Czech University of Life Sciences Prague

Faculty of Economics and Management

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Master's Thesis

Comparison of Project Management Methodologies in a Selected Company

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Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

Shahina Islam Tripty

Systems Engineering and Informatics
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Thesis title

Comparison of project management methodologies in a selected company

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Objectives of thesis

The main objective of this diploma thesis is to compare traditional software development project management methodologies and currently following agile methodology in an IT company. In terms of meeting defined objective, it is divided into the following deliverables in order to acquire the defined goal:

- To compile all relevant information in the field of traditional and agile methodology in IT project.
- To compare mentioned two project management methodologies.
- To analyze and characterize traditional and agile methodologies.
- To propose a comparatively more approachable methodology for an individual Project.
- To suggest the next steps for overcoming challenges over the current difficulties in the project management field of the company.

Methodology

The methodology of this diploma thesis is based on more beneficial findings and implementations by studying and comparing two project management methodologies. For this purpose, in the theoretical part, the current methodology of a selected company will be examined thoroughly, which includes IT project, project quality, project success, project management methodology, its benefits, and barriers.

Then from clear understanding of current related literature, scientific papers, and online resources of each part of agile project management methodology and traditional methodologies separately, a clear depiction will come out that which methodology will be more applicable according to the structure of the IT organization.

And finally, the practical part will deal with the analyses and corrections of the present limitations of the project running by the IT company. At the end, the Diploma thesis conclusion will be defined based on the findings from the practical and theoretical parts.

The proposed extent of the thesis

60-80 pages

Keywords

Project Management, Agile Methodology, Kanban, Scrum, Waterfall, IT projects.

Recommended information sources

Daniel J. Fernandez & John D. Fernandez (2008) Agile Project Management —Agilism versus Traditional Approaches, Journal of Computer Information Systems, 49:2, 10-17, DOI: 10.1080/08874417.2009.11646044

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Declaration

I declare that I have worked on my master's thesis titled " Comparison of project management methodologies in a selected company" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

In Prague on 30 of November 2022 _____

Shahina Islam Tripty

Acknowledgment

I would first like to express my sincere gratitude to my Almighty Allah, and secondly, I would like to express my gratitude to Ing. Petra Pavlíčková, Ph.D., for her insightful comments throughout the preparation of the diploma thesis. And I like to express my gratitude to my husband and my parents for all of great support.

Comparison of Project Management Methodologies in a Selected Company

Abstract

The topic of the diploma thesis has been built on project management and provides a more in-depth look at this topic. It gives a summary, defines the fundamental terms, and then discusses two main project management methodologies. The purpose of this study is to recognize when using traditional methods and when using agile methods in the development of IT project management methodologies. Individual approaches are described, and their development is recorded.

In the case of the traditional approach, attention is paid to the methodology called Waterfall. This methodology is characterized by an elaborate plan, a linear procedure, comprehensive documentation. For the agile approach, the work mainly deals with the SCRUM methodology, the essence of which lies in an iterative process (Sprints), effective response to changes and is used when it is not possible to completely determine the procedure to achieve the goal of the project. Subsequently, the differences of these are listed methodologies and their selection is justified on practical examples of IT projects.

Keywords: Project management, Waterfall, Agile, SCRUM, IT Project, Sprint

Porovnání metodik projektového řízení ve vybrané společnosti

Abstrakt

Téma diplomové práce je postaveno na projektovém řízení a poskytuje hlubší pohled na toto téma. Poskytuje shrnutí, definuje základní pojmy a poté diskutuje dvě hlavní metodiky projektového řízení. Účelem této studie je rozpoznat při používání tradičních metod a při použití agilních metod při vývoji metodik řízení IT projektů. Jednotlivé přístupy jsou popsány a zaznamenán jejich vývoj.

V případě tradičního přístupu je pozornost věnována metodice zvané Waterfall. Tato metodika se vyznačuje propracovaným plánem, lineárním postupem, komplexní dokumentací. U agilního přístupu se práce zabývá především metodikou SCRUM, jejíž podstata spočívá v iterativním procesu (Sprinty), efektivní reakci na změny a používá se v případech, kdy není možné zcela určit postup k dosažení cíle. projekt. Následně jsou uvedeny rozdíly mezi těmito metodikami a jejich výběr je zdůvodněn na praktických příkladech IT projektů.

Klíčová slova: Projektový management, Waterfall, Agile, SCRUM, IT Project, Sprint

Table of Content

1 Introduction

Project management helps implement larger and smaller projects that are needed plan so that they have the best chance of being successful achieving their objectives. The cooperation of a group of people is necessary for these projects to be accomplished (team). Planning consists of thorough estimate of costs and deadlines. A successfully implemented project is considered one when the goals of the project was achieved within the estimated costs and deadlines. If the project deviates significantly from its plan during the course, it is the task of the project manager to transform the project back. As far as IT projects are concerned, it is necessary to be able to react dynamically to processes, because the modern age is complex, volatile and, last but not least, rapidly evolving. In response to modern time came an agile approach to project development, which offers flexibility in project management. But the traditional approach must not be condemned because it also has its advantages.

The goal of this work is to better comprehend various methodologies and identify their key components, which might assist in deciding on the methodology that will be most beneficial for the job.

Selecting the appropriate methodology will increase the project's chances of being successful and enable resource conservation (both financial, time and human). There are other approaches as outside of those that are purely traditional or completely agile. The project management organization has the option to customize the methodology.

2 Objectives and Methodology

2.1 Objectives

The purpose of this diploma thesis is to introduce the reader to the problem within the theoretical area of project management in general. Then, a summary of project management will be given using both traditional and agile methods. At the end of the theoretical chapter, these two types will be compared methodologies based on different perspectives. The objective of the practical section is to complete a thorough examination of the project assignment, which results in the choice of an appropriate approach. What made the technique chosen useful is stated at the conclusion of every project.

2.2 Methodology

The study of recent literature provides as the foundation for the development of the theoretical portion. The work begins with professional terminology to ensure that the topic of project management is correctly understood. This terminology contains, among other things, the characteristics of the project's organizational structures. Understanding each methodology independently is important in order to be able to compare them. It is first attention paid to the traditional approach, where the Waterfall model is presented and described its process. The agile methodology is the focus of the second sections, which also provides an overview of the fundamental ideas behind it. In more detail, this paper concentrates on SCRUM's current methodologies. These approaches are evaluated and analyzed based on the information obtained, with the goal of determining which methodology should be used in particular circumstances. Two real projects are highlighted in the practical section. First, NN Management Service s.r.o., a company that offered more thorough information on two previously finished projects, will be introduced. Due to a confidentiality agreement, the sponsors of the project have been made anonymous. Each project's focus will be familiarized as work on it.

Finally, an appropriate approach will be chosen based upon the information provided, and also the subsequent rational explanation of why the methodology was adopted, will be deigned. The project's progress will then be described in more detail since it is not described in more detail under the required focus and is not the subject of this study.

3 Literature Review

The world was launched into a global age of business, invention, conflict, politics, and technology at the start of the twentieth century. As the Industrial Age came to a conclusion, businesses sought to expand domestically and internationally into new markets. Administrators were tasked with differentiating operational staff into two categories when business initiatives arose: one group to maintain current operations running while using another group to participate on strategies to grow the business, whether there was opening a new location, increasing market share, continuing to expand nationally, creating a new good or service, or acquiring a new line of business. As a result, the current notion of project management has been emerged. Researchers, analysts, and managers have studied the practice of project management for over the century. This research has revealed a number of

approaches to implementing project management within a company. However, a complete analysis of the literature surrounding the history, terminology, and methodology utilized in modern project management is expected to proper understand the actual benefits of project management. Consequently, managers may make evidence-based determinations regarding the advantages of a good project management project management methodology and pick the project management methodology that best suits the goals and objectives they want to achieve after reviewing the literature supporting project management. (Hannah Snyder, 2019)

The knowledge and insights gathered from the literature review were critical in identifying the essential themes and issues that contributed in the shaping and structuring of this body of work. To meet the study topic's objectives, it is necessary to provide a comprehensive, in-depth examination of current literature in the field of organizational culture in IT project management. It was able to build a theoretical framework to solve the research problem stated in the preceding chapter with the assistance of journals, books, and scientific papers. (Hannah Snyder, 2019)

The author also investigates the significance of internal culture and the many implications it may have on an organization. The author develops an overall picture of the culture inside the selected organization by analyzing prior literature and frameworks that strive to investigate organizational culture in depth. The author focuses on many cultural topics such as corporate standards, behaviors, structures, systems, power structures, and symbols. This contributes to the overall picture of organizational culture and allows for the measurement of the influence of organizational change on the current culture. (Hannah Snyder, 2019)

3.1 Project

A project is an action that is carried out in order to create a unique product or service; hence, activities that are carried out to complete normal tasks are not considered projects. (Susan & Nels, 2005)

A project can be defined as a "temporary activity with a beginning and an end that must be utilized to generate a unique product, service, or outcome," according to the third version of the PMBOK 2010 (Project Management Body of Knowledge). It's also becoming better and better. Projects, according to this definition, are activities that cannot be continued continuously and must have a specific goal in mind.

It is important to understand that the term "temporary" does not relate to the project's outcome or service. The project may be finished, but the outcome is not. A project to create a monument, for example, would have a limited term, whereas the monument itself may be for an endless amount of time. (PMBOk, 2010)

A project is an activity that involves the creation of something unique. Finally, a project should be developed incrementally. This indicates that the project is being carried out in stages and in increments. This also implies that the project's description is fine-tuned at each stage, and the progress's goal is stated in the end. This implies that a project is defined first, and then as the project proceeds, the definition is examined, and additional clarity is added to the scope of the project as well as the project's underlying assumptions. (Susan & Nels, 2005)

The authors are divided on how to define a project uniformly. One of the features is that "Projects have a three-dimensional aim, are distinctive, employ resources, and are implemented within companies," (Rosenau, 2017)

The three-dimensional aim specifies specific requirements for the project's timeline and budget to be implemented. It is a one-of-a-kind project since no two are same. And if the project is quite similar to another, such as for a project with the same objective, there will undoubtedly be some differences in the details. The project is only for a short period of time, and each participant has a distinct beginning and conclusion. It should also include something fresh and unique. (Rosenau et al., 2017)

Unique, temporary, multi-disciplinary, and structured efforts to implement contracted outputs (deliveries) for predetermined requirements and limits, according to IPMA 2017. To accomplish project objectives, these outputs must meet a variety of limitations, including time, money, resources, and standards quality or quality criteria. Each project is a one-of-a-kind attempt to create something fresh. With the exception of extremely simple initiatives, this necessitates abstraction abilities and conceptual thinking, which is breaking down a given subject whether an output, plan, demand, risk, circumstance, or problem into smaller bits and combining them into new and useful concepts. (IPMA 2017)

3. 1. 1 Project Stages

(IPMA 2017) Defines, A time period within a project that is distinct from other time periods and has a predetermined outcome.

