POLITECNICO DI MILANO

School of Civil, Environmental and Land Management Engineering

MSc Civil Engineering

**How Agile Project Management Approach Is Redesigning The Project Management Software
(Focus on the Construction Industry)**

Thesis Supervisor: Prof. Fabrizio Tellarini

Author: Ing. Jozef Pemaj
ID Number: 10777838
Matriculation Number: 969438

Academic Year: 2022-2023

Dedicated to my Family. The tradition goes on!

Acknowledgement

I would like to thank all the people who have supported and encouraged me during the process of writing this thesis. I'm grateful for the time and effort that the employees of Politecnico di Milano have given me. Their sharing of knowledge, experiences within the field and their willingness to share their thought and willingness with me has been central for conducting this thesis and inspired me to engage in this thesis further.

I would like to thank Professor Fabrizio Tellarini, my supervisor, who has been the main source of motivation for conducting this thesis. I'm grateful to him for the valuable support, guidance, and advice throughout this thesis. He was very kind and provided access to case company employees and was always there whenever I had any concerns or questions. He believed in me and helped me to stay focused throughout the thesis writing process.

In addition, I extend my heartfelt gratitude to two prominent construction companies in Milan for their generous support and collaboration during my research. Their willingness to share their wealth of expertise and insights through interviews has been a cornerstone in enriching the depth and quality of this thesis. These invaluable contributions have played a pivotal role in shaping the research findings and conclusions presented here.

Finally, I would like to acknowledge my family who tried to provide the best possible educational opportunity and their constant support through my academic years. Without these wonderful people this couldn't have managed to complete my dissertation.

A big "THANK YOU" to all of you

Abstract

Agile project management has emerged as a popular approach for managing projects that require frequent changes or updates. As a result, project management software has had to evolve to meet the needs of Agile teams. This thesis explores the ways in which Agile project management is redesigning project management software. Specifically, it examines the new features and functionalities that have been introduced to support Agile methodologies, including Agile boards, collaboration tools, integration with development tools, and customizable workflows. In addition to exploring Agile project management's impact on software design, this thesis delves into its application within the construction industry, conducting in-depth research on the fundamental tools employed in this sector. Additionally, we provide a comprehensive understanding of two prominent construction companies by conducting insightful interviews and scrutinizing their daily operations and project management strategies. This exploration not only sheds light on the practical application of Agile methodologies but also offers valuable insights into the dynamic and evolving landscape of the construction industry.

The thesis also explores the benefits and challenges of using Agile project management software, as well as the future of Agile methodologies and their impact on project management software. To gather data, a literature review and interviews with software developers, project managers, and Agile coaches were conducted. The findings suggest that Agile project management has had a significant impact on the design of project management software, with a greater emphasis on collaboration, flexibility, and customization to support dynamic and iterative development processes. The thesis concludes with recommendations for future research in this area and implications.

Table of Contents

List of Figures

Introduction

Project management has been a critical element in the success of various organizations across different industries. The need to efficiently manage resources, deliver quality results within budget, and on time has become paramount in today's competitive business environment. Traditional project management approaches, which were primarily focused on predictability, documentation, and control, have been found wanting in delivering results on complex projects with poorly defined requirements. In recent years, Agile methods have gained traction in project management, promising to provide a more flexible and iterative approach to delivering results.

The Agile movement, which started in 2001, is a response to the shortcomings of traditional project management approaches. Agile methods aim to provide a more responsive approach to project management, with a focus on customer collaboration, flexibility, and iterative development. Agile methods have been adopted in various industries, including software development, engineering, and manufacturing, to name a few.

The use of Agile methods in software development has been particularly widespread, with Agile software development methodologies becoming increasingly popular in recent years. Agile software development methodologies, such as Scrum and Kanban, have become the go-to approach for software development teams. These methodologies have proven to be effective in delivering results on complex projects with poorly defined requirements.

The success of Agile methods in software development has led to the emergence of Agile project management software, which promises to provide a more flexible and responsive approach to project management. Agile project management software is designed to support Agile project management methodologies, providing features such as Agile boards, Sprint planning, and backlog management.

However, there is still a lack of understanding of the impact of Agile project management software on project management. This is particularly relevant in the context of project management software, which has traditionally been designed to support traditional project management approaches. The purpose of this thesis, therefore, is to examine the impact of Agile methods on project management software, with a focus on how Agile project management software is redesigning project management software.

Chapter 1

The Definition of Project Management

There is no doubt that you need to be able to define what a project is beforehand in order to define "project management" effectively.

Projects are defined in a variety of ways. One of the most suitable as well as the fact that the clear distinction between projects and other types of activities is that projects essentially have a beginning and an end (Artto, Martinsuo, Kujala, 2011). Therefore, a project can be described as a special process that entails the execution of various coordinated and interconnected activities with varying purposes. Over the years, it has always been felt more important to have a professional figure, the project manager, who would ensure that the deadlines, costs, and conditions of the project are respected in order for projects to be completed according to the requirements that have been set.

Each project has its own unique and non-repetitive nature because risk and uncertainty are two elements that are always present in the project manager's daily work (Acebes et al., 2014). The project manager's primary responsibility will be to try to reduce these inevitable risks and uncertainties.

The fact that you need to have a majority of innate soft skills in order to manage projects effectively makes things even more challenging. You need to possess these skills in addition to studying specific techniques and methodologies.

The pm must be very good at communicating, must engender confidence and be liked, while also being strong, honest, and most importantly credible. The primary responsibility of the project manager is to effectively coordinate the efforts of the various teams within the organization while ensuring that the needs of the client are met.

A project team is a collection of human resources who cooperate to complete tasks given to them by the project manager within the allotted time frame. The project team is accountable for not only carrying out the necessary tasks in a proper manner but also for reporting project-related issues, progress, and reports on time. The project manager must assemble the project team while considering the availability of the resources, their level of expertise for the tasks, their level of commitment to the project, and their labor costs.

The project team should then be developed while attempting to motivate the team as much as possible with incentives and rewards for the resources that produce the most positive results. This will ensure that the 3C rule is followed, which states that a certain level of collaboration between the various team members must always be maintained through proper coordination, which is only possible thanks to excellent communication tools.

Last but not least, it will have to move forward with the actual management of the project team through scheduling, planning, and resource allocation, keeping in mind that in a company experiencing continuous growth, each resource should have specific tasks related to their skills and competencies.

The 3R rule (Resources, Roles, and Responsibilities) states that each resource is given a specific role in accordance with its responsibilities (De Marco, 2007). In a nutshell, the

Project Management ferrous triangle can be used to effectively summarize what has just been said (Figure below). The first goal is the scope, or what to do, with what features and functions; the second is the schedule, or how long it will take to complete each activity and how many phases there will be in the project; and the third goal is related to resources, with a focus on the costs associated with each and the available budget. (PMI, 2001)
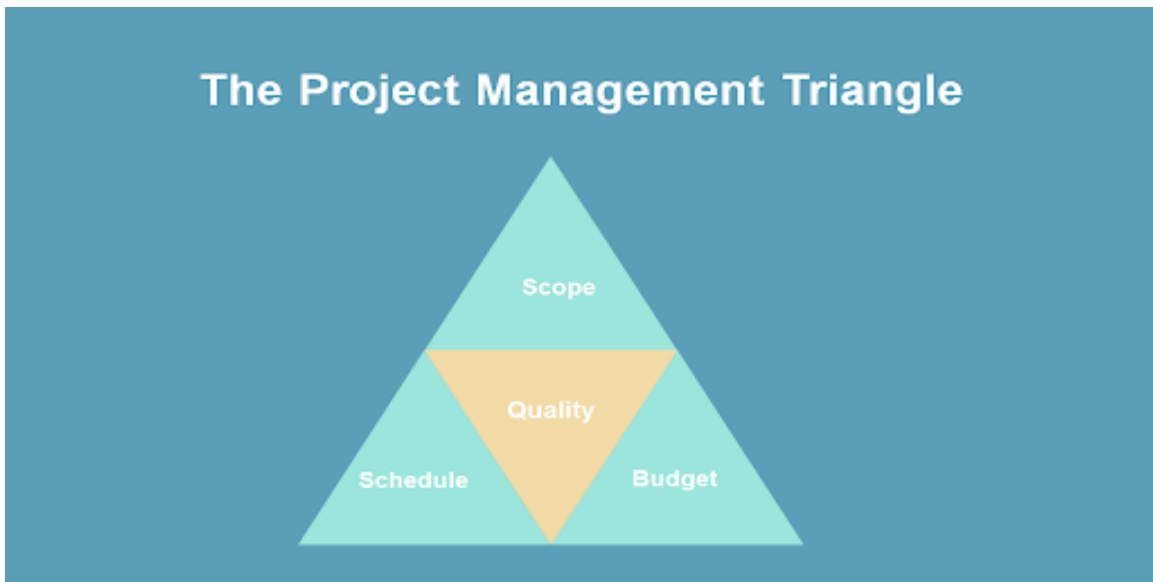
Figure 1_The Project Management Triangle

Chapter 2

Project Management History

Although project management has been practiced for thousands of years, dating back to the Egyptian era, it has only been in the last few decades that organizations have begun to use this concept in a systematic manner. In the past, large engineering and construction companies have managed large budget, schedule-driven projects using project management principles. Since the 1960s, institutions like NASA and the Department of Defense have started applying these ideas. While the manufacturing and software development industries didn't begin implementing project management practices until 1980. By the 1990s, numerous businesses and organizations had adopted project management theories, tools, and techniques (Carayannis, Elias, Young-Hoon, Anbari, Frank 2005, 1). People have used the idea of project management since the beginning, whether consciously or unconsciously, but those who kept records of their project work, successes, and failures shared their findings, which laid the groundwork for project management. Although project management concepts are constantly changing, they can still be broken down into three distinct time periods.

