Project Management Tools in Software Development - the Use of JIRA in Software Project

Bachelor Thesis within Business Informatics

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Abstract

Introduction: As information technology has been developing so rapidly, it affects all business processes. Project management is also greatly affected, as organizations worldwide constantly strive for competitive advantage, major tools were produced and management control of project progress throughout their lifecycle is becoming increasingly recognized for its importance.

Problem: The study of software project management tools has aroused a great deal of interest in modern research circles as well as inspired extensive research in the area of managerial science. However, there still seems to be confusion, disagreement and limited research regarding these concepts of job performance.

Purpose: The purpose of this thesis is to examine, how project management tools can affect the efficiency in a software development project. Efficiency will be measured by time, from project start to finish, human and financial resources.

Method: An electronic qualitative and partly quantitative questionnaires were sent to three sampled companies. In each company one Web programmer, one project manager and one executive level employee had filled out the questionnaires. The acquired data was then analysed in relation to the frame of reference.

Frame of Reference: Theoretical framework is build on a literature within software project management field, Iron/Golden Triangle, Productivity Paradox, Technology Acceptance Model, and Software Project Management.

Conclusion: To conclude the results of the study, after analyzing the data gathered from various companies implementing JIRA has in all cases resulted in increased product quality, more efficient and faster communication, as well as lower product development costs. This means that implementing JIRA can be beneficial for time, money and quality of software development.
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I Introduction

1.1 Background

Information system (IS) and information technology (IT) are the fastest growing and dynamically changing industry in developed countries. Huge amounts of money continue to be invested in these industries (Abdel – Hamid & Madnick, 1990; cited in Hartman & Ashrafi, 2002). Due to pressure of time-to-market, there is a continuous demand to enhance efficiency. “To maintain a competitive edge in today’s fast changing world, an organization’s success depends on effectively developing and adopting IS.” (Hartman & Ashrafi, 2002)

As information technology has been developing so rapidly, it affects all business processes. Project management is also greatly affected, as organizations worldwide constantly strive for competitive advantage, major tools were produced and management control of project progress throughout their lifecycle is becoming increasingly recognized for its importance. Project management is fast rising focus discipline within most businesses and organizations. According to Tonnquist (2008) “finding the optimal way of operating and managing projects is a continuous challenge. It might involve fine-tuning work methods, clarifying roles and simplifying project reports, or visualizing progress through the utilization of user-friendly project tools”. Nowadays project management concerns whole organization, no matter if it is public authority or private venture. More or less every person in their professional careers come across projects one way or the other. “Individual employees, who might be involved in one or more projects, all the way up to the senior management where it is decided which projects to run and how to distribute resources, are affected by project management” (Tonnquist 2008). While some different suggestions about what is project management have been made, the criteria for success, namely cost, time and quality remains.

Project Management is also affected by rapidly accelerating globalization. According to Kumar (2011), organizations are increasingly aware of the need to effectively manage the opportunities that globalization offers. Information technology has an extremely important role in facilitating effective management of globalization opportunities. Global IT management (GITM) includes facilitating access to new products and services, in addition to effective management of a firm’s IT resources. As organizations become increasingly dependent on information technology enable process, management of globally distributed projects and processes could be the key determinant of organizational performance. Effective Global IT management can quickly and efficiently enable creation of projects and processes that help acquire, reconfigure, or integrate resources. (Kumar, 2011)

According to Madritsch and May (2009), since 1990’s computer – aided project management has been providing efficient information technology (IT) tools for the mapping, evaluating and controlling of project management structures and processes. Since then numerous software systems with various systematic approaches, functions and varying degrees of success have been established on the market. Project management software delivers tools which allow control over the enormous complexity of project management process, without IT support the challenging goals of international project management cannot be reached or can only be achieved insufficiently. The proper project management software became one of the critical success factors of project implementation. (Madritsch & May, 2009)
1.2 Problem

According to Hebert and Deckro (2010), nowadays project management can reach back its roots to the development of Program Evaluation and Review Techniques (PERT)\(^1\), and Critical Path Method (CPM)\(^2\) in the late 1950’s and the creation of the Project Management Institute (PMI) in 1969. Since that time a lot of new project management software have been developed. Project management tools are used to deal with the complexity of large and globalized projects. Diverse types of software is commonly used for estimation and project planning, scheduling, cost control and budget management, recourse allocation, collaboration and communication, quality management and documentation or administrating systems. (Hebert & Deckro, 2010)

In practice, project management tools in a software project have been long becoming essential in any company that is dealing with software development, either for internal usage or for clients. The demand for such tools has been rapidly increasing within last few years, especially along with the Web 2.0 hype.

The study of software project management tools has aroused a great deal of interest in modern research circles as well as inspired extensive research in the area of managerial science. However, there still seems to be confusion, disagreement and limited research regarding these concepts of job performance (Chih-Hsing et al., 2010).

Theory of software project management tools has also been met with great deal of skepticism. Even though researchers understand the concept and benefits of the software project management tools, the documentation of it have not been fully explored.

Therefore, we believe that the absence of sufficient research dedicated to software project management may be an excellent ground to explore and examine efficiency of software project management tools, specifically ‘JIRA’.

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1. **PERT** - is a project management tool used to schedule, organize, and coordinate tasks within a project. PERT stands for Program Evaluation Review Technique, a methodology developed by the U.S. Navy in the 1950s to manage the Polaris submarine missile program. A similar methodology, the Critical Path Method (CPM) was developed for project management in the private sector at about the same time. (NetMBA, 2010)

2. **CPM** - is a project management method designed to address the challenge of shutting down chemical plants for maintenance and then restarting the plants once the maintenance had been completed. (NetMBA, 2010)
1.3 Purpose

The purpose of this thesis is to explore, how project management tools can affect the efficiency in a software development project. Efficiency will be measured by time, from project start to finish, human and financial resources.

1.4 Research Questions

In order to give the reader a straightforward and easy to understand target for this research, some research questions have been framed. The main research question will be as follows:

1. How is the use of software project management tools making the management of software projects more efficient (in terms of time, human and financial resources)?

1.5 Delimitations

Since companies that we are taking into consideration to fulfil thesis purpose, are located in different countries, one of the delimitation is cultural differences within the team. According to Kruyt, Malan and Tuffield (2011) cultural difference do not impact on project accomplishment. Most important factor is to get right people on the team. Skills, previous experience and knowledge are leading factors for successfully accomplish project.

Main focus of this thesis is to find our efficiency of using software project management tools with specific program JIRA. However, technical parts such as hardware and other software that companies are using are not considered in detail and are out of the scope in this thesis. Furthermore, we are also not taking into consideration other software project management tools.

We are also not taking into consideration success of the product. It has to be finished, but not necessarily sold or in other ways distributed to consumers.

1.6 Definitions

Project management - is the application of a collection of tools and techniques (such as the CMP and matrix organization) to direct the use of diverse resources toward the accomplishment of a unique, complex, on – time – task within time, cost and quality constraints. Each task requires a particular mix of theses tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task. (Project Management Institute, 2000).

Project Management Tool – tool is the mean that hepl managers and team memebers successfully plan, manage and execute the different tasks involved in each project.

Efficiency – measure of time, cost and effort. Measures of an efficient information system include its productivity, processing time, operational costs and level of automations. Measures of an efficient information product include the speed of processing, the functionality of the solution, the ease of use of the solution and output, and the cost of information processing.

Software project management – is the process of planning, organizing, staffing, monitoring controlling, and leading a software project (Bennatan, 1995).
2 Method

2.1 Research Approach

One of the first and most important matters we have considered before writing and constructing our thesis is the choice of research approach. Deductive and inductive are two perspectives that can be used to approach research design (Saunders et al., 2007).

Research about software project management tool efficiency is rather limited, there is very little information and theories that could be used as a basis for current study. For this reason deductive approach which could be simply referred to as “testing an existing or assumed theory” (Grix, 2004), would not be well suited for the thesis purpose. Deductive study is more appropriate for testing and confirmation of an existing theory or hypothesis, and not for creating new knowledge which the research aims to do.

We aim to identify if there are any benefits of using software project management tools. From researched cases construct a theory that is only applicable for chosen companies concerning software project management (SPM), to be precise the aspects of time, money, and human resources. Therefore, inductive approach which can be viewed as “building a theory and drawing conclusions based on conducted research” (Grix, 2004) appeared to be more appropriate to answer research questions and chosen purpose. We believe that inductive study is more suitable for our research, for the reason that it leaves more freedom for interpretation and explanation of a phenomenon observed, and suggests more flexible and innovative research results. Moreover inductive approach perfectly fits our aim to uncover, describe and suggest reasons behind chosen subject of matter.

2.2 Research Strategy

2.2.1 Exploratory

Saunders et al. (2007) suggests three possible research outcomes, explore, explain or describe. Hence, there are three achievable ways to approach a research strategy – exploratory, explanatory or descriptive.