Features of the project stages,

- At the beginning of the project, products can be designated clearly.
- During the stage, there was no notable change in course.
- All participants' responsibilities are well defined.
- A good assessment of the required time and resources in advance.
- There is no requirement for the project sponsor to be actively involved.
- Finally, a managerial decision is required.

3. 1. 2 Project Management

When the term "project" is defined, the history of project management begins. While most businesses focus on generating products and services for their consumers on a daily basis, there are occasions when a temporary assignment is undertaken to test the introduction of a new possibility and see whether it would be beneficial to the department or company. A project is defined as a "temporary endeavor undertaking to produce a one-of-a-kind product, service, or outcome." (Stackpole, 2010).

A project does not endure eternally, but rather has time limits and is focused on producing a product, service, system, or outcome that is unique to the business. A program, which may exist forever, or a portfolio, which is a collection of initiatives, do not have the same uniqueness as a project. (Stackpole, 2010). Project management pioneer Henry Gantt, an engineer at the start of the twentieth century, was attracted by its singularity. Gantt started with the development of tools to aid his team of engineers as they managed projects and provided consulting services to huge corporations including Westinghouse, Canadian Pacific Railways, and Union Typewriter (Gantt Henry Laurence, 2006). The Gantt chart, which emerged as a daily balance chart representing the daily process of labor, is Gantt's most renowned invention. This diagram was crucial in bringing about a shift in the planning process. The graph was more concerned with time and detail than with quantity. While the chart was shockingly basic, it was remarkable for the period of time. Many other engineers and managers were inspired by Gantt's work to look at projects in a whole new perspective, focusing on punctuality, attention to detail, and productivity, and how these elements might be represented on a big scale. When it came to new prospects, the notion of project management was in full swing, and managers sought for the finest project management methods to provide their companies a competitive advantage in the marketplace. However,

unlike mid- to late-twentieth decade, when projects were expanding and new to the organizational environment, today's projects are more mature. (Gantt Henry Laurence, 2006).

3. 1. 3 Project Lifecycle (Kathrin Koster, 2010)

The project undergoes adjustments and goes through many stages as it progresses. The project life cycle is what we call these phases.

Initiating phase:

The front-end phase or kick-off phase are other names for the initiating phase. The opportunity or necessity is confirmed. After rigorous consideration and determination of the project's overall viability, the project is developed. The business case is established during this phase.

Planning:

Choosing what has to be done to accomplish the project's goals within the established organizational restrictions is the basis of project planning. The so-called project management plan or project master plan is given as a consequence of this phase, together with the list of resources needed to carry out the project.

Executing / controlling:

The project plan is implemented, monitored, and managed during this phase. The project design is also finished during this phase and utilized to create the project's deliverables.

Completion:

The transfer of the product or service to the internal or external client constitutes the completion, termination, or closing phase. Additionally, a final evaluation of the entire project is conducted in order to draw lessons from previous failures and triumphs. A new team will be assigned to the project.

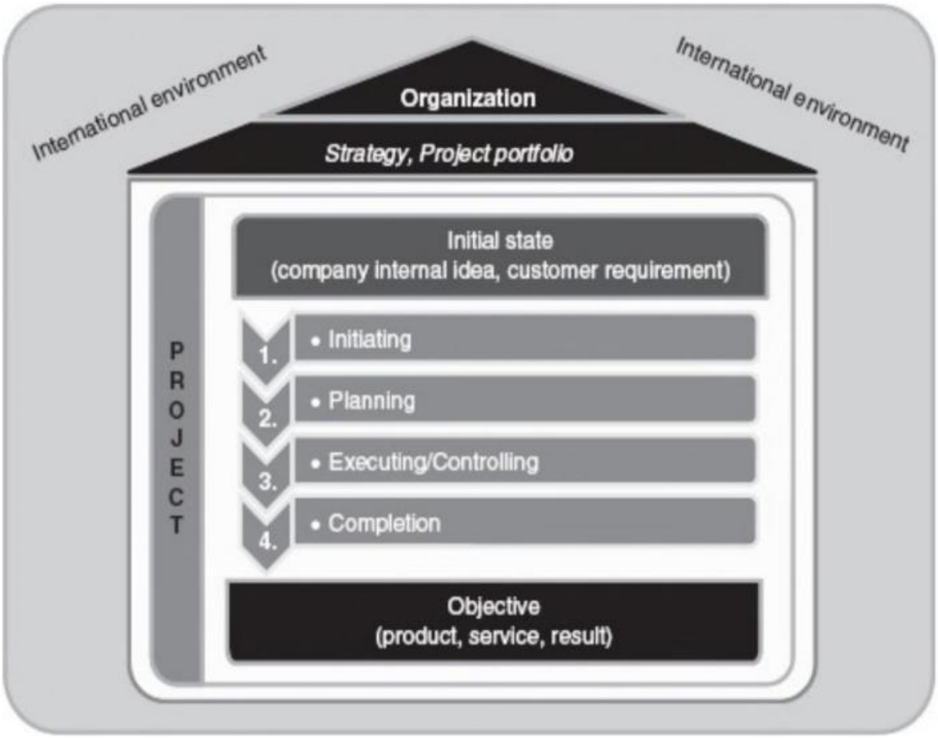

Figure 1: The project management Life- Cycle. (Kathrin Koster, 2010)

The typical project flow pattern from beginning to end follows a sequence of identifiable phages, during which the project is born, matures, aged, and finally expires. For instance, a project manager for software development might specify the following stages as part of a project's life cycle: initial proposal, process engineering-specifications, design, testing, development, deployment, and support, project requirement analysis. The following phages may also be present in a project that leads to the creation of a new product: conception, technical feasibility, development, commercial validation and production planning, full-scale manufacturing, and product support. There are six phases of the product life cycle, each with its own purpose and characteristics, however there may be some overlap as well. The owner must first decide on certain pre-project decisions. The project's planning and design are then put into action. Following the selection of the contractor, the latter mobilizes to carry out the field operations. It is possible to think of the field work, which the average person frequently equates with "building," as a separate phase. Since these actions are separate from the installation work, the project must be finished and brought to an end. So, six phages of project lifecycle are (Lawrence Bennett 2007):

Pre-project Phase

A concept, a perceived need, a wish to enhance or increase productive capacity, or the desire for more effective delivery of some public function all serve as the foundation for a building project. During the planning and design stage, it will be determined whether the idea will be turned into a finished project. The owner must first decide what kind of project delivery system will be employed, though, before doing anything else. How will the different parties be connected. Will the owner hire a designer to create the designs and specifications before hiring a construction company separately. Or will the entire project be handled by a single organization. (Lawrence Bennett, 2007)

The use of a construction manager as an advisor to the owner, the use of the owner's own construction forces, and the phasing of the project such that specific elements of the field work are started prior to the completion of all design work are all additional possibilities that could be considered. The owner must also make a decision about the form of contract to be employed with the contractor early on in the project. No of the real amounts used in the project or the contractor's actual expenditures, the contractor will be paid a predetermined fixed fee. Will the contractor be paid based on the measured material amounts and previously agreed-upon unit rates for each material? Or would the contractor receive payment for its real expenses in addition to a fee, maybe up to a predetermined maximum? The owner must also decide how the design professional will be compensated. These choices are frequently made with guidance and consultation. During this pre-project phase, the owner may consult a professional engineer, an architect, or a project manager for advice on these crucial decisions, depending on the owner's knowledge and experience in managing construction contracts. (Lawrence Bennett, 2007)

Planning and Design Phase

During the planning and design phase, the project is completely defined and prepared for contractor selection and deployment. This phase can be broken down into three sections for convenience. Defining the project's objectives, considering different approaches to achieving them, and determining whether the project is financially feasible are the aims of the first stage. A project brief will be developed, additional information will be provided in a program statement, various sites may be investigated, public input may be sought, a preliminary cost estimate will be prepared, funding sources will be identified, and a decision

will be made regarding whether to move forward with the project. The design expert will use the outcomes of the planning efforts in the second stage to create schematic diagrams that illustrate the relationships between the major project components, which will be followed by thorough design of the structural, electrical, and other systems. The latter activity is the traditional hard-core engineering that is familiar to students in the design professions. It involves selecting materials, determining component sizes and configurations, estimating loads and other requirements, and ensuring that each element is appropriate in relation to other elements. The results of this design creation process are used in the last phase when contract documents are created to be used in the hiring of contractors and the installation work at the construction site. (Lawrence Bennett 2007)

Contractor Selection Phase

The owner must decide in advance of choosing a contractor whether to extend an open invitation to all potential tenderers or to just pick contractors, as well as whether to use a pre-qualification process to reduce the number of tenders. Contractors, on the other hand, will need to think about a variety of aspects before deciding whether to put up the time to put together a proposal for a specific job. There will be two significant duties to complete if a contractor decides the potential project is appealing. Before anything else, a series of planning procedures will be carried out, including research into potential methods and equipment as well as the creation of a preliminary project schedule with an anticipated timetable for each main task.

Second, a budgeted proposal will be created that includes the direct expenses of labor, supplies, equipment, and subcontractors as well as different overhead fees and a profit margin large enough to cover costs. The submission, opening, and evaluation of bids, the choice of the winning contractor, and the conclusion of the construction contract are the concluding steps in this phase. (Lawrence Bennett, 2007)

Project Mobilization Phase

Before installation work may start at the project site, a number of tasks must be finished after the contractor is chosen. A number of bonds, permits, and insurances must be obtained. It is necessary to create a detailed schedule for the construction tasks. It is necessary to transform the cost estimate into a project budget and set up a mechanism for monitoring real project costs. The jobsite needs to be organized with areas designated for temporary structures and

services, delivery routes, storage facilities, and site security. It is necessary to start the process of acquiring the tools and materials that will be used in the project, as well as to make plans for the other crucial resource—labor. This phase is now complete, and the actual field construction may now start. (Lawrence Bennett, 2007)

Project Operations Phase

In this phase, the duties fall under three categories: resource management, monitoring and control. communication, management, and documentation. There are five crucial components to controlling and monitoring the work. To evaluate whether the project is on schedule or not, actual schedule progress must be compared to the project program; if not, steps must be made to try to bring the program back into compliance. The cost status must also be examined to determine how actual performance stacks up against the budget. Quality management, which ensures that the work conforms with the technical requirements contained in the contract agreements, is an equally crucial component of monitoring and control. Additionally, the contractor must manage the work in a safe manner while minimizing any negative effects on the environment. (Lawrence Bennett, 2007)

3. 1. 4 Project Constraint

Every project is bound in a unique way, frequently by its goals for scope, timing, and budget. The triple constraint or “iron triangle” is a term used in project management to describe these restrictions. A project manager must balance the often-incompatible goals of scope, time, and cost in order to achieve a successful project. There has been a lot of research in the domain of project management, but little of it has focused on quality management. Quality has received less attention than time, money, and scope. But quality now is included as a primary parameter; in this way, "iron triangle "time, budget, and scope quality comes. (Schwalbe 2016).