1945 – 1960

Between 1945 and 1960, project management was handled by line managers who employed the "over-the-fence" management principle, where each manager was only responsible for their own specific tasks and would delegate responsibility for the project to someone else once they were finished. This was manageable for smaller projects, but for larger ones, it was complicated and time-consuming to determine who was in charge. However, the US government began implementing project management to keep track of financial transactions and monitor spending. The Department of Defense appointed single project managers for larger projects, and NASA required project management for all space program activities. Private businesses were less enthusiastic about project management techniques during this time because they did not perceive any real benefits from it and it was widely misunderstood. Nonetheless, project management became widely used in the fields of defense and space exploration by the end of the 1950s, with a project manager leading the project instead of multiple line managers delegating responsibility to others.

1960 – 1985

In the 1960s, project management was not widely accepted due to a lack of knowledge and fear among managers and executives. Although aerospace and defense industries were using the best project management techniques, many businesses continued to use unofficial methods. As the size and complexity of activities grew, businesses recognized the need for change and adopted formalized project management methodologies. The benefits of project management were not entirely apparent at first, and there were

problems with project control due to middle managers' dominance over upper-level managers. However, advancements in technology, increased investment in R&D, and shortened project life cycles led to the adoption of project management in other industries. The hiring of a project manager was a major development during this time, as it became necessary to assign a person to a specific responsibility. With project management, executives were better able to adapt to the changing environment, understand customer problems, and have a clearer understanding of their responsibilities. Best practices began to develop based on lessons learned from both successes and failures. Although skepticism remained, the change in technology finally forced companies to practice formal project management, and the public sharing of best practices laid the groundwork for modern project management techniques.

1985 – 2001

During the 1990s, project management became a necessity rather than an option for businesses, and today, almost all industries rely on project management best practices. The speed at which companies adopt and implement these practices is crucial. Lower and middle-level managers, who work on projects, recognize the significance of project management, while executives make the decision to implement it. Six driving forces, including capital projects, customer expectations, competitiveness, executive understanding, new project development, efficiency, and effectiveness, lead to the need for project management. Large-scale manufacturing companies are examples of capital projects, while businesses selling project management expertise must have a superior methodology to meet customer expectations. Other driving forces could coexist with efficiency and effectiveness. Although the benefits of project management were evident by the 1990s, the question of how to achieve them persisted. With the right training and education, the cost of implementing project management is offset by the organization's profits. Project management tools enable businesses to make fact-based decisions and follow a methodical roadmap to achieve project goals and objectives.

In 2001, the Agile Manifesto was created, marking a significant milestone in the history of project management. The Agile Manifesto transformed the way project management was approached and led to the development of various Agile methodologies such as Scrum, Kanban, and Lean, which are widely used today. Its impact is evident as businesses across industries continue to adopt Agile practices to achieve their goals in a rapidly changing environment.

Chapter 3

The Roots of Agile

The most notable shift in software development philosophy over the past two decades has been toward agile techniques (Fowler 2005). But their history began much earlier than that. Agile methodologies have a long history that dates to the 1930s. The concepts that are now the foundation of agile approaches were

As an alternative to conventional methods, a long time ago. These concepts independently manifested in many locations, yet many of them at the time were misunderstood and undervalued (Laanti 2012).

Iterative and evolutionary development, in accordance with Craig Larman, served as the basis for contemporary agile methodologies. According to him, "iterative and evolutionary approaches are a subset of agile methods." He provides a history of "iterative development, which is at the core of agile approaches" in his book "Agile and Iterative Development: A Manager's Guide." (Larman 2003.)

Similarly, iterative and incremental approaches were the first ideas linked to agile methodologies to be recorded, according to Larman and Basili (2003). They developed from American engineer Walter Shewhart's work, in which he suggested using short-term "plan-do-study-act" cycles for quality improvement. (Larman & Basili 2003.)

According to the report by Larman and Basili, the first instance of adopting an incremental and iterative technique in the project dates to 1957. The reason it is important for the current research is because the same team worked on a huge software project a few years later, in the early 1960s, even though that project did not involve developing software.

Mercury was a NASA project that "had very brief (half-day) iterations that were time constrained." It's interesting to note that the team even employed a few extreme programming techniques, including test-first development and planning and creating tests prior to each increment. (Larman & Basili 2003.)

Since then, there were also a number of projects using the abovementioned and other agile-related approaches in the 70's, 80's and 90's. Surprisingly, the bulk of them were engaged in creating significant life-critical systems. Software for a US submarine, ballistic missile defense, and other systems were among them.

US Naval weaponry, the main avionics software for the NASA space shuttle, and compilers for a group of computer languages adapted for certain applications. (Larman & Basili 2003.)

As a result, the incremental and iterative approaches served as the basis for the development of agile methods. Before the concepts and guiding principles of agile software development were formally declared and documented in the well-known Agile Manifesto in 2001, they had been employed primarily in large-scale projects for decades. (Beck et al 2001.)

Chapter 4

Major Areas of Application

What occurred when the Agile movement began 20 years ago? It fundamentally altered how software firms work and how they produce their goods. It was a game-changer that completely altered the software industry's landscape.

What happened next is the interesting part. The benefits of Agile on business processes are being recognized by an increasing number of industries. Business leaders understood that delivering more regularly to the market, getting early feedback, and continuously improving is preferable to delivering delayed perfection. More and more businesses viewed this as a chance to respond more quickly to market demands, competitive pressure, and market shifts.

In other words, it became necessary to be agile in order to survive in the modern business world. For this reason, in order to stay competitive, an increasing number of sectors are attempting to incorporate Agile principles into their work processes. Industries that you would never have imagined could move from dated, antiquated methods of operation to modern ones (Kanabize,2023).

Agile in Construction Management

Figure 2_Agile + Construction Management

Prior to the start of the actual construction work, during the planning phase, the agile methodology is typically most useful. Agile construction teams focus on creating an iterative work process that involves frequent value delivery and can adapt to changes during this phase. In order to ensure that requirements are effectively communicated, the team quickly gathers initial feedback from clients using sketches, site plans, and other techniques. In the construction industry, responding to changes early in the process is much less expensive than making changes later (Kanabize,2023).

Agile in Engineering
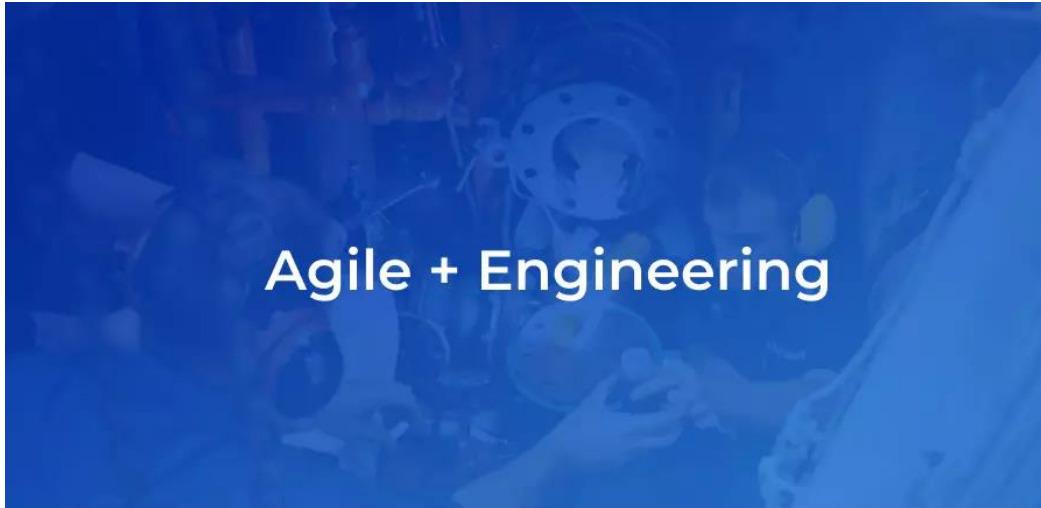
Figure 3_Agile + Engineering

Similar to construction management, engineering and product development traditionally follow a linear and sequential process. However, engineering teams and businesses are altering how they approach their work in response to the market's rapid change and the growing demand for innovative products.

Agile methodologies are becoming more popular in the sector, including the development of minimum viable products (MVPs) and frequent product demonstrations. Engineering teams can improve communication with stakeholders and reduce the possibility of having to redo work in the later stages of product development by putting these and other Agile practices into practice. Companies can work more productively and shorten their time to market by visualizing their workflows and continually improving them (Kanabize,2023).

Agile in Aerospace Industry

Figure 4_Agile + Aerospace

It's important to note that, outside of information technology, Agile principles have been successful in many other industries. The aerospace sector is one of these unexpected industries. To cut costs and shorten time to market, a number of aviation companies have already embraced Agile project management techniques. This is due to the fact that, similar to many other industries, knowledge work is essential in the aerospace sector prior to physical production. It's critical to align strategy, collaborate proactively, maintain focus, and create quick feedback loops in order to reduce the likelihood that a product will fail. It should come as no surprise that the aerospace industry has embraced Agile principles given that these are all essential components of the business agility model (Kanabize,2023).