In order to completely accomplish chosen research purpose we believe to approach the research with an exploratory study. Due to fact that software project management as a whole is relatively little studied, we believe that there are many unknown aspects when it comes to SPM and for that reason we intend not only to explain if there are any benefits of using software project management tools during the execution phase but also to identify the unknown aspects of it. As Saunders et al. (2007) note, exploratory studies usually address chosen problems of interest - questions such as “What is happening? Are there facts that are not known about a phenomenon? Is there a way to perceive the observed in any other way?” Moreover we believe that other two approaches, explanatory and descriptive, would be too narrow and envelop only some parts of our anticipated research, therefore it would not allow to fulfil the research purpose only to some extent.

2.2.2 Qualitative and Quantitative Research

According to Sobtsenko et al. (2009) primary data collection is strongly connected to the kind of information qualitative or quantitative would be most fitting for the research purpose. “Depending on the type of data necessary for the purpose research can be divided into qualitative or quantitative” (Sobtsenko et al., 2009).
We believe that quantitative research, even though could be some use to carry out current research purpose does not allow to answer the research problem fully. According to Saunders et al. (2007) “quantitative research is more suitable when general trends and occurrences need to be indentified and quantitative data are based on meaning carried out from numbers, the collection of results is in numeric and standardized, data analysis conducted through diagrams, charts and statistics.”

According to Sobtsenko et al. (2009) “Qualitative research on the other hand is based on collecting detailed in depth information in order to deeply evaluate and understand the phenomenon and the reasons behind it.” “Qualitative data collection is based on meanings collected through words and results in non-standardized data; analysis requires categorization and conceptualization” (Saunders et al., 2007). This strategy also as quantitative strategy could be some use to carry out current research purpose but also does not fulfill it fully.

As we aim to collect rather complex and interrelated data we have combined both qualitative and partly quantitative research strategy for collecting required data for purpose of this thesis. Moreover we believe that this strategy approach will be more applicable to answer our research questions and meet the purpose

2.2.3 Time Horizons

Time issue is extremely significant when carrying out research. According to Saunders et al. (2007) and Sobtsenko et al. (2009) most of the choices on research strategy and data collection methods depend on the research time frame.

When doing research with limitless or fairly large time frame, the researcher can chose to carry out types of research that analyse a certain phenomenon over a period of time. Saunders et al. (2007) suggest to this type of research as longitudinal – “observing a certain phenomenon during a continuous period of time.” It allows the researcher to keep an eye on development and gain an in depth observation on changes of the phenomenon over time Sobtsenko et al (2009). We do not believe that continuous observations might add extra data or value to research, this is why we do not presume it.

Since the time frame for this thesis is constrained to one semester, for this reason, time frame should be carefully thought through when making decisions on various aspects of the research. In this current case the phenomenon is studied in a particular time frame and it is not continuous. This type of research is called cross – sectional and the outcome of it is a sort of ‘snapshot’ of what is happening with the phenomenon at a particular moment, Sobtsenko et al (2009). According to Saunders at al. (2007) “it is used to capture an occurrence without providing past trends or prospect developments for the future, these can be only assumed.”

2.3 Primary Data Collection

2.3.1 Sample Selection

Given that in the majority of research cases, it is possible to test entire population, in order to get the needed empirical data a sample has to be selected, Sobtsenko et al (2009). According to Groves et al., (2004) “sample is a group selected from target population from which the needed data will be sought.”
The list of the companies was selected from Atlassian.com client list. Since the respondents had agreed to participate in the research beforehand, we had access to all the information necessary to meet the research questions.

The sample was selected within the companies that are currently running software projects. Since, one of the research questions of this thesis is to find out efficiency of using software project management tool, we looked for the companies that are currently using software project management tool in specific ‘JIRA’, but have not used it in their previous projects. This will help us to measure time, money and human resources spent on projects with software tool and without. Sample was selected between companies that use Agile Methodology (SCRAM Method) when creating new software projects. We also selected companies that are developing exactly the same software products. In order for collected data to be relevant and valid it is important that the respondents are familiar with the area of interest, therefore every respondent is to an extant involved in project.

We have selected three companies that meet our criteria. We have sent questionnaires to each company’s executive, project managers and programmers of that project. We believe that multiple perspectives and comparing opinions and responses from the same organization will give us opportunity to completely understand and study the phenomenon.

2.3.2 Data Collection Method

There are many ways how data can be collected. Different methods of collecting data have their different limitations, advantages and disadvantages; as a result of some them prove to be more practical for one and less practical for other types of research and research purpose, Sobtsenko et al. (2009).

Therefore, before we decided upon the data collection method, we have considered the problem and purpose of this thesis. Since the aim is to examine, how project management tools (JIRA) can affect the efficiency in a software development project, observation which usually provides no reasoning for the observed incidence selected and is not very accurate unless the phenomenon studied is very straightforward (Saunders et al., 2007) is evidently not a appropriate method to collect data.

According to Saunders et al. (2007) “interviews could provide with reliable and explicit data, suggesting new ideas or viewpoints that could have failed to notice previously, as well as giving the opportunity to interpret respondents’ behavior, body language that would give a deeper insight and meaning of the answers.” However, interviews takes long time to conduct and it appears to be unsuitable for our thesis time frame and taking in fact that all three selected companies are located in different countries it is impossible to have interviews.

Questionnaire according to Saunders et al. (2007) allows including higher number of respondents into the research, are easier to conduct and analyze as opposed to observations or interviews, that are time consuming and fairly easy to misinterpret. We believe that questionnaire would provide us with all the necessary empirical data to solve the research problem and carry out the set purpose within this time frame. Even though we are aware that some related information and insights may be lost or not fully answered when collecting empirical data from questionnaires, it is clear for us to acknowledge and deal with this disadvantage and strongly believe it is an one of the most appropriate solution to our time frame.
2.4 Designing a Questionnaire

2.4.1 Structure of the Questionnaire

According to Sobtsenko et al. (2009) different purposes and phenomenon need different approach to the type and collection of data. “The choice of questionnaire will be influenced by a variety of factors related to research question(s) and objectives” (Saunders et al., 2007). This is why, it is very crucial element to consider, when designing questionnaire. Researchers have to think about what type of questions would provide empirical data most fitting to fulfil research purpose.

One of the biggest decisions when building a questionnaire is to choose either closed – ended or open – ended questions, as the type and quality of empirical data collected and the type of further analysis, strongly depends on questions’ structure Sobtsenko et al. (2009). There is a noteworthy difference in data suitability and analysis depending on whether person who is answering the questions, is free to answer whatever he/she think fit, given no other proposals or respondents have to answer by them self – open-ended questions or whether he/she are given a various alternatives to choose from – closed-ended questions (Saunders et al., 2007).

As our thesis questions and phenomenon are rather complex, amount of data needed is quite broad and questionnaire includes large number of questions, a single type of questions appears not to be fitting to fulfil purpose of this thesis. Considering the number of questions it would be relatively challenging to persuade respondents to answer significant number of open – ended questions. Moreover, analysis of open – ended survey are quite difficult, hence there are no clear criteria on how to base the analysis part on.

Taking into consideration our limited time frame, but rather small sample size and to keep away from the difficulties discussed above, we decided to design both open – ended and close – ended questionnaire which is faster to fill out and less problematical when writing the analysis part and drawing conclusions.

According to Saunders at al. (2007) and Sobtsenko et al. (2009) “closed – ended questions can be structured in a few different ways in relations to techniques used when listing alternatives.” Furthermore, we have decided to use different approached of closed – ended question types. Since the complexity of the thesis requires diverse kind of data, we believe that collecting only with one method might become imprecise and have damaging result on excellence and clearness of the questionnaire.

As Saunders et al. (2007) and suggest “closed – ended questions can be: List – respondent can choose alternatives from given list of answers. Ranking – respondent is given a list of alternatives that have to be placed in order of importance. Scale of rating – a rating tool is used to collect necessary data. Quantity – number showing an amount to each question. Grid (matrix) – matrix technique can be used when responses to multiple questions is needed.”

We also have included some questions that gives, the person who is answering the questionnaire, with a list of alternatives to choose from. As we are aware that we might have not included some substitutes while designing questionnaire, we have included ‘other option’ for both ranking questions and list questions in order to get more accurate and better quality answers.
In order to get better insight and extensive explanations of the companies open-ended questions were asked. We believe that open-ended questions will provide us with developmental and extensive answers in order to obtain facts and relevant attitudes within the company. According to Smith et al. (2002) open-ended questions should help to avoid biased answers.

We believe that both open-ended and closed-ended questionnaire will provide us with better results to answers our research purpose. As stated above our research is both qualitative and partly quantitative mixed questionnaire will also give better insight of phenomenon and will help us to answer our research questions.

2.4.2 Content of the Questionnaire

According to Saunders et al. (2007) “one of the most common problem that researches meets is when designing questionnaire is the identification of the most relevant information necessary and ensuring that the collected data will allow research questions to be answered and research purpose carried out.” One of the first steps to accurate and valid research results is from correct questionnaire. According to Sobtsenko et al. (2009) “If the content of the questionnaire is not relevant enough to the problem and purpose of research or does not give a complete overview of the phenomenon, the outcomes of the research might and most probably will be biased and the results not reliable enough to provide trustworthy conclusions.” Then again, it is very important not to have very detailed, or too specific questionnaire and keep it within the certain limits.

