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APPLICATION OF RISK MANAGEMENT IN EDUCATIONAL SOFTWARE DEVELOPMENT PROJECTS

Enhancing the Awareness of Risks and Risks' Responses in
Educational Software Development Projects

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Application of Risk Management in Educational Software Development Projects: Enhancing the awareness of Risks and Risks' Responses in Educational Software projects.

ABSTRACT

In real life, it is said that many industrial projects failed because of lacking Risk Management. Therefore, author realized how important to bring the knowledge of Risk Management to educational teams. With understanding of RM methodology and how to put it into practice, students can be more aware of issues in their projects and it can stimulate students' problem solving for their projects issues.

This present research consists of literature review and empirical segment. The literature part provides brief information of interrelation between project and project risk management. Furthermore, Risk Management methodology will be introduced into steps. Additionally, the created light-weight Risk Management Toolkit is introduced for its structure and usage.

The study is conducted in qualitative way and it is an explorative research on Risk Management. The created light weight Risk Management Toolkit are utilized by two study cases. Teams' risk plan and report documents are collected for the purpose of research's analyzing. Furthermore, answers from teams' interviews and clients' interviews are gathered as research data analysis.

The results of data analysis provides that Risk Management Guideline, Reference Risk List and Risk Plan are effective tools for project teams. Project teams' awareness of issues and its responses are increased. In addition, Risk Report is realized as useful tool for educational teams. However, with small scale project as educational projects, the usefulness of Risk Report is not used as its maximum.

Keywords: Risk Management, Proactive Risk Plan, Effective Risk Management in Educational projects.

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ABBREVIATIONS

LAMK	Lahti University of Applied Sciences
BIT	Business Information Technology
IT	Information Technology
RM	Risk Management
RMT	Risk Management Toolkit
SDLC	Software development Life Cycle
SRS	Software Requirement Specification

1 INTRODUCTION

Nowadays, information technology has become an essential part of human life. Therefore, to be able to satisfy the need of human, information technology companies have been released tons of new products. Unfortunately, among those released products, there are many which does not match clients' need or its performance is worse than clients' expectation. These outcomes are results of failed IT projects. Besides, based on a number of studies which focus into success/failure rate in IT industry, the number of failed projects is very high (68%) (Michael Krigsman, 2009), and has not changed much over the past 15-20 years (P.Lientz, Larssen, 2006). In addition, according to Laurie Williams (2004), it is reported that only 28 percent of software project are successful completed on time without running out of budget, over 23 percent of projects are cancelled and 49 percent of projects needs more budget than its original estimation to complete. (Standish, 1995) With the help of developed technology, advanced techniques and tools, how can projects lead to failure?

After participating in some educational software development projects, experiencing its success and failure, it is realized that having a proactive risks management plan is a must for projects to be successful. In software development projects, there will be risks occurring without being acknowledged. Similar as industrial projects, issues in educational projects are not only related to people, technology and management but also arise in every project phases.

This study focus on understanding and implementing risks management in educational software development projects and its effectiveness to the first four stages of software development process in educational projects. These are requirements, design implementation and testing phases. By understanding the important role of risk management; by participating and observing educational projects and team-works, the author would like to bring risk management technique into those projects, in which risks are not well considered, managed and controlled, to archieve the knowledge from educational project's environment.

Risk management provides software development teams effective guideline to detect latent issues which might become a threat to the project. According to Boehm (1989), risk management contains two interrelated phases. There are risk assessment and risk control. Moreover, it is important to perform risk management as a proactive management plan. In other words, one of the key for a successful software development project is having a plan beforehand to manage and control future harms. Indeed, these IT companies stated if they would have received the warning of high-risk elements earlier, it is possible that those problems would have been strongly reduced or avoided. (Bruegge and Dutoit, 2000)

“Risk management is a series of steps whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive rework.” (Boehm, 1989)

2 RESEARCH BACKGROUND

In this chapter, description of the key concepts and research motivation are contained. After that, it is continued with the research framework – shortly describing how the thesis will be conducted.

2.1 Definition Of Key Concepts

Risk and risk management process in software development projects, Software Development Life Cycle, Educational Software Development Team.

These key concepts will be defined below in following subchapters.

2.1.1 Risk And Risk Management

We have been hearing the word “risk” throughout our life’s activities. Therefore, it is easy to understand that “risk” mostly stands for negative consequence of an event (Rowe, 1988). As same as that, “risk in software development projects” indicates the potential of loss in the product or project’s outcomes. In addition, not all risks happening in the project are harmful, some risks can be opportunities for the project, for example: unprofessional project manager is changed, prototype is successfully created by implementing new technologies, etc.

Due to the fact that most of occurring risks are harmful, “risk management” was introduced in software development process to prevent future damages or disadvantages in projects by Boehm in the 1980s. In 1988, Boehm defined the risk-driven spiral model, one year later, the very first risk management process was described (Boehm, 1989). According to Boehm (1989), risk management process includes two interrelated sub-processes, “risk assessment” and “risk control”. And there are three connective phases for each sub-process. See Figure1.



FIGURE 1. Boehm's risk-management process (Boehm, 2004)

Risk Assessment process begins with risk identification phase in which project team members are encourage to list all the potential risks to the project. After risks are listed, they are all evaluated in risk analysis phase by considering the probability of each risk and its impact. At the end of the risk assessment process, all evaluated risks are ranked in risk prioritization phase for further action.

After all suggested risks are prioritized, each risk from the top high risks list is given solution in risk planning phase. When potential risk happens to occur, suggested solution from planning phase is implemented to minimize the risk's negative impact, this phase is called risk resolution (or risk mitigation) phase. After action is done, risk monitoring keeps track of the efficiency of the measures implemented. It is important that all the resolved risks are monitored and reviewed by specific risk monitoring metrics in risk planning phase and in risk resolution (risk mitigation) stage, all the related data is captured.

2.1.2 Software Development Life Cycle

Software Development Life Cycle (SDLC) is also called Software development process. SDLC is a process used by a software organization and followed by a software project. It consists of phases which describe details of how the project will be performed and how the product will be made. The process basically consists of six interrelated phases: Requirement phase, Design phase, Implementation phase, Testing phase, Deployment phase and Maintenance phase. In addition,

there are different models of Software Development process, each of them is used based on specific and suitable circumstance. For more information, these models are Waterfall model, V model, Incremental model, RAD model, Agile model, Iterative model and Spiral model. Therefore, it is important for the software organization or project team choose the suitable model for their project. See figure 2.

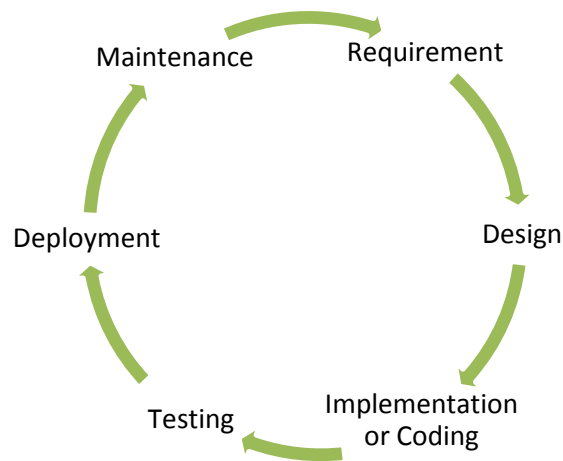


FIGURE 2. Software Development Life Cycle

In this thesis, risk management method will be apply and focus on the first four phases of the SDLC: Requirement phase, Design phase, Implementation phase and Testing phase. These four phases will be shortly described below.

In SDLC, Requirement stage is the most important and fundamental in the SDLC. In this stage, the requirements are gathered, documented and discussed from different areas with its specific perspective. The meetings are set up with the participation of project managers, stakeholders and users to ensure that every provided requirements is met with right understanding. After that, all provided information are reviewed, discussed and documented among senior team members. Software Requirement Specification (SRS) document is created to provide the needed requirements for the project's outcome.

After SDS document is made by agreement, it is used as a reference for preparing system and software design in design phase of SDLC. System design helps to define the overall system architecture and specify the hardware and software requirements.

In this following stage – Implementation stage, the development team is in charge with project second hardest job. The work is divided into tasks and the actual coding is started following up with the received system design documents. Developers should consider if there is unclear parts in SRS documents or system design documents. Every ill-defined information has to be discussed with analysts to be provided resolution as soon as possible.

After the development part is done, product's functionalities are tested in testing phase. In this stage, functionalities are tested against the requirements to make sure that the product meets customer's needs. Testing phase contains unit testing, integration testing, system testing, acceptance testing.

When the product is successfully tested, it is released and delivered to customer for usage. As soon as customer starts to use the product, it comes to maintenance phase, in which errors occurs will be taken care of developed product by development team.

These six stages are performed continuously to make sure that the products meet customer's needs.

2.1.3 Software Development Team

In software project, there are many groups of people involved. But the Software Development Team is the group which is responsible for building the product. To be able to have a successful project's outcome, project team roles should be defined and defined roles are responsible for their own works. They are six key roles including Project Manager, Requirements Analyst, Design Architect, Build Lead, Test Lead and Change Co-ordinator in the development team.

In addition, client and user are not involved in development team but they are important to the project. To have a satisfied result, clients should be updated with the project status and involved in meetings during the project. As important as clients, users provide information which helps project team to reach the project's business

goals including of making sure that users' needs are reached and understood right. See Figure3.

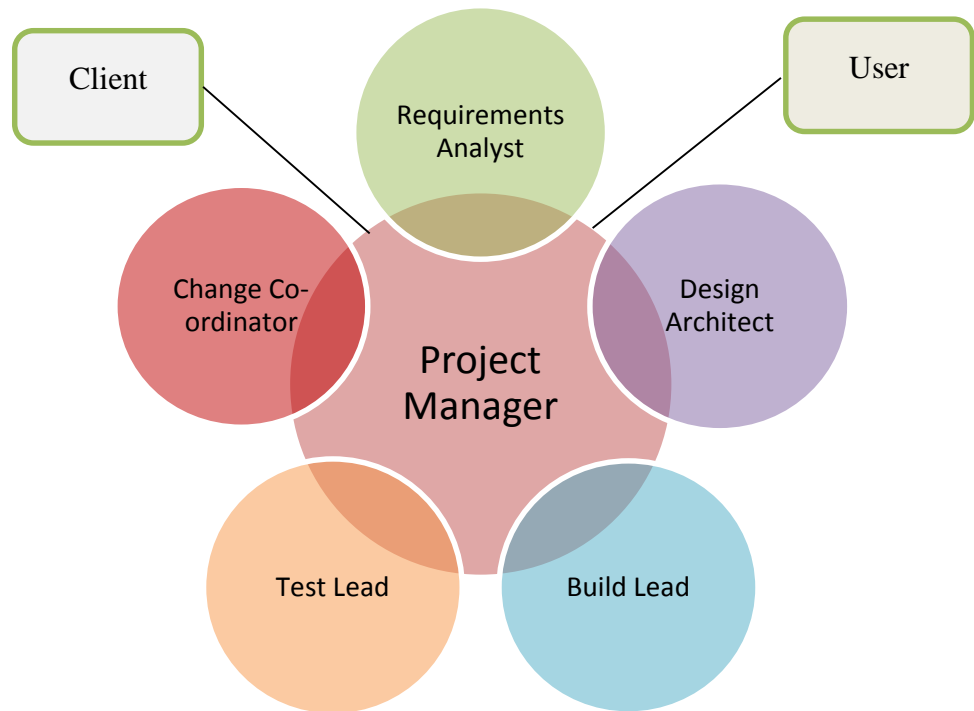


FIGURE 3. Development Team Roles

Project manager is responsible for managing and leading the whole team from the start day until the project accomplish. This person ensures that the project follows up the constraints of time, cost and quality. In addition, this person has the main responsibility for risk resolution and mitigation.