Agile in the Pharmaceutical Industry

Figure 5_Agile + Pharmaceutical

The pharmaceutical sector is a slower industry with the need for a good amount of approvals, lots of paperwork, rigid procedures, and stringent rules and regulations. This is probably the reason why pharmaceutical companies have historically favored waterfall project management. This is no longer the case, though.

Many industry players are now using Agile methodologies because they understand how important it is to interact with customers and gather feedback rather than relying solely on clinical data.

Agile's capacity to deliver value in various contexts is a key benefit it offers pharmaceutical companies. This sector necessitates intensive communication, consistent research and development work, and a focus on innovation. Agile methodologies can give these businesses a competitive edge by accelerating innovation and achieving operational excellence (Kanabize,2023).

Agile in the Automotive Industry
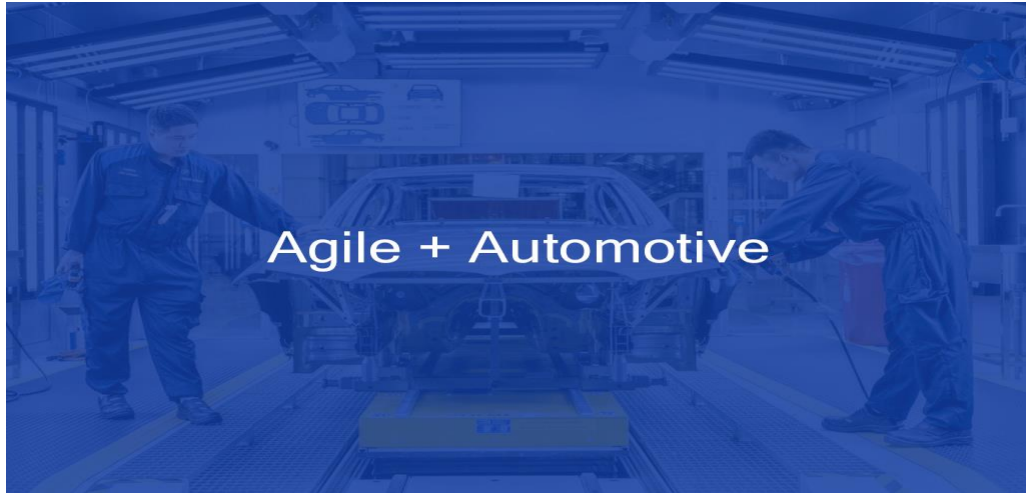
Figure 6_Agile + Automotive

Similar to many other industries, the automotive sector is being significantly disrupted by technology. Car-sharing, autonomous driving, electric vehicles, and in-vehicle connectivity are changing what it means to be a vehicle owner.

The primary factor influencing car purchases in the past was the driving experience. Today's consumers, however, see cars more as "smartphones on wheels," and the in-car experience is what most strongly influences buying choices. In addition to offering services like networked parking, over-the-air updates, and cybersecurity, modern cars are anticipated to be autonomous, electric, and environmentally friendly. This dynamic market situation poses a series of challenges for Original Equipment Manufacturers (OEMs) in the automotive industry. Automotive companies are under pressure to innovate more quickly due to rapidly shifting consumer demands. To ensure innovations are current when new models hit the market, the production cycle must be shortened. The survival of automotive companies depends increasingly on their capacity to learn and adapt quickly.

Agile methodologies are becoming more and more common in the automotive sector thanks to their iterative approach and emphasis on delivering customer value in smaller batches. This method is a natural fit for the modern era of car manufacturing because it enables businesses to respond more quickly to shifting circumstances and deliver innovations more quickly (Kanabize,2023).

Chapter 5

The Definition of APM

Agile project management can be described as a management principle that uses iterative development techniques at regular review points with an emphasis on closer collaboration between the client, stakeholders, and small autonomous development teams in a flexible way that allows the system to evolve towards the true project requirements at a specific point in time under a specific contextual environment to completely minimize the effect of complexity, unpredictability, and change.

Agile project management does not have a single definition because various academics have proposed various definitions for the concepts involved. It is essential to define agility from both a literal and organizational context in order to understand APM. Organizational agility is the capacity to be inherently adaptable to changing conditions without having to change (Owen, 2006). Agility is the capacity to act proactively in a dynamic, unpredictable, and continuously changing environment (Tang, 2004). Many academics have tried to define APM using various dimensions. According to (Owen, 2006), the definitions mainly differ based on the scholar's industrial bias and how seriously they take the term "agile," but they all share some characteristics. Agile methods, for instance, are a combination of Extreme Programming, Scrum, Feature Driven Development, Lean Development, Crystal Methods, and APM, according to (Aguanno, 2004). The definition, which combines lean and agile methodologies, adds to the confusion and is obviously biased in favor of information technology (IT). His central claim in developing this definition is that the term "agile" was chosen to describe these methodologies' capacity to respond to dynamic environments through flexible and controllable approaches.

(Conforto and Amaral, 2008) contest this combination on the grounds that lean is a methodology all by itself designed to shorten process times by eliminating non-value-adding waste, while maximizing customer value. This approach involves continuous improvement and the involvement of all employees in the process. Lean methodology aims to improve quality, reduce lead time, and lower costs by using tools and techniques such as value stream mapping, 5S, and Kanban. The goal of lean methodology is to create a streamlined process that delivers the desired value to the customer with minimal waste and maximum efficiency. Agile is more focused on enhancing delivery speed by minimizing the impact of uncertainties and complexities. From an IT standpoint, (Cadle and Yeates, 2008) definition of APM as the "various systems development approaches that emphasize flexibility, speed, and user involvement in development systems" (provides a slightly more general definition. The general definition of APM provided by Conforto and (Amaral, 2008) and cited in (Highsmith, 2004) is that it is "a set of values, principles, and practices that assist project teams in coping with this challenging environment." Hass (2007) provides a more thorough definition of APM, describing it as a highly iterative and incremental process that requires project stakeholders and developers to actively participate in "working together to understand the domain, identify

what needs to be built, and prioritize functionality." However, what is more crucial to note is that agile environments always exhibit internal and/or external uncertainty, necessitating specialized knowledge and a high degree of urgency to reduce the impact of dynamism (Fitsilis, 2008; Alleman, 2005). Given the current circumstances and the growing impact of the financial crisis on organizations, this is especially crucial. The agile project management environment is defined by Chin (2004) using an intriguing equation, which is;

APM Environment= (Uncertainty + Unique Expertise) x Speed

Our definition of APM in this thesis is derived from definitions and some pertinent literature in to prevent confusion. For instance, Augustine and Woodcock (2008) claim that the manager's primary duties in an agile environment include establishing clear and generative system rules, fostering continuous feedback, adaptation, and collaboration. They contend that doing so enables project teams using agile implementation to deal with change and view the organization from the perspective of a biological system (i.e., as a fluid and adaptive system inhabited by intelligent people). In addition to this, Alleman (2005) emphasizes that agile project management relies heavily on small, manageable teams. Additionally, agile project management acknowledges that self-organization and intelligent control are the fundamental principles of establishing order (Conforto and Amaral, 2008).

Chapter 6

The Agile Manifesto

Due to many different methodologies floating around in the software development industry during the 90's. A lack of structure of these methods spurred 17 method developers to create a common set of principles and values to represent most of the methodologies. During a meeting taking place in 2001, the Agile Manifesto was created. The agile manifesto was the birth of the term agile. However, working in an "agile" way was expressed differently in the existing methodologies. Therefore, these 17 method developers who represented different agile methods saw the need to concretize these flexible, adoptable and always evolving approaches as well as giving it a name. The result was 12 principles that together would represent the term Agile, the principles are (Beck et al., 2001);

- Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
- Businesspeople and developers work together daily throughout the project.
- Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
- Working software is the primary measure of progress.
- Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely.
- Continuous attention to technical excellence and good design enhances agility.
- Simplicity—the art of maximizing the amount of work not done—is essential.
- The best architecture, requirements and designs emerge from self-organizing teams.
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

When using agile methodologies, the essence of these concepts can be reduced to a set of values. Four key values emerged from the 12 principles as best capturing agile, and they are as follows:

Individuals and interactions** over* ***processes and tools
Working software** over* ***comprehensive documentation
Customer collaboration** over* ***contract negotiation
Responding to change** over* ***following a plan.

The values on the right are necessary, but the values on the left are more important when it comes to being agile, thus it's crucial to recognize that they are values rather than prioritizations (Gustavsson, 2013).

The agile manifesto's principles are not a formal definition of agility; rather, they are a set of recommendations for producing high-quality solutions in an agile way. At its essence, agility refers to the capacity to innovate and adapt to change in the business and technological domains quickly and flexibly.

Individuals and Interactions over Processes and Tools

The Agile Manifesto places more emphasis on how people produce solutions and how they interact with one another than it does on how they work and what technologies they use. The value of creating strong teams where everyone works together and performs better than a team where only few members are contributing.

Few people who do not share their experiences have a skillset. The tools used to develop a solution are crucial, but the team should test the current ones and make use of what is already on hand before investing in new, expensive tools. It's crucial to build a team, give the group dynamic element in front of technology solutions, let the team design their own workspace, and help them determine the tools they'll need (Martin, 2003).

Working Software over Comprehensive Documentation

A project is typically designed with the intention of delivering all the project's outcomes at once, sometime in the far future. Instead, the agile method entails the division of work into brief cycles with an initial planning phase at the start of each cycle.