It is also important for researchers to have good understanding and knowledge with the phenomenon when creating questionnaire. According to Saunders et al. (2007) “it is important to know terminology, concepts and background of the researched phenomenon, for researcher in order not to collect useless information or not to make mistakes while doing questionnaire.” In order to create and construct an accurate questionnaire we have decided to get the needed information from both theoretical and practical perspective.

Theoretical perspective to get necessary information about current research was approached by reviewing secondary literature. According to Saunders et al. (2007) “secondary literature – subsequent publication of primary literature such as books and journal.” Previous research as well as much as we could find related articles was reviewed on software project management. As for practical perspective we have had experience working with software projects and dealing with complex software project management tools, which will help us in order to answer our research phenomenon.

We have combined both practical experience and theoretical perspective from previous research and scientific articles when designing the questionnaire. Merging those two perspectives had helped us to get a better summary on the phenomenon and design more suitable questionnaire.

2.4.3 Validity and Reliability of the Questionnaire

To design a comprehensive questionnaire was rather problematic. According to Foddy (2004) “the question must be understood by the respondent in the way intended by the researcher and the answer given by the respondent must be understood by a researcher in the way intended by the respondent” (cited in Saunders et al., 2007). This is why before sending questionnaires to the selected three companies we conducted pilot testing. We have sent pilot questionnaires to fellow business informatics students. After receiving feedback
about what needs to be changed and what parts of the questionnaire were not clear, we had improved the questionnaire and reworded some misunderstood questions.

After design of the questionnaire was completed, we faced another issue. Since all three companies are located in different countries and English is not their primary language, translations had to be made. Translations process was rather difficult and time consuming since it requires accuracy and precision. One company is located in Jakarta, Indonesia, and since one of the authors of this thesis is originally from there it was rather easy to translate it. Other company is located in Kaunas, Lithuania. It was also quite easy to translate into Lithuanian this questionnaire because the other author is also originally from there. One of the main difficulties was to translate our questionnaire into Swedish. In order to solve this problem and avoid misunderstandings we had asked our fellow business informatics student whose native language is Swedish to translate it.

After translations have been made, we did one more pilot test with translated questionnaire, since it was rather difficult to find some translations from English terms into equivalent Indonesian, Lithuanian or Swedish. There were some risks some meaning might be lost after we translated the questionnaires, creating miscommunication between the respondents and us. Translated questionnaires were sent to a group of people who speak Indonesian, Lithuanian or Swedish. After receiving results we were quite satisfied, even though some questions and formulations had to be changed to develop better quality and validity of the questionnaire.

2.5 Distribution of the Questionnaire

Questionnaires can be also categorized by how they are delivered to the respondent. According to Saunders et al. (2007) “there are few ways how questionnaires can be delivered to respondent: on-line and postal delivery.” Due to time frame we decided to conduct an on-line questionnaire which is delivered and answered through the internet. As this type of delivery allows researchers and respondents to save time and would be more time effective for the reason that it would show the results immediately.

We have not used postal questionnaire delivery which is delivered to the respondent by post and after it has been answered sent back to us, due to tight time frame.

2.6 Data Analysis Method, Interpretation and Validity

We have used the EasyResearch software for closed – ended questions. This software allows us to see closed-ended answers immediately in a excel sheet, where every response was documented and presented. Due to the fact that our questionnaire has open – ended questions it was hard to summarise them in a EasyResearch software. Qualitative data is different and more complicated then the statistical and numeric analysis of the quantitative data analysis.

Since our sampling is rather small and questionnaire was sent only to three companies. We decided to include all the answers from questionnaire into empirical findings. All questionnaires were design according to respondent’s position in the company: Web designer, project manager and executive. For empirical findings we have categorized according to employees position within the company. We believe that this categorization will give us better view on how each level is affected, not on how each company. On the other hand it was easier to categorize from different employees perspective because all the answers that we
got were quite similar. We also had made one more section from every perspective, to find out what was the difference between the companies in the same level of employees.

As for analysis part we have categorized it through different frame of reference perspective. We have combined both theory and results that we got from respondents, and applied it to different theoretical framework:

2. Iron/Golden Triangle, to find out the efficiency of using JIRA from money and time perspective.

3. Productivity paradox, to find out whether implementation of JIRA boosts the productivity within selected three companies.

4. Technology Acceptance Model, to find out how companies manage to implement software project management tool JIRA in their company and how did employees accepted it. This framework will also give us good insight whether JIRA is more efficient when it come to human resources.

According to Sanders et al. (2007) “validity – the extent to which data collection method or methods accuracy measure what they were intended to measure.” Since our thesis purpose is to find out how is the use of software project management tools making the management of software projects more efficient (in terms of time, human and financial resources), we find out three companies with the same product, sent questionnaire not to one person per company but to three to get more reliable and valid answers.
3 Frame of Reference

3.1 Iron/Golden Triangle

The project management research was made to establish and define the attributes of effective software project performance and the success criteria of software project (Bryde and Robinson, 2007; Cooke-Davies, 2002) i.e. the critical success factors (CSFs) (Daniel, 1961; Rockart, 1979). Software project performance and efficiency had been defined in terms of the Iron/Golden Triangle (Gardoner and Stewart, 2000; Atkinson, 1999), which refers to Money (cost, budget), Time (schedule) and Scope (features, quality technical-related criteria).

Although there are many arrangements of the Iron/Golden Triangle, most commonly used definition is money, time and scope. According to Morris et al. (2008) “the triangle shows the balance between the three core parts of a project.” When it comes to setting the efficiency of the project, this idea works quite well, however, when companies need to begin to measure project success, the Iron/Golden Triangle begins to fail. “It fails because there are many more factors to consider” (Morris et al., 2008).

3.1.1 Critique

Even though, Iron/Golden Triangle is still a suitable measure of project performance it focuses only on a narrow range of criteria that are managed during a project’s lifecycle. According to Bryde and Robinson (2007) in addition to narrow focus, Iron/Golden Triangle also views project performance from a tactical perspective, detached from the high-level, long-term strategic imperatives that exist in organizations. Bourne et al. (2000) recognized the deficiencies of a narrow perspective in the performance measurement domain. Ghalayini and Noble (1996) said that “in operations the limitation of traditional performance measurement frameworks that focuses on a narrow range of mainly financial-based measures, such as return of investment included a failure to focus on a continuous improvement and the sub-optimization of performance.” As a result of narrow focus of
Iron/Golden Triangle many organizations developed frameworks that consider a range of attributes i.e. the Balance Scorecard (Kaptan and Norton, 1992).

3.1.2 How Iron/Golden Triangle Works

The Iron/Golden Triangle is representative of the way a real project works. All three sides of a triangle are equally dependent on each other, just as the three factors of a project are equally dependent on each other as well (Morris et al., 2008). If during the project one side of the triangle will be changed, it will affect at least one of the other sides.

- Money Focus: according to Morris et al. (2008) “if cost is the focus, then scope or time will need to be adjusted. Usually when there is a focus on cost, it is due to budget constraints. If a project has an unlimited budget, then money is rarely a factor; however, if cost is constrained, then key decisions must be made. To limit cost, the project may have to use more inexpensive resources, reduce scope cycles, or cut testing in order to meet the budget.”

- Time Focus: if time is of the fundamental factor of the project, then quality or cost will need to be adjusted. According to Morris et al. (2008) “if the schedule needs to be accelerated, then the project manager (PM) could assign more resources to the project causing cost (increasing the amount paid to do the same work) or quality (tougher communication streams) to be adjusted. Sometimes both will be changed. If the project must meet a specific deadline, quality could be cut to meet the accelerated time frame.”

- Scope Focus: if in the project the most important element is quality, then money or time that is spent on it will need to be adjusted to permit an increase of time or budget (Morris et al., 2008). Quality usually affects both other sides of the triangle. Not only task will take longer to accomplish but it also will increase the cost. “Since an extra step or process will be required to increase the quality” (Morris et al., 2008).

Depending on the project, the factor that is needed the most must be selected. For example, “if a project is a regulatory or market – driven project, time is usually the most constrained. The project must finish at a certain time” (Morris et al., 2008). If project is quality related, money or time must be prearranged to effectively complete them. According to Morris et al. (2008) once Iron/Golden Triangle is understood, it can become one of the most powerful tool not only for project success but also to see how aligned the stakeholders are with each other.

3.1.3 Contribution for thesis

Since our thesis purpose is to study, how project management tools can affect the efficiency in a software development project and the efficiency will be measured by time, from project start to finish, human and financial resources. This theoretical framework will give us an excellent contribution to measure whether there are time and financial benefits of having software project management tools.
3.2 Productivity Paradox (Solow paradox)

The connection between information technology (IT) and productivity is broadly discussed but slightly understood. According to Brynjolfsson (1993) “delivered computing – power in the economy has increased by more then two orders of magnitude since 1970, yet productivity, especially in the service sector, seems to have stagnated”. Given the enormous promise of the IT to usher in “the biggest technological revolution men have known” (Snow, 1996; cited in Brynjolfsson, 1993). Statements like “No, computers do not boost productivity, at least not most of the time” (Economist, 1990) are evidence that technology usually does not fit its function, and creates disillusionment and even frustration with technology.