Requirements Analyst is the one who discuss and take requirements from clients. All the requirements are documented as SRS document clearly by analyst.

Design Architect takes SRS document from requirements analyst then transform into models which represents solutions for the project.

Build Lead is responsible in developing designed model into product.

Test Lead is the person who makes sure that every built functionalities are matched with client's requirements and if there are bugs or errors occur.

Change Co-ordinator makes sure that the developed product is used correctly and there is minimum amount of disruption to the operational element after the product is successfully tested.

Depending on the size of the project and project team, one person can act in one or more than a role in the development project.

Client is the one who pays for the products and give the product's requirements to the project team. Which means it is important for client to be involved and informed enough information about the project's status to make sure that required functionalities are matched client's needs.

There can be one or a group of users who will be utilizing the product after its releasing. Therefore, it is a wise decision to involve them into the implementation and testing phases.

Client and user can be the same person but most of the time, they are not. These people have to be organised and coordinated so that the products can match required deliveries.

2.2 Motivation of The Study

It was mentioned that "Sometimes, the need for risk management can seem far off for students" (Laurie Williams, 2004, 8). Moreover, author had participated in several educational software development projects in LAMK throughout Business Information Technology studying program. As experienced in these educational projects, risks management and risks' response seemed to be unfamiliar with students although there were risks occurring. These projects started with project plan including one section where project team could define project risks. Although Risk Management was mentioned in the project plan document, it was not introduced in details and was not paid attention to. Therefore, it happened as these risks were not reviewed throughout projects, especially, it was not reported and documented if happened. These incaution actions can lead projects to failure or unsatisfied result.

Therefore, in this study, author would like to adapt Risk Management in Educational Software Development projects. The purpose of this study is to gain knowledge of how educational software development teams manage risks in their projects after being introduced to Risk Management methodology. In addition, there is Risk Management Toolkit which goes along with the methodology. This Toolkit is designed and meant for educational project teams. Furthermore, author hopes the study can reflect the importance of Risk Management practice. Additionally, as being stated that, in the beginning of computer science classes, as a student, people just have small and defined assignments to work alone. But later on, when advancing in academic career, it requires people to cooperate and work with at least one other person. In addition, there will be more ambiguous requirements which are changeable. Henceforth, things will be hard to manage and control. (Laurie Williams, 2004, 9.). For this reason, providing students Risk Management knowledge for their future careers is one of the purposes of this study.

2.3 Research Question, Objectives and Scope

In this research, the objective is to observe and find out results of risk management pattern implemented in educational projects. With the findings, author hopes to improve the effectiveness of Risk Management to educational projects. Risk management method is used from the beginning of the project at Requirement stage when the project plan is created. In Design stage and Implementation stage, risk management is held with information updates and carried-out actions (if needed). An effective proactive risk management plan, implemented throughout the project, can minimize the loss of the project and increase project's performance as well as quality of the product. Therefore, the question below will ensure the study is built precisely:

“How Risk Management enhance project team's awareness of risks and risks' response by using Risk Management Toolkit in Educational Software Development projects?”

As mentioned above, this research is implemented on Educational Software Development teams with Educational Projects. Development teams are groups of students who have not got much knowledge in managing risks in their projects. Their projects are school projects which means they has no worry about budgets for developing products.

2.4 Research Methodology

In this study, qualitative research methodology is used. This methodology is chosen because the purpose of this research is obtaining people responses and experiences to their circumstance.

As defined, qualitative study is an inquiry process of understanding a social or human problem, based on a complex, holistic picture, formed with words, and reporting in a natural setting. (Cresswell J., 1994) Additionally, qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts. This research requires in-depth understanding in using tools and solving problems in the specific context. The process needs to be observed and documents are collected for analysing and publishing findings and results. Therefore, quantitative research is not a right methodology for this study.

The aims of this study are to examine if effective Risk Management can enhance the awareness of risks in Educational development teams, in addition, discover common risks in Educational projects as well as how project teams respond to risks in their projects. The knowledge of how effective Risk Management is to Industrial Software Development projects and common risks in those projects are the base for this research. Therefore, deductive approach will be chosen for this research in order to confirm the hypotheses created at the beginning of the thesis. The Figure 4 below describes how the research process is designed.

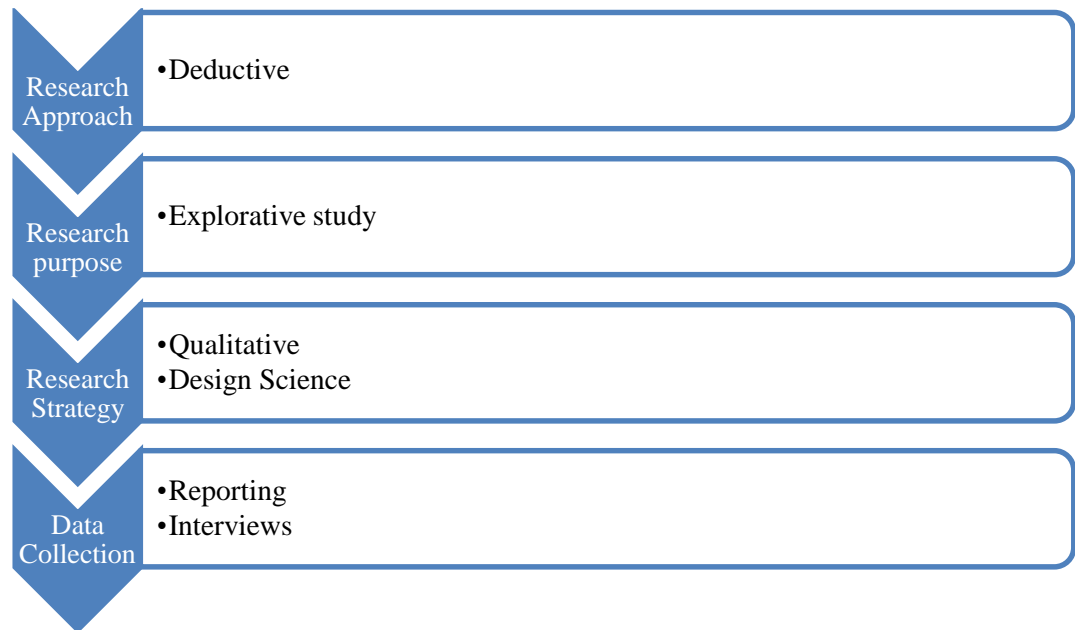


FIGURE 4. The Thesis's Research Design

For more information, design science, a research approach which creates and evaluates IT artifacts for the purpose of solving addressed organizational problems (Klein and Meyers, 1999). Design concludes not only process (activities set) but also a product (artifact) – combination of a verb and a noun (Wall et al., 1992). Additionally, an IT artefact which adopted into an organizational circumstance is usually the study's object of Information System behavioural-science research. With the respect to the artifact's use, recognizable usefulness as well as its impact on organizations and individuals, theories look for predicting and explaining the phenomena. (DeLone and McLean, 1992; Seddon, 1997; DeLone and McLean, 2003.) Described as figure below.

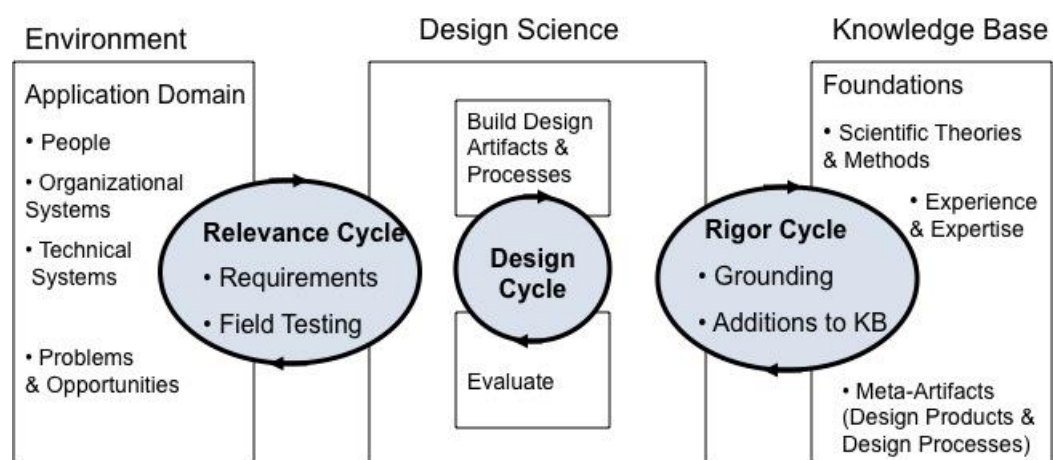


FIGURE 5. Design Science Research Cycles (Hevner, 2007)

Therefore, in order to find out how Risk Management can enhance awareness of risks and risk's response in Educational projects, the author will consider the findings of previous studies in Industrial projects, concerning the advantage of Risk Management to projects. Furthermore, to simplify the Risk Management process and tool, the author will create the light-weight Risk Management Toolkit. Additionally, this Toolkit will be made based on earlier researches' findings in Industrial projects.

As main purpose of this research is to study about project team's response to risks and the use of Risk Management Toolkit in Educational projects, the design science is the most suitable for this research approach, when the study focus on people's responses for risks (behavioural science) and an artefact as Risk Management Toolkit used in projects (information system, design science).

2.5 Research Framework and Structure

This sub-chapter describes how the study will be conducted. These steps are drawn into a picture below as Figure 6 which determines what aspects to cover and provides quick understanding of the thesis's conduction.