Opportunity to carefully prepare the forthcoming cycle while also reviewing the previous one. A useful portion of the results is presented at the conclusion of each cycle.

Working software includes knowledge that is relevant to the software development industry, as the title implies. However, this does not preclude its use to other industries. It retains the same high value for different industries by just rewriting it as "Workable project results over clear documentation" (Gustavsson, 2011).

Customer Collaboration over Contract Negotiation

Unlike any other project, software development is not just a process. As a result, it might be challenging to negotiate contracts with specified timeframes in the hopes that they will be carried through. A contractual framework being out of date when the project begins is not unusual. This is as a result of there are long gaps between the project's specification and its conclusion. The manifesto proposes that, in order to produce the intended output, the work should be closely supervised by the client (Martin, 2003).

Responding to Change over Following a Plan.

The longer a project progresses, the more experience and common understanding is shared, by both the customer and the supplier. Incorporating change into a product or service could be the perfect finishing touch to a successful outcome. Although planning is important, according to the agile methodology, the plan changes so often that there is no value in spending time on extended planning. Instead, planning should only be done for short periods of time and the remaining part of the project should be planned as little as possible for the work to continue.

Chapter 7

Agile Methods

In this section, the four most popular agile methods are presented to demonstrate the origins of agile and the development of Scrum, the most popular agile method.

These techniques are designed specifically for the software development sector, primarily because they are big projects that are challenging to scale. However, it is critical that this study understands the history of agile methodologies. Additionally, as you read this study, keep in mind that these methodologies existed before the agile manifesto, which later served as the umbrella term to describe a range of methodologies. All methods in this section are explained in accordance with Jansson's (2015) exhaustive doctoral analysis of all current agile methods and working approaches.

Extreme Programming (XP)

Incremental planning, straightforward documentation, rapid development, and regular informal communication between participants are the core principles of XP. The approach is founded on several fundamental principles and values, including:

- Simplicity (what is the simplest solution that could work)
- Frequent feedback on performance
- Courage (to be patient, to dare to be sincere and to seek real answers) and mutual respect.

The method mainly offers techniques and tools on how the team's work should be organized. The project manager is an illustration of this because they help with communication both within the team and between the team and the business environment. Product Managers facilitate communication between the team and the client and are in charge of outlining and ranking the functions that need to be developed. Coaches promote independence.

Techniques and method components may differ depending on the project at hand, as well as how and where they are applied, as long as they uphold the fundamental values and principles.

In XP, independence is key. The approach can be viewed as a set of fundamental assumptions (values), guiding principles, and suggestions for practical arrangements to carry out real-world situations that reflect values. However, XP is most useful for small teams and the task of developing the program. Since these values are challenging to achieve in scaled organizations, the focus is clearly restricted to systems development.

Feature Driven Development (FDD)

Three different challenges are listed by FDD. Language and communication barriers between various parties and individuals involved in the project, the system's inherent complexity that must be managed, and the challenge of balancing internal quality against external (i.e., technical excellence versus functional). The approach taken to deal with this is not explained in detail.

Success is first and foremost a result of talented people's dedication and aptitude, and it is secondarily a result of having access to relevant procedures and technologies. FDD is organized as a method using best practices, clear roles, and processes. The processes divide the workflow into five phases, the first three of which produce a detailed model of the system, the features required, and a rough schedule for upcoming work. The last two, a sequence of design and development per feature, iterated until all features are complete and the system is complete. Finding the proper level of abstraction or detail for a particular feature is crucial; it must not be larger than what can be developed in two weeks, preferably much smaller. FDD also suggests using predetermined forms for feature documentation and standardized stage-gate meetings for progress monitoring.

Crystal Family

Is a group of method variations that take the form of rough templates and are tailored to various project circumstances. The family Crystal Method relies on frequent deliveries, reflection, improvement, and close informal communication as its main strategies. The item in question ought to be increased, with reflection workshops being held by the teams at least before and after each increment to discuss and decide on ongoing modifications to the method to be used.

In addition to the basic principles of frequent deliveries, reflection and improvement, and the close informal communication, four principles are listed and considered central to success but not always possible to completely satisfy; Individual security (to express concerns without risking harsh criticism), Focus (knowing what to do and having the time and working environment to be able to do it), Access to expert users, Technical environment with automated testing, versioning and frequent integration of systems. The strategy can be described as creating natural opportunities for close informal communication between the parties involved.

Adaptive Software Development

The team is centered on a mission that provides direction, serves as inspiration, and directs decisions. Speculate, Collaborate, and Learn are the three cyclical steps that all

work follows. Since complex tasks cannot be planned in the traditional sense, the word speculate is used to emphasize this to create a kind of work hypothesis as well as the direction (mission) for the project. Collaborate emphasizes that all work generates learning and new circumstances that can be used in subsequent iterations of the steps. Learn is focused on work. The term "timebox" is used to describe a specific task within a specific time frame, where the time frame has a set deadline that cannot be changed. Timeboxing forces pragmatism and learning by obligating a balance between internal and external quality, short- and long-term perspective.

Scrum

Scrum is an agile project management framework that uses a set of values, principles, and practices to assist teams in organizing and managing their work. Scrum encourages teams to learn from experiences, self-organize while working on a problem, and reflect on their wins and losses to continuously improve, much like a rugby team practicing for the big game (where it gets the name).

The scrum I'm referring to can be used for all types of teamwork, even though software development teams use it most frequently. This is just one of the many benefits of scrum. Scrum is a set of meetings, tools, and roles that help teams organize and manage their work. It is frequently thought of as an agile project management framework (DRUMOND, Claire.)

Chapter 8

Agile vs Traditional Method

	Traditional	**Agile**
Fundamental Assumptions	Systems are fully specifiable, predictable, and can be built through meticulous and extensive planning	High-quality, adaptive software can be developed by small teams using the principles of continuous design improvements and testing based on rapid feedback and change
Control	Process centric	People Centric
Management Style	Command-and-control	Leadership-and-collaboration
Knowledge Management	Explicit	Tacit
Role Assignment	Individuals favors specialization	Self-organizing teams encourages role interchangeability
Communication	Formal	Informal
Customer's Role	Important	Critical
Project Cycle	Guided by tasks or activities	Guided by product feature
Development Model	Life cycle model (Waterfall, Spiral etc.)	The evolutionary-delivery model
Desired Organizational Structure	Mechanistic (bureaucratic with high formalization)	Organic (flexible and participative encouraging cooperative social action)
Technology	No restriction	Favors object-oriented technology

Figure 7_Agile vs Traditional Method

Chapter 9

Project Management Software

Even though project management has been practiced for a while, project management software was only recently used for the first time. In its early years, project management software was only available for use on large mainframe computers and was only applied to complex projects. They were challenging to use and had their own set of capabilities limitations. It could perform the fundamentals of project management, such as planning, monitoring, and controlling the project, but the software improved over time as technology advanced. The benefits will increase as the project gets bigger and more complicated (Kimmons, Loweree 1989). These computer-aided project management tools can process a lot of data and make quick adjustments to the changing project plans even at the execution phase. They are programmed to be able to produce status reports for various management levels as well as provide potential alternative scenarios. You should not be a slave to the system, as Kimmons says. Project management software is widely available, but the one you choose should help you with your work and you, as the project manager, should have a clear understanding of it as well as the project requirements, project team, and senior requirements.

"A 2006 survey of 753 project and program managers was conducted to rate several project management tools. Respondents were asked to rate tools on a scale of 1-5(low to high) based on the extent of their use and the potential of the tools to help improve project success. "Super tools" were defined as those that had high use and high potential for improving project success. These super tools included software for task scheduling (such as project management software), scope statements, requirements analyze, and lessons- learned reports." (Schwalbe 2013)

Chapter 10

Requirements of a Project Management Software

These requirements also act as the criteria for this thesis and set up the basis for evaluation of the chosen software in the next stage. Kimmons has discussed and analyzed the capability of computer aided project management to fulfill the needs of project management from the viewpoint of project manager, the project itself, the project team and the senior management.

Different projects are managed by project managers in various ways. In some cases, the system database contains a thorough description of the project details and is always accessible; the system is expected to process a large volume of data quickly. The project team would have more freedom to work on their plans even though the project manager might enter the project details into the system but not access them until they are needed. Kimmons' third style, which explains how little information is entered into the system database and accessed, enables the project team to work independently without having to give the system any information. And the last style involves a highly responsive program capable of providing summary of the project without many details of the project. These are merely generalized styles, and the project manager and team are free to select whichever is most comfortable for them. Schedule, cost, physical requirements, and visibility issues must also be considered. If there is a lack of input during the planning phase and if the project is operating on a limited budget, the software needs to have strong planning and monitoring capabilities. People in various positions have different perspectives on projects. The owner might want to look at the project in its entirety rather than in every detail and compare it to other projects. While the project's engineer is more focused on the project's designing stage and wants to take a close look before building it. General problems like system compatibility, the ability to track various projects and subtasks, and the capacity to forecast the necessary manpower and resources may stand out for projects, among others.

The combination of people working on a project determines the project's outcome; the software is merely a tool for project success. A project team with members who have extensive experience does not rely heavily on the software, while the team Members need a program that can give them information about the project plan and be able to track the details because they have little experience with project management. Since there should be constant communication between team members, computer-aided project management should serve as an interface. To ensure that the project goes as planned, the system must plan and monitor the team members agreed-upon milestones. Senior management, on the other hand, needs the system to give them a summary of information, such as important schedule deadlines, cost projections, and scenarios or records of any corrective action that has been taken.