“Productivity paradox” has engendered a significant amount of research, but, thus far, researchers have difficulties clarifying it. Solow and Laureate characterized Productivity paradox as “we see computers everywhere except in the productivity statistics.” (cited in Brynjolfsson, 1993). It seems that the underperformance of the IT productivity is as much due to deficiencies in measurement and methodological tools kit as to mismanagement by developers and users of IT. (Brynjolfsson, 1993)

3.2.1 Dimensions of the Paradox

According to Brynjolfsson (1993) “productivity is the fundamental economic measure of a technology’s contribution.” Taking this into consideration, CEOs and production managers should start to question huge investments in computers and related technologies. “While major success stories exist, so do equally impressive failures” (Kemer and Sosa, 1990). The shortage of high – quality measures for the output and value created by IT has made management information system (MIS) manager’s work on justifying investment particular difficult. Not only MIS managers have difficulty but also researches have had similar problems assessing the contribution of this critical new technology, and this has been generally interpreted as negative signal of its value (Brynjolfsson, 1993). Even though newest productivity growth has increased to some extent, especially in manufacturing, in general there is still some negativity in relationship between productivity and the IT. Some researchers believe that IT has not helped productivity or even that IT investments have been counter – productive. (Brynjolfsson, 1993)

3.2.2 Critique

Upon closer examination, the alarming correlation between higher IT spending and lower productivity at the level of the entire economy is not compelling because so many other factors affect productivity. Even though an alarming number of researchers in this area have similar conclusions, it is hard not to over interpret these findings. In fact, many of the most cited aspects of the “productivity paradox” do not stand up to closer study.

Until now, information technologies were not a major share of the technology. According to Brynjolfsson, (1993) “information technology capital stock is currently equal to about 10% of Gross National Product (GNP). The return on IT investment is 20%.” Computers do have significant effects in specific areas, such as transaction processing, employment shares, organizational structure or productivity variety.

Beaudreau (2009) stated that, replacing workers by a control device (computer, etc) will, in most cases, be profit – increasing factor. The increase of IT/IS is evidence of an increase,
not a decrease, in firms’ relative productivity. Osterman (1986) also suggested that clerical employment often increase after the introduction of computers. Many other researchers have confirmed that opinion “IT capital is, on average, a complement for labour even as it leads to fewer workers” (Berndt and Morrison, 1991)

3.2.3 Explanations of the Paradox

Although to state that IT’s productivity has been weak is too early, a productivity paradox remains. The various explanations on why paradox exists have been proposed, and it can be grouped into four categories:

1) Miss-measurement of outputs and inputs; according to Brynjolfsson, (1993) “it is important to note that measurement errors not necessarily bias IT productivity if they exist in comparable magnitudes both before and after IT investments”. Many managers believe that IT should increase; quality, variety, customer service, speed and responsiveness. However these aspects are output measurements that are poorly accounted for the productivity statistics. This can lead to systematic underestimates of IT productivity. (Brynjolfsson, 1993)

2) Lags due to learning and adjustment; Gurbaxani et al. (1991) in their research found that the benefits from IT can take several years to show up on the bottom line. “Lags of two to three years before the strongest organizational impacts of IT were felt” (Gurbaxani et al., 1991). For business that new technologies may not have an immediate impact is common, to take at much as five years for IT investments to pay – off. Brynjolfsson (1993) stated, “if only short-term cost and benefits are measured, then it might appear that the investment was inefficient.”

3) Redistribution and dissipation of profits; as Brynjolfsson (1993) stated “IT may be beneficial to individual firms, but unproductive from the standpoint of the industry as a whole or the economy as a whole.”

There have been several opinions for why rearrangement may be more of a factor with IT investments then for other investments. As Baily and Chakrabarti, (1998) stated “IT may be used to the firm while adding nothing to total output.” If compared information and other goods, is particularly vulnerable to rent dissipation, in which one firm’s gain comes at the expenses of others, instead by creating new wealth. This will lead to excessive incentives for information gathering (Brynjolfsson 1993)

4) Mismanagement of information and technology; Roach (1989) claimed that “manufacturing industry has made better use of IT than has the service sector because manufacturing faces greater international competition, and thus tolerates less slack.” nevertheless decision – makers increasing their slack, building inefficient systems, or simply using outdated criteria. Several authors suggested that “our currently low productivity level are symptomatic of a economy in transition, in this case to the “information era” David, 1989; Franke, 1987. Rapid change of IT can create unexpected bottlenecks at each human in the information process chain. Those bottlenecks need to be addressed and changed, because if not, more money that is spent on IT will not help to the company.
### 3.2.4 Contribution for thesis

This theoretical framework will provide us with the ability to measure whether implementing project management tools can boost the effectiveness of software development projects and if the results can be explained by using different concepts of productivity paradox.

### 3.3 Technology Acceptance Model

Information technology investments and realization of their economic value, has been discussed in many research. Usually, researchers bind these factors and processes to User Perception about IT and how it impacts their work. There are many ways to examine such perception, in general there have been two leading approaches; employed – user satisfaction (Seddon 1997) and technology acceptance (Davis 1989, Venkatech et al. 2003). Technology Acceptance Model (TAM) provides sound predictions of usage by linking behaviours to attitudes and beliefs (ease of use and usefulness) that are consistent in time, target, and context with the behaviour of interest (system usage) (Wixom, B. H. and Todd, P.A., 2005). In spite of its predictions ability, TAM also gives guidance about to influence usage through design and implementation (Venkatesh, 2003). TAM can help build design and implementation decisions to system characteristics to prediction on usage.

#### 3.3.1 Behaviour Beliefs and Attitudes

According to Ajzan and Fishbein (1980), “external variables influence beliefs about the outcomes associated with performing a behaviour, which in turn shape attributes toward performing behaviour.” Attitude, in turn, influences intention to perform the behaviour itself (Wixom, B. H. and Todd, P.A., 2005). According to Theory of Reasoned Action (TRA), these relationships between attitude and behaviour will be predictive when the attitude and believe factors are specified in a manner consistent with the behaviour to be explained in terms of time, target, and context (Fazio and Olson, 2003; cited in Wixom, B. H. and Todd, P.A., 2005 ). Attitude, which is constructed in TAM, represents attitude towards the behaviour of using technology.
Over the last decades, technology acceptance has included a large number of empirical test, comparisons and model variations. As figure 3.3 illustrates, three primary ways to provide greater understanding and explanatory power and additional points of managerial leverage in its application (Wixom, B. H. and Todd, P.A., 2005). First approach involves introducing factors from related models, such as subjective norm, perceived behavioural control, and self efficacy (Mathieson et al., 2001). Second approach involves introducing additional or related alternative belief factors to the model. Often times, this contains adding key related factors from the diffusion of innovation literature, such as compatibility, visibility, or result demonstrability (Plouffe et al., 2001). A third approach examines external variables, which are antecedents to or that moderate the influence of ease of use and usefulness within the TAM, such as personality traits and demographic characteristics (Venkatesh and Morris, 2000).

3.3.2 Critique
Regardless of numerous research activities, only few studies of technology acceptance model have looked explicitly at the role of system characteristics as previous circumstances to ease of use or usefulness (Davis 1993, Lim and Benbasat 2000). According to Wixom, B. H. and Todd, P.A. (2005), for the most part, these research studies have treated system characteristics at a holistic level or have looked at a limited number of features. Their results show mixed effects with only relevance influencing both usefulness and ease of use. Venkatesh et al. (2003) stress the need to extend this literature by explicitly considering system and information characteristics and the way in which the might influence the core beliefs in TAM, and might indirectly shape system usage (cited in, Wixom, B. H. and Todd, P.A., 2005).

3.3.3 Contribution for thesis
As we said above our thesis purpose is to find out how software project management tools can affect efficiency in software projects this theoretical framework will provide us with necessary information about human recourses respond and acceptance toward new technology or new system while developing software projects.

3.4 Software Project Management
According to Bennatan (1995) the software project management provided together with methods, procedures, and tools need to make software development more successfully. It has to be done on time, within the budget and according to requirements. For easing pains and distresses given by complexity of software development, software project managers have explored many techniques to improve software maintainability and development. One of the techniques that we are going to use in this thesis to fulfil our purpose is Agile methodology (SRUM method).
3.4.1 Software Development throughout Agile Methodology (SCRUM Method)

Figure 3. 3 Agile Methodology (SCRUM method).

There have been many cases when software development projects are over schedule, do not meet user needs and often over budget (Lamsweered, 2000). The most important issues are associated with people related problems. Agile philosophy was introduced with an associated portfolio of Agile methods, in order to address this problems. Agile methodology is specifically designed to improve software development project team management (Sutharshan, 2011).

Since the creation of Agile Manifesto in 2001, several Agile Software development methods have come into practice (Albrahamsson et. al., 2003). One method that was developed and that we are using in this Bachelor Thesis is SCRUM Method.

According to Vlaanderen et. al., 2011 “strong points of such method are that by employing it, the development process becomes more responsive to a changing environment, working software is chosen over extensive documentation, individuals and interactions are considered more important than tools and processes, and customer collaboration is valued more than contract negotiation.”

Companies that have adopted SCRUM method into practice range from small companies to large multinationals (Fitzgerald at al., 2006). Many research have shown that use of SCRUM method within the company lead to significant benefits, and that its use is not limited to local projects (Mann, C., Mauer. F. 2005, Danait, A. 2005).