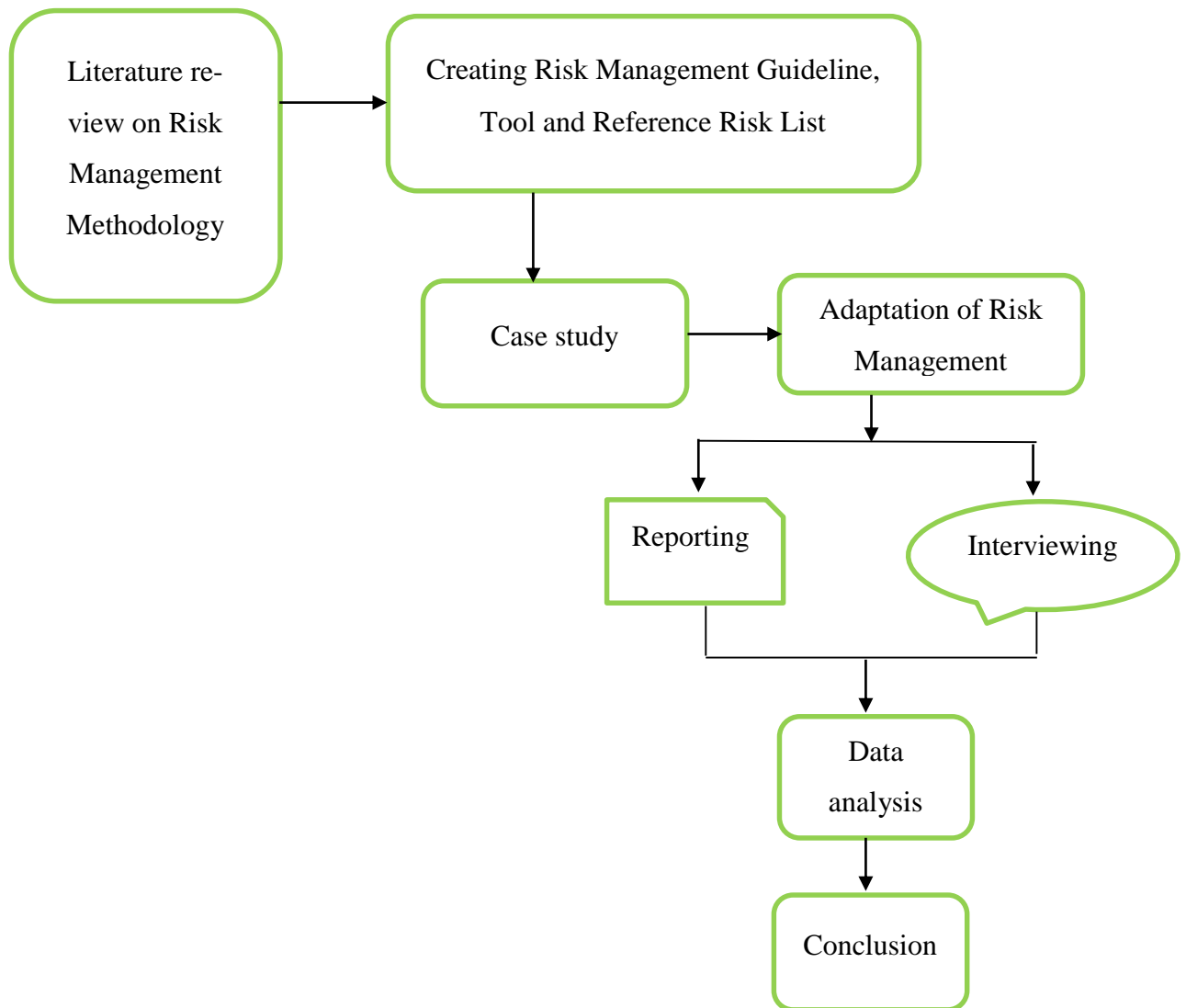


FIGURE 6. Research Framework

At the beginning, the research started with literature review on Introduction to Project Management as well as Risk Management methodology. It provides solid knowledge for the author to build a comprehensive Risk Management understanding and its effectiveness in Software Development projects. There are many studies about Risk Management in Industrial Software Development projects which prove that effective Risk Management is a key to project's success. However, it seems to have a little amount of researches for Risk Management in Educational projects. And as mentioned above, with experiences in LAMK's educational software development projects, risks were not handled and treated in time. The literature review also provides knowledge for author to create the light-weight Risk Management Toolkit for Educational project. This Toolkit will be introduced in the next section of this chapter.

The two case studies for this study are group of students who participate in developing software products. They has a basic knowledge of project management and solid knowledge in software development, but, they are unfamiliar with risk management.

Author will introduce the Risk Management methodology to these two teams. After that, for the best results, they will be asked to utilize the Toolkit, and follow the Guideline with Reference list in managing risks along with their projects' development.

To be able to uncover the corresponding between teams and Risk Management Toolkit, qualitative data analysis is used. With the combination of words and observation in data collection, creative and systematic approach is utilized in this analysis process. (Taylor-Powell, E. & Renner, M., 2003)

Research data will be collected during the project's process. Author observes how project teams apply the provided resources for controlling project's issues and collecting documents from those two teams. These excel documents are Risk Plan and Risk Report documented by teams and collected by author. Furthermore, researcher has the access to teams' project plans for clear understanding in clients' requirements and keep track in project timeline. As soon as products are tested, the interview will be held only once (face-to-face) with project team members. The interview form will contains questions which help researcher to generate the findings.

All together, the results of data collecting will be compared against the literature review to demonstrate if the earlier hypothesis is right or not. And also, Risk Management Toolkit will be updated to be more suitable for Educational Software Development projects based on these research findings.

2.6 Risk Management Toolkit Framework and Structure

This sub-chapter will provide the brief information of the light-weight Risk Management Toolkit created by the author, which will be tried out by case studies. For the purpose of providing quick information and understanding about Risk Management, this Toolkit is created condensely and easy to follow as Figure below.

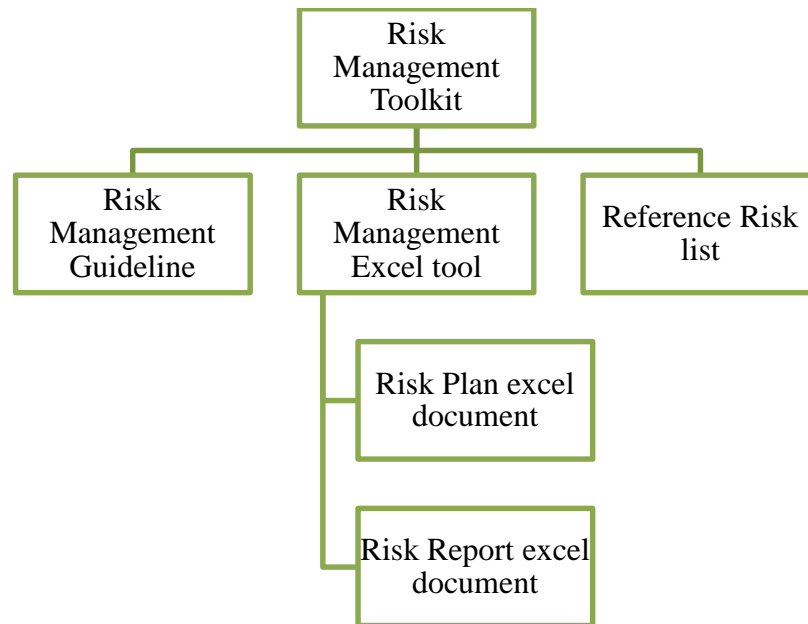


FIGURE 7. Risk Management Toolkit Framework

By understanding the scale of school's projects, which are usually small, the author creates the light-weight Risk Management Toolkit, aimed for the use of students' projects. The structure of this light-weight Risk Management Toolkit consists of Risk Management Guideline, Reference Risk list and Risk Management excel tools. The Risk Management excel tools includes Risk Plan and Risk Report documents.

At the beginning of the Guideline, team members will get the idea of why it is important to have proactive risk plan in their projects. Then, risk categories for student's projects will be given shortly. Later on, there are step by step on how to implement risk management into the project. It includes the Risk Management process, how team members should be treated in the Risk Management meetings and what they have to do in those meetings.

The two excel documents are tools for defining and responding to risks. In these two documents, there are explanation for each attribute on risk table which helps project's member to use it right.

Last but not least, the Reference list provides some common risks in software development projects. This list stimulates members' thought about potential issues in the project.

3 RISK MANAGEMENT IN SOFTWARE DEVELOPMENT PROJECT

In this chapter, Project Management and its relationship with Risk Management will be briefly described. After that, Risk Management Methodology will be introduced along with Communication and Reporting in Risk Management as well as dealing with Multiple Issues and Recurring Issues.

3.1 Project Management

In this section, author will explain about Project Management concisely. Furthermore, the important role of Risk Management in Project Management will be described.

3.1.1 Introduction to Project Management

Project is a temporary planned undertaking with defined start and end in time. It consists of tasks which needed to complete for archiving a specific goal by a group of people with different specific skills. The development of an application is an example. Therefore, to be able to reach the goal in a defined time, it is important for the project to be managed effectively. This term is called project management.

Generally, Project Management is a group of interrelated processes in which consists of different activities. The output of the previous process becomes an input of the following ones. There is integration between these processes for creating a successful product at the end of the project.

“Project Management is the process of the application of knowledges, skills, tools, and techniques to project activities to meet project requirements”

(PMBOK® Guide, 2004)

3.1.2 Risk Management and Project Management go hand in hand

In order to have a successful project, project team must deliver a product, service or a result of the project on time within the provided budget that meets the project requirements. Therefore, time, cost and scope is the triple-constraint which qualified the successful of a project. These three factors has the interrelated affection, if one factor changes, there will be atleast another one affected. The Figure below shows this constrained relationship.

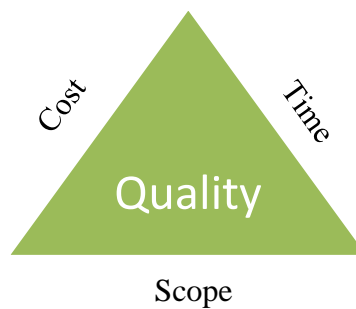


FIGURE 8. Project triple constraint

To be able to balance the triple constraint above, it requires the project team to have the knowledge in nine different areas of project management (PMBOK® *Guide, 2004*):

1. Integration Management
2. Scope Management
3. Time Management
4. Cost Management
5. Quality Management
6. Human Resource Management
7. Communications Management
8. Risk Management
9. Procurement Management

In this study, author wants to focus on Risk Management – one of the area which most of educational and small projects less concern about or bigger projects still have difficulty in managing.

In Risk Management, the uncertainty is measured throughout the project. It allows manager and team members to obtain the general agreement from the team or/and development organization on how to handle unexpected events or issues occurring in the project. More importantly, Risk Management affects all aspects of your projects' triangle constraint and other factors related to the project. The advantage of effective risk management is providing project team and organization constant awareness of unexpected issues which might appear in the future. For those reasons, Risk Management should be conducted from the beginning of the project, discussed constantly to provide actions when needed. Additionally, Risk Management manager can be another person differ from project manager or they can be one person, depends on project's dimension. Futhermore, risk can be positive or negative one, which means the positive one can be new opportunity for the project and the negative one is a threat to the project.

By understanding the impact of risks, in this study, author wants to emphasise the important role of Risk Management to project management. Additionally, the earlier and more effective Risk Management is planned, the more successful the project will be.

3.2 Risk Management

An IT project, to be able to succeed, needs a good project plan with realistic strategy, schedule and resources. In addition, a proactive management of risks is extremely essential for a project to be prosperous. As soon as the work is conceived, development organization and project team should define potential issues which might occur during development process. Therefore, risks which happen to arise in project can be avoided or reduced. In other word, putting action beforehand can save project resources and time.

3.2.1 Risks Categories

To help controlling software project risks more accurately, it is divided into categories. The purpose of those risks categories is to help project team understand the

differences between different types of risks to discover the possibilities of each risk and gain its specific knowledge of problem solving.

Risks categories are describes condensely in Table 1. below.

Generic Risks		Product - Specific Risks	
Project Risks	Product Risks	Business Risks	
Factors to consider:			
People, size, process, technology, tools, organizational, managerial, customer, estimation, sales, support.			

TABLE 1. General Categories of Risk
Original Table: Risk Management, Laurie Williams, 2004, 2

Generic Risks contains issues which likely happens in every software development projects. For example: schedule slip, changing requirements or company's or client's bankruptcy. Those types of risks should be documented as a checklist for development organization so that project teams can evaluate the impact of these risks to their projects. Project – Specific Risks contains specific issues which are only identified by specialized persons by their deep understanding in the technology, the people or the environment of specific product. (Laurie Williams, 2004) For example: new technology is used in the product, new development team which lacks of experiences.

These two risks types can be broken down into more specific types. There are project, product and business risks that provide teams more focused in each risk type's extent. (Laurie Williams, 2004) Project risks contains factors which affects schedule, resource (personnel, budget) of the project. Product risks contains factors which affects the performance and quality of the product being developed. Business risks contains factors which threatens the viability of the product for ex: no one wants to use the product or out-of-date product.

In order to have an accurate judgement and solution for risks, project teams and development organization should consider some specific factors when analyzing

project, product and business risks. Here are some specific factors given which is not factors checklist but can help to stimulate team members' way of solution.

- People risks contains the working skill level, their availability and retention of development team members.
- Size risks relates to product's magnitude and product team which mean the more complex the product is, the more interaction it requires; the bigger the teams is, the harder for them to communicate and cooperate.
- Process risks relates to whether a defined, appropriate software development process is used and to whether the process is followed by the team.
- Technology risks consist of issues from softwares and hardwares used in the project. It is easy for this risk type to increase when using new or complex technologies.
- Customer risks are arisen from requirements changing, the management process of requirement changes or from customer's communicating ability.
- Estimation risks arises from wrong or unprecise estimation of resources or project's schedule.
- Sale and support risks occur when built product is not understood by sales for selling purpose or the product is hard to adapt or maintain after being released.