Chapter 11

Key features of Project Management Tools

Scheduling

Organizations can schedule meetings, plan activity dates, and lay out project tasks with the aid of calendars or milestone tools like Gantt charts. Project completion times and task interactions can both be displayed on an editable schedule. (Musyoka, Alice)

Task lists

Users can review, assign, and update tasks using project management software with task management features, keeping the team updated. Task lists make it easier for team members to get status updates and meet deadlines. (Musyoka, Alice)

File sharing

By placing documents in one central location, document sharing and collaboration tools boost productivity. Sharing important project documents becomes simpler, and time spent looking for files is eliminated. (Musyoka, Alice)

Reporting

For team members to understand how a project is progressing, a reporting feature is crucial. Project management software can be used by businesses to streamline bug and error reporting.(Musyoka, Alice)

Chapter 12

What are the Benefits of Using Project Management Software?

Better collaboration:

Improved collaboration stops unneeded project delays and makes it simple for team members to discuss project objectives. Teams can communicate and share knowledge during projects with the help of native and third-party solutions provided by project management software. (Musyoka, Alice)

Streamlined task delegation:

The software allows project managers to quickly assign tasks and send out reminders, which helps to clarify roles and responsibilities and improves performance in general. (Musyoka, Alice)

Improved project planning:

Project managers can use PM software to make a thorough project plan, monitor KPIs, and guarantee that every member of the team has easy access to project information. (Musyoka, Alice)

Easier file access and sharing:

Project teams' needs for user access management are facilitated by storing files in a central repository like PM software. Team members can more specifically easily share project documents and create threads for communications regarding project milestones. (Musyoka, Alice)

Effective risk mitigation:

Software for project management gives teams the visibility they need to spot potential bottlenecks and put workable solutions in place to reduce project risks. (Musyoka, Alice)

Chapter 13

Project Management Software Using Agile PM Approach

Active Collab

Figure 8_Active Collab

ActiveCollab is a project management and collaboration software designed to help teams and organizations streamline their work, manage projects, and facilitate effective communication. Its main goal is to improve project management and teamwork by giving team members a central location to organize assignments and projects and foster collaboration. Many different industries use ActiveCollab, which is appropriate for small to medium-sized businesses. It is a useful tool for teams looking to better project planning, task tracking, and collaboration in order to boost productivity and project success thanks to its user-friendly interface and extensive project management tools. (Capterra)

Key Features of ActiveCollab:

- **Task Management:** The powerful task management system offered by ActiveCollab allows users to create, assign, prioritize, and track activities. Teams can keep organized and on top of their work with the help of this feature.
- **Time Tracking:** Users can record the number of hours they spent working on assignments and projects thanks to the software's time tracking features. This is helpful for resource allocation, project analysis, and correct billing.
- **Project Planning:** Projects can be planned and created by users in ActiveCollab. Project templates, task dependencies, and Gantt charts are among the scheduling tools it offers.
- **Collaboration:** Through features like task discussions, comments, file sharing, and real-time notifications, ActiveCollab encourages teamwork. Team members can readily exchange information about assignments and projects and communicate with one another.
- **Reporting and Analytics:** Users can use the software's reporting and analytics features to have a better understanding of how teams are doing and how projects

are progressing. Making educated decisions is made easier with this data-driven strategy.

- **Integration:** ActiveCollab enhances its usefulness and compatibility with other tools that the team may use by integrating with well-known third-party applications and services.
- **Customization:** Users can modify ActiveCollab's workflows, project templates, and task kinds to suit their particular needs and project specifications.
- **Client Collaboration:** ActiveCollab offers client-specific access, enabling external collaborators to be involved in projects without being overburdened with details (such as clients or stakeholders).
- **Mobile Accessibility:** Team members can work and collaborate while on the go thanks to ActiveCollab's mobile apps, which are available for both iOS and Android smartphones.

Asana

Figure 9_Asana

Asana is a work management tool for managing tasks and other work among a group of people. Its primary purpose is to improve teamwork and productivity by providing a centralized platform for organizing and managing work-related activities. Asana is widely utilized by companies of all sizes, from start-ups to massive corporations, across a variety of industries. It is a useful tool for teams looking to enhance their project management, task tracking, and collaboration efforts because of its adaptability and versatility. Asana strives to make managing tasks and projects simpler to increase productivity and efficiency, regardless of whether you're managing marketing campaigns, software development projects, or any other form of work. (PCMag)

Key Features and Purpose of Asana:

- **Task Management:** Users may create, assign, prioritize, and track tasks using Asana. It offers a methodical technique to control personal to-do lists and project assignments.
- **Project Planning:** Users can construct projects and divide them into tasks and subtasks using the project planning feature. To aid in efficiently visualizing and planning projects, Asana provides a variety of views, such as task lists, Kanban boards, and Gantt charts.
- **Collaboration:** Asana encourages team members to work together. To encourage collaboration and information sharing, users can add comments to tasks, mention team members, and attach files.
- **Goal Setting:** By enabling users to specify objectives, key results (OKRs), and milestones inside projects, Asana promotes goal setting. This function aids teams in connecting their efforts to more general goals.
- **Integration:** The software allows teams to connect their preferred tools with a variety of third-party programs and services, including Google Workspace, Slack, and Microsoft Teams.
- **Reporting and Dashboards:** Asana offers reporting and analytics tools that let teams monitor the status, workload, and performance of their projects. Users who can customize their dashboards can learn more about their job.
- **Customization:** To fit Asana to their unique requirements and processes, users can modify workflows, task fields, project templates, and task kinds.
- **Access Anywhere:** Teams can interact from any location thanks to Asana's availability through web browsers and mobile apps for iOS and Android devices.

Basecamp

Figure 10_Basecamp

Basecamp is an online collaboration app that lets people manage their work together and communicate with one another. You use it to keep track of all the tasks, deadlines, files, discussions, and announcements that happen around work. In the Scrum community, Basecamp is a well-liked Agile project management tool. The tool is made to function as a team collaboration tool as well as a project management tool. On desktop computers and mobile phones, the software solution is simple to use. Basecamp is ideal for teams and organizations seeking a straightforward, all-in-one project management and collaboration solution. It's user-friendly interface and focus on simplicity make it an accessible choice for teams who prefer a straightforward and easy-to-use platform for managing projects, tasks, and communication. (PCMag)

Key Features and Purpose of Basecamp:

- **To-Do Lists:** Basecamp's to-do list feature makes it simple to organize activities and keep track on their progress. Users have the ability to assign tasks to team members and give each to-do item a due date.
- **Message Boards:** For team discussions and announcements, the program offers message boards. This function promotes free discussion and keeps team members updated on project developments.
- **File Sharing:** Basecamp makes it simple to share files. To guarantee that everyone has access to pertinent materials, users can upload and share papers, photos, and other assets within projects.

- **Scheduling:** Basecamp has a shared calendar that users may utilize to mark off events, deadlines, and milestones. Teams benefit from having a better sense of organization and time management.
- **Client Access:** Basecamp provides projects with client-specific access. Clients or stakeholders who are external participants on a project may be invited, but their access to other project information may be restricted.
- **Check-Ins:** The program offers automated check-ins that enable team members to communicate task and project progress updates and status updates. This function supports project health monitoring.
- **Integration:** Basecamp offers integrations with a few third-party programs and services, expanding its capabilities, albeit these are not as broad as those offered by some other tools.
- **Customization:** Basecamp enables teams to modify some aspects of project boards and task templates so they may fit the platform to their particular workflows and processes.

ClickUp

Figure 11_ClickUp

ClickUp is a versatile work management and productivity platform designed to help teams and organizations streamline their work processes, manage tasks and projects, and improve collaboration and productivity. It's a potent Agile project management solution known for its intuitive UI and rich set of customizable features to increase efficiency all around. It is suitable for teams and organizations across industries seeking a flexible and customizable work management solution. It caters to project management, task tracking, and collaborative work management needs. (Capterra)

Key Features:

- **Task and Project Management:** Teams may organize and prioritize their work with the help of ClickUp's extensive task and project management features, which include task creation, subtasks, and checklists.
- **Hierarchy:** Task hierarchy can be customized by users, enabling organized project organization.
- **Collaboration:** ClickUp encourages teamwork with features like comments, mentions, and real-time editing that make it easier for team members to communicate.
- **Goal Setting:** It facilitates goal-setting and goal-tracking, allowing teams to match their work to goals.
- **Integration:** ClickUp offers thorough third-party app and service connections that improve compatibility and usefulness.
- **Reporting:** ClickUp provides sophisticated reporting and analytics to monitor workload and project progress.
- **Customization:** Users can alter workspaces, perspectives, and processes to better suit their individual requirements and tastes.

JIRA

Figure 12_Jira Software

JIRA is a tracking program used for both project management and Agile testing. It is designed for project management, bug tracking, and issue tracking in software and mobile development processes. The ability to capture, assign, and prioritize work is one of the key features.