3.4.1.1 SCRUM in Software Project Management

Due to SCRUM success, request for the extension of agile principles to other domains has risen. One such a domain is Software Project Management (SPM). According to Elbert (2007) original area of project management can be defined as “the discipline and role, which governs a project from its inception to the market/customer delivery in order to generate biggest possible value to the business.” SPM is then “the process of managing requirements, defining releases, and defining products in a context in a context where many internal and external stakeholders are involved” (Gorchel, 2000).
Schwaber in 1995 proposed SCRUM development method, and at the time when SCRUM method became clear to majority of professionals that the development of software projects is complex process with large range of stakeholders, long list of requirements and fast changing environment. Software was not something that could be panned, estimated and completed successfully using the “heavy” methods (Vlaanderen et al., 2010). Pittman (1996) and Booch (1995) work was based on SCRUM method, and holds on to principles of agile software development.

According to Vlaanderen et al. (2010) “central to SCRUM is the idea that many of the processes during development cannot be predicted. It therefore addresses software development in a flexible way.” There are only two parts that are fully defined during a software development project; the first and the last steps of the project (planning and closure) (Vlaanderen et al., 2010). “In between, the final product is developed by several teams in a series of flexibility black boxes called ‘Sprints’.” According to Vlaanderen et al. (2010) during these ‘Sprints’ no new requirements can be introduced, since it guarantees that the final product is being developed with a high probability of success, even with a rapidly changing environment. This environment, which contains parts such as competition, financial pressure and time, maintains its influence on development until the closure phase (Vlaanderen et al., 2010).

One of the most important instrument in a SCRUM process is backlog. There are few backlogs that play a part in SCRUM development.

- **Product Backlog (PB)** as Schwaber 1995 described “is the central to the SCRUM method. The PB contains a prioritized list of all items relevant to a specific product. This list can consist of bugs, customer requested enhancements, competitive product functionality, competitive edge functionality and technology upgrades.” Once all the requirements have been completely specified, with developers’ approval, the requirements can be copied from product backlog onto the development sprint backlog.

- **Development Sprint Backlog (DSB)** every team that is participating in software development project maintains its own DSB. Every requirement that is allocated to the development team at the beginning of a sprint is placed on their DSB. All requirements are decomposed into several tasks, which are then assigned to specific team – members (Vlaanderen et. al. 2010), “The Development Sprint Backlog is fed by the product backlog with items that have been fully specified” (Vlaanderen et. al. 2010).

The development of software projects with large number of developers requires a steady flow of elicited product requirements. According to Vlaanderen et al. (2010) “without this steady flow of requirements, software vendors run the risk of delaying new software releases and bad code due to badly specified requirements, all resulting in the waste of large amounts of resources.” To keep away from these problems, functioning team of product managers is required, that can, cooperatively with the development team, supply approved and well – defined requirements (Vlaanderen et. al. 2010).

SPM method applies SCRUM method to maintain a balanced flow of new requirements for the DSB. According to Vlaanderen et. al. (2010) “furthermore, agile SPM enables a software vendor to flexibly define requirements according to a pre – defined procedure. The pre –defined procedure forces a software vendor to explicitly manage the lifecycle of a re-
quirement, leading to better – defined requirements. Simultaneously, the process remains agile, i.e., some requirements can be defined and implemented quickly, while others move through their lifecycle at a regular pace” (Vlaanderen et. al. 2010).

3.4.1.2 Critique
At the moment, there are little work exist regarding SCRUM SPM. Pichler at al. (2006) described the use of agile requirements engineering. Nevertheless, the research does not provided enough details regarding the agile requirements engineering process. Vahanity and Rautiainen (2008) tried to link long – term product planning and agile development. Greer and Ruhe (2004) elaborate on agile release planning by providing an iterative optimization method. Relationship between development teams and product managers in rapidly changing and challenging environment, such are where no complete requirements are available, is studied by Fricker et al (2010). Mismanagement was identified in all these studies between agile principles and the needs of pre – project activities in market – driven development. Researches state that “differences between agile methods and the needs of market – driven software development may threaten product development by disabling effective product management” (Vlaanderen et al. 2010).

3.4.2 Management Skills for Software Development
Managing software projects is more difficult since it is less measurable, more difficult to estimate, and more dependent on subjective human factors, then other areas of technology development (Bennatan, 1995). Specific management skill and techniques are required when managing software projects:

- Supervision and control. According to Bennatan (1995) “This includes the different management of the development team members and requires constant awareness of the real status of their work on the project”

- Planning. Planning software projects is one of the most crucial management activities and according to Bennatan (1995) it includes the preparation of good estimates, the maintenance of the development schedule and the efficient assignment of personnel.

- Consumer relations. In some software project, one of the major management activities is interaction with consumers. “This includes documenting the customer’s requirements, controlling requirements by the customer, handling the customer’s involvement in the developing process, providing reports and organizing reviews and product decompositions.” (Bennatan, 1995)

- Technical leadership. “Good technical leadership is usually a desirable quality in effective software management. This often requires the ability to provide guidance in the solution of technical problems that arise during project development. It does not mean necessary the provision of the actual solution itself.”
3.4.3 JIRA

JIRA is a product developed by Atlassian Pty Ltd. An Australian-based software company started in 2002 with some of their flagship products within the issues and collaboration software. One of their core products is JIRA, an issues and bug tracking software, it was made to help software developers working together in a team to collaborate and manage a software development process, ranging from creating new tasks, fixing bugs and documentation.

However, over the last several versions, JIRA has evolved not just becoming to an issues and bug tracking tools only, but it has turned into an all-in-one collaboration tools for almost every part of a software project. It supports more features such as native Agile methodology support, reports and analysis, project tracking, etc.

More large enterprises are starting to use JIRA as their center project management tools to be used by their team developers. They use JIRA when they have to develop a new product, add new features or iteration of an existing product.

Atlassian has cleverly built several different plugins and products surrounding JIRA, so they can accommodate and fill in the customer’s needs in Software Project Management. Since JIRA was mainly developed to help software project managers and programmers to organize and manage their software projects better, Atlassian has built several plugins for JIRA that support special needs of software development process. Fisheye, a plugin for JIRA used to connect JIRA with existing versioning tools such as Git or SVN, it allows programmers to see every changes that happens in the source code that they are working on. Confluence, another plugin for JIRA allows programmers to easily publish documentations of their project and share it to public or internal users.

With all the plugins and products supporting JIRA, without a doubt, it has become one of the most versatile and sophisticated software project management tools industry especially when it comes to managing software development project.

3.4.4 Contribution for thesis

This theoretical framework will provide the reader with the knowledge necessary to understand how software projects are created while using Agile methodology (SCRUM method). Moreover, it will present what management skills are needed for developing software project. Also, it will give an insight about our chosen software project management tool JIRA:
4 Empirical Findings

4.1 Introduction

After receiving answered questionnaires from the companies’ we have extracted the empirical data and identified the most relevant information, in order to see trends and patterns within the selected companies.

We have chosen to categorize our empirical data according to three different perspective; Web programmers, project managers and executives (CIO and CTO). We have chosen to categorize in this perspective because even though all three companies are located in different countries, as we stated above we are not taking into account the impact that cultural differences can have on job performance. We believe that by looking from different organizational levels will give us better insights.

As one of the company decided to remain anonymous, we identified respondents of our questionnaire using the position within the company using the following format. For example WP-A stands for Web programmer from company A, PM-B stands for project manager from company B and Exec-C stands for executive from company C.

4.2 Web Programmers

Web programmers translate the requirements of end-users and internal clients into functional product, in other words a programmer know how to make a computer do what people want it to do. Usually, that product is an application which allows an end-user to do something on the Web, for example order pizza, make a stock trade, or buy an airline ticket (The Princeton Review, INC, 2011). We have chosen to send questionnaire to Web programmers because they have daily interactions with JIRA software and also they are the most effected level of employees when it comes to changing software project technique. In essence they are the actual JIRA users.

4.2.1 Empirical Findings from Web Programmers

According to Web programmers from all three companies, the most important aspect when creating new software project for them is scope. A web programmer from company A told us that “Scope is very important for us to produce a high quality product in a limited time span. However, if necessary, we are willing to extend the development period to make sure that our work does not go below standard requirements set by a customer”. We believe, creating a product, codes or program is a handcrafted product. It requires detailed attention and effort to create something that will satisfy the requirements. So, the programmers have to concentrate and make sure that the scope/quality of their work is either approvable or excellent.

Web programmers stated that before implementing JIRA it took longer period of time to finish the product. WP-B stated that “before JIRA a single website or web application can range between 2-3 weeks to 3-4 months to complete. That also depends on the number of people working on the project. A single website can be done by 1 web designer and 1 web programmer, meanwhile a web application needs 2 designers, 4-5 programmers, 1 tester somewhere along that number”, while WP-B said that “with JIRA, we are able to cut down the amount of misunderstandings and able to communicate better through the internal collaboration tools, that really cuts down the amount of delays from a project”. Same situation
also happens with WP-C stated that “after implementation of JIRA, we are able to cut down the development of a single website to 1-2 weeks only and web application to 2 weeks – 3 months.”