3.2.2 Risk Management Process

In this sub-chapter, six stages of risk management will be described. There are Risk Identification, Risk Analysis, Risk Priority, Risk Management Plan, Risk Mitigation and Risk Monitoring.



FIGURE 9. Risk Management Cycle

Original Figure: Risk Management, Laurie Williams, 2004, 2

Stage 1: Risk Identification.

In risk identification stage, all team members are encouraged to enumerate potential risks. Reference risks lists from past projects can be a base to stir their mind up. But remember that each project is different as well as its potential risks. The purpose of this stage is to make future issues become explicit before turning into threats to the project. Risks which are listed by team members or development organization must be written down.

These defined risks can be identified into risks categories mentioned above for further analysing and providing actions. However, do not rank these risks yet. The condition-transition-consequence CTC format (Gluch, 1994) is used to help people described risk in more details and provides better understanding for following stages. The CTC format is structure as below.

Given that <condition> then there is a concern that (possibly) <transition> <consequence>. With condition is description of current condition prompting concern, transition describes parts that involve change (time) and consequence provides description of potential outcome.

Stage 2: Risk Analysis.

In this stage, identified risks are transformed into decision-making information. Each risk will be considered and judgment made about its seriousness and probability. There are two elements to be considered: the probability of loss occurring and the impact of the loss if it will occur. To assess the probability of loss occurring, numeric scale (percentages) or categorized scale (very improbable, improbable, probable or fluent) can be utilized to reflect the perceived likelihood of the risk. Furthermore, the impact of the loss is also needed to evaluate by delineating the consequence of risk and establish its impact to project or product. Team can choose either numerical monetary value to magnitude of loss (5000euros lost for three-week delay) or categorized categories (1=negligible, 2=marginal, 3=critical and 4=catastrophic) to assign for this evaluation.

It might seem to be difficult for team members and development organization to determine the probability and magnitude of risk. Even though it is hard to to, each team member estimate each of these risk probability individually. Later on, these estimations will be collected and reported to the whole team. Team member debate based on submitted reports and make decision by using technique called Delphi Technique (Gupta and Clarke, 1996).

The Delphi Technique is a group consensus method which is used when factors under consideration are subjective. The purpose of Group Consensus decision making is to gather and reach agreement from participants. Decisions which are made by this technique aim to seek solutions that satisfy all group members and meet their concerns. Additionally, all members are treated equally and solicit all the participants' input. In another words, by utilizing this technique, the group wish to bring out the best resolution for all participants.

Stage 3: Risk Priority.

After being analyzed and input into risk table, project team have to rank identified risks based on its probability and impact, in order to decide which risks are more important and which less likely happen to the project.

Risks list will be sorted from the high probability, high impact to low probability, low impact. The interrelationship between risk probability and its impact will be shown in the Figure 5 below.

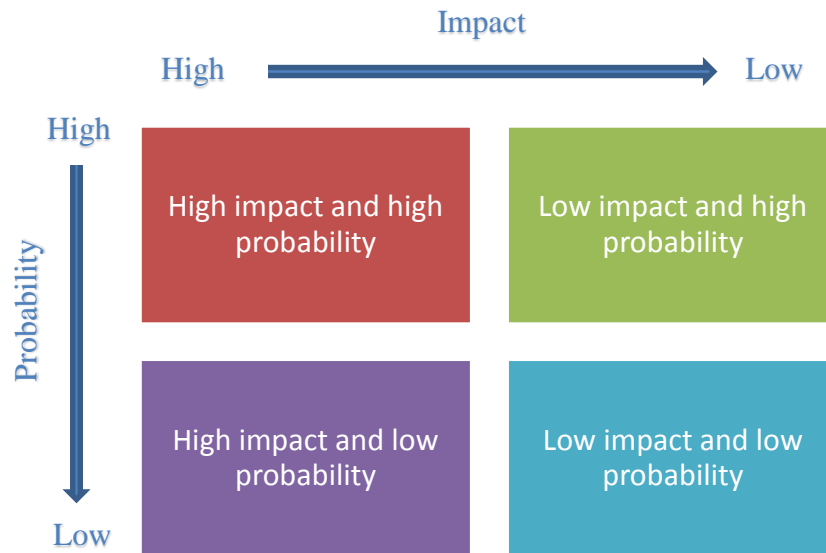


FIGURE 10. The interrelationship between risk probability and risk impact

Based on values that team members agree to give for risk probability and its impact, there are two ways to prioritize risks which are described below:

If Probability (categorical values: very improbable, improbable, probable, frequent) and/or Impact (categorical value: negligible, marginal, critical, catastrophic), group consensus technique may need to be used to produce the risk ranking. If numerical values were given for Probability (percentage) and Impact (monetary), the risk exposure can be calculated. Risk exposure is calculated as follows (Boehm, 1989).

$$\text{Risk Exposure (RE)} = P \times C$$

P (Probability), C (Impact). If RE is calculated for each risk, the prioritization is based on a numerical ranking of the risk exposure.

After risk prioritizing phase, the team, led by project manager, defines a cut off line for the list. Risks above the line will be given further attention. Risks below

the cut off line will be monitored. Usually there are ten high risks above the cut off line which will be given further actions. As the matter of fact, risks below the cut off line can still occur in the project. For this reason, these low risks will be monitored.

Stage 4: Risk Management Plan.

Each of those above-the-line risk will be given its own management plan. Those plans will be documented into Action section of risk table. Here are some examples of risk planning action: information buying, contingency plans, risk reduction, risk acceptance.

Information buying provides the team and organization more information through the investigation to reduce the perceived risk. For example: the throw-away prototype can be developed using the new technology, in that case, people can learn from that prototype how to use the new technology right for creating the product.

Contingency plans can be called proactive plans for potential risks. In this type of action, project team plans ahead what should be done if certain risks materialize. With this proactive plan, project team and development organization are strategically prepared to deal with issues when it occur.

Risk reduction involves reducing the severity of the loss or the likelihood of the loss from occurring.

Risk acceptance means that the organization accepts to live with the risk's consequences (Hill, 1998) and the results of potential loss. There is no action planned in this case.

Stage 5: Risk Mitigation.

In risk mitigation stage, strategies are created to lower the possibility or the loss impact of occurred risks. Risk item can be eliminated or resolved through the sit-

uation which risk mitigation creates. Risk avoidance or risk protection are two examples of risk mitigation strategies. Risk avoidance means deciding to not developing any part which may cause problems, when risk protection requires some financial for covering up if the issue arises.

In this stage, the analysis for cost/benefit should be done to evaluate if the risk management steps bring more benefits to the project than its implementing costs. Risk leverage (Pfleeger, 1998) which is utilized in this calculation, is described below:

$$\text{Risk Leverage (RL)} = (\text{risk exposure before reduction} - \text{risk exposure after reduction}) / \text{cost of risk reduction}$$

When RL value (rl) equals or less than one, there is no need for applying risk reduction. If rl is only slightly greater than one, it still be questioned whether it is wise to implement the risk reduction. Therefore, rl is multiplied by a risk discount factor p ($p < 1$). When the result of the multiplication ($p \times rl$) greater than one, risk reduction will be considered to implement. Moreover, less costly solution or more effective reduction techniques are better choice for the team and organization when the discounted leveraged valued is not high enough to justify the action.

Stage 6: Risk Monitoring.

After identifying, analysing, prioritizing, planning actions, monitoring those risks is essential. The progress will be observed and taking corrective action if necessary. Risk monitoring can be done with team project management activities or just in explicit risk management activities. Regularly, around 10 top risks will be monitored by the whole team.

As long as the project goes on, it is a must to revisit and reevaluate each risk to find out if new circumstance causes risk's probability and/or impact to change. In the meantime, there might be new risks added and/or old risks removed. Hence, risks are needed to reprioritize so that team and organization know which issue needs to be given further actions.

3.2.3 Issue and Risk Communications and Reporting

It is essential to have effective and ongoing communication between management, development team, client's representatives and business team. Exchanging needed information between those groups can prevent misunderstanding and unwelcomed issues in the project.

At first, author wants to mention about effective ways of communications. The best way for issue and risk communicating is having face-to-face meeting with a standard approach which helps team members easy to understand and respond to issues. In this way, participants can obtain face expression, body language and tone of voice from others in the discussion. The next possible way for risk and issue communicating is via phone. This way is less effective since listener cannot see and hear issues from the sender clearly. It might confuse both and affect the issue's understanding and its solution. The last one, via email or text, is the least effective way in communication in general. The reason it is the worst case is because receiver of the communication might leave the discussion up to the air for a long time and come back at it when it already becomes a threat to the project.

Secondly, the willing of discussing issues between team members and development organization must be considered. All participants are encouraged to raise their voices, participate in the discussion and talk about issues as well as ideas or solutions. Some managers seem to forget their team members as project participants and try not to discuss issues within the team, because they think that team members cannot understand the problems.

Thirdly, in the discussion, there are sender(s) and receiver(s) which means when a team member raise up an issue, idea or a solution, others must listen and try to understand it by asking for more explanation (in case the issue or idea is not clear enough). Avoiding or pretending to already understood issues are the worst behaviors in communication. It will not help the team to solve problem but making the project' issue unhandled. But remember, avoiding chit-chatting in meetings or work time is a must for not wasting project's time.

Last but not least, keep reporting on issues which already became threats to the projects is important. Reporting document should includes risk name, risk ID, explanation for risk, in which date the risk occurs and be solved, person and project's stage relate to the risk and risk solution. Risk reporting must be accurate, clear, contains enough information and reflects events happend in the project. These information helps team members to understand and relate the issue with its event, involved person and project stage much faster and easier.

Risk report documents of projects can be reviewed again at the end of the project in the close-up meeting as lessons learned for other projects in future. Futhermore, it can be helpful document for monitoring risks during projects.

3.2.4 Multiple Issues and Recurring Issues

In a project, there are likely more than one issue occur. The team and organization should try to figure out other related issue(s) if one occurs. For example: team member lacks of experiences in using the specific programming language which is used in the project, it will take time for that person to self-educate oneself to be able to cope with the project; therefore, there might be another issue appears – delayed task and it can cause the project's schedule to slip. Under this circumstance, defined issues should be understood clearly about where is its root as well as what and how it relates to others. The good way to manage is to group these related risks into specific groups based on how much it relates and affects other risks or the level of its urgency or importance.

In reality, risks which have been solved, might happen again in the same project. The reason for recurring issue is because occured risk was solved partially or addressed too early in the project. Moreover, there might be issues arise from decisions or actions of other issues. Hence, the whole team and organization should view old and new issues not only in details but also in a big picture. In risk management meetings, participants needs to question about the reason of recurring risks and its impact.

Consequently, it requires full understanding, structure and thought in giving solutions for treating multiple issues and recurring issues in risk management.

4 THE LIGHT-WEIGHT RISK MANAGEMENT TOOLKIT

In this chapter, the light-weight Risk Management Toolkit (RMT) will be described into details to help people understand its package and usage. The RMT structure will be explained below. For deeper understanding, RMT will be provided in Appendix 1.

First of all, this light-weight RMT is made based on knowledge which gained by author from literature review. Combining with the author own experiences in previous school's projects, the author would like to make Risk Management (RM) become lighter for students in educational projects. In this way, the author hopes to bring the knowledge of RM methodology to educational project teams, as well as helping them to realize how essential RM practice in projects.

Secondly, this light-weight RMT contains three different parts. These are RM Guideline, Reference Risk List and RM Excel tool. Furthermore, in the RM excel tool, there are Risk Plan and Risk Report. The following sub-chapter will explain more about these three parts of RMT.

4.1 Risk Management Guideline

The first part of RMT is RM guideline. The purposes of this guideline are providing educational project teams quick understanding about RM methodology and explaining how to manage risks in the project step by step.

In this guideline, risk categories will be introduced in three categories. They are Project risks, Product risks and Business risks. Because educational projects are usually small scale projects, so that the author consider these three basic risk categories for students, which are easy for them to understand and apply into their projects.