- **Scope:** What tasks are involved in the project? What special deliverable, service, or outcome does the client or sponsor anticipate from the project? How will the scope's validity be checked? (Schwalbe, 2016).
- **Time:** What is the project timetable and how long should it take to complete? How will the team monitor the execution of the actual schedule? Who has the authority to authorize schedule changes? (Schwalbe, 2016).

- **Cost:** What should the project's completion cost be? How much does the project cost? How will the expense be monitored? Who has the authority to approve budget changes? (Schwalbe 2016).

Figure 2: Project management triple constraints or iron triangle. (Schwalbe 2016).

3. 1. 5 Project Quality

The concept of "Zero Defect," first introduced by Philip Crosby in 1989, guarantees that "there is no waste occurring in a project." The idea contributes to the improvement of project processes and the enhancement of quality by identifying waste in the project, including any unneeded processes, ineffective tools, and workers. It is necessary to remove anything that will not help the project. Additionally, the zero-defect theory is the idea of satisfying the requirements correctly the first time around in order to reduce the cost and time involved in the project management process. (Crosby, 1989)., In his list of four standards for quality management, which are:

- Conformity to project specifications is a sign of quality.
- We can reach acceptable quality by avoiding errors.
- Zero Defect is the quality performance criterion, and
- The cost of quality is the most significant performance metric.

However, others contend that employing the zero-defect principle is insufficiently effective. Meanwhile, others have made great efforts to demonstrate the viability of the zero-defect idea, stressing that it does not, in reality, entail perfection but rather that reducing waste and making sure things are done correctly the first time ensures the highest levels of quality for the project. (Crosby, 1989).

Techniques, procedures, and approaches all fall under quality management. Project quality management, according to (Herman Steyn, 2008), focuses primarily on planning and control, whereas quality assurance is seen as a program that incorporates both planning and quality control. The Shewhart cycle, also known as the Plan-Do-Check-Act cycle, was mentioned by the author in relation to these project quality processes. The entire project management team must carefully design these processes since quality assurance is defined as the "Do" element and quality control as the "Check Act" element. The phrase "Failure mode and effect analysis" (FMEA) is used to describe a procedure that is done to discover technical system breakdowns and is well suited to risk management in general. Hazards associated to technical concerns are addressed by quality management approaches, although non-technical risks are also addressed by the standard risk management approach. (Ghadi, Mashael, 2022)

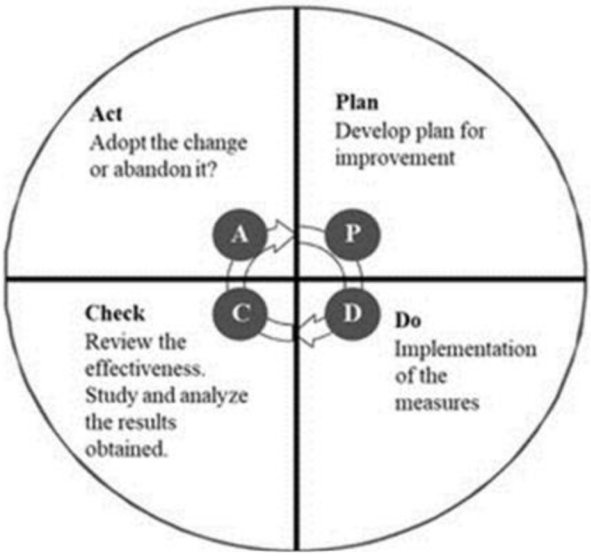

Figure 3: Shewhart cycle / PDCA cycle (Ghadi, Mashael, 2022)

Overall, these findings showed that quality cannot be separated from other facets of project management as is stressed in project quality management. The use of the failure mode and effect analysis technique demonstrates the close connection between risk management and quality control techniques. analyzed the "Zero Defect" idea, one of the most well-known quality theories. (Ghadi, Mashael, 2022)

3. 1. 6 Project Functional Structure

Executive managers and different expert vice presidents must report to the executive director in a hierarchical system. Workers only carry out tasks that are specific to their line of work.

In the traditional functional structure, there is a hierarchy with one obvious superior for each employee. At the top level, employees are divided into specialties including production, marketing, engineering, and accounting. The functional units that are centered on a particular specialty, such mechanical and electrical engineering, can be further separated into. In a functional organization, each department will carry out its project work independently of other departments. (PMBOK guide- 5th edition.)

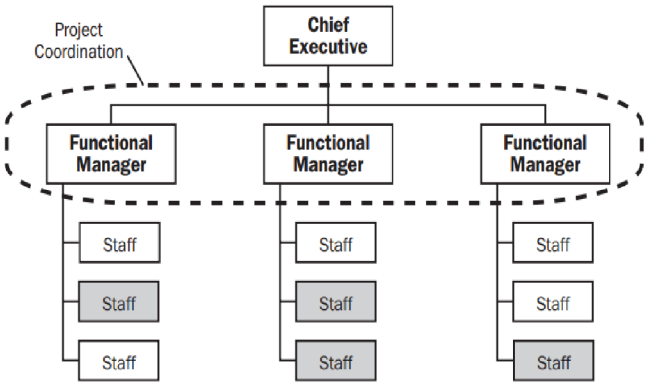

Figure 4: Functional structure of a project of an organization. (PMBOK guide - 5th edition.)

3. 1. 7 Matrix Structure

Depending on the relative balance of authority and influence between functional and project managers, matrix organizations can be categorized as weak, balanced, or strong. The project manager's position is more akin to that of a coordinator or expediter in weak matrix organizations, which nonetheless retain many of the traits of a functional organization. In addition to serving as staff assistant and communications coordinator, a project expediter. Decisions cannot be made or carried out by the expediter directly. Project managers are given some authority, some decision-making ability, and are required to answer to a higher-level management. Strong matrix organizations have many traits with projectized organizations, including the presence of full-time project managers with significant power and full-time administrative employees for projects. (Harrison, 2017)

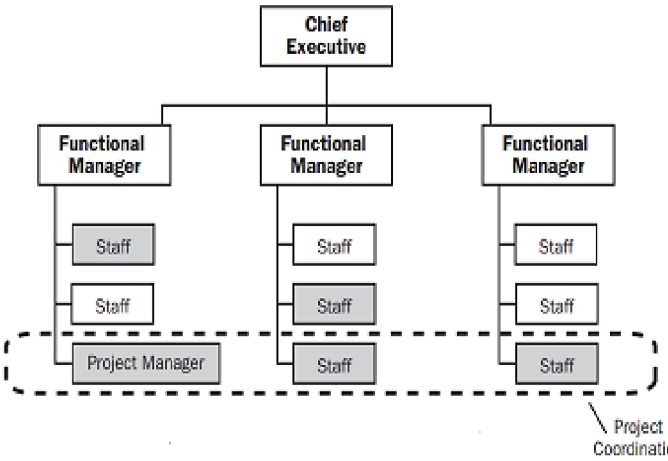

Figure 5: Weak matrix organization. (PMBOK guide - 5th edition).

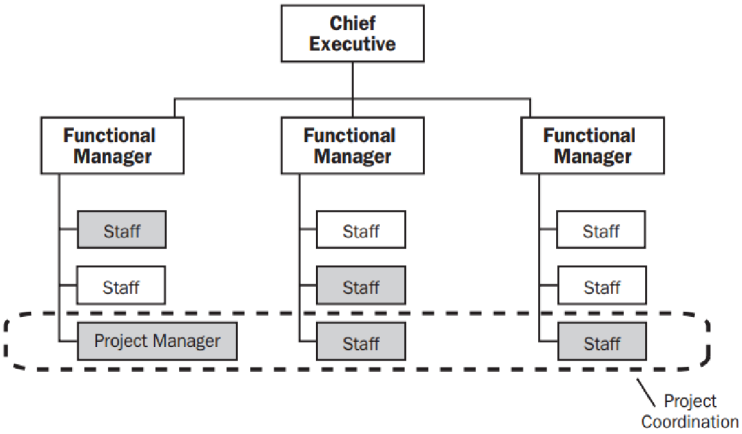

Figure 6: Balanced matrix organization (PMBOK guide- 5th edition).

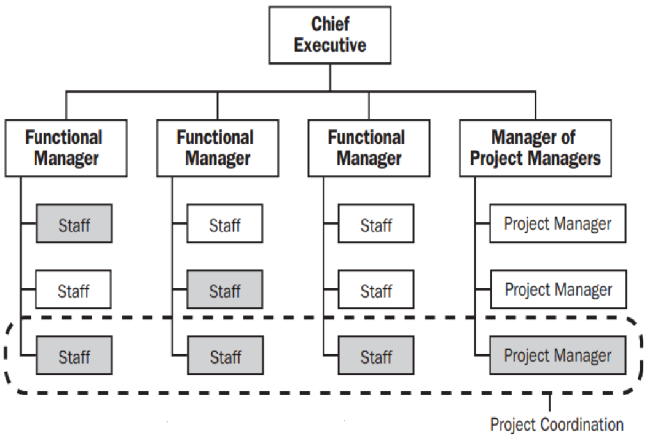

Figure 7: Strong matrix organization (PMBOK guide - 5th edition).

3. 1. 8 Participants on the project:

All those participating in the project or whose participation in the project will in some way influence them are the actors (participants), or stakeholders. (Schwalbe 2016).

The contracting authority project, project users, and project owners are typically included in the team that is authorized to engage in the project, according to Schwalbe (2016). Participants are also frequently able to influence the project (Schwalbe 2016) and adds that the following people are involved in the project:

- The project's client (contractor): an organization that demands the project be carried out specifically.
- Sponsor of the project (owner): His word is typically the most important factor when making decisions.
- Suppliers for the project: The company that assures it will fulfill the demands of the contractual authority.

Significant Positions in the Project Team

(Schwalbe 2016) states that, “People are the primary driving force behind the project, and they depend on the shape that a particular project takes when they are placed in suitable temporary organizational structures related to the project." The team's principal duty is to oversee the project.

Manager

One of the most crucial traits for a project manager is a broad knowledge base. Working together with the project's participants and, most important of all, the project owner is the project manager's responsibility. (Schwalbe, 2016).

Table 1: Essential characteristics of a project manager (Schwalbe, 2016)

1	Personnel skills
2	Leadership
3	Listening
4	Integrity, ethical behavior, principles
5	The art of creating trust
6	Verbal communication
7	The art of team building
8	Conflict resolution and management
9	Critical thinking, problem solving
10	Understanding and balancing priorities

Additionally, respondents were asked which abilities and competences they thought were most crucial in certain project scenarios (Schwalbe, 2016) :

Large Project: The most crucial factors were leadership, pertinent experience, planning skills, people skills, verbal communication, and team-building abilities.

Projects with a high degree of uncertainty: Need the greatest risk management, expectation management, leadership, planning, and interpersonal skills.

Innovative Project: The most crucial traits were vision, goal setting, self-assurance, expectation management, listening skills, leadership, and people skills.