All three companies’ Web programmers assured that after implementation of JIRA software not only the quality of projects increased but also it improved communication between employees within the project. “Before JIRA we exchanged information only through emails and online chats, but after JIRA was implemented it gave us to use JIRA’s internal collaboration tools, we are able to share files of a project easily. We are also able to check and review our codes between programmers directly through JIRA, by using one of JIRA’s Plug-in called Fisheyes. We are able to see what other people have done and their comments on the work that they did” as answered by WP-B.

All three companies have had backlogs before implementing JIRA software, but according to Web programmers after JIRA implementation and after they got used to work with it, companies stop having backlogs related to unclear project management. As mentioned by WP-C, “Yes we have had backlogs and it was because of the assigned person of the tasks, got behind on the project, so sometimes, other programmers have to wait for the other person’s jobs to be done before they can start and they have no idea on the progress of the person’s work”. WP-A also mentioned “There where backlogs and after implementation of JIRA but just in the beginning of implementing/switching to JIRA. Mainly due to getting used to of using a single project management tools and changing our habit”.

When we asked if there were any resistance between Web programmers when company decided to implement JIRA software, within all three companies’ WP-C stated that “there were no resistance we were just following the company’s strategic decision to use JIRA”. Trainings and time spent on implementing JIRA within all three companies were almost the same, according to WP-A “we just did conference meeting on learning JIRA and read the tutorials they have on their company website. We spent around 2-3 days on the beginning of the implementation to learn it and another 2-3 weeks to get used to it and start putting everything into JIRA”.

4.2.2 Significant Differences Between the Companies

Even though all three companies have been using JIRA differently, from 1 to 2 years, in the beginning in all three companies’ Web programmers had similar problems “The main problem was the difficulty of its User Interface and getting used to putting everything into JIRA and do your reporting there. It requires certain amount of discipline” WP-B. One of the biggest different within those three companies Web programmers was adjusting to the system. Company’s A Web programmer stated “it took as only several weeks to adjust it.” Meanwhile Company’s B and Company’s C Web programmers had more difficulty and it took them over few months to adjust the new system “it was quite difficult to adjust to the system, and it took as two months.” In spite of that, Company’s B and Company’s C Web programmers had more difficulty to adjust to the system, all three companies’ stated that “after you get used to JIRA and everyone else is using JIRA then, it is easier to do software projects” WP-C.

4.3 Project managers

As we have stated above, when it comes to software project managers they have to have specific skills in creating new software project. They also need to have previous experience
or already been involved in software development on the coding level for several years prior to their managerial position. The reason for this is that to measure software projects is more difficult if we do not have feedback from the people who are using it to manage their actual projects. We have sent our questionnaire for project managers in order to find out how JIRA affects their work and how it contributes for company from managers’ perspective.

4.3.1 Empirical Findings from Project Managers

Managers from selected companies stated that from their perspective most important aspect when it comes to create new software project is scope and time. Project Manager from company A replied “mainly scope and time. We always strive to put our customer satisfaction on every job that we do, we never want to deliver a product or a result half done. The stressing would be mainly on the Quality of the product and after that would be the time or the length of the project. As usually we have several projects at the same time, so, resources allocation is really important for us”.

Project Managers also stated that before implementation of JIRA there were several factors influencing projects time. “well it depends on several factors, such as the number of people working on the project, the geographical location of the team members, the difficulty level of the project, time and costs needed to develop the project and the materials from the client also can be a big problem” PM-A. “resources allocation has been the main problem on every project, if we have enough people to work on the project or not and the location of team members also contribute on the speed of the project” PM-B. “when everyone works together on the same place, then it could be faster, as the communication between team members is easy. I would say anywhere between 1 – 2 weeks for a website if everything goes well and 2 – 3 weeks if we have some delays, while for web application can be anywhere from 1 – 2 months to 3 – 6 months” PM-C. After JIRA was implemented project managers assured that to finish projects is much faster “After we started using JIRA, we are able to manage our resources way much better. Everyone knows what to do and what their tasks are. Also, we can monitor the progress of each person’s work. Let’s say from 2 – 3 weeks we can cut down a week’s work and coordination meeting from that and web application we can cut down 1 – 2 months due to better collaboration” PM-A.

When we asked about spending on projects project managers did not want to share the information but they said “we can say that it was more expensive before we implemented JIRA” as mentioned by PM-C. As PM-B replied “mainly due to the bad resources allocation, so we wasted our already limited human resources on a project when it could have used less human resources”. PM-A told us when it comes to initial investment cost that they have to spend “we already invested in the beginning on hardware and software and our external consultants or temp workers they use their own tools, so it was not such a problem for us”. “As we are able to manage our resources better, we are able to cut down the number of people working on a project and make it faster, which already cut down our operational expenses and also provide better customer service by delivering the product faster than our estimated timeline. So it definitely helps us on retaining our customer satisfaction level to where we want it” PM-C. “We are able to cut down personnel and unnecessary spending; after JIRA was implemented we are able to produce products in better quality” PM-B.
Project managers as well as Web programmers said that after JIRA was implemented quality of the project has increased. JIRA also helps with communication between employees “before we had JIRA information was exchanged only through emails and online chats” as said by PM-A, he also mentioned “after JIRA communication had changed. Through JIRA internal collaboration tools, we are able to share files of a project easily. We are also able to check and review our codes between programmers directly through JIRA, by using one of JIRA’s Plug-in called Fisheyes. We are able to see what other people have done and their comments on the work that they did”.

When we asked about backlogs manager stated that with JIRA companies still has them but not as many as without JIRA. “Before implementing JIRA there were a lot of reasons why we had backlogs, from coordination problems, to tasks distribution problem, resource allocation problems, etc. PM-B. “After we got JIRA in the beginning we had backlogs and it was because of our programmers have to get used to the JIRA system and we have to change our culture or working habit to adjust with JIRA’s workflow. But after that, it was mainly because of the progress from a certain person got delayed so if it’s interconnected with other tasks, the other person has to wait until that task is done” PM-A.

According to all of the project managers mainly they spent several days on getting to know JIRA and a lot more time on getting used to it. PM-B said, “We spent around 2-3 days on the beginning of the implementation to learn it and another 2-3 weeks to get used to it and start putting everything into JIRA”. Project Manager from company C stated that “we just did conference meeting on learning JIRA and read the tutorials they have on their company website.” When project managers decided to implement JIRA, they stated that “there were no resistance from Web programmers; they were following company’s strategy” PM-A.

Managers also said that after JIRA was implemented it is easier for them to keep track on a project and also in the beginning of the project they can assign resources more accurate so they do not waste any resources in a project. With JIRA it is easier to find out what needs to be done, make the strategy and split up the tasks to your available resources. The biggest problems project managers faced was how it is difficult to use JIRA, PM-A stated that “difficulty of JIRA’s User Interface and getting used to putting everything into JIRA and do your reporting there. It requires certain amount of discipline”.

### 4.3.2 Significant Differences Between the Companies

The project managers have to manage different projects, each company have their own case, environment, human resources and budget plan. Also they have to manage the projects in their own working culture, habits and culture of the people that they work with.

The numbers of resources that each project manager has are also different from each other, along with the load or amount of work they have to do. However, we actually got very similar answers from all three of them. As we mentioned before in our delimitation section 1.5 that “cultural differences do not impact on project accomplishment” Kruyt, Malan and Tuffield (2011).

### 4.4 Executives (CIO and CTO)

Apart from project managers and actual web developers, we also went to the management level of the companies in this case the CIOs and CTOs were asked the same questions as we gave to the others. These people are the actual decision makers and responsible for all of the strategic of the company’s technology department, their job mainly is to provide the Information Technology infrastructure to support the company’s goals.
4.4.1 Empirical Findings from Executives (CIO and CTO)

The responds that we were hoping was more about the actual effects of JIRA implementation to the company’s performance. Exec-A answered “after we implemented JIRA, we were able to cut down costs on the number of human resources allocated into a project, for an example from one of our recent projects, we were able to reduce from 5 people working specifically on a case, to 3 people only after we use JIRA” another interesting respond was that, the company are now able to set certain position level to work on several projects at the same time. Since they are now able to split up the tasks more easily on JIRA and they are now able to arrange the tasks so they can work on another project while waiting for the result of the other project Exec-B.

When we asked if it is easier to do software project with JIRA, Exec-A responded “we find it now it is way much easier for us to manage the projects through JIRA, we are able to monitor the progress of each project down to the tasks. Something that was a painstaking effort previously”. Another Exec-B are also pleased by the features inside JIRA that allows them to monitor the progress of every project that they are currently working on. Something that they had to do manually by asking the Person In Charge (PIC) of the project, he responded “previously, we had to ask the person who’s in charge of the project or as all of the project members or have a daily meeting just to get updates. Now, I can just look at it online” Exec-B.

Executives are also satisfied with the performance of the company after JIRA implemented. Customer satisfaction when it comes to speed of the delivery has improved a lot. Thus, although not yet proven, their customers are satisfied and expected to conduct more businesses with them.

Another question that we asked was if JIRA make their job easier when creating new software projects. An Exec from company C mentioned “when we achieved a contractual deal with our client, we are able to plan out the project, find out the requirements and all other necessary preparations, then we just upload them on JIRA along with the new project creation and assign people on each project. So much better organized.” While Exec-B mentioned “Customers are very satisfied and choose us instead of our competitors.”.