JIRA is primarily used by software development teams, IT operations, and project management teams. It is particularly popular among agile teams looking for comprehensive agile project management solutions. It's robust feature set and focus on

agile methodologies make it a powerful tool for software development teams and IT professionals. It helps teams plan and execute projects, track issues, and adapt to changing requirements, all while providing transparency and visibility into project progress and performance. (PCMag)

Key Features:

- **Issue Tracking:** JIRA is excellent at handling issues by letting users create, allocate, prioritize, and keep track of issues and bugs.
- **Agile Capabilities:** It offers thorough support for agile approaches, including sprint planning, backlog management, and scrum and kanban boards.
- **Custom Workflows:** Users can design workflows that are specific to the needs and procedures of their team.
- **Integration:** A sizable ecosystem of third-party tools and services are smoothly integrated with JIRA.
- **Reporting and Dashboards:** JIRA provides reporting and editable dashboards for monitoring team performance and project progress.
- **Automation:** To increase productivity, users can automate routine operations and procedures.
- **Advanced Searching:** JIRA provides powerful search features to swiftly filter and locate issues.
- **Project roadmaps:** It has tools for building and displaying project roadmaps.

MeisterTask

Figure 13_Meister Task

MeisterTask is appropriate for groups and organizations of all sizes seeking a simple and visually appealing task management and collaboration solution. It's especially helpful for teams looking for project management and task tracking simplicity.

MeisterTask is a user-friendly and aesthetically pleasing platform to make task management and project collaboration easier. It's the best option for groups who want to simplify their work management and collaboration procedures while valuing an intuitive user interface. MeisterTask seeks to improve team coordination and productivity whether you're overseeing projects for a small team or working across departments. (PCMag)

Key Features:

- **Task Management:** MeisterTask provides a user-friendly task management system with customized task fields, due dates, and priority.
- **Kanban Boards:** It offers Kanban boards for visualizing activities and workflows.
- **Collaboration:** Task comments, file attachments, and task assignments all encourage collaboration with MeisterTask.
- **Integration:** It allows connections to well-known third-party applications including Dropbox, Google Drive, and Slack.
- **Automation:** To increase productivity, users can automate routine operations and workflows.
- **Reporting:** MeisterTask provides straightforward reporting tools for monitoring task progress.
- **Customization:** Project boards and task templates in the software can be modified in several ways.

Pivotal tracker

Figure 14_Pivotal Tracker

Pivotal Tracker is an agile project management application created for teams working on software development, new businesses, and groups committed to incremental and iterative growth. It is a useful tool for teams wanting to produce software repeatedly and effectively because it is specifically made to help agile software development processes. It places a strong emphasis on collaboration, transparency, and adaptability, enabling software development teams to successfully plan, track, and modify their work throughout the development process. (Capterra)

Key Features:

- **Story Management:** Pivotal Tracker represents user needs using the concept of stories, which makes it simple to organize and prioritize work.
- **Iterations and Releases:** By making it easier to plan iterations and releases, teams are better able to control their development cycles.
- **Collaboration:** Pivotal Tracker promotes cooperation with tools like team conversations and story comments.
- **Velocity Tracking:** The program aids teams in keeping track of their velocity, enabling more precise project planning.
- **Integration:** It works with a few different third-party applications, including GitHub and Slack.
- **Reporting:** Pivotal Tracker provides simple reporting and project progress metrics.

Wrike

Figure 15_Wrike

Wrike is a flexible project management and collaboration tool created to aid teams and organizations in effectively managing tasks, projects, and work processes. The use of Wrike is widespread, with applications in marketing, advertising, IT, and other fields. It serves groups and teams looking for an all-encompassing work management and collaboration solution. Teams can manage tasks, projects, and work processes efficiently with Wrike's unified platform. Wrike strives to improve work management and collaboration to increase team efficiency and project performance, whether you're managing marketing campaigns, supervising creative projects, or managing IT initiatives. It is appropriate for a variety of use cases and sectors because to its adaptability and customization capabilities. (PCMag)

Key Features:

- **Task and Project Management:** With customized workflows, task dependencies, and Gantt charts, Wrike provides strong task and project management features.
- **Teamwork:** Real-time editing, task comments, @mentions, and document sharing encourage teamwork.
- **Resource Management:** To increase team productivity, Wrike offers solutions for allocating resources and managing workloads.
- **Reporting and Analytics:** It provides sophisticated reporting and analytics for monitoring the performance of projects.
- **Integration:** Wrike features numerous third-party app and service connectors.
- **Customization:** Project workflows and dashboards can be completely customized using the program.

Chapter 14

All Software in One Table

Software	Agile Project Management	Project Planning	Bug Tracking	Reporting	Collaboration Tools	Customization	Accessibility	Integrations	Security Features
Active Collab	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asana	✓	✓	✓	✓	✓	✓	✓	✓	✓
Basecamp	✓	✓		✓	✓	✓	✓	✓	✓
ClickUp	✓	✓	✓	✓	✓	✓	✓	✓	✓
JIRA	✓	✓	✓	✓	✓	✓	✓	✓	✓
MeisterTask		✓		✓	✓	✓	✓	✓	✓
Pivotal tracker	✓	✓	✓	✓	✓	✓	✓	✓	✓
Wrike	✓	✓	✓	✓	✓	✓	✓	✓	✓

Figure 16_Features in one table of each Software

Main Features	Meaning
Agile Project Management	The software offers features for agile project management, including support for agile methodologies like Scrum and Kanban.
Project Planning	The software offers features for project planning, including tools for creating and managing project timelines, task lists, and project milestones.
Bug Tracking	The software offers features for bug tracking and issue management, including tools for reporting, tracking, and resolving bugs and other issues that arise during the project lifecycle.
Reporting	The software offers features for reporting, including tools for generating project reports, tracking progress, and analyzing project data.
Collaboration Tools	The software offers collaboration tools, including features for real-time communication, file sharing, and team collaboration.
Customization	The software offers some degree of customization, but may be limited in terms of the ability to customize certain features or workflows.
Accessibility	The software offers accessibility features, including support for multiple languages and accessibility for users with disabilities.
Integrations	The software offers integrations with other tools and software platforms, including support for APIs and third-party integrations.
Security Features	The software offers security features, including data encryption, access controls, and other security measures to protect user data and prevent unauthorized access.

Figure 17_Legend of the figure 16

Chapter 15

Agile Project Management features in one table

	Kanban Boards	Sprint Planning	Burndown Charts	User Stories	Backlog Management	Agile Reporting	Agile Metrics	Scrum Board	Agile Planning	Retrospective	Agile Methodology Support
Active Collab	✔	✔									✔
Asana	✔										✔
Basecamp											✔
ClickUp	✔	✔									✔
JIRA	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
MeisterTask			✔	✔	✔						
Pivotal tracker				✔	✔	✔	✔				
Wrike											✔

Figure 18_Agile features for each software

Feature	Explanation
Kanban Boards	A visual project management tool that uses cards and columns to track the progress of tasks and projects.
Sprint Planning	The ability to plan and organize work into sprints or iterations.
Burndown Charts	Visual representations of remaining work against time, commonly used in Agile projects to track progress.
User Stories	A technique for capturing user requirements or features in a concise and understandable way.
Backlog Management	The ability to manage and prioritize a list of tasks or user stories in a backlog.
Agile Reporting	The ability to generate reports and metrics specific to Agile project management.
Agile Metrics	Key performance indicators and measurements used in Agile project management.
Scrum Board	A visual representation of work items, typically organized in columns representing different stages of the development process.
Agile Planning	The ability to plan and schedule work items in an Agile project.
Retrospective	A meeting or activity to reflect on the past iteration or project and identify areas for improvement.
Agile Methodology Support	Overall support and alignment with Agile principles and practices.

Figure 19_Legend of the figure 18

Chapter 16

Software Ranking

	Grade	Reviewers
Active Collab	4.5	395
Asana	4.47	12015
Basecamp	4.3	14146
ClickUp	4.66	3669
JIRA	4.42	13000
MeisterTask	4.72	1117
Pivotal tracker	4.32	138
Wrike	4.31	2400

Figure 20_Ranking for each software (Software Advice)

Chapter 17

Software in the Construction Industry

Bim

Figure 21_Bim

Introduction

The Construction Industry is vibrant and in the present scenario there is cutthroat competition in the construction industry. It is now changing from conventional to nonconventional ways of contracting. Day by day profitability is decreasing due to increased uncertainty at every stage of the project. In this scenario it is very much essential to manage the project successfully with optimum use of resources and for that keen monitoring of the project is very much essential. With the availability of software like Auto Cad, it was possible to represent the status of the project in 3Dimension viz. x, y, z which helped investor/stakeholders to understand the current status of the project in a better way. Nowadays there is a considerable development in information technology which can be effectively used for adding two dimensions viz. Time & Cost to available 3 dimension and hence at any moment of time the status of the project can be presented in all 5dimensions facilitating the stakeholders to get the right feel and to take appropriate steps for effective project management to avoid Time & Cost overrun. This paperwork will deal with understanding the concept of 5D project management tool and its application in Real Time project management which is a need of an hour.

What is Bim?

While preparing a BIM model proper sequence will help to simulate project easily. First preparation of 3D model for a project based on the construction drawing for a project is to be done. In this, only the architectural drawing's part will be considered for modelling. Accurate models are required to be generated to get accurate quantities. Microsoft project software will be used to prepare the proper execution schedule and for time estimation. This construction sequence is then used for 4d simulation. Then next part is to preparation of model using mechanical and Air conditioning drawings. To achieve these soft wares like Archi CAD, Autodesk Revit will be used. These soft wares have their BIM modules, but Navis works BIM software will be used for the further simulation process because of its ease of use. Linking of the BIM model project schedule and costs along with association of this with available drawings will be done. Using the prepared model conflicts are to be identified in different services. Microsoft Project Software will be used to prepare the proper charts, reports and graphs of time and costs.