In general, a leader encourages others to work for long-term goals and broad objectives while concentrating on the short term. A manager frequently works with the ongoing intricacies of achieving certain goals. The position of both leader and manager, however, is frequently assumed by project managers.

Reliability of Output

"The guarantor of the project output is the bearer of responsibility for correctly, on schedule, and within budget developed output (product) of the project to be consistent with the project aim and the ensuing projected benefits." The guarantor is often in charge of achieving the necessary goals. In some situations, a single individual can fulfill the responsibilities of both the project manager and the output guarantee. (PMBOK guide - 5th edition)

3.2 Traditional Methodologies

For projects with defined goals and objectives, a clear way for achieving them from the start, and a low amount of uncertainty, the conventional approach is better suitable. It is anticipated that few adjustments will be made, and customers or other project beneficiaries are not required to participate at any point in the process. Moreover, some research contend that this strategy is more effective when dealing with large projects or businesses where the project team exhibits inexperience or has a high staff turnover.

Source: “The adoption of project management methodologies and tools by NGDOs: A mixed methods perspective”, Journal of Business Research, 2019

An established manner "to think about projects and their management" is anticipated by the traditional approach to project management. For instance, the PMBOK and other comparable methods (such as PRINCE2 and APMBOK) adopt a conventional project management approach that emphasizes standardization of procedures to ensure "its robustness and applicability to a wide variety of projects from the smallest and simplest to the largest and most complex."

Source: “The adoption of project management methodologies and tools by NGDOs: A mixed methods perspective”, Journal of Business Research,2019

3. 2. 1 Waterfall Methodology

The Waterfall method was created by Winston Royce in 1970, adopted by software project managers, and improved via the application of lessons discovered throughout software projects. The Waterfall technique gave rise to modern project management approaches like PRINCE2 and PMBOK, which are the most used in Europe and North America today (Harrison, 2017). The Waterfall method views a project as a linear process made up of a number of fundamental sequential steps, each of which must be officially verified before progressing to the next level. This approach helps to reduce the complexity of an implementation process. (Harkirat Kaur Aroral, 2021).

The Waterfall systems development life cycle, also known as the Waterfall model or Waterfall technique, was one of the earliest development life cycles established and is still commonly used today for system development. Winston Royce refined the Waterfall model in 1970 by including a feedback loop so that each stage within the model could be carefully evaluated. Herbert D. Benington had first recommended that software be improved in phases back in 1956. For being more straightforward than other models of the systems development life cycle, the Waterfall model is praised by many academics, who also claim that it has helped other system development life cycles. Over time, the nomenclature for waterfall steps has changed, but still divides into five different sections: conception of the system, analysis of the system, design of the system, coding, and testing. (Harkirat Kaur Aroral, 2021).

The Waterfall model is a sequential software development method in which development is viewed as flowing ever-decreasingly downwards (much like a waterfall) via a set of steps that must be completed in order to properly construct a computer program. The Waterfall model specifies a number of parallel stages that must be finished one after the other, with the transition to the subsequent phase occurring only after the completion of the phase before it. This is why the Waterfall model is recursive, allowing each stage to be improved upon indefinitely. The fundamental steps of the waterfall methodology are the analysis phase, in which the software development process is analyzed, the design phase, in which the design of the software is chosen, the implementation phase, in which the steps are put into action, the testing phase, in which the software is tested, and the maintenance phase, in which the output is refined. (Bassil, 2012).

Royce first introduced the waterfall model, a software development life cycle model, in the 1970s. Projects used the waterfall method of software development prior to the advent of agile software development. The waterfall technique worked like a sequence of logical steps, with development moving naturally from one to the next. The fundamental presumption was that in order for the software to be planned, developed, and tested, the requirements had to be established in advance (Gray & Larson, 2017). The waterfall model is a sequential software development method that advances downhill, like a cascade (Bassil, 2012). It lists numerous sequential steps that must be finished one after the other, and it only moves on to the next phase once the one before it has been fully completed.

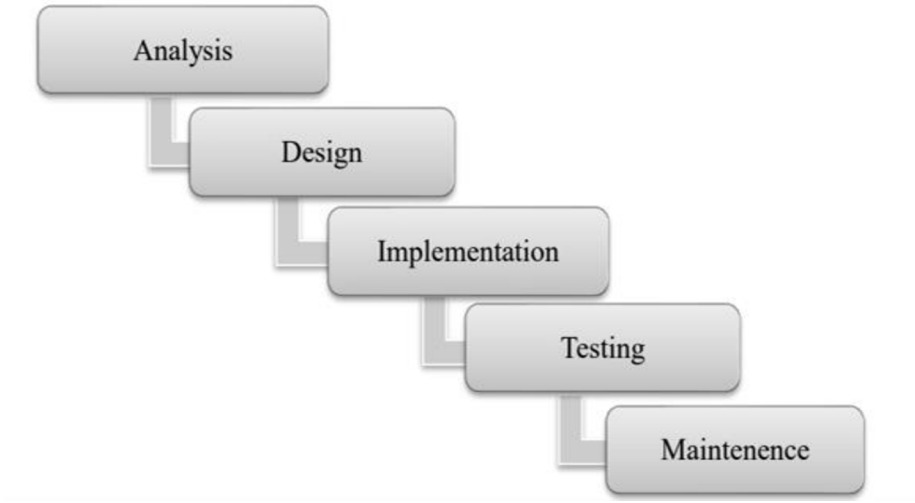

Figure 8: Waterfall approach. (Bassil 2012)

Waterfall Method's Phases

Analysis Phase

Also known as software requirement specifications (SRS), the analysis phase is a comprehensive description of the behavior of the program that will be produced. Both functional and non-functional requirements should be defined at this phase by the business analyst. Purpose, scope, viewpoint, and functions are only a few examples of functional requirements.

User traits, program features, and database needs. Contrarily, nonfunctional requirements cover restrictions, limits, and specifications for how the software must be designed and run. It possesses traits like dependability, scalability, testability, performance, and adherence to quality standards, among others. (Kaur, 2021)

Design Phase

The planning and problem-solving steps involved in creating a software solution are included in the design phase. Accordingly, the plan for a solution will be defined by the software developers and designers, and it will comprise things like algorithm design, software architecture design, logical diagram scheme, data structure description, etc. Software design is the subject of the current phase, which also involves more design work. (Kaur, 2021)

Phase of Implementation:

This describes the knowledge of business needs and the design and development of those requirements into a reliable execution program, database, or website. From where the database and text files were built, this is where the actual code is written and compiled into a working program. It basically refers to the transformation of the process phase into the manufacturing phase. (Kaur, 2021)

Phase of Testing:

Also referred to as verification and validation, this phase is a procedure for ensuring that the software expectations match the original performance and specifications and serve the intended purpose. Verification is the process of evaluating software to see if it meets the requirements that were set forth at the beginning. On the other side, validation describes the process of assessing the software both during and after the development phase to determine that it fulfills the stated criteria. The problems and system flaws are identified at this phase, and they are fixed and redefined appropriately. (Kaur, 2021)

Maintenance Phase:

The maintenance phase entails the actions taken to alter a software solution after it has been delivered and deployed in order to enhance output, fix mistakes, and boost performance and quality. This can also involve adapting software to its surroundings, addressing new user requirements, boosting dependability, etc. (Kaur, 2021)

(Harrison, 2017) states that, the circumstances under which the waterfall model is applied

- After the preceding phase is complete, the subsequent phase's outputs are utilized as inputs in the subsequent phase, which is carried out in a sequential manner.
- If we are provided the phases' order in advance, we are able to produce a high-quality output.
- An alternative sequence of steps may not ensure a better outcome.

3. 2. 2 Spiral Model

In order to combine the benefits of top-down and bottom-up approaches, the spiral model is a software development process that incorporates components of both design and prototype in phases. Due to its status as a meta-model, it may be utilized by other models. It also puts a lot of emphasis on assessing risks and lowering project risk. This may be done by dividing a project down into smaller pieces, which makes changes easier to make during the development process and gives the chance to assess risks and balance the pros and disadvantages of continuing the project across its whole life cycle. As a result, the development team has the opportunity to draw fresh conclusions from the first iteration (via a risk analysis process). Until the program is prepared for the installation and maintenance phase, the team will also continue to add functionality for new requirements in ever-increasing "spirals". Each iteration before the final output is referred to under this approach as an application prototype. (Adel & Abdullah, 2015)

A quick summary of the phases of the Spiral model is provided in the steps below (Adel & Abdullah 2015):

- **The first part of the process is planning:**

which involves understanding the needs of the system through ongoing contact between the system analysts and the consumers.

- **Risk Analysis:**

In this stage, a procedure is used to find potential risks and workarounds. This phase ends with the creation of a prototype.

- **Development/Engineering:**

During this stage, testing and the creation of the program take place.

- **Evaluation Phase:**

Before moving on to the following spiral or round, the client is given the opportunity to assess the project's results during this phase.

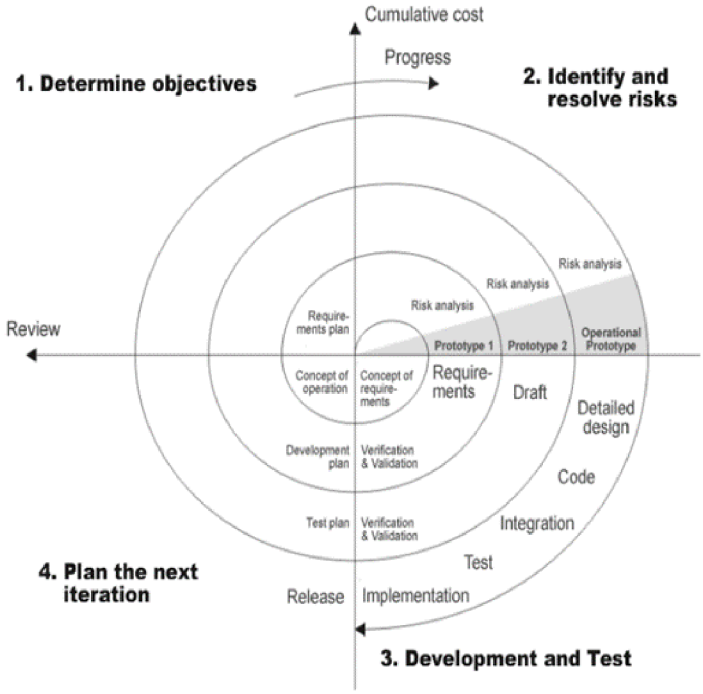

Figure 9: Spiral Model of the software process. (Barry W. Boehm, 1988)

The model is most beneficial to the project team. Early issue detection will be increasing the project completed successfully and on time. Minor issue, but if we wanted to know exactly when it happens, it also provides. The current state of the project, quality is primarily determined by the skill level of the team working on the project. However, because the planning is built on the waterfall model, it is still challenging to include new features in the future approach. (saykol, 2012).