Furthermore, RM process will be explained carefully in steps. Each step represents for each RM stage. In order to provide enough understanding of each RM

stage, the purpose and explanation of how the stage should be done will be given in the guideline.

Additionally, the purpose of educational project is to providing students stimulation of real working life. Therefore, there are no budget included in the mentioned constraint triangle in literature review part, but replaced as resources (as project team members and providing tools), time and scope. Because of this special circumstance, in Risk Analysis and Risk Priority stages, students can use only categorized scale to analyse and rank their risk list. The analysing method which uses numeric scale and numerical monetary value as well as calculating risk exposure for prioritize risks can be considered as more advanced knowledge for real working life.

4.2 Reference Risk List

In the purpose of providing more information for unexperienced project teams in their RM knowledge, Reference Risk List is attached into the RM guideline. In the list, risk categories are provided along with potential risks.

Risk categories helps project teams to sort projects potential issues into different classes in able to manage interrelated issues more effectively. The set of potential risks is provided to stimulate students' mind of thinking about possible future project's issues. The list does not contain all possible risks, it is just the basic source for students in order to develop their risk analytical thinking. Therefore, students can input more potential risks which they discover into their Risk Plan, Risk Report documents and Reference Risk List for future use or the later use of other school teams.

4.3 Risk Management Excel Tool

The last part of the RMT is RM Excel tool. This RM excel tool is an important part of managing risks throughout the project. This tool has two interrelated excel documents, one is Risk Plan and the other is Risk Report.

4.3.1 Risk Plan Document

Risk Plan document is created in the purpose of providing educational teams the tool to documented their possible risks from the beginning of the projects. These listed risks will be analysed and ranked within the Risk Plan. Although there might not be new risks addressed in the following week, project team should quickly go through them weekly. The reason for this action is keeping the team risk's status and condition throughout the project, so that they do not forget about happened risks which can recur or defined potential risks which might suddenly happen. In other word, it gives the project team the continuous analytical risk flow.

In Risk Plan document, there are Rank, Risk_ID, Risk_Name, Risk_Description, Probability, Impact, Rank last week, Number of weeks on the list and Action.

These attributes will be explained below:

- Rank represents the priority of each risk in the list. It indicates which risk needs to be paid more attention.
- Risk_ID is for identify risks since there are different potential risks in the list, it is also easy to retrieve risks from its ID.
- Risk_Name provides team shortly understanding about the specific risk.
- Risk_Description gives team full understanding about risk's circumstance and impact.
- Probability represents the how likely each risk might occur.
- Impact represents how serious the risk affects the project and related tasks.
- Rank last week provides team members if the priority of each risk has change.
- Number of weeks on the list provides the team if this identified risk is always a potential issue throughout the project or a totally new one.
- Action section is a place where team members can documented what should be done to control and monitor risks.

For managing Risk Plan effectively, every time Risk Plan is updated, the person who documented these plans has to create new table which contains all mentioned

attributes. Each Risk Plan will be differentiated by RM Plan No. and Date of meeting.

4.3.2 Risk Report Document

Risk Report is created in order to document these occurred risks in the project. This report helps team members to note down which risk has happened as well as how it has been treated. In addition, this report provides project teams the vision of risk's impact by providing the information of project phase in which risk happens. Furthermore, it provides person(s) who is related to happened risk in able to treat the whole impact effectively. Risk which occurs in the project needs to be documented with occurring date and the date it is successfully treated.

This Risk Report document contains attributes providing needed information to educational projects team for the purpose of risk's controlling and monitoring. There are No, Risk_ID, Risk_Name, Risk_Description, Rank in RM Plan, Related to whom, Occur on date, Stop on date, In which project phase, Action attributes. These attributes' explanation will be given below.

- No represents ordinal number of each risk.
- Risk_ID is for identify risks since there are different potential risks in the list, it is also easy to retrieve risks from its ID.
- Risk_Name provides team shortly understanding about the specific risk.
- Risk_Description gives team full understanding about risk's circumstance and impact.
- Rank in RM plan gives the team information about risk's priority in their RM plan.
- Related to whom gives team members clear information about the person whom related to risk or being affected by that risk.
- Occur on date indicates the date when risk starts to become a treat to project.
- Stop on date indicates the date when risk is treated successfully.

- In which project phase provides the process stage in which risk occur so that team members can also have the vision of that risk's impact to other phases or tasks.
- Action section gives information about how occurring risk were treated.

As same as Risk Plan document, Risk Report is documented by updating document whenever there is risk happens. In addition, each Report will be indicated by its Report No. and Date of meeting.

With the provided information from this RMT, the team can gain RM knowledge quickly and adopt it into practice for better result of managing project's risks. In another words, it improve the awareness of risks in the project teams and stimulate their response to risks.

5 THE STUDY CASES

This chapter will introduce the study cases of this present research. In addition, it will briefly describes structure of both study cases.

These two study cases are educational software development teams formed by groups of students from Lahti University of Applied Sciences. Half of each group members are from Business Information Technology program of Business department and the other half are from IT department.

In order to participate into software development teams, students had to send application contains their resumes and application letters to the leading supervising teacher via email. After carefully going through students' applications, the leading supervising teacher divided students into teams based on their skills. The reason for this careful selection is to assure that project teams have enough knowledge and skills to work for projects, which provided by companies in the city of Lahti, Finland. This kind of projects provides students the idea of real working environments and products.

After projects were assigned, these project teams started their projects by dividing roles to their own team members. To develop products which match client's requirements, these teams held a meeting with their own client to gain more understanding about client's needs. To be able to start their projects, they had to prepare their own project summary for the meeting with their own supervisor who is in charge of supervising the project team.

Throughout projects, IT products or services were developed. Along with the project's process and usual documents, these two project teams were asked to create plan and report documents in order to support this study. These reports were collected by the author throughout requirement phase, designing phase, implementing phase and testing phase of the project.

In order to respect the confidentiality protocol, no real name of clients or project teams will be provided in this study. They will be presented by first letter of their names.

Following information will provide these two educational teams' structures.

5.1 The T project team

The T project team was formed by three students from IT department and one student from Business department (BIT program). In the second or third year of their studies, these students from different departments had some courses together.

The T team consists of four Finnish members and being supervised by one supervising teacher. There are one project manager, one documentor, one programmer and one designer. The T team were assigned the project from a company named SU which is operating in Lahti, Finland. The goal of this project were to create a design and a prototype for their client. In the figure below, T team structure will be shown.

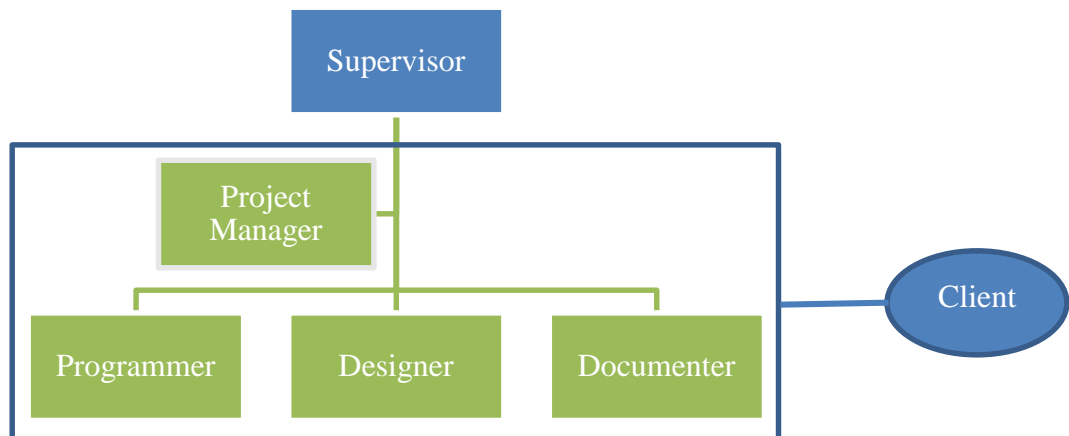


FIGURE 11. The T team structure.

In the figure above, the communication among project participants are also described. In steering group meetings, there are supervisor, client and project manager. Otherwise, in normal customer meetings, there are the whole project team members and client.

5.2 The S project team

Different from the previous team, the S project team consists of two students from BIT program of Business department and other two from IT department.

The S project team has two Finnish, one Vietnamese and one Russian members. Unlike the first team, one of the team members of this team has one's own practical training which requires this one not to be able to participate in most of project meetings. Under the supervising of their supervisor, their team consists of one project manager, two programmers and one designer. Their goal is to improve customer's tools for business purposes. In the figure below, S team structure will be shown.

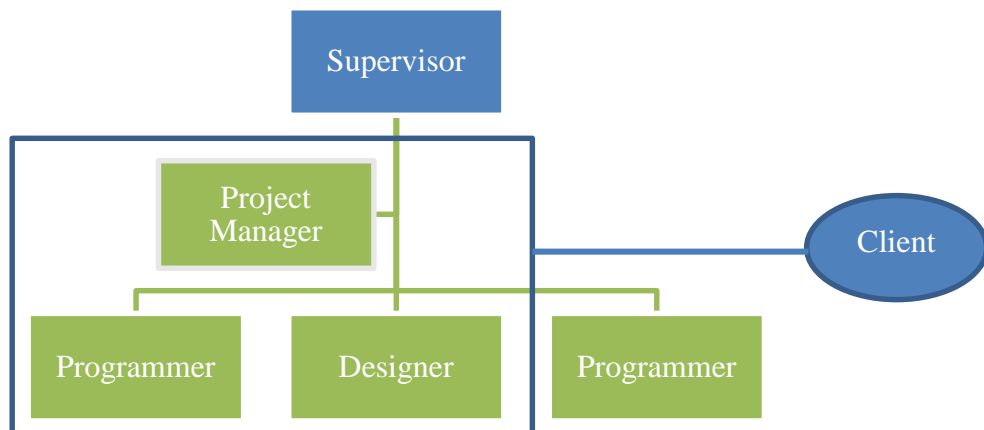


FIGURE 12. The S team structure.

The figure above also describes how project participants communicate with each other. In steering group meeting, there are project manager, client and supervising teacher, while in customer meetings, there are whole team members and client. As mentioned above, even though one member is not participated in any of project's meetings, this person is still assigned tasks by the S team.

6 FINDINGS

This chapter will provide the findings of the present study based on two study cases' reports and interviews. These collected reports include Risk Plan and Risk Report documents which were made through out four project's phases: Requirement, Design, Implementation and Testing phases. Furthermore, in order to understand how the study cases implemented RM methodology into their projects, as well as how project teams evaluate the effectiveness of RM Toolkit, direct team interviews were held.

Additionally, the S project team has four members but in the interview day, there were only three members coming for the interview. As provided information from S team, this absent member did not participate into any risk management meetings. Therefore, there will be no information of this person's interview in this study.

Project team's interview form will be shown in Appendix 2.

6.1 Risk Management knowledge of Educational project teams

As stated, students seem not to have limited knowledge in Risk Management. (Laurie Williams, 2004, 9) In addition, in IT industries, it is acknowledged that if high-risk issues were announced early, its damage to projects would have been reduced or avoided. (Bruegge and Dutoit, 2000). According to these cited issues, the two project teams were interviewed for their RM knowledge with their past projects.