A parametric object model consists of a series of geometric definitions and their data and rules. It does not allow inconsistency between model and associated data sets. This means any change made directly to the model will result in equal change to the data set associated with that model. BIM can be defined as creation and use of coordinated, consistent, computable information about a building project, in parametric information used design decision making, production of high-quality construction documents, prediction of building performance, cost estimating and construction planning. BIM technology is quite new and initial experience indicates that the creation of 3D model with associated information reduces errors, improves design quality, shortens construction time and significantly reduces costs. Due to these initial findings demand for BIM has tremendously increased in the past decade.

Figure 22_Benefits of Bim

MODEL PRODUCTION

BIM consists of a variety of different data and models which are produced by different people. These models are produced in different software tools. There are different models like architectural, MEP, Fire protection, site model etc. Finally, all these models are to be collected at one place.

Software Tool	Manufacturer	Function
Revit Architecture	Autodesk 3D Architectural Modeling	3D Architectural Modeling and parametric design
Cad-pipe	HVAC AEC Design	Group 3D HVAC Modeling
Revit Structure	Autodesk	3D Structural Modeling and parametric design.
Revit MEP	Autodesk	3D Detailed MEP Modeling
AutoCAD Civil 3D	Autodesk	Site Development
Bentley BIM Suite	Bentley Systems	3D, Structural, Mechanical, Electrical, and Generative Components Modeling
Archi CAD	Graphisoft	3D Architectural Modeling
MEP Modeler	Graphisoft	3D MEP Architectural Modeling
Tekla Structures	Tekla	3D Detailed Structural Modeling
VicoOfice	Vico Software	5D Modeling which can be used to generate cost and schedule data
Power Civil	Bentley Systems	Site Development

Figure 23_Bim Softwares

Conclusion

Project Managers play a very vital role in driving Construction Industry Development. The Use of BIM is to improve collaboration between stakeholders, reducing the time needed for documentation of project and producing more predictable project outcome. BIM is an emerging tool for visualization, quantity take off, scheduling and resource allocation. It generates reports indicating present and future scope of work through 3D coordination, Cost Estimation and Clash Detection. (Eastman, Chuck, et al)

Oracle Primavera P6

Figure 24_Orackle Primavera

Introduction

Large construction projects with huge budget it becomes very difficult for project team to handle the task, so it becomes very necessary to provide tool in hand of project team that keep a track an activity. Primavera P6 software from product from Oracle is very powerful tool to present the efficient management in hands of project team. It helps in planning, controlling and scheduling effectively. In addition to provide insight on various project tasks, their inter relationship, dependencies to predict total project duration during planning phase the schedule should be comprehensive enough to let the user understand in detail the purpose of various activities in the schedule.

Key features:

Ensure project delivery success for all your projects and programs.
Primavera P6 EPPM is a versatile project portfolio management (PPM) tool designed to cater to the specific needs of team members. It provides real-time project performance insights to executives, offers user-friendly capabilities for effective project execution, and enables data analysis and timely decision-making across the organization. This scalable solution is known for its robust architecture, high performance, tight security, flexible integration, and real-time reporting and analytics, suitable for both small and large projects, on-site or in the cloud.

Project management—anytime, anywhere access

Primavera P6 EPPM provides project teams with flexible web-based interfaces for accessing project information anytime, anywhere. Users can choose from various interfaces like dashboards, web apps, and forms tailored to their roles. Team members can easily update project status via interfaces like P6 Team Member for iOS, Android, web (optimized for tablets), or email reporting. The software also offers interactive Gantt charts for precise project schedule communication and calendar/activity network views for intuitive assignment management.

Portfolio and program management—prioritizing projects and optimizing organizational capacity.

With Primavera P6 EPPM, project managers can have assurance that their projects and programs are in sync with the strategic goals of the company. The Portfolio and Program Management module offers a unified view and assessment of the portfolio or program, even as projects are added or removed. This empowers project managers to effectively handle incoming requests, choosing the optimal mix of projects. This approach ensures that resources are not stretched too thin and allows for straightforward measurement and communication of project performance to stakeholders.

Planning and risk management—executing complex projects

Many organizations handle numerous projects across different departments, making overall management complex. Primavera P6 EPPM simplifies this by offering a Planning and Scheduling module.

This tool is ideal for organizations managing multiple projects concurrently with multi-user access. It provides features for scheduling, resource control, and supports various project hierarchies, resource scheduling, data management, and customizable views.

It also includes risk management, robust reporting, and analytics features, allowing project-driven organizations to create efficient, risk-adjusted plans, improve project delivery, and proactively address unexpected challenges or trends across their projects.

Resources management—matching people with projects

Primavera P6 EPPM supports both top-down and bottom-up resource requests and allocations, facilitating communication between project and resource managers throughout a project's lifecycle. The software provides graphical insights into resource utilization, enabling proactive resource management. This centralized system helps identify and resolve resource conflicts, ensuring smooth project execution and optimized resource utilization.

Tracking progress to gain insights into costs and resource use.

Primavera P6 EPPM streamlines time tracking for managers, allowing team members to record their project hours and non-project time, like personal leave. The software provides interfaces pre-populated with assignments from all projects and enables direct communication with project managers, facilitating updates and feedback.

Collaboration and content management—improving organizational performance through collaboration.

Primavera P6 EPPM enhances team collaboration through automation. It incorporates collaboration and communication directly into the workflow, eliminating interruptions. The integration with email and mobile devices ensures real-time communication, keeping project schedules on track. It also supports existing content management systems for better project documentation control and accessibility.

Reporting and analytics—driving sound decision-making

Primavera P6 EPPM enables the scheduling and efficient sharing of project information via email, content repositories, file sharing, and printing. Users can access a variety of standardized reports or create customized ones in formats like .pdf, .csv, and .xml through its integrated reporting system. Additionally, Oracle offers Primavera Analytics for creating operational reports and business intelligence on projects and programs. Primavera P6 Visualizer visually tracks project performance against the plan, making even complex schedules easily shareable.

Integration—interoperating with ease

Primavera P6 EPPM from Oracle seamlessly integrates with existing Oracle enterprise management solutions, as well as ERP solutions from other providers like SAP. It empowers project and program managers to create customized solutions using features like Primavera Gateway, Primavera Web Services, and Integration API.

 Primavera Gateway ensures data consistency and transparency across the enterprise, while Primavera Web Services facilitates integration with existing business systems, enhancing productivity and project outcomes. (Construction and Engineering, Oracle)

Interviews

This chapter delves into the interviews conducted as part of this thesis research. The study engaged two distinct construction management companies in a comprehensive exploration of their operational practices and technological preferences. The participants comprised a renowned international corporation with a substantial presence in Milan and a comparatively smaller, Milan-based entity, both actively engaged in the field of construction management. The interviews were designed to elicit insights into their daily challenges, project management methodologies, and software utilization. Additionally, the interviewees were prompted to envision ideal tools to streamline their daily work processes for enhanced effectiveness.

1 Participant Profiles

The participants in this study were strategically selected to provide a comprehensive perspective on construction management practices. The first company, an international giant, maintains a global presence while being rooted in Milan, Italy. In contrast, the second company, a smaller enterprise, primarily operates within Italy but is also headquartered in Milan. Both organizations are deeply entrenched in the domain of construction management.

2 Software Utilization

A significant aspect of the interviews focused on the software tools employed by these companies in their project management endeavors. Distinct differences were observed between the companies' approaches, largely contingent upon project scale. Notably, for smaller construction projects, the absence of specialized software was conspicuous. In these instances, project teams relied on collaborative brainstorming sessions, augmented by email communication, for project delivery. However, a substantial shift in methodology was evident when examining larger construction projects, where sophisticated software systems played a pivotal role.

Highlighted Statement 1:

The interviewees from both companies unanimously acknowledged that, for smaller projects, conventional communication methods sufficed, underscoring the significance of scale in software utilization.

In contrast, substantial software integration was evident for large-scale projects, with Building Information Modeling (BIM) and Oracle Primavera P6 emerging as the primary tools of choice. BIM facilitated the creation of 3D models and quantity estimations, while Oracle Primavera P6 integrated financial aspects such as cost and duration.

The smaller company's reliance on BIM and Oracle Primavera P6 for their project management needs contrasted with the larger corporation's more intricate approach. In the latter case, a distinctive process unfolded. Initially, a 3D model was developed using BIM, followed by data transfer to Oracle Primavera P6 for financial evaluations. Subsequently, data from Primavera was further employed in the Synchro software for graphic simulations.

Highlighted Statement 2:
The primary point of differentiation between the two companies was the presence of a centralized core system within the larger corporation, simplifying access to critical project management resources.

3 Insights on Process Improvement

Interviewees were probed regarding their perspectives on measures to enhance work processes and project efficiency. The representative from the smaller company emphasized the critical need for improved organizational structures within the company, citing concerns related to personnel competence and allocation. In contrast, the representative from the larger company stressed the importance of cross-functional transparency, highlighting the necessity for each employee to possess comprehensive knowledge of their colleagues' activities to maintain uninterrupted workflow.

4 Ideal Software Systems

In discussing their ideal software systems, the interviewees articulated distinct preferences. The representative from the smaller company expressed a desire for software resembling BIM but with heightened flexibility to accommodate the uniqueness of each project. Notably, this viewpoint was accompanied by a keen observation regarding the increasing complexity characterizing modern project management practices.