Table 2: Strengths and Weaknesses Comparison of Waterfall, Spiral (Adel, 2015)

Model/feature	Strengths	Weaknesses	When to Use
Waterfall	• Easy to understand and implement. • Widely used and known. • Define before design, and design before coding. • Being a linear model, it is very simple to implement. • Works well on mature products and provides structure to inexperienced teams. • Minimizes planning overhead. • Phases are processed and completed one at a time.	• All requirements must be known upfront • Inflexible. • Backing up to solve mistakes is difficult, once an application is in the testing stage, it is very difficult to go back and change something that was not well-thought out in the concept stage. • A non-documentation deliverable only produced at the final phase. • Client may not be clear about what they want and what is needed. • Customers may have little opportunity to preview the system until it may be too late. • It is not a preferred model for complex and object-oriented projects. • High amounts of risk and uncertainty, thus, small changes or errors that arise in the completed software may cause a lot of problems.	• When quality is more important than cost or schedule. • When requirements are very well known, clear, and fixed. • New version of existing product is needed. • Porting an existing product to a new platform
Spiral	• High amount of risk analysis. • Software is produced early in the software life cycle. • Strong approval and documentation control. • Additional functionality can be added at a later date. • Project monitoring is very easy and effective. • Concerned people of a project can early review each phase and each loop as well because of	• Cost involved in this model is usually high. • Risk assessment expertise is required. • Amount documentation required in intermediate stages makes management of a project very complex. • Time spent for evaluating risks for small or low-risk projects may be too large. • Time spent for planning, resetting	• For medium to high-risk projects. • When risk evaluation and costs are important. • When significant changes are expected.

3. 2. 3 Rational Unified Process (RUP):

The Unified Process (UP) groups all activities, including modeling, into workflows and carries them out incrementally and iteratively. Figure 10 shows the UP's lifetime.

The following are some of the UP's most important characteristics (Awad, 2005):

- It makes advantage of a component-based design to build a system that is simple to extend, encourages software reuse, and is readily comprehendible. The tool frequently used to manage projects involving object-oriented programming.
- Employs diagrammatic notation to express its code in visual modeling applications like UML, to enable those who are less technically adept but may have a better understanding of the issue to contribute more.
- It has been discovered that managing requirements through use-cases and scenarios is a very efficient way to both capture functional needs and aid in keeping an eye on the expected behaviors of the system.
- Design is gradual and iterative; this lowers the risk profile of the project, allowing for more customer feedback, and aids in developers' concentration.
- In a software project, confirming software quality is crucial. Planning quality

control and evaluation that is integrated throughout the whole process and involves every team member is helped by UP.

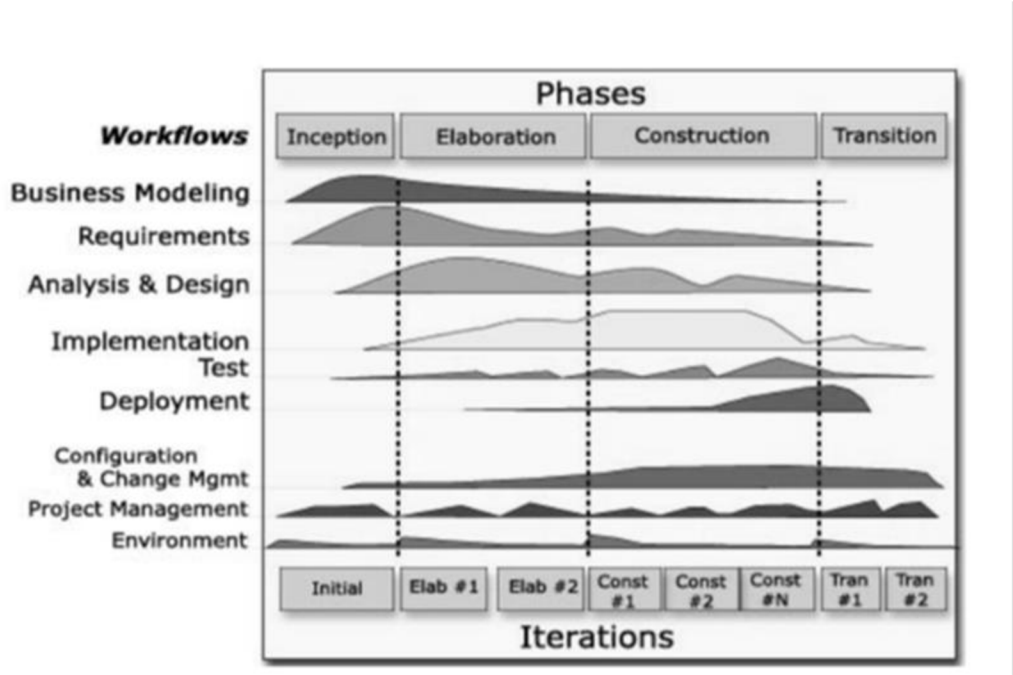

Figure 10: Unified Process Lifecycle (Awad 2005)

3. 2. 4 Iterative and Incremental Model

This model iteratively mixes components from the waterfall model. Additionally, each linear sequence results in software deliverable increments. The first increment, which is the core product, addresses the fundamental criteria; nevertheless, many supplemental features (some known, some unknown) are still not achievable at this iteration. A partial implementation of a whole system is created using this paradigm. Then, it gradually incorporates more functions. As a result, until all intended features are realized, each successive release will add a function to the preceding one. (Adel & Abdullah 2015).

3. 2. 5 IPMA

The International Project Management Association is the full name of the approach of IPMA. Acts in union with several members spread throughout various continents. Members of the IPMA create project management competencies. The technique focuses on evaluating project managers' knowledge and abilities. Tests are used to assess knowledge and skills, and as a result, the manager is certified. Each candidate for certification has their

examinations examined by qualified individuals. Technical, behavioral, and contextual competencies, among others. (Jan Bartoska, Radka Svobodová , 2011)

3. 2. 6 PMI

A non-profit organization with a worldwide impact, the Project Management Institute (PMI) brings together members working in project, program, or portfolio professions. (Kabeyi, M. J. B. 2019)

The business brings together specialists from throughout the world. With the use of standards and qualifications, PMI offers its members the chance to further their careers in project management-related fields. The PMBOK Guide, which outlines the key tenets of the approach, serves as its foundation. The PMBOK Guide defines five primary process categories, as was stated at the outset. Each of the aforementioned process categories is defined separately as a project management independent component. At reality, they frequently overlap, either during the whole project or in certain project stages. The project's end result, which is what the assigned groups will produce, will bind them together. (Kabeyi, M. J. B. 2019)

There are ten "knowledge areas," or groupings, that make up the total of forty-seven project management procedures that are defined by the PMI standard (Knowledge Areas). Every knowledge group embodies a complex collection of ideas, expressions, and actions that come together to form a profession, a project management area of study, and a field of specialty. (Kabeyi, M. J. B. 2019)

3. 2. 7 Prince 2

Prior until now, information technology projects were managed using the Prince2 model. But in Britain, project management was seen as a given approach that needed to be improved since it had certain flaws. It was for instance, a frequent variability in the managers in charge of supervising the project as well as the designers themselves, the lack of experience of the new managers with the project's management of the teams, or the lengthy period needed for the orientation of new managers, which actually needed gaining the necessary experience, the author write. (Haughey, D. 2021)

The approach was primarily used in the state bureaucracy, but because it was so well-liked, it has now been adopted by the private sector as well. European Union-sponsored initiatives also use it. The document about the Structure of the Project Management Method of Prince2 contains the fundamentals of the methodology. The above document outlines the fundamentals of project management during its course. (Haughey, D. 2021)

3. 2. 8 Pros and Cons of Traditional Methodologies (Martin, Thesing, Feldmann, 2021)

The Traditional Methodology for Project Management is a comprehensive approach for managing ongoing projects that includes initiating, planning, carrying out, monitoring, controlling, and closing. It works well for projects that can be finished in a single step-by-step process. It successfully completes the project's delivery in a timely manner and on a tight budget.

Pros:

- **Cost Effective**

  Since traditional project management makes projects easier to execute. Because of this, they probably complete more quickly and effectively fulfill the deadline. The likelihood of running into flaws, mistakes, or complicated issues during the project's planning, designing, testing, and final execution is extremely low.

  For smaller, sequential initiatives, the businesses gladly choose the traditional methodology. They need fewer resources, less time, and fewer developers to finish. Because the businesses don't need to utilize expensive gear and technology to do such tasks, it is also less expensive.

- **Effective for Innovative Projects**

  For larger and more complicated projects, communication and distance become important obstacles. Traditional projects are often smaller and simpler, making them ideal for distant work. As a result, these projects may be created by a variety of individuals and the challenges can be overcome with less communication.

- **It is sequential**

  The traditional technique is simple to follow because of its sequential patterns. The development of the successive projects doesn't need many changes. The best

possibilities to complete the project on time and in accordance with all other requirements are probably present if professionals follow to the evolving strategy. Additionally, the sequence facilitates management and development.

Smaller projects with clear and understood needs are best suited for the traditional model. Every phase in the conventional methodology has a beginning and a finish, making it adaptable for stakeholders and clients to be updated on progress. Prior targeted planning and preparation on design and requirements decreases the risk of mistakes and delays while creating code.

The sequential process necessitates accurate documentation for each stage, which improves comprehension of the code's and evaluation's underlying logic. This order sets up the correct pathways are for stakeholder to gain knowledge of a specific stage.

- **Faster Time Around**

  No matter where they are during the product lifecycle, many companies consistently struggle with the issue of being disappointed in day-to-day tasks and neglecting initiatives that might help the company expand. It squanders time, money, and resources. Projects using traditional methodologies don't need to be changed much that much because they are sequential. They are supplied on schedule as a result.

- **Increasing customer satisfaction**

  Traditional Projects don't require too much complexity to complete in order to satisfy the client. Every project management technique places a strong priority on customer satisfaction. The needs of the customer are carefully considered during the whole development process. The client is informed of every step of the process, receives confidential feedback, and has each demand given priority.

  The traditional model seems to be the ideal method to adopt if the customer is clear about the demands of the technology that will be built since it uses a progressive approach and objectives are made apparent in the very first phase.

- **Training is not necessary**

  The traditional project management method is flexible since it doesn't require any training or prior experience to start projects. The conventional technique is a rigorous

model as well, but it is simple to manage and improve due to its clear deliverables and evaluations.

- **Secured**

  Neither any project is ever completely risk-free, but the type and complexity of the project will most likely determine how the risks will affect the overall success of the endeavor. Larger projects will necessitate higher levels of collaboration to evaluate the additional technical and business requirements.

  Security and privacy are guaranteed by traditional project management. While the software is being executed from beginning to end, it supports a strong security mechanism.

- **Easy to change**

  Short development cycles allow for the basic project design to be changed as needed once the project begins with a straightforward design.

- **Efficiency**

  The ideal project management approach and the project's successful completion foster strong client relationships that will benefit future projects. Additionally, the team benefits from accumulating expertise and experience to manage difficult and technical tasks. It's best suited to projects created in challenging situations when speedy outcomes are required.