JIRA implementation is not something that you just install and start using without changing the way you work. With JIRA, companies are required to change or adapt their way of doing software projects into a more standardized way. The three companies had to re-educate their workers and introduce them to JIRA. Exec-C said “we had to spend couple hours a day for 3 days in the conference room just to learn about JIRA, not to mention another couple of weeks until we got used to it”. Similar situations also happened with the other two companies.

As for return of investmen all three companies’ executives have similar responds to what Exec-A stated that “JIRA cost is relatively small when it come to total spending of the company and even though we do not do return of investment we can already feel and see from our productivity that implementation of JIRA is successful and worth having in the company”.

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4.4.2 Significant Differences Between the Companies

The main differences that we found out in the level are the implementation and maintenance costs of JIRA that varies. In company B and C, they only need the relatively not expensive JIRA license for just about $10 for 10 users license (JIRA’s limited charity promo pricing plan), while on company C, since they have more than 10 users, they have to purchase different pricing plan which costs at least $1200 for 25 users license. The difference in the costs shows a huge gap here. However, since they put JIRA as one of their investment costs, so none of them complained about the license cost.
5 Analysis

5.1 Introduction

As we based our empirical findings chapter from different level of employee’s perspectives, we decided to divide this chapter from theoretical framework perspective. Firstly we will discuss Iron/Golden Triangle (presented in section 3.1). We will take theory and apply it together with empirical findings to find out if using software project management tool ‘JIRA’ can affect project quality, safe money and time for company when creating new software projects.

In the second part of the analysis we will discuss the Productivity Paradox (presented in section 3.2) and how project managers and executives could prevent it from happening in their companies, and if Productivity Paradox accure in their companies, what measures to take for it to stop.

Third part of analysis will be examined how selected companies implements new technology in their organization, what methods they use, and together with theory we will provide thorough analysis of Technology Acceptance Model (presented in section 3.3).

5.2 Analysis of Iron/Golden Triangle

According to many researchers (Gardoner and Stewart, 2000; Atkinson, 1999) with Iron/Golden Triangle it is possible to measure software’s project efficiency, which refers to money, time and scope. All three sides depends on each other, if one is affected then at least one other side is equally affected.

Respondents of a questionnaire stated that ‘money focus’ is rarely a factor when it comes to creating new software project. According Morris et al. (2008) if companies have unlimited budget then they can use more expensive resources, increase scope cycles, and have more testing. However, every studied company wants to reduce spending, even though, they have unlimited budget. This is why companies that we have been questioned stated that software project management tool ‘JIRA’ was implemented. Although we have not received exact number of money they have saved but project managers stated that after implementation of JIRA it is cheaper to create a new software project then it was before JIRA. “We can say that it was more expensive than before we implemented JIRA, mainly due to the bad resources allocation, so we wasted our already limited human resources on a project when it could have used less human resources.”

All three companies’ project managers stated that time is one of the crucial aspect when it comes to create new software project “Mainly score and time. We always strive to put our customer satisfaction on every job that we do”. According to Morris et al. (2008) if project have a deadline, then the project managers could assign more resources to the project cost, hire more people or to improve communication between employees within the project. JIRA come in handy in this case too. Project managers said that implementation of JIRA not only cut down time to produce new project, but also increased communication between employees “after implementation of JIRA we can cut down a week’s work and coordination meeting from that and web application we can cut down 1 – 2 months due to better collaboration, “before we had JIRA, information was exchanged only through emails and online chats after we started using JIRA, we are able to manage our resources way much better. Everyone knows what to do and what their tasks are. Also, we can monitor the progress of each person’s work.” However, for all three companies it was not necessary
to hire extra personnel because, with JIRA, and a number of employees that companies have it was possible to finish project on time as stated in section 4.4.1.

All three companies’ Web programmers, project managers and executives stated that ‘scope focus’ is most important when it comes to create new software project (stated in section 4.2.1). According to Morris et al., (2008) scope affects both other sides of the triangle (time, money). Due to fact that quality is most important for companies it takes more time to produce new software project, therefore it increases the cost and time. In current case we can argue that even though theory states that it takes longer time to produce new software project and companies has to spent more money on the project, to get better quality, it is not applicable for this case. As respondents said implementation of JIRA not only increased the quality of the product, but also as we stated above in section 4.2.1 and 4.3.1 decreased spending and shortened time to produce it. On the other hand we can say that theory was applicable in current case before implementation of JIRA, as respondents stated, before JIRA it took them longer to communicate between each other, allocate resources, split the tasks, therefore there were backlogs, which affected time and money (presented in section 4.2.1 and 4.3.1).

After analysing software project management tool’s ‘JIRA’ efficiency with Iron/Golden Triangle we can state that JIRA increases the quality of the product, helps companies to communicate between employees which affects time focus, and cuts down spending’s when it comes to create new software project.

5.3 Analysis of Productivity Paradox

As Kemer and Sosa stated there are major success stories about how company’s benefits from implemented hardware or software into their business, but there are also equally impressive failures. In order to benefit from the information technology and not to have productivity paradox companies have to take some action.

Brynjolfsson (1993) suggested that miss-measurement of outputs and inputs, for example quality of the product after IT investments, variety, customer service, speed and responsiveness can lead to systematic underestimation of IT productivity.

In current case all three companies said that JIRA had improved not only quality of their product but also customer satisfaction, presented in section 4.4.1. As long as it comes to miss-measurement our sampled companies are doing quite well. Executives of the companies have stated that after implementation of the company, they become more faster to produce the product, without any drawbacks, “were able to cut down costs on the number of human resources allocated into a project, and faster to produce new product which increases customer satisfaction and they are willing to conduct more business with us.”

Other suggestion was made by Gurbaxani et al. (1991) why productivity paradox might exist in the company is “lags due to learning and adjustment.” Gurbaxani et al. stated that even though IT investments do not show improvements or benefits immediately it might take several years for them to show. There are many examples when it took more than two to three years before impacts of IT’s investment were felt.

When it comes to present case it is hard to state whether implementation of software project management tool JIRA had already paid off. All three companies have been having JIRA for different time period. Company C has JIRA for two years but since it is bigger
company they have to pay every year 1200$ in fees. Other two companies A and B has JIRA one year, but they are relatively small (10 people) so they pay 10$ fee every year due to the special discount program from Atlassian. When we asked executives (CIO and CTO) of the companies if they are doing return of investment (ROI) they have stated that since the cost of JIRA is rather small, it does not worth to do return of investment. They also have stated that “even though we do not do return of investment we can already feel and see from our productivity that implementation of JIRA is successful and worth having in the company.”

Brynjolfsson (1993) emphasised one more aspect of productivity paradox which is “redistribution and dissipation of profits”. He stated that “IT may be beneficial to individual firms, but unproductive from the standpoint of the industry as a whole or the economy as a whole.”

Since our research sampling is comparatively small we cannot state that implementation of JIRA can be beneficial for all the companies. But we can state that in current case all three individual firms that we have been questioned, do benefit and gain competitive advantage of using JIRA as stated in the section 4.4.1.

Other researchers Baily and Chakrabarti, (1998) gave other reason why productivity paradox might happen within the company, they stated that “IT may be used to the firm while adding nothing to total output.”

In present case we can argue with their statement, as companies stated output after implementation of JIRA has increased significantly, “we are able to cut down personnel and unnecessary expenditure after JIRA was implemented we are able to produce products in better quality.”

Roach (1989) suggested that manufacturing industry had made better use of IT than service sector. However in current case we can argue with this statement, for the reason that after implementation of JIRA it is not only faster to produce new software project but also it increases customer service. Our selected companies’ executives stated that “after JIRA speed of the delivery has improved a lot. Thus, their customers are satisfied and expected to conduct more businesses with them.”

After analysing all three selected companies we can state that at their companies’ productivity paradox does not exist. Executives stated that outcomes of JIRA are noteworthy and positive. Spending of using JIRA is equivalent to beneficial gains. One of the biggest drawbacks in current case is that companies have JIRA for short time of period, and it is impossible to state if they will not have any future problems when it comes to productivity paradox.

5.4 Analysis of Technology Acceptance Model

Apart from all the benefits and disadvantages of new technology implementation into a company, it may or may not affect the production output of the company, thus it has direct effect on the company’s performance, time, money or scope. We also have to keep in mind the responds of the actual users of the new technology; do users or employees accept the new technology? Are there any resistance? Does it make their job easier and make them produce better quality work?

The Technology Acceptance Model (TAM) is a model that shows and research on how users are able to accept and use a technology. When employees are introduced with new
technology that will directly change their current way of work, their way of doing things, there are several factors that influence their decision on whether accepting the new technology or not and how to use it.

What TAM does, it take into consideration the human acceptance factors toward new technology where its implementation can be influenced by different factors, external factors for example. A company has to keep up with the current updates of the market and trends. They need to keep their competitive advantages in the market to stay on top or to keep up with the market leader.

Ever since the early 70’s technology acceptance into industries and businesses have grown beyond believe, to where it stands right now, becoming un-separable ingredients in our daily life. During those times, new technologies keep on being introduced and invented and during those times also, people have to learn to adapt and change their behaviour to use the new modern techniques.