Conversely, the representative from the larger company envisioned streamlined, rule-based systems that would foster uniformity in processes and data sharing. Additionally, the concept of establishing a comprehensive project database, spanning the company's entire history, was proposed. Such a repository would serve as a reservoir of experiential knowledge, continuously updated with contemporary technological advancements.

Highlighted Statement 3:

Both interviewees emphasized that software, while pivotal, is not the sole determinant of efficiency; instead, it is the way these tools are effectively utilized that drives differentiation in project outcomes.

5 Agile Methodologies

To conclude the interviews, the participants were queried regarding the applicability of agile methodologies within their work environments and whether the software tools themselves aligned with agile principles. Remarkably, both interviewees concurred that agility was inherent in their daily work routines. They highlighted their commitment to seeking effectiveness and efficient problem-solving as the essence of agility. Consequently, it was deduced that the agile mindset permeated their work culture, transcending the software tools utilized.

In conclusion, project effectiveness is predicated on a confluence of factors: the organizational structure of the company, the cultural background of its personnel, and the judicious utilization of tools. It is the harmonious amalgamation of these elements in an agile manner that truly defines the success of a construction project. The insights gleaned from the interviews elucidate the intricate dynamics at play, highlighting the interdependence of technological resources, organizational ethos, and individual perspectives. These findings provide a holistic perspective on the multifaceted nature of project management, offering valuable insights for optimizing project outcomes within the realm of construction management.

Chapter 18

Conclusion

In the ever-evolving landscape of project management, this thesis has embarked on a journey to explore the profound transformation brought forth by Agile methodologies and their impact on project management software. From the early origins of project management to the emergence of Agile as a response to dynamic project environments, we have traversed through history and witnessed the evolution of practices that underpin modern project management.

Agile, with its roots firmly planted in the Agile Manifesto and a spectrum of Agile methods, has transcended industries, making its presence felt in construction management, engineering, aerospace, pharmaceuticals, and the automotive sector. Agile Project Management (APM) has emerged as a paradigm, a philosophy that embodies the essence of agility in project execution.

Within the realm of project management software, we have dissected the essential components and features that have become indispensable to Agile practitioners. Scheduling, task lists, file sharing, and reporting have been reimagined to align with the dynamic and iterative nature of Agile project management.

But it is not merely the tools; it is the people, the organizational culture, and the collaborative spirit that infuses life into Agile practices. The insights from interviews with seasoned professionals underscore the paramount importance of organizational structure, cultural backgrounds, and the judicious use of tools. Whether it's a smaller enterprise relying on flexibility or a larger corporation championing uniformity, it is the effective utilization of software that separates excellence from mediocrity.

As we reflect on this journey, we discern the synergy between Agile methodologies and project management software. It's a synergy that places collaboration, flexibility, and customization at the forefront, underlining the transformative potential of Agile in the modern project landscape.

In conclusion, this thesis celebrates the fusion of past and present, history and innovation, tradition and agility. It is a testament to the ever-adapting nature of project management, where the Agile mindset reigns supreme. The future promises continued evolution, with Agile principles continuing to reshape project management, enabling organizations to thrive in a world defined by change and innovation.

This thesis offers not just a retrospective, but a compass pointing toward the future. It beckons for further exploration, for deeper dives into the evolving relationship between Agile methodologies and project management software. The implications of our findings extend far beyond these pages, offering a wellspring of insights for project practitioners, software developers, and organizations daring to chart a course in the dynamic waters of modern project management.

As we bid adieu to this chapter, we set sail toward new horizons, where the legacy of Agile in project management continues to unfold. Notably, while our research delved specifically into the construction industry, it paves the way for similar investigations in

other relevant industries. This journey is but the beginning, as the transformative potential of Agile principles holds promise across a spectrum of sectors, reshaping the future of project management software and practices.

Chapter 19

References

Acebes, Fernando, et al. "A new approach for project control under uncertainty. Going back to the basics." International Journal of Project Management, (2014).

Aguanno, K. (2004) Managing agile projects, (1st Edition). Ontario: Multi-Media Publications Inc.

Alleman, G.B. (2005) 'Agile project management methods for IT projects', in Chapter 23 of 'The story of managing projects', USA: Greenwood Press, Praeger Publishers. Artto K., Martinsuo M., Kujala J., Project business, Helsinki, (2011).

Augustine, S., and Woodcock, S. (2008) 'Agile Project Management.' Retrieved on 26th Oct. 2009.

Beck, K. et al. 2001. Manifesto for agile software development. Referenced 23 November 2014. agilemanifesto.org.

Cadle, J., and Yeates, D. (2008) Project management for institution system (5th edition)), England: Pearson Education Ltd.

Carayannis, Elias G., Young-Hoon Kwak, Anbari, Frank T. 2005. The Story of Managing Projects: An Interdisciplinary Approach. Preger Publishers.

Chin, G. (2004) Agile project management: how to succeed in the face of changing project requirements. New York: Amacom Publishers.

Conforto, E.C., and Amaral, D.C. (2008) 'Evaluating an Agile Method for Planning and Controlling Innovative Projects,' Project management Journal, Early View, (Articles online in advance of print), published online: 18 Dec 2008.

Construction and Engineering, Oracle. "Primavera P6 Enterprise Project Portfolio Management." Oracle Primavera P6, 2023, www.oracle.com/it/construction-engineering/primavera-p6/.

De Marco, "Project Management Theory Book" URL: http://hdl.handle.net/11583/1659508, (2007).

Drumond, Claire. "Scrum - What It Is, How It Works, and Why It's Awesome." Atlassian, 2018, www.atlassian.com/agile/scrum.

Eastman, Chuck, et al. BIM Handbook. John Wiley & Sons, 25 Mar. 2011.

Fitsilis, P. (2008). "Comparing PMBOK and Agile Project Management software development processes". Netherlands.

Fowler, M. 2005. The new methodology. Referenced 25 November 2014. http://www.martinfowler.com/articles/newMethodology.html.

Gustavsson, T. (2013) Agil project ledning. Second edition. Stockholm, Sweden: Sanoma Utbildning AB.

Gustavsson, T., & Rönnlund, P. (2013) Agile adoption at Ericsson hardware product development. In the 22nd NFF Nordic Academy of Management Conference, Reykjavik, August 2013. Island: ResearchGate.

Hass, K. B. (2007) 'The Blending of Traditional and Agile Project Management. PM world today, Retrieved on 30th of August 2009.

Highsmith, J. (2008). 'Keeping the Customer in the Product Loop', The cutter Edge, Retrieved on 15th December 2009 from:

Jansson, Tomas. Agila Projekt lednings metoder Och Motivation. Sept. 2015, www.diva-portal.org/smash/record.jsf?pid=diva2%3A782985&dswid=9789. Accessed 15 Mar. 2023.

Kerzner, Harold R. 2006. Project Management: A Systems Approach to Planning, Scheduling, and Controlling. John Wiley Sons.

Kimmons, Robert L. , Loweree, James H. 1989. Project Management: A Reference for Professionals. Marcel Dekker.

Kimmons, Robert L. , Loweree, James H. 1989. Project Management: A Reference for Professionals. Marcel Dekker.

Laanti, M. 2012. Agile Methods in Large-scale Software Development Organizations: Applicability and Model Adoption. University of Oulu. Faculty of Science, Department of Information Processing Science. Academic dissertation.

Larman, C. 2003. Agile and Iterative Development: A Manager's Guide. Addison-Wesley Professional.

Larman, C. & Basili V. R. 2003. Iterative and Incremental Development: A Brief History. Referenced 20 November 2014.

Martin, R. C. (2003) Agile software development: principles, patterns, and practices. NJ, USA: Prentice Hall PTR.

Musyoka, Alice. "Best Project Management Software and Tools | 2019 Reviews of the Most Popular Systems." Capterra.com, 2019, www.capterra.com/project-management-software/.

Musyoka, Alice. "Best Project Management Software for 2022." Webopedia, 24 June 2022, www.webopedia.com/definitions/best-project-management-software/. Accessed 16 Apr. 2023.

Owen, R., Koskela, L.J., Henrich, G., and Codinhoto, R. (2006) 'Is Agile Project Management Applicable To Construction?', Ponteficia Universidad Católica de Chile, Santiago, Chile.

Schwalbe, Kathy. 2013. Information Technology Project Management.

Tang, T. C., Juhary, A., and Thong, G.C. (2004), 'Knowledge Management in Agile Organizations', Sunway college journal.

"Software Advice." Softwareadvice.com, 2019, www.softwareadvice.com/.

"Best Project Management Software for 2022." Webopedia, 24 June 2022, www.webopedia.com/definitions/best-project-management-software/. Accessed 16 Apr. 2023.

"Best Project Management Software and Tools | 2019 Reviews of the Most Popular Systems." Capterra.com, 2019, www.capterra.com/project-management-software/.

"PCMag." Pcmag.com, PCMag, 2019, www.pcmag.com/.

Guide, A. "Project Management Body of Knowledge (PMBOK® GUIDE)." Project Management Institute. (2001).

Carayannis, Elias G., Young-Hoon Kwak, Anbari, Frank T. 2005. The Story of Managing Projects: An Interdisciplinary Approach. Preger Publishers.

Construction and Engineering, Oracle. "Primavera P6 Enterprise Project Portfolio Management." Oracle Primavera P6,