Cons:

- **Slow**

  If any client's needs are unclear, the development will be delayed. Because traditional project management's sequential paradigm makes modifications challenging, Changes might throw the development process out of order, delaying the next stage until the last one is finished.

- **No customer's central focus point**

  The customer's input doesn't always have a lot of room in the development process. Until the task is complete, the customers are not engaged or accepting of the full development process. It will be a time-wasting occurrence if it does not meet the

needs of the client. It is currently too late to assess the product's marketing responsibility in the finalization stage.

- **The lack of authority**

  Individual subcontractors are in charge of managing the development process. There isn't a single, core source of dynamic teamwork and leadership.

- **Time Management**

  Traditional methodologies are vulnerable to the problem of time management since there isn't enough cooperation, unity, and mutual growth amongst participants.

- **Lack of Observation**

  Traditional Methodology doesn't leave much room for the application of novel concepts. The sequential approach does not allow for ongoing evolution. You are limited to just following the steps.

- **Lack of Co-ordination**

  The subcontractors work individually rather than as a single dynamic team. No effort is made to create harmonious relationships, participation, and commitment to the progress. Coordination problems can seriously hinder progress and cause delays.

- **Basic efficiency**

  Every subcontractor just considers their own work and abilities. When something bad happens, there isn't a mutual defense and problem-solving effort. In traditional project management, there is no collaboration or dream work.

- **No Fluent Change**

  It is likely difficult, time-consuming, and costly to go back and make changes to an application once it has entered the testing stage. To put any changes into action, you sometimes have to start over.

- **Risk-involved and difficult development**

  When consumers and other stakeholders are unsure of their requirements at first, waterfall software development could not only begin until all important info and

requirements have been gathered. Because of this, the conventional strategy leaves little room for client feedback and a final product that is specifically tailored. Additionally, it is a paradigm that cannot be used to construct complicated, large-scale, object-oriented projects.

3.3 Agile Methodologies

Agile is a general phrase that encompasses iterative software development methods that adhere to the principles of the Manifesto for Agile Software Development. Agile software development approaches are created to adapt to the demands of the project and the company. Agile is a set of tools and best practices that support development organizations in concentrating on effectiveness, collaboration, quality, and the production of customer values rather than describing a particular technique. (Sondra, Kristin 2015)

Agile project management first came into use as a result of the frequent failure of traditional approaches and the inadequate and ineffective circumstances of present projects. Agile techniques enable quick solution generation and requirement-driven adaptation. During the 1990s, the technique really started to take shape. They also take into account the idea that the best method to create a system is to move swiftly and then, if necessary, modify it to suit the needs of the client. (Sondra, Kristin 2015)

Cooperation and communication are the foundations of an agile methodology. Only the necessary tightening is being done by the project team at this time. The development of an agile manifesto, which itself is controlled by the following principles, was a prerequisite for the advent of the agile methodology. (Sondra, Kristin 2015)

Table 3: Agile value explained (Sondra, Kristin 2015)

Value	Definition	Implementation Example
Individuals and interactions over processes and tools.	It is more important to focus on the contributions that each person brings to the team and the trust and communication that exists within the team rather than the adherence to process or the use of elaborate tools.	People are more effective when they can talk and work together face-to-face. Reduce barriers that inhibit people's ability to get together.
Working software over comprehensive documentation.	Software product development is a creative activity that is difficult to fully envision through the use of static documents. By creating working code that customers can try, you will get better feedback than you would when customers imagine using the documents alone.	Rather than exchanging documents such as test plans and product specifications, Agile teams should build limited capability versions of the product that customers and business users can actually try before signing off on them.
Customer collaboration over contract negotiation.	It is more important that the customer become intimately involved with the product development team than to focus on the terms and conditions of the project.	Specific project timelines are difficult to predict and commit to. Instead, an Agile project should focus on regular interaction with customers for feedback and work with them to adjust the timelines as the project progresses.
Responding to change over following a plan.	The only thing most teams can be certain about when they start a project is that something will change. Agile teams must be able to respond and adapt to regular change rather than sticking to a plan that was created at the beginning of a project or an iteration.	Product requirements are prioritized at the beginning of the iterations rather than the team agreeing to all product requirements at the beginning of a project.

Agile Principles (Sondra, Kristin 2015)

The project does not become more agile by utilizing one of the existing techniques. These outlined criteria must be followed for a project to be deemed agile. (Sondra, Kristin 2015)

I. Consistent Deliveries

The project team only concentrates on a small portion of the overall scope in to avoid scattered work from happening and to make it possible to track the gradual increase in the proportion of the product that has been completed. Project products are released slowly over time in the form of temporary intervals, with each improvement serving as a distinct functional unit.

II. The Iterative Approach

The mentioned steps must be supplied in equal-length stages and must not extend beyond a predetermined "time-box." A short one interval is thought to be sufficient.

III. Multidisciplinary Teams

Despite having various areas of expertise, team members must cooperate with one another due to the restricted time available for each particular sub-output. Testers and programmers are two examples.

IV. Customer Participation

The client must be accessible for the whole project. He must cooperate in a limited way based on the quantity of modifications, continually improve the needs, and be able to give feedback.

V. Routine Evaluation of Requirements (scope)

Due to the challenging concept of the project's final form, required methods are implemented to ensure that regular input and new issues may be caught under time constraints.

Agile Behavior

Meaningful task distribution among the project team's members and their drive to produce results in the best way possible. (Sondra, Kristin 2015)

3. 3. 1 Pros and Cons of Agile Methodology

The agile methodology was motivated by the drawbacks of traditional software development project management techniques rather than being a specific technology. The flaws with the waterfall methodology are fixed by agile. Agile is a better technique, specifically, for creating software in the face of uncertainty. Agile is a particularly strong fit for projects where there is a lot of uncertainty regarding the type of product you are producing, who might require it, how often they might even want to charge for it, and how they may want it

to appear and function. Agile gives people the freedom to make adjustments when they are necessary, which is one of its finest qualities.

A firm can benefit from agile software development's faster turnaround times, better required stakeholders, and on-demand deployment. The risk of the original planning becoming outdated increases as the project progresses. (Martin, Thesing, Feldmann, 2021)

Pros:

- **Unity**

  working together as a cohesive team with the client, team leads, project managers, and developers to continuously focus on technical quality and design agility. (Martin, Thesing, Feldmann, 2021)

- **Communication**

  According to agile software development, effective communication is the most effective way to provide data to and among a development team. (Martin, Thesing, Feldmann, 2021)

- **Teamwork**

  Agile technique emphasizes collaboration. Agile project management fosters a positive work environment for the group by allowing them to collaborate freely and support one another. (Martin, Thesing, Feldmann, 2021)

- **Sustainability**

  Sustainable progress is ensured through agile software development. The sponsors and developers are capable of maintaining the project's development and execution moving along smoothly. (Martin, Thesing, Feldmann, 2021)

- **Software development of life cycle of Agile methodology**

  Instead of employing a sequential design process, the agile methodology employs a constant change, user friendliness, and progress. Shorter planning cycles were designed and continually evaluated to ensure the change was successfully implemented. The backlog is calculated by the ongoing change, which also refines development. Agile is the ideal application method for larger projects, however

managing such huge programs may be challenging. Additionally, because it is the most crucial component of the agile value chain in scrum projects, quality improvement procedures are strictly adhered to in every sprint to guarantee the generated product is faultless. Together, the client and the developers figure out how to adjust to any change that occurs throughout the project. (Martin, Thesing, Feldmann, 2021)

- **Customer's Feedback**

  The agile technique prioritizes user friendliness, progress, and rapid change in place of a sequential design process. In order to guarantee that the change was properly implemented, short iterative cycles were created and regularly assessed. The continual change, which also improves development, determines the backlog. Larger projects are the perfect fit for agile, yet managing such massive initiatives may be difficult.

  Additionally, quality improvement methods are closely followed in every sprint to ensure the created product is flawless as it is the most important aspect of the agile production chain in scrum projects. The customer and the developers work together to determine how to respond to any change that arises during the project. (Martin, Thesing, Feldmann, 2021)

- **Popularity of Agile Approach**

  In the modern marketplace, it's critical for businesses to advance quickly and nimbly. The business may be frustrated that IT doesn't seem to comprehend what they want and whines when revisions are required right even before project is due. It's unlikely that most businesses will receive multimillion dollar government bailouts.

  A company that specializes in application development will take on this task and, after a series of revisions, provide an application that satisfies all client and statutory requirements. The big management consulting companies offer a wide range of services, sometimes with an international focus. (Martin, Thesing, Feldmann, 2021)

Cons:

- **Project Development**

  The most important aspect of creating effective software is customer interaction.

The foundation of the agile approach is customer participation since the whole project is created in accordance with the specifications provided by the customers. Therefore, the project development will turn sequence if the client representative is unclear about the product characteristics. (sharma, 2012)

- **Missing Documentation**

  Although the least amount of documentation speeds up development as an obvious benefit of the agile technique, it is a major drawback for developers. Due to the project deadline, it is not viable to keep the comprehensive documentation of design and construction in this situation since the internal design is constantly changing based on user needs after each iteration. Therefore, because there is less information accessible, it is highly challenging for new developers who joining the development team later to comprehend the real process used to construct the product. (sharma, 2012)

- **Better Adapted to Management than Developers**

  The agile technique aids management in making choices on software development, setting expectations for developers, and establishing deadlines. However, it is quite challenging for the basic developers to keep up with the constantly changing environment and constantly updating the design and code depending on urgent needs. (sharma, 2012)

3. 3. 2 Feature Driven Development (FDD)

A general model is first developed, then two-week iterations are performed. Individual utility properties are designed and put into operation at this stage. A helpful feature may be thought of as a little accomplishment that serves the needs of the consumer. This outcome, along with future versions, is clear, quantifiable, and actionable. The technique focuses on creating new software in an object-oriented way. (A. Buchalcevova, 2009)

3. 3. 3 Extreme Programming (XP)

It is a fairly structured technique that is appropriate for small to medium company teams who want to create software but cannot define a definite brief. The key lies in standard software development procedures but goes beyond those procedures. What may be considered to be demonstrated will be utilized to a great amount. For instance, if testing is

successful, all developers and clients will continue testing; if simplicity is successful, the most basic solution that can yet function will be created. (A. Buchalcevova, 2009)