Information Technology has without any doubts become a key factor in a success of modern companies. Despite all of the previous research on the productivity paradox, we believe in current fast pace technology world, basically, there are no other choices for companies but to comply with the new norm.

Due to such situation, companies have to keep up their awareness with new trends and technologies that will increase their productivities, keep their competitiveness and ease effort in accomplishing their job. Managers and CIOs are the people who are responsible with these strategically decisions in a company. They decide the usage and implementation of new technology into the company’s way of work and their culture. As mentioned in section 4.2.1 that the programmers have no problem with following the decision to use JIRA following the company’s policy.

Often, decision makers find difficulties and problems when they believe that a reform through technology will result in positive output for the company, however, they may find resistance and rejection from the actual users to change their previous way of work.

TAM model tries to assess these factors of acceptance of a system through some of their important components, such as, Perceived Usefulness (PU), “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis 1989). In our three companies, the top decision makers are the ones who make the decision of using JIRA as one of their main component in doing their job. In these companies, JIRA has changed their already built culture and replace it with a new way of doing things, the JIRA way.

Another important component in the TAM theory is the Perceive Ease-of-Use (PEOU), where users believe that by using the new system, it will make their life much easier and
help them with their job. Communicating this idea to the users by managers is a challenge of itself. Users have to be educated about the benefits of the newly implemented practices. That is why, all of the companies invested in effort and time to educate their employees on learning how to use JIRA and what is it all about. For one company, it took them only couple of days in introducing JIRA to the people. However it took them way much longer in getting used to JIRA ways of managing projects. We can see it from section 4.2.1 that the programmers had to spend couple of days to learn about JIRA and ranging from a week to couple months to get used to the new system.

A company with all its internal operations and processes have learned and setup their own way of working. Changing a work habit in a company can be proven very difficult. Due to the size of the companies we talked to, less than 100 people. They all have no problems in enforcing the usage of JIRA into their development department. In a structured company where hierarchy is already clearly defined, putting down orders to the sub-ordinates becomes easier, depending on the size or number of people underneath.

Our featured companies already have clear structure and small in size, they were able to tell the workers to start using JIRA and they found little or no resistance. The level of education of the workers in their fields mainly has helped them to understand the benefits and usage of JIRA in helping their work.

Once the users already understand and accept the implementation, they have created their own decision of intending to use the new system, try it and find it out by themselves. Such behaviour in the end will lead to another important component, which is their attitude toward using the new system.

Even though, it took the companies longer time than they have initially expected to get the programmers get used to the new system, they were ultimately able to get a grasp of the ideas and use JIRA to its full potential. Time, here is of the essence in letting the users to use it and give them space to get to know it better.
6 Conclusion

To conclude the results of the study we want to address the research question and the purpose set in the beginning of the research. The aim was to identify whether the use of software project management tools makes the management of software projects more efficient (in terms of time, human and financial resources).

After analyzing the data gathered from various companies engaging in software product development in terms of various theories gathered throughout the literature study, we have been able to answer the initially set research question.

Implementing JIRA has in all cases resulted in increased product quality, more efficient and faster communication, as well as lower product development costs. This means that implementing JIRA can be beneficial for time, money and quality of software development.

Another aspect the study analysed concerns whether the companies perceive and make assessments on how beneficial implementing JIRA is. This was analysed in terms of productivity paradox literature. The results show that all three researched companies’ productivity paradox does not exist and the expenditures of using JIRA are equivalent to benefits gained.

Nonetheless that JIRA is time, money and scope efficient the companies have had difficulties in the initial stages of implementation. The research results show that difficulties occur throughout the employee training. It takes time to get used to the new systems and use of the software, however once the skills are gained and the concepts of use understood, the system is used in an efficient and productive way.
7 Discussion

Even though research about software project management tools efficiency is relatively new and there are not that many previous studies made, but it is rapidly growing concept. The study has shows that the implementation of JIRA is perceived to be useful in cutting down the time, financial and human resources used on software project development. However the study at hand has a rather small sample size which means that the results can not be claimed to apply universally to other organizations working with software project management.

The study has also had a few difficulties with actually measuring the extent of efficiency increase after JIRA implementation. This could be because the companies themselves often have no tools or chose not to measure the ROI of software project management tools numerically (exact hours spent, money saved etc.). Conducting a very statistical comparison including exact numbers may have been very interesting for the validity of study results, however given the lack of information available not only for external but for internal praties such approach was not possible.

Nonetheless as mentioned above the research base for software project management tools implementation to increase the efficiency of the software development performance is very small. We believe that for this reason the research results are valuable as a stepping stone for further research. There study at hand has a rather focused and hence somewhat limited scope, which only includes how project management tools can affect the efficiency in a software development project (measured by time, from project start to finish, human and financial resources). Other factors such as cultural differences, resources availability, company size and other factors may have influence of the implementation process and the effectiveness of implementing software project management tool, which are potentially interesting factors to be researched in following studies.
References


Appendix 1

Questionnaire for Web programmers

1. When creating new software project which aspect is most important for your company?
   - Time
   - Money
   - Scope (product quality)
   - Other

2. Before implementing JIRA software in average how long did it take to finish new software project?

3. After JIRA implementation in average how long does it take to finish new software project?

4. Did JIRA improved communication between employees within software projects? If Yes how?
   - NO
   - YES

5. How long do you have JIRA?

6. Have you ever had backlogs before implementing JIRA? If yes what was the reason
   - NO
   - YES

7. Have you ever had backlogs after implementing JIRA? If yes what was the problem?
   - NO
   - YES

8. How much time have you spent on implementing JIRA and getting to use it?
9. What training program did your company used to train you to use JIRA?

10. How long did it take?

11. Where there any resistance between Web Developers? If YES what technique your employer used to explain that JIRA well be more beneficial for your company?
   - NO
   - YES

12. What problems did you faced with JIRA program?

13. How long did you take to adjust working with JIRA?

14. In your opinion is it easier to do software project with JIRA?

15. In your opinion does JIRA make your work easier when creating new software project?

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**Appendix 2**

. Questionnaire for Project Managers

1. When creating new software project which aspect is most important for your company?
   - Time
   - Money
   - Scope (product quality)
   - Other

2. Before implementing JIRA software in average how long did it take to finish new software project?

3. Before implementing JIRA software in average how much money did your company spent on a new software project (including salaries of employees, software expenses and other related spending)

4. After JIRA implementation in average how long does it take to finish new software project?

5. After JIRA implementation in average how much money does your company spent on a new software project (including JIRA maintenance fee, salaries, software expenses and other related spending)?
6. After implementing JIRA did quality of new software project changed?
   • Increased
   • Decreased
   • Did not changed

7. What methods of communication between employees within software project did you have before JIRA?

8. Did JIRA improved communication between employees within software projects? If Yes how?
   • NO
   • YES

9. How long do you have JIRA?

10. Have you ever had backlogs before implementing JIRA? If yes what was the reason
    • NO
    • YES

11. Have you ever had backlogs after implementing JIRA? If yes what was the problem?
    • NO
    • YES

12. How much do you spent on JIRA maintenance every month?

13. How much time have you spent on implementing JIRA and getting to use it?

14. What training program did you used to train your employees to get used JIRA?

15. How long did it take?

16. Where there any resistance between employees or project managers? If YES what technique your employer used to explain that JIRA well be more beneficial for your company?
    • NO
    • YES
17. What problems did you faced with JIRA program?

18. How long did you take to adjust working with JIRA?

19. In your opinion is it easier to do software project with JIRA?

20. In your opinion does JIRA make your work easier when creating new software project?

**Appendix 3**

Questionnaire for Executives
1. When creating new software project which aspect is most important for your company?
   - Time
   - Money
   - Scope (product quality)
   - Other

2. Before implementing JIRA software in average how long did it take to finish new software project?

3. Before implementing JIRA software in average how much money did your company spent on a new software project (including salaries of employees, software expenses and other related spending)

4. After JIRA implementation in average how long does it take to finish new software project?

5. After JIRA implementation in average how much money does your company spent on a new software project (including JIRA maintenance fee, salaries, software expenses and other related spending)?

6. After implementing JIRA did quality of new software project changed?
   - Increased
   - Decreased
   - Did not changed

7. What methods of communication between employees within software project did you have before JIRA?
8. Did JIRA improved communication between employees within software projects? If Yes how?
   - NO
   - YES

9. How long do you have JIRA?

10. Have you ever had backlogs before implementing JIRA? If yes what was the reason?
    - NO
    - YES

11. Have you ever had backlogs after implementing JIRA? If yes what was the problem?
    - NO
    - YES

12. How much do you spent on JIRA maintenance every month?

13. How much time have you spent on implementing JIRA and getting to use it?

14. What training program did you used to train your employees to get used JIRA?

15. How long did it take?

16. Where there any resistance between employees or project managers? If YES what technique your employer used to explain that JIRA well be more beneficial for your company?
    - NO
    - YES

17. What problems did you faced with JIRA program?

18. How long did you take to adjust working with JIRA?

19. In your opinion is it easier to do software project with JIRA?

20. In your opinion does JIRA make your work easier when creating new software project?

21. Do you do Return of Investments?

22. What are the outcomes from JIRA?