In order to achieve the purpose of discovering students' knowledge on RM, the author stated four questions listed below:

- In every educational projects which you participated before, was there any risk occurred? If yes, was it treated completely and effectively?
(If you answer NO in question 1, please skip question 2 and 3.) (1)
- How did your previous teams define and response to risks in your previous projects? (2)

- Are you familiar with Risk Management methodology before this project? (3)
- Does introduced Risk Management methodology bring you new knowledge on how to manage risks effectively by creating proactive risk plan? What you have learned from it? (4)

To ensure if risks actually occur in educational projects, question (1) was asked. With this question, there are two members of T team who answered that there were risks occurred in their past projects. One of these two also stated that "communication has been an issue in past projects and actions have been mostly in the responsibility of the project manager". The third T team member provided the "I don't know" answer and the fourth played as programmer role answered "No, I don't think so". While in the S team, the question (1) was answered with one "No" and two "Yes" answers. The two members which answered yes also provided further information on how risks in their previous projects were dealt with. The first one stated that sometimes, previous risks were dealt effectively and sometimes it did not. The second one answered "it was moderately effective".

In the purpose of discovering how risks were actually treated in their previous project, the question (2) was asked. The T team replied with one blank answer from the programmer, an "project manager's responsibility" answer and two answers providing that risks were handled without any documents. In the S team, one member said that they had risk assessment chart in previous project, the other one said that only one member in charge with defining and reporting risks to project manager.

With the question (3), in the T team, there are two members who did not know about risk management before, one member said that "somewhat, mostly based of power point presentations during 2012 -2013" and the other answered "yes but not within this kind of scale". As same as T team, answers of question (3) provides that two out of three S team members were not familiar with Risk Management before. The other member had experiences with risk management in his previous successful projects.

The question (4) was asked in order to ensure if all T team members have gained new knowledge in Risk Management after the methodology was introduced. All of them give "Yes" as their answers. They also providing their new RM knowledge such as "identifying and collecting risks helps us on working toward resolving them", "some idea on controlling possible risks and defining them", "team can easily look into past risks that have been listed and could possibly learn from it". Meanwhile, in the S team, there is one member answered that proactive risk plan helps to recognize possible risks and it is a good tool. The other one who is in charge with risk documentation in this current project, answered that in able to manage risks effectively, risks should be monitor through out the project, not only at the beginning. The last member seems to not gain much knowledge with the answer "Yes a little, I gave the main responsibility of risk plan to my group so I didn't learn as much as others from this".

Based on these answers for first three questions, it emphasises that there are risks happen in educational projects and those problems are not carefully handled. Furthermore, three-fourths of T team members and one S team member did not have knowledge for managing risks in software development projects. Additionally, the given answers from the question (4) supply that even though most of these students were not familiar with RM, during their current project, they have learned about treating potential issues and applying their new knowledge into the project.

6.2 Impact of Risk Management Toolkit to educational projects

In order to find out how effective Risk Management methodology is to educational projects, the two study cases were asked to adopt the methodology along with utilizing RMT into their current projects. Therefore, it is important to collect their thoughts about how efficient the Toolkit is in their school projects.

As mentioned in the previous chapter, the Toolkit consists three parts: RM Guide-line, Reference Risk List and RM Tool which has Risk Plan and Risk Report documents. So that there were four questions provided with one for each part of the Toolkit:

- Does Risk Management Guideline help you to understand quickly and adopt the method structurally into your project? How it helps and if it doesn't, why not? (5)
- Does Reference Risk List help to stimulate your awareness of risks which might happen in your project? Do you think that it is necessary to provide it along with the Guideline? (6)
- Is it important to have proactive plan for risks? If you answer no, please explain why. If you answer yes, what effectiveness that Risk management plan brings you? (7)
- Does Risk Report help you to focus on current project situation by stating out which risks have been solved and which have not solved yet? Please explain why if you say no and explain how if you say yes to question 8. (8)

Answers for these questions from T and S team will be shown in the two following tables. The table 2 provides team T members' thought about the Toolkit and its impact to their project.

Members	Project Manager	Designer	Programmer	Documenter
Questions				
(5)	The guideline could work on monitoring larger scale projects risks and assist in controlling them. In our project, the usefulness was limited.	It helped defining rules and methods for Risk Management.	As a programmer I don't really pay attention to it.	It is informative Guideline in filling risk management report wasn't very clear though.

(6)	The reference risk list was useful but lacking, too short. Yes, very necessary.	It helped and it is useful to be included.	The list helps people to realize possible risks, and what kind of risks would be possible.	Yes, it is necessary. Makes easier to understand the guideline.
(7)	Yes, understanding current risks in different phases is vital, and comparing old project might help prevention.	Yes, it helps you see quickly what is not working.	Yes, it is important. Things like backup server would be good in case main server is acting up.	Proactive plan itself is a good idea.
(8)	It's a good list of known problems to keep track of, but due to the small scale of the project, more work than useful.	Yes, because every week we can put effort into solving our problems.	No, if I run into problems, I'll fix them myself. If I can't fix them, fixing it with the team would take everyone's time.	I don't think we've made so much advantage of it in project.

TABLE 2. Answers of team T members

As shown in table 2, although there is one member said that the usefulness of the Guideline was not used at its maximum level, all of them agreed that the RM Guideline is useful for the the T team to adopt RM into their project. In addition, there is one member said that the guideline was not clear on guiding how to fill the report. Therefore, the author wants to emphasise that the purpose of the RM guideline is to provide information about RM process and how team members should act in order to deal with risks. Information for filling Risk Report is provided inside the excel document for risk report.

All T team members agreed that Reference Risk List is an useful part of the Toolkit since it provides awareness of potential risks for the team. Although, the project manager said that it was too short. Therefore, the author wants to remind

students that they always can add more potential risks into their reference risk list. The purpose of this list is to cover some basic potential risks, and stir up team members' thought in discovering their own project risks.

By answers of question (7), it is clear to see that proactive plan created in the beginning of the project, helped their team to have a clearer vision on their project situation.

Opposite to Risk Plan, Risk Report seems to be not that useful for the T team since there is only one member agreed on its usefulness, the rest of them thought that it was suitable for bigger scale project and they didn't get much advantage from it.

Following table 3 will provide the realization of S members to the Toolkit and the impact of it to their current project.

Members	Project Manager	Programmer	Designer
Questions			
(5)	Yes it helped a lot but then again, I didn't work with this risk part much.	It does help but take quite sometimes to adopt.	It helps to clarify the bigger risks involved. Project group has to be truly invested in the project for it to be helpful.
(6)	The list is good and should be provided with the Guideline	Yes it does. I think that it is necessary to provide it because some simple risks might be overlooked by the team.	Yes to both.
(7)	Yes, it increased our awareness of risks.	Yes, Risk Plan brings me a general view upon all the risks might occur and	Yes, general awareness of project situation.

		when it happens, you already have a plan how to take action. It saves time for the team.	
(8)	Yes, it helps to manage risks	Not yet. Because most of the time when the risk happens, we take action to solve it right away. So I think it might help more in the larger scale project.	Yes as before, it helps in awareness

TABLE 3. Answers of team S members

As shown in table 3, with answers from question (5), all of S team members agreed on the usefulness of the Guideline even though it took sometimes for them to adopt it into their project.

As same as the T team, all members of S team also agreed that Reference Risk List should be provided with the Guideline. This list helps the team to not overlooked and forget some basic potential risks.

Answers for question (7) also emphasise that proactive risk plan is necessary for the project. As soon as the plan was created, the team could have the general view upon their future issues which might become threat to their project.

In this project team, there are two members said that Risk Report helps their project while the other one thought that it was more suitable for bigger scale since as soon as risks occurred, it was solved right away.

In conclusion, from answers providing by these two teams, RM Guideline is important for people to understand and adapt RM methodology into their project. Along with the guideline, Reference Risk List is one of the necessary document to be provided because of its easy use and its helpfulness in stating basic potential

project risks. Additionally, Risk Plan document which is created from the beginning of the project can provide a good vision for the team, as well as helping the team to control their project's situation by monitoring the plan through out their projects. Beside useful listed features of RMT, Risk Report document seems to be less useful in small scale projects since addressed risks can be treated as soon as it appears. Furthermore, the school project duration is quite short (around four months) so that the percentage of recurring risks is not so high. Therefore, the usefulness of Risk Report is limited in school projects.

6.3 The Awareness of risks and risk's response in practice

This sub-chapter will be divided into two parts. First of all, it will focus on the how these two team adopt the RM method by using RMT in practice. Secondly, the second sub-section will be about communication and reporting in Risk Management.

These two teams' projects officially started at the same date when projects were assigned by main supervising teacher. After that, these two teams were introduced the RM method and the light-weight RMT. They were asked to implement the method and toolkit into their project from the beginning till the testing phase. In their project, Risk Management meetings will be held through out the project's processes. In addition, their Risk Plan and Risk Report documents were updated whenever there was potential risk defined or became threat to their projects.

6.3.1 The Utilization of Risk Plan in practice

This section will include two sub-parts, team T's utilization of RMT and team S' utilization of RMT. The purpose of this division is to compare how each team utilize the introduced RM methodology and RMT into their own project.

Throughout the project, the T team has four Risk Plan in total. These plans were updated in the same document but differentiated by Risk Plan No. and Date of meeting.

These four plans will be provided below as tables:

Rank	Risk_ID	Risk_Name
1	PJ23	Time management
2	PJ08	Team members lack specialized skills required by the project
3	PJ04	Lack of communication
4	PJ05	Loss of team member
5	PJ25	Client management
6	PJ24	Resources

TABLE 4. Team T's Risk Plan No. 1, Date of meeting: 5.3.2015

Rank	Risk_ID	Risk_Name
1	PJ23	Time management
2	PJ02	Delayed task
3	PJ08	Team members lack specialized skills required by the project
4	PJ07	Misunderstanding in requirements
5	PJ12	Lack of planning for the work
6	PJ04	Lack of communication
7	PJ25	Client management
8	PJ05	Loss of team member
9	PJ24	Resources

TABLE 5. Team T's Risk Plan No. 2, Date of meeting: 11.3.2015

Rank	Risk_ID	Risk_Name
1	PJ23	Time management
2	PJ25	Client management
3	PJ08	Team members lack specialized skills required by the project
4	PJ26	Team member absent from group working situation
5	PJ07	Misunderstanding in requirements
6	PJ12	Lack of planning for the work
7	PJ03	Lack of teamwork
8	PJ02	Delayed task
9	PJ04	Lack of communication
10	PJ24	Resources
11	PJ05	Loss of team member

TABLE 6. Team T's Risk Plan No. 3, Date of meeting: 19.3.2015

Rank	Risk_ID	Risk_Name
1	PJ23	Time management

2	PJ02	Delayed task
3	PJ08	Team members lack specialized skills required by the project
4	PJ04	Lack of communication
5	PJ07	Misunderstanding in requirements
6	PJ03	Lack of teamwork
7	PJ24	Resources
8	PJ26	Team member absent from group working situation
9	PJ25	Client management

TABLE 7. Team T's Risk Plan No. 4, Date of meeting: 2.4.2015

Through team T's Risk Plan document, it is clearly to see that new potential risks can be addressed in every phases of project randomly. In addition, the priority of each risk is unstable, its impact and probability change based on the circumstance

of the pro- ject at	PJ23	Time management
	PJ24	Resources
	PJ25	Client management
	PJ26	Team member absent from group working situation

each time. *TABLE 8. Team T's added risks in Reference Risk List* Based on

these two reasons, risk plan should be gone through weekly or once in two weeks. This monitoring action can keep the project team the awareness of undefined risks and stimulate their proactive actions to respond to each risk if it is needed. Additionally, in team T's Reference Risk List, there are four added risks which will are shown in the table below. Once again, the usefulness of Reference Risk List in stimulating T team's awareness of project's risks is asserted by this action.

Unlike team T, throughout the project, team S had updated their Risk Plan document poorly. Their three plans including the same risks with its unchanged priority. In this situation, it can be assumed that it was true. The table below will display three different plans with the same content.