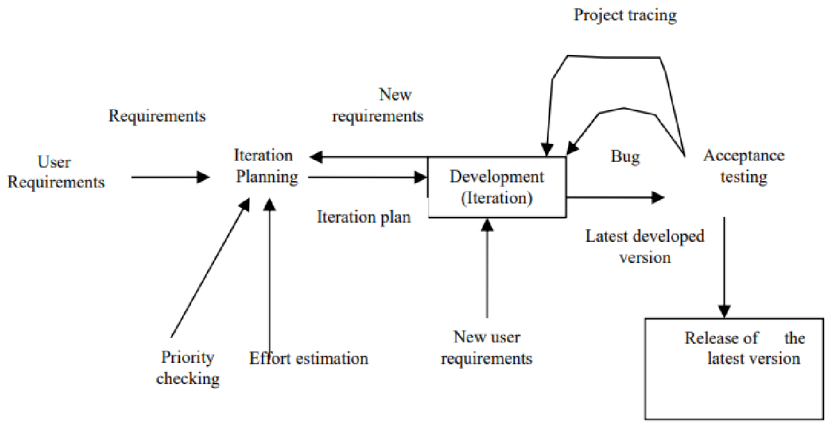

Figure 11: Process of agile methodology using extreme programing. (sharma, 2012)

3. 3. 4 Kanban

Software development is not covered by Kanban. To utilize Kanban, the program must already be under development. Although it isn't explicitly an agile approach, it might be added to an agile methodology. And this so "Kanban board" is the most crucial component. This chalkboard has columns that are separated by lines. One header appears in each column: must be completed, is being done, and done. The appropriate columns are then filled with task cards. The board might be physical or electronic. A physical whiteboard's drawback is that the entire team must constantly assemble in front of it. (Turner,2019)

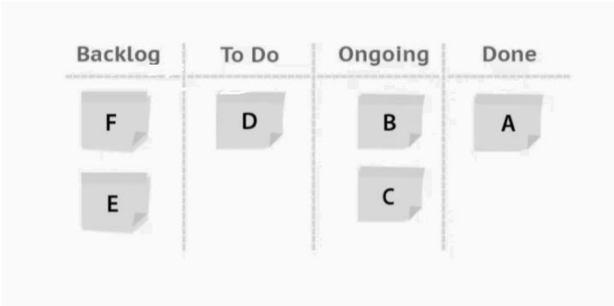

Figure 12: Example of Kanban Board. (Turner,2019)

3. 3. 5 Scrum

There have been around one dozen Agile techniques in use right now. The most well-known of these is the scrum framework. Increasing feedback mechanisms and responding to it are what lead to agility. The Scrum methodology promotes quick feedback loops, reduces risk, and speeds up return on investment (ROI). Three roles are necessary for Scrum, namely the Product Owner (PO), Scrum Master, and Team Member. The product manager is a function that some businesses have that is not included in the scrum paradigm but is highly crucial to the success of the team (PM). The project manager (PM) is in charge of developing a vision for this product's design, also known as the product roadmap, as well as how it will function in the market and how it will be financed. This vision should serve as motivation for everyone to show up to work each morning. Eventually, the vision becomes a backlog. The backlog is a collection of tasks that must be completed in order to make the aspirations a reality. Almost anything may be added to the queue, including risks, non-functional and functional needs, faults, technical debt, and improvement requests. There is only one restriction: Backlog items must be presented in (non-technical) commercial terms. (McKenna 2016)

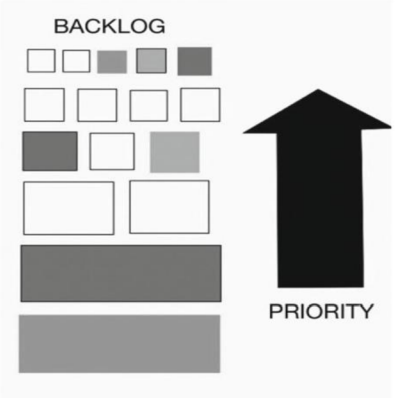

Figure 13: An Example of Backlog. (McKenna 2016)

Scrum Team

A Scrum Team is a small group of individuals that make up the basic unit of Scrum. A Product Owner, a Scrum Master, and developers make up the Scrum Team. There are no hierarchies or sub-teams inside a Scrum Team. It is a team of experts that work well together and are committed to achieving the Product Goal.

Scrum Teams have cross-functional, which means that each member possesses the knowledge and abilities required to provide value each Sprint. They also self-manage, which

means they determine internally who performs what, when, and how. The Scrum Team, usually consisting of 10 or fewer members, is both small enough to be flexible and yet big enough to finish meaningful work during a Sprint. Smaller teams tend to communicate better and work more effectively, according to our research. If Scrum Teams get too big, they should think about splitting up into many strong Scrum Teams that are all working on the same project. As a result, they ought to have the same Product Owner, Product Goal, and Product Backlog.

The Scrum Team is in charge of all tasks linked to the product, including stakeholder participation, verification, upkeep, operation, experiment, research and development and any other necessary tasks. The organization has given them the tools and authority to handle their own job. The concentration and consistency of the Scrum Team are improved by performing in Sprints at a high-performance level.

Every Sprint, the complete Scrum Team is responsible for producing a worthwhile, practical increment. The developers, the product owner, and the scrum master are the three members of the scrum team whose roles are specifically defined by scrum. (SCHWABER, et al., 2020).

User Stories

A brief customer description is typically expressed as follows: "Like (kind of user), I wish to (some aim) to (some reason)." User stories were once merely written as comments, but they are now a key component of agile management. The specifications are being written in such a way that the development team and the client will both fully comprehend them. Every user experience must follow the following principles (McKenna 2016):

- **Individuality** - A user narrative should only address one presumption.
- **Benefit** - The specifications under development must offer some sort of advantage.
- **Predictability** - it shouldn't be very detailed, or the team will struggle to follow it could anticipate how much work there would be.
- **Testability** - the attributes that make functionality possible are identified.

Scrum Board

User stories that have been divided into smaller portions are shown on the Scrum board, also known as the Scrum bulletin board. They are fairly thorough; thus, they are not included in the backlog. The message board has segmented, and tasks are completed in accordance with user stories. It should be noted that after someone completes an activity, it will be transferred toward the "In Progress" column. The task should be finished at the following team meeting, at which point the note will be changed to such "Done" column. The board might potentially have more columns added to it, but it shouldn't get too crowded or complicated. (SCHWABER, et al., 2020).

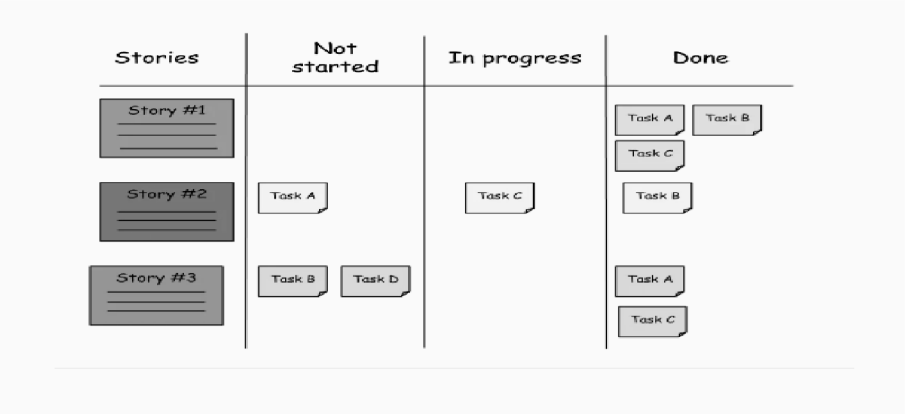

Figure 14: Scrum board (SCHWABER, et al., 2020).

Product Owner

The Product Owner is responsible for increasing the value of the finished product that the Scrum Team produces. It is possible for businesses, Scrum Teams, and people to implement this in quite different ways. The Product Owner is however responsible for the creation and effective communication of Product Backlog items:

- The development and explicit communication of the Product Goal. purchasing things from the Product Backlog; and
- Ensuring that Product Backlog is clear, understandable, and transparent.
- The Product Owner can carry out the aforementioned tasks themselves or assign the job to others. Nevertheless, the Product Owner is still responsible.

The whole organization needs to respect the decisions of Product Owners for them to flourish. These choices may be seen in the Product Backlog's content and hierarchy, as well as in the inspectable increment during the Sprint Review.

This same Product Owner is an individual, not a group. Numerous stakeholders' demands may be represented by the product owner mostly in product backlog. Those who desire to alter the Product Backlog may try to encourage the Product Owner to do so. (SCHWABER, et al., 2020).

Scrum Master

Setting up Scrum according to the Scrum Guide's definition is the responsibility of the Scrum Master. They achieve this by assisting everyone in the Scrum Team and the company in understanding Scrum theory and practice. The efficiency of the Scrum Team is the Scrum Master's responsibility. They achieve this through facilitating the Scrum Team's practice improvement inside the Scrum framework. True leaders who support the Scrum Team as well as the greater company are Scrum Masters. (SCHWABER, et al., 2020).

The Scrum Master assists the Scrum Team in a number of ways, such as

- mentoring the members of the team in self-management and cross-functionality,
- assisting the Scrum Team in concentrating on producing high-value increments that adhere to the Definition of Done,
- causing obstacles to the Scrum Team's progress to be removed, and
- ensuring that the Scrum Team meets its goals. (SCHWABER, et al., 2020).

The Product Owner is assisted by the Scrum Master in a number of ways, including:

- Assisting the Scrum Team members understand the need for simple and straightforward Product Backlog items
- Finding methods for efficient Product Goal concept and Product Backlog management.
- Establishing conceptual production planning for a dynamic environment; and
- Boosting stakeholder collaboration as demanded or necessary. (SCHWABER, et al., 2020).

The Scrum Master assists the organization in a variety of ways, such as:

- Leading, educating, and coaching the organization in the adoption of Scrum;
- Planning and advising Scrum deployments within the organization;
- Aiding staff members and stakeholders in comprehending and putting into practice an empirical approach for complex work.

- Reduces barriers between stake - holders and Scrum Teams. (SCHWABER, et al., 2020).

3. 3. 6 Monitoring the Project's Progress

The ability to judge whether or not anything needs to be edited is essential during the software development process. The measures designed for this aid in the proper evaluation. Frequently, the so-called Burndown diagram is the measure utilized in SCRUM development. The below figure illustrates the number of tasks that need to be finished in proportion to the sprint's phase.

