdf last accessed: 24.11.2010
[11] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Monte_Carlo_method last accessed: 24.11.2010
[12] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Covariance last accessed: 24.11.2010
[13] en.wikipedia.org. Wikipedia: http://www.riskglossary.com/link/cornish_fisher.htm last accessed: 24.11.2010
[14]en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Extreme_value_theory last accessed: 24.11.2010
[15] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Value_at_risk last accessed: 24.11.2010
[16]Financial Engineering Associates: http://www.fea.com/resources/pdf/Backtesting1.pdf last accessed: 24.11.2010
[17] Kevin Dowd, 2004: http://web.me.com/kevindowd1958/web.me.com_kevindowd1958_Site/Financial_risk_management_files/A%20modified%20Berkowitz%20backtest%20Risk%202004.pdf last accessed: 24.11.2010
[18] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Beta_(finance) last accessed: 24.11.2010
[19]en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Bond_convexity last accessed: 24.11.2010
[20] QFINANCE: http://www.qfinance.com/asset-management-calculations/basis-point-value last accessed: 24.11.2010
[21] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Greeks_(finance) last accessed: 24.11.2010
[22]en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Vasicek_model last accessed: 24.11.2010
[23]en.wikipedia.org. Wikipedia:http://en.wikipedia.org/wiki/Ornstein–Uhlenbeck_process last accessed: 24.11.2010
[24] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Black-Scholes last accessed: 24.11.2010
[25] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Cox-Ross-Rubinstein_model last accessed: 24.11.2010
[26] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Futures_contract last accessed: 24.11.2010
[27] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Forward_price last accessed: 24.11.2010
[28] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Swap_(finance) last accessed: 24.11.2010
[29] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Vanilla_option last accessed: 24.11.2010
[30] en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Exotic_option last accessed: 24.11.2010
[31] RiskMetriks: http://www.riskmetrics.com/ last accessed: 24.11.2010
[32]RiskMetriks: http://www.riskmetrics.com/sites/default/files/available_models.pdf last accessed: 24.11.2010
[33] Capital IQ, ClariFI: http://www.clarifi.com/Solutions-ClariFI.php last accessed: 24.11.2010
[34] RMS: http://www.rms.com/Catastrophe/Software/ last accessed: 24.11.2010
[35]STG Active Risk Manager: http://www.strategicthought.com/riskmanagement.html last accessed: 24.11.2010
[36] Allegro: http://www.allegrodev.com/risk-management/simulation last accessed: 24.11.2010
[37] citicus: http://www.citicus.com/oursoftware.asp?gclid=CLPo65zWhqQCFQkrDgod6kIqIg last accessed: 24.11.2010
[38] enablon: http://enablon.com/ last accessed: 24.11.2010
[39] capacent: http://www.capacent.no/Services/Our-Services/Risk-Management/ last accessed: 24.11.2010
[40] patsystems: http://www.patsystems.com/riskSolutions/riskLanding.aspx last accessed: 24.11.2010
[41] Aon: http://www.aonriskconsole.com/aonES last accessed: 24.11.2010
[42] Envision Technology Solutions: http://www.envision-ts.com/ last accessed: 24.11.2010

[43] Mountainview Software: http://www.mvsc.com/ last accessed: 24.11.2010
[44] Noweco: http://www.noweco.com/emse.htm last accessed: 24.11.2010
[45] jun auza 14.04.2010 http://www.junauza.com/2010/04/open-source-project-management-software.html last accessed: 24.11.2010
[46] riskconnect: http://www.riskonnect.com/rmis-videos/ last accessed: 24.11.2010
[47] SAP: https://www.sap.com/ last accessed: 24.11.2010
[48]ClearRisk Manager: http://www.clearrisk.com/Manager/ last accessed: 24.11.2010
[49] PALISADE: http://www.palisade.com/risk/ last accessed: 24.11.2010
[50] Risk Reasoning: http://www.riskreasoning.co.uk/product_riskaid.cfm last accessed: 24.11.2010
[51] citicus: http://www.citicus.com/oursoftware.asp?gclid=CLPo65zWhqQCFQkrDgod6kIqIg last accessed: 24.11.2010

[52] capacent: http://www.capacent.no/Services/Our-Services/Risk-Management/ last accessed: 24.11.2010
[53] Endpoint Security Lumension: http://www.lumension.com/Resources/Demo-Center/DemoDetail-Compliance-and-IT-Risk-Mgmt.aspx last accessed: 24.11.2010
[54]en.wikipedia.org. Wikipedia: http://en.wikipedia.org/wiki/Main_Page last accessed: 24.11.2010
[55] 24SevenOffice, product: 24SevenOffice Project: http://24sevenoffice.com/ last accessed: 24.11.2010
[56] Corporater, product: Corporater Enterprise Performance Management Suite, v3.0, website: http://www.corporater.com last accessed: 24.11.2010
[57]Mamut Software Limited, product: Mamut Validis: http://www.mamut.com last accessed: 24.11.2010
[58] Software Innovation, product: ProArc: http://www.software-innovation.com last accessed: 24.11.2010
[59] Visma AS: http://www.visma.com last accessed: 24.11.2010
[60] Det Norske Veritas: http://www.dnv.com/ last accessed: 24.11.2010
[61] Synargi Solutions AS: http://www.synergi.com/ last accessed: 24.11.2010
[62] balsamiq: http://balsamiq.com/ last accessed: 24.11.2010