Rank	Risk_ID	Risk_Name
1	PJ04	Communication with customer
2	PJ05	Bad communication inside the group

3	PJ08	Lack of skills
4	PJ02	Task delayed
5	PJ09	Team member absent at meeting

TABLE 9. Team S' Risk Plan No. 1-2-3, Date of meeting: 3.3.2015-18.3.2015-31.3.2015

With the assumption above, in the interview when there were one team S's member absent, the author interview the team S's manager about the absent member's work. There were two questions provided in this situation:

- What is this absent person's role in the project?
- How did this absent person do one's own parts throughout the project?

The provided answer for the first question from the project manager was "maybe programmer or designer". This answer asserts that eventhough this absent member is in the team, his/her role is not clear. Furthermore, the following answer for the second question was "Sometimes, he/she didn't complete his/her tasks." With this additionally provided information compared with the Risk Plan document, it is clearly affirmed that at least one risk was not addressed: PJ01 - Team member doesn't do his/her task. This risk was provided in Reference Risk List from light-weight Risk Management Toolkit.

Through S team's risk plan, it is easy to see that there are basic risks which occurred can be overlooked. In addition, with three different risk plans with the same risk items and priorities as well as additionally provided answers from S team, it states out that sometimes, Risk Management in educational projects is not considered strictly. Therefore, the awareness of risks in project teams which do not understand the effectiveness of Risk Management can be limited. Furthermore, undefined risks from these kind of team can become threat to their projects. Although, threat's scales can vary from unimportant affect to very serious damage, every threat should be treated because of its potential affection to other issues in the project.

6.3.2 Communication and Reporting

In this section, each team's way of communication in Risk Management will be

included. In addition, their risk reporting will be provided through their Risk Report documents.

6.3.2.1 Communication in Risk Management

In order to know which way of communication each team had for managing their risks and how often it was held as well as how decision on risk plan and report were made, the author provided three question sets below:

- Were your team's Risk Plan and Risk Report updated based on team's agreement? Did it change throughout the project? (9)
- Did every members of your team participate in risk management process? Was it face-to-face meetings or virtual meetings? (10)
- How often your team has meeting for risk management? (11)

In the team T, provided answers for the question set (9) were all decision on risk plans and risk reports were made based on their team's agreement, as well as these plans and reports changed throughout the project. In addition, question set (10) was answered that meetings for risk management were face-to-face meeting and all members or three out of four members participated into these meetings. Additionally, RM meetings were help once a week or once in two weeks, it depended on the project's circumstance. With these provided answers, it is cleared that team T took Risk Management seriously by putting their effort into utilizing RM methodology and RMT to their project.

Unlike T team, answers from S team seems to be inconsistent. To provide clear image of this problem to reader, the following table will show team T's members' answers on three question sets.

Members	Project Manager	Programmer	Designer
Questions			
(9)	It didn't change. I agreed the risk	Sometimes yes sometimes no but	It was updated to some extent. It

	plan with the whole group.	it did change little bit throughout the project	did not change.
(10)	Not everyone. Main responsibility was on Programmer and other did the different parts of the project plan same time. Mainly virtual meetings, but also one long face to face meeting	No, they didn't. There are a lot of virtual meetings however.	Few meetings in the beginning of the project which were face to face. Everyone was present if I recall correctly.
(11)	Never. Just for risk management but it is checked along with other meetings.	Twice for three weeks.	Not after the start of the project.

TABLE 10. Team S's members' answers for question sets (9),(10),(11)

As showed above, their answers about way of meeting and how often risk management meeting was held are not the same. One member said that they had face-to-face meetings while the other one said that they had both virtual and face-to-face meetings. The programmer, also the one who was responsible for the risk management also gave the different answer: a lot of virtual meetings. In addition, the programmer said that documents changed a little bit throughout the project while two others said that it did not change. In addition, answers for question set (11) are different. For these reasons, the author has a suspect on team S communication and reporting in Risk Management in practice.

6.3.2.2 Reporting in Risk Management

In this section, Risk Report document of each team will be provided in the purpose of understanding how trustful of each team's answers about their reports and meetings.

First of all, team T's Risk Report document consists of four different reports which were updated throughout the project. Those reports are differentiated from its Risk Report No. and Date of meeting. These following tables showed those risks which occurred and were treated through their project.

No	Risk_ID	Risk_Name
1	PJ23	Time management

TABLE 11. Team T's Risk Report No.1, Date of meeting: 11.3.2015

No	Risk_ID	Risk_Name
1	PJ08	Team members lack specialized skills required by the project

TABLE 12. Team T's Risk Report No.2, Date of meeting: 19.3.2015

No	Risk_ID	Risk_Name
1	PJ23	Time management

TABLE 13. Team T's Risk Report No.3, Date of meeting: 2.4.2015

No	Risk_ID	Risk_Name
1	PJ23	Time management
2	PJ24	Resources
3	PJ04	Lack of communication

TABLE 14. Team T's Risk Report No.4, Date of meeting: 13.4.2015

Team T occurred risks were addressed and handled. As shown in these tables, risk with ID PJ23 recurred after treated. For this reason, risk report should be documented so that team can keep knowledge on risk's factors, its impact and understand about the differences of recurring risks with its original ones.

As same as T team, S team also provided Risk Report document with three reports which are defined by its No. and Date of meeting. Besides, in team S's project, there was one risk with ID PJ04 recurred during their project. This happening

once again reminds how Risk Reports should be documented whenever risk appears to become threat to project. Three table providing below will describe how risks occurred throughout their project phases.

No	Risk_ID	Risk_Name
1	PJ05	Bad communication inside the group
2	PJ09	Team member absent at meeting
3	PJ02	Task delayed

TABLE 15. Team S's Risk Report No.1, Date of meeting: 18.3.2015

No	Risk_ID	Risk_Name
1	PJ04	Communication with customer

TABLE 16. Team S's Risk Report No.2, Date of meeting: 26.3.2015

No	Risk_ID	Risk_Name
1	PJ04	Communication with customer

TABLE 17. Team S's Risk Report No.3, Date of meeting: 31.3.2015

In addition, with the interview with project manager about the absent member, it is concluded that there was at least one risk which occurred were not reported: PJ01-Team member doesn't do his/her task. Therefore, in this team, their reporting document is not accurate.

6.4 Clients' feedbacks

In the purpose of collecting clients' satisfaction about the product and project teams, client's interview questions form was made and sent to these two teams' clients. Questions of client's interview form will be provided in the Appendix 3.

These two clients gave positive feedbacks to these two educational teams about their project teams' performances and responsibilities. However, there is one feedback saying "Communications it one thing there is to be learned to whole team. Especially listening, taking into consideration that I am not an expert of IT-issues". This feedback states out that educational project teams should learn to communication with other team members as well as their clients.

With the respect of client's needs, educational teams should consider to ensure each and every clients' requirements by carefully listening and raising questions to their clients if needed. This is one of the general and basic risks which can happen from the beginning till the end of projects. It seems to be harmful at the beginning when the project has just started but in the long run or till the end of the project, it can cause a big loss in project's business purpose since the created product does not suit its client's needs. Furthermore, educational project teams should avoid to think that their clients are IT experts because this assumption might lead projects to the wrong path, which can create mismatched products.

7 CONCLUSION

In this research, the object was to discover how Risk Management can enhance the awareness of risks and risks' responses of educational project teams by utilizing light-weight RM Toolkit.

The present study was conducted in the educational environment with the purpose of getting students familiar with real life working. The two project teams were formed from groups of Lahti University of Applied Sciences presented as study cases of this research. From the start of the project till testing phase, these two teams were asked to adopt RM methodology and implement the Toolkit into their projects.

The utilized light-weight Risk Management Toolkit in this present study can be consider as a managing tool for project risks by educational project teams. Futhermore, in order to provide RM knowledge to students who study Business Information Technology or IT, RM methodology can be introduced, understood

easier and adopted faster by the condensed RM Guideline in RMT. The purpose of this RMT is to improve students' understandings about project's issues, which can become a threat to their future projects, as well as how they should respond to it.

7.1 Limitation of The Study

Due to the time limit, the study was conducted through four phases of software development process: Requirement, Design, Implementation and Testing phases. At the end of this present research, these projects were in their testing phase, in which the first prototypes were introduced to their clients. By that, it means these projects were still continuing to deployment phase where these products would be installed to clients' systems and used by users. Therefore, there might be issues appear in that phase which also needs to be controlled and monitored.

Furthermore, in educational projects, maintenance phase is more likely to be excluded. The circumstance of this project type is different from industrial real life projects, in which problems can occur and might become threats to business purposes.

7.2 Conclusions

With the respect of earlier studies in Risk Management in industrial projects, light-weight Risk Management Toolkit was created by knowledge from literature review and experiences in previous educational projects of the author. The framework of this Toolkit was built in order to provide students basic knowledge in Risk Management step by step. Additionally, the Reference Risk List and RM Excel tool which are parts of the RMT can stimulate the awareness of risks and give students a easy way to monitor it.

These two teams gave positive feedbacks to RMT which they utilizing through out their projects. Although, the team T was more active and responsible in their

Risk Management than team S. Additionally, most of members of these two study cases were not familiar with Risk Management before but after this present study, they said that they gained the idea of being aware of risks and how to treat those issues in their projects.

With the Reference Risk List, team T had updated more issues into the list. In addition, both team T and team S agreed that the List was useful for them in stimulating and not overlooking projects' issues. It is proposed to be a must have in the toolkit with its usefulness. In addition, the list can be updated after every educational projects so that it can give next educational teams more addressed issues to be aware of.

Furthermore, the Risk Plan excel document which was used in these team projects are proved to be essential for project teams to document their proactive risk plans. With the changes in each plan from team T, the priority and amount of addressed issues, it states out that project risks are usually unstable and needs to be monitored throughout the project. With the plan, team T can be able to keep their eyes on high rank risks and its impact so that they can provide suitable actions to it in time. Unlike team T, team S had really "stable" risk plan from the start of the project till testing phase. However, through team's interview, the author discovered that there was at least one risk related to team's absent member was not be addressed. By this, the author realized that not all students understand the effectiveness of Risk Management and they seem to be not responsible for project risks.

On the other hand, Risk Report Excel document which was used to document occurring risks, was considered to be unsuitable for small project scale like educational projects by these two teams. By carefully going through their Risk Report documents, the author discovered that both of these project teams had recurring issues throughout their projects. The purpose of Risk Report is to monitor occurring risks which was controlled by understanding risk's surroundings, past decisions and past impacts. The Risk Report seems to not be used at its maximum usefulness since small scale projects usually have short duration of time.

Last but not less, the RM Guideline was proved to be easy to understand and it helped students to adopt RM into their projects. Although these teams didn't state out that numeric and numerical monetary value scales in analysing phase, as well as risk exposure method for prioritizing risks were not used in their projects, the author discovered that they only used categories scale in their risk plans due to its simplicity and suitable for educational projects (no money included as project's source).

Updated Risk Management Toolkit will be attached in appendix section. The updated version will add team T's added risk items into Reference Risk List, state out numeric scale, numerical monetary value scale and risk exposure method as advanced knowledge for Risk Management process.

7.3 Further Research

In this present study, Risk Management methodology and the RM Toolkit were only utilizing through first four project phases. Although, in real industrial projects, it is also used throughout the whole software development project life cycle. Therefore, Risk Management Toolkit can be used and observed in deployment and maintenance phases for further study.

In deployment and maintenance phases, Risk Report can be a useful tool as it gives project teams information of recurring risks which occurred in earlier project phases. With information about risk's surroundings, its impact and past decision for recurring risk, team members can understand why it recur and get the idea easier on how it should be solved. In addition, Risk Report can be an effective tool for project teams to relate one risk's impact to other risks.

Furthermore, lessons learned from earlier educational projects such as risks on previous projects, its impact and actions on those risks, those information can be

gathered and created into risk database. With this database, students can have more awareness about risks and it can stimulate students' knowledge about problem solving for their upcoming risks.

For further study, it should provide answers for these questions below:

- Does Risk Report provide the team needed information about recurring risks? Can you list those information out?
- Does Risk Report provide the team bigger picture on several relating risks and its impacts? Can you tell how effective Risk Report is in giving information in multiple issues in projects?
- Does risk database stimulate your awareness of risks and problem solving solution? Which information in risk database is useful for your project?

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APPENDICES

APPENDIX 1. Risk Management Toolkit

1. Risk Management Guideline

1. Risk Management in Software Project.

An IT project, to be able to succeed, needs a good project plan with realistic strategy, schedule and resources. In addition, a proactive management of risks is extremely essential for a project to be prosperous. Therefore, this document will give IT teams which participate in software development projects a guideline to control its future risks.

2. Risk Management process.

Every present actions can be a cause of future risks. For example: a delay task will lead to a split schedule, an unrealistic plan will lead to a failed project in many

ways (e.g. lack of time or resources), etc. According to that, it is necessary for the team to have their own proactive risks management.

Risk management is a series of steps whose objectives are to identify, address, and eliminate software risk items before they become either threats to successful software operation or a major source of expensive rework.

(Boehm, 1989)

There are two interconnected phases in risk management process: risk assessment and risk control. These two phases are broken down into small steps. In risk assessment phase, there are risk identification, risk analysis and risk prioritization. The next phase – risk control involves risk planning, risk mitigation and risk monitoring. (Boehm, 1989) Show in Figure 1.

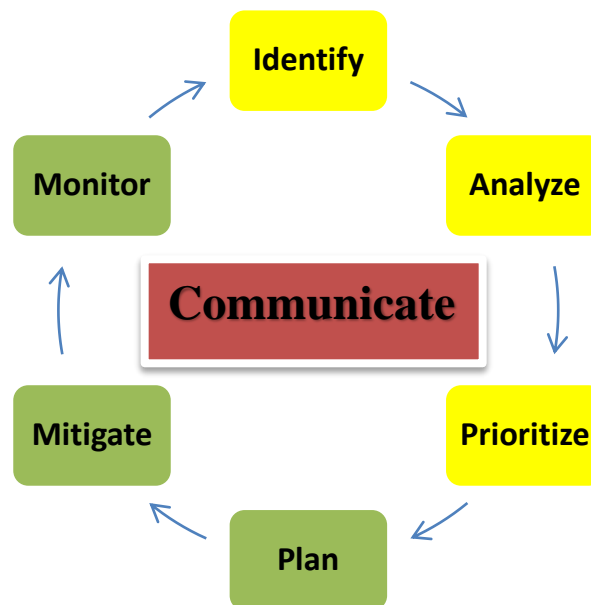


Figure 13. The Risk Management Cycle

Step 1: Risk Identification

Risks are divided into several categories. In this document, there will be three types of risks: Project risks, Product risks and Business risks. To make it more clearly, here are some explaining about these three risk categories:

- Project risks contains factors which affects schedule, resource (personnel, budget) of the project.

PJ00	Lack of knowledge	Given that <condition: no one in our team has ever developed a product in Prolog>, then there is a concern that (possibly) <transition: the project> <consequence: will take two months longer than has been estimated.>	3=probable	2=marginal			
PD00					

Figure 2. The Risk Management Plan Table

Step 2: Risk Analysis

In the meeting, each risks will be considered and judgment will be made for its seriousness and probability.

- Assess the probability of a loss occurring by using categorized scale (1=very improbable, 2=improbable, 3= probable, 4=frequent) or numeric scale (percentage of probability of issue going to occur).
- Assess the impact of the loss if the loss would be occur. Team members together delineate the consequence of risk and estimate the impact of risks to the project and product. Team can choose to assign numerical monetary value to magnitude of loss, e.g.: 5000euros for a two-week delay in schedule or can assign categorized scale (1=negligible, 2=marginal, 3=critical, 4= catastrophic).
- Write it down into the table.

*In educational projects, categorical value can be a simple scale for analyzing risks. Other scales can be read as advanced knowledge.

Step 3 Risk Priority

In order to decide which risks are more important than which, project team have to rank it based on its probability and impact.

Risks list will be sorted from the high probability, high impact to low probability, low impact.

- If Probability (categorical values: very improbable, improbable, probable, frequent) and/or Impact (categorical value: negligible, marginal, critical, catastrophic), *group consensus technique* may need to be used to produce the risk ranking.
- If numerical values were given for Probability (percentage) and Impact (monetary), the risk exposure can be calculated. Risk exposure is calculated as follows (Boehm, 1989).

$$\text{Risk Exposure (RE)} = P \times C$$

P (Probability), C (Impact). If RE is calculated for each risk, the prioritization is based on a numerical ranking of the risk exposure.

*In educational projects, Risk Exposure can be read as an advanced knowledge.

After risk prioritizing phase, the team, led by project manager, defines a cut off line. Risks above the line will be given further attention. Risks below the cut off line will be monitored.

Step 4: Risk management plan

The management plans **for those above-the-line risks** should be developed and documented into the Action column of the Risk table for the proactive action. Here is an example: When none of team members has use one of needed technology before, seek help from professional person, self-learning from internet and share knowledge in the team.

Step 5: Risk Mitigation

Related to risk planning, risk mitigation can also strategy that creates a situation in which risk item can be eliminated or resolved. Here is an example of risk mitigation strategy: When the project is running out of time, teams must discuss with client about cutting off less important

features and try to accomplish the most important ones. This is called lose-lose strategy.

Step 6: Risk Monitoring

After identifying, analysing, prioritizing, planning actions, monitoring those risks is essential. The progress will be observed and taking corrective action if necessary. Risk monitoring can be done with other team project management activities or just in explicit risk management activities. Regularly, around 10 top risks will be monitored by the whole team.

Communication and Reporting

Communication:

- Face to face or at least telephone or virtual meeting applications. Avoid messages, emails and not discussing at all.
- Response to others as soon as possible directly and politely.

Report:

- Accurate reports for risks and project status.

No.	Risk_ID	Risk_Name	Risk_Description	Rank in RM Plan	Related to who	Occur on date	Stop on date	In which project phase	Action
1	PJ00	Lack of knowledge	Given that <condition: no one in our team has ever developed a product in Prolog>, then there is a concern that (possibly) <transition: the project> <consequence: will take two	1	Member(s)'s name				Self-learning from previous projects and asking instruction from the organization

			months longer than has been estimated.>						
--	--	--	-----------------------------------------	--	--	--	--	--	--

Figure 3. The Risk Management Report Table

2. Reference Risk List

Risk_ID	Risk_Name
PJ01	Team member doesn't do his/her task
PJ02	Delayed task
PJ03	Lack of teamwork
PJ04	Lack of communication
PJ05	Loss of team member
PJ06	Overriding other people's work
PJ07	Misunderstanding in requirements
PJ08	Team members lack specialized skills required by the project
PJ09	Being absent in team meeting
PJ10	Unclear/ misunderstood scope/ objectives
PJ11	Faulty reporting on the work
PJ12	Lack of planning for the work
PJ13	Users are not committed to project
PJ14	Lack of cooperation from users
PJ15	Project involved the use of new technology
PJ16	Unrealistic time (and cost) estimates
PJ17	Lack of effective project management skill
PJ18	Lack of effective project management methodology
PJ19	Late changes to requirements
PJ20	Poor project planning
PJ21	Lack of commitment form upper management
PJ22	Changes to membership on the project team
PJ23	Time management
PJ24	Resources
PJ25	Client management

PJ26	Team member absent from group working situation
PD01	No new feature release after times
PD02	Developing the wrong software functions
PD03	Developing the wrong user interface
BU01	Costs associated with late delivery
BU02	Costs associated with defective delivery

Risk Categories

Category	Abbreviate
Project risk	PJ
Product risk	PD
Business risk	BU

3. Risk Management Excel Tools

Risk Management Plan Excel Tool

Risk Management Plan								
<u>Team's name:</u>								
<u>Team's members:</u>								
<u>Project's name:</u>								
<u>RM Plan No.:</u>								
<u>Date of meeting:</u>								
Rank	Risk_ID	Risk_Name	Risk_Description	Probability	Impact	Rank last week	Number of weeks on the list	Action
1	PJ00	Lack of knowledge	Given that <condition: no one in our team has ever developed a product in Prolog>, then there is a concern that (possibly) <transition: the project> <consequence: will take two months longer than has been estimated.>	3=probable	2=marginal			
	PD00					
<u>RM Plan No.:</u>								
<u>Date of meeting:</u>								
Rank	Risk_ID	Risk_Name	Risk_Description	Probability	Impact	Rank last week	Number of weeks on the list	Action
1	PJ00	Lack of knowledge	Given that <condition: no one in our team has ever developed a product in Prolog>, then there is a concern that (possibly) <transition: the project> <consequence: will take two months longer than has been estimated.>	3=probable	2=marginal			
	PD00					

Risk Management Report Excel Tool

Risk Management Report									
Report No.:									
Team's name:									
Team's members:									
Project's name:									
Date of meeting:									
No	Risk_ID	Risk_Name	Risk_Description	Rank in RM Plan	Related to who	Occur on date	Stop on date	In which project phase	Action
1	PJ00	Lack of knowledge	Given that <condition: no one in our team has ever developed a product in Prolog>, then there is a concern that (possibly) <transition: the project> <consequence: will take two months longer than has been estimated.>	1	Member's name(s)	20.2.2015	29.2.2015	Designing	Self-learning from previous projects and asking instruction from the organization
	PD00						

APPENDIX 2. Project team's interview sheet

Interview Topic: Enhancing the Awareness of Risks and Risks' Response in Educational Software Development Projects

Interviewer's name: Doan Vo Thuy Linh

Date of interview:

Interviewee's name:

Team name:

Project name:

Your role in project:

Interview themes:

1. Knowledge about Risk Management

1.1 In every educational projects which you participated before, was there any risk occurred? If yes, was it treated completely and effectively?

(If you answer NO in question 1, please skip question 2 and 3.)

1.2 How did your previous teams define and response to risks in your previous projects?

1.3 Are you familiar with Risk Management methodology before this project?

1.4 Does introduced Risk Management methodology bring you new knowledge on how to manage risks effectively by creating proactive risk plan? What you have learned from it?

2. Impact of Risk Management Toolkit to current project

2.1 Does Risk Management Guideline help you to understand quickly and adopt the method structurally into your project? How it helps and if it doesn't, why not?

2.2 Does Reference Risk List help to stimulate your awareness of risks which might happen in your project? Do you think that it is necessary to provide it along with the Guideline?

2.3 Is it important to have proactive plan for risks? If you answer no, please explain why. If you answer yes, what effectiveness that Risk management plan brings you?

2.4 Does Risk Report help you to focus on current project situation by stating out which risks have been solved and which have not solved yet? Please explain why if you say no and explain how if you say yes to question 8.

3. Risk Management Communication and Report

3.1 Were your team's Risk Plan and Risk Report updated based on team's agreement? Did it change throughout the project?

3.2 Did every members of your team participate in risk management process? Was it face to face meetings or virtual meetings?

3.3 How often your team has meeting for risk management?

APPENDIX 3. Client's interview sheet

1. Purpose of Client's satisfaction investigation document.

This interview document is created in the purpose of collecting client's satisfaction about the product and project team. Your contributed answers and compliments will give us ideas on how to improve projects more effectively in the future.

2. Questions

2.1 What is your name?

2.2 What is your project?

2.3 Does the project team understand your product's requirements completely? If no, please let us know which one was not understood right.

2.4 Are you satisfied with the current prototype from project team? If yes, how do you like the prototype? (For example: how much it matches your requirements?) If no, please explain why.

2.5 Is there any requirement changes during the process? If yes, did the team and you agree on how it should be and done? Has the changed requirement added to the current prototype yet?

2.6 Has the project team ever delayed to show you the promised work they made from the previous meeting?

2.7 Do you have any compliments for the team's project work from the beginning until now? (For example: how excellent/poorly they response to project, communication, product, etc.)