It may be used to evaluate how well the tasks in the sprint backlog are really being performed. On The dependent variable, Day, is a corresponding independent variable to the X-axis. Remaining work, which may be specified as a particular amount or a percentage (relatively) (absolutely). This line graph-style illustration shows the percentage of the backlog that has already been completed. (Erne, 2022)

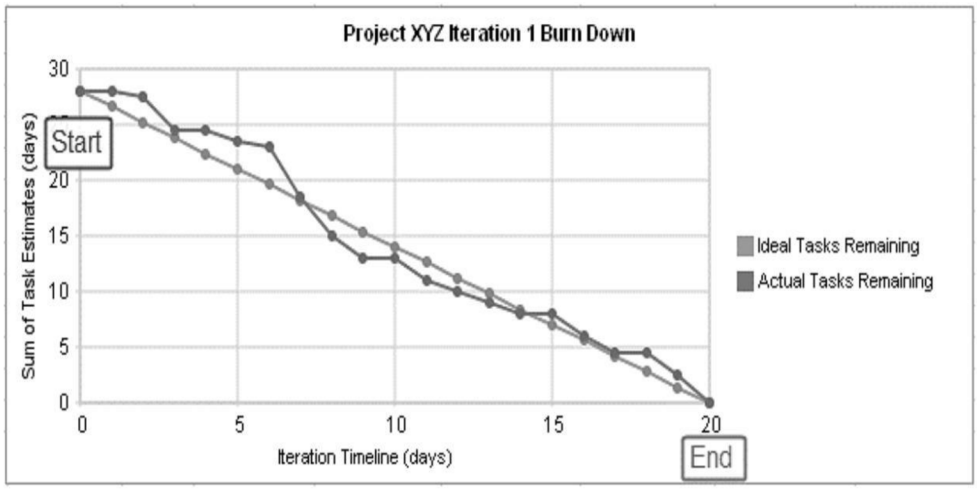

Figure 15: Burndown diagram (Erne, 2022)

The graph also displays an optimal straight line to make the differences between the real track and the ideal one easy to see. In order to develop a standard method of quantifying the remaining work, the Burndown diagram must be believable in order to be used to infer information about the sprint's stage. The number of tasks and projects in the backlog, typically corresponds to the number of tasks left in the current sprint, may be used to quantify either. The approach is more straightforward, but since not all activities are equally challenging, it confuses the diagram and has negative effects. This drawback may be mitigated by carefully selecting tasks for the sprint backlog so that their total complexity complies with a certain

criterion and by thinking when creating the sprint backlog. Using techniques that gauge the overall amount of effort, the Burndown diagram's objectivity can be improved. Each activity has a number appended to it to indicate how difficult and intricate it is. The following criteria can be employed to assess effort. For example, in the case-

- The SCRUM Master will create a scale of difficulty for internal evaluation and uses it to determine the number of each task.

- Users measure a task's difficulty in man-hours, which is how long it takes.

The Sprint backlog is constructed only with tasks considered in this manner such that the burden of the entire backlog is almost constant. Meetings, communication, and, finally but still not least, a backup that will assist in the case that things do not go as planned, must all be considered in these measurements, it is important to remember. (Erne, 2022)

3. 3. 7 Sprint

Iterations is one of the primary tools used in agile methodologies, and in Scrum they are referred to as sprints. In essence, they state that the development process will be divided into sprints, and that at the conclusion of each sprint, the team must present the client with a finished product or a completed component. Because of this, the team receives feedback from the client on the product and will be directed by any criticisms he may have throughout the following Sprint. Sprints shouldn't be too lengthy, according to the popular view. The entire development process will go more quickly if the sprint is quick.

A design sprint combines elements of the scientific approach and the design process with the agile perspective. There are five distinct phases in a design sprint. (Banfield, Todd, Wax 2015)

Table 4: Five distinct phases in a design sprint. (Banfield, Todd, Wax 2015)

0.	Prepare (Get ready)
1.	**Understand (review background and user insights)**
2.	**Diverge (brainstorm what's possible)**
3.	**Converge (rank solutions, pick one)**
4.	**Prototype (create a minimum viable concept)**
5.	**Test (observe what's effective for users)**
6.	Iterate...to another design sprint, or a Lean and Agile build process such as Scrum or Continuous Delivery/Extreme Programming

A design sprint lowers the likelihood of errors occurring later on and produces visioned targets the team may use to gauge its progress. (Banfield, Todd, Wax 2015)

A sprint is one of several iterative cycles that occur repeatedly during in the software development process with the aim of producing an application that can be executed and tested and on which the user may ultimately decide whether or not to rely. The sprint is designed before the outset, including what the material will also be and how it needs to be decided. Implementing the tasks that are most crucial to the program and are given the highest priority comes first. Tasks are removed again from Sprint Backlog by developers. (SCHWABER, et al., 2020).

The backlog may be thought of as a list of unfinished jobs that have been broken down into user stories that need to be integrated into the system. The approach consists of two main backlogs. The first one is referred to as the Product Backlog and includes a comprehensive list of user stories along with extra details (such as status and priority). The Sprint Backlog, a subset of it, comprises a number of user stories that will be addressed during the anticipated sprint. Tasks cannot be updated towards the sprint backlog once a sprint has begun, and the necessary modifications are made to the product backlog. (SCHWABER, et al., 2020).

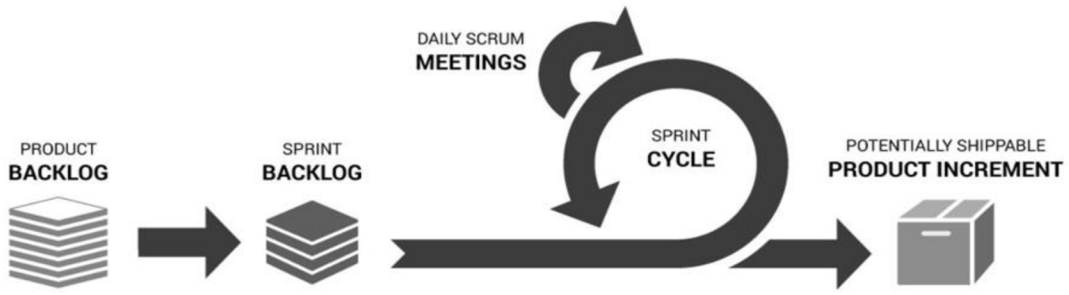

Figure 16: SCRUM methodology-based software development cycle (McKenna 2016)

Sprint Planning

By outlining the tasks to be completed during the Sprint, Sprint Planning kicks off the Sprint. The collective efforts of the whole Scrum Team went towards creating the final plan.
The Product Owner makes sure everyone is ready to address the most crucial things on the Product Backlog and how they relate to the Products Goal. In order to get input, the Team Members might even invite other persons to Sprint Planning. (SCHWABER, et al., 2020).
The following topics are addressed by sprint planning:

- What makes this Sprint worthwhile?

The Product Owner suggests ways to improve the product's worth and usefulness during the current Sprint.

The entire Scrum Team then works together to create any Sprint Goal that explains to stakeholders why it is that the Sprint is important. Before Sprint Planning is finished, overall Sprint Goal must always be decided upon.

- What can be accomplished during this sprint?

The Developers choose things from of the Product Backlog to include during the current Sprint after consulting with the Product Owner. During this process, the Scrum Team may improve these elements, which boosts confidence and comprehension.

It may be difficult to decide how much can be accomplished in a Sprint. However, the more information the Developers have on their previous performance, forthcoming capability, and Definition of Done, the more assured they will be about their predictions for Sprint.

- How will the selected job be completed?

The Developer plan the tasks required to produce an Increment that satisfies the Concept of Done for each chosen Product Backlog item. This is frequently accomplished by breaking down tasks from the Product Backlog into shorter work items that last one day or fewer. The Developers have complete control over how this is carried out. Nobody else instructs them on how to convert things from the product backlog into measurements of value. (SCHWABER, et al., 2020).

3. 3. 8 Meetings and Procedures

Scrum Daily

The goal of such Daily Scrum is just to review the Sprint Goal's progress and modify the Sprint Backlog as necessary to change the forthcoming planned work. The Scrum Team's developers meet for 15 minutes every day for the Daily Scrum. It takes happen each working day during the Sprint in the same place and time to minimize complication. If somehow the Product Owner or Scrum Master are working actively on items mostly in Sprint Backlog, users participate as Developers. As long as each Daily Scrum concentrates on progress towards to the Sprint Goal and generates an effective action plan for the following day of work, the Developers are free to choose whichever structure and methodologies they wish. This fosters concentration and enhances self-control.

Daily Scrums increase communication, spot obstacles, encourage speedy decision-making, which obviates the need for more meetings. The Daily Scrum doesn't represent the only opportunity for developers to modify their strategy. They frequently get together during the day to have more in-depth talks about how to modify or re-plan the remainder of the Sprint's work. (SCHWABER, et al., 2020)

Sprint Review

The Scrum Team and stakeholders evaluate what was achieved in the Sprint and examine what changed in their environment throughout the event. On the basis of this knowledge, participants decide together what to do next. To take advantage of fresh possibilities, the Product Backlog may even be modified. The Scrum Team must always avoid from converting the Sprint Review only into a presentation as it is a working session.

For a one-month Sprint, the Sprint Review is the second-to-last event and also is timeboxed to a maximum duration of four hours. The event is often shorter for Sprints that are shorter. (SCHWABER, et al., 2020).

Sprint Retrospective

The Sprint Retrospective's goal is to develop strategies for raising quality and efficacy. The Scrum Team evaluates the performance of the previous Sprint in terms of people, interactions, procedures, tools, and their concept of doneness. Examined components frequently change depending on the job domain. The assumptions that misled them are discovered, and their roots are investigated. The Scrum Team talks on what worked effectively during the Sprint, what didn't work well, and how problems were fixed (or not). The most beneficial adjustments are chosen by the Scrum Team to increase efficiency. The most significant changes are made as quickly as feasible. They could even be incorporated into the following sprint's backlog. The Sprint comes to an end with the Sprint Retrospective. For a Sprint that lasts one month, it must be timeboxed to a maximal of three hours. The event is often shorter for Sprints that are shorter. (SCHWABER, et al., 2020).

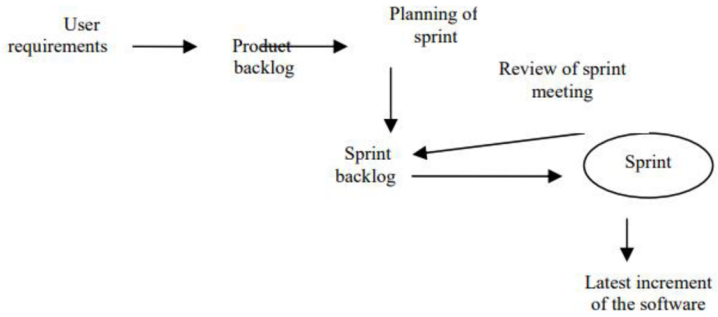

Figure 17: Process of developing agile approach using scrum. (sharma, 2012)

3.4 Comparison Between Traditional and Agile Methodologies

Traditional techniques are distinguished by their meticulous, sequential defining procedures. Their utilization requires that the project's direction and scope be carefully planned in advance and that substantial changes from of the plan are not anticipated. Team members concentrate solely on their assigned tasks since their responsibilities are well defined. Extensive paperwork and the requirement for approval at all decision-making levels for every necessary modification are problems with traditional approaches as well. The previously noted detail, however, gives these techniques structure, certainty, and predictability. These approaches are appropriate for larger-scale initiatives that may be geographically dispersed. (Awad, 2005)

The agile methodology is built on general flexibility, which is necessary in particular for software development, because progress of which cannot be completely characterized, and when we just have a general notion of the final product. capable of quickly adapting to changes and client demands, with whom strong collaboration is formed throughout the project. They are attempting to cut out pointless red tape and concentrate mainly on the documentation which will help them achieve their objective, which is to provide high-quality software. The customer receives continuous outputs so they may choose how to proceed with development. (Awad, 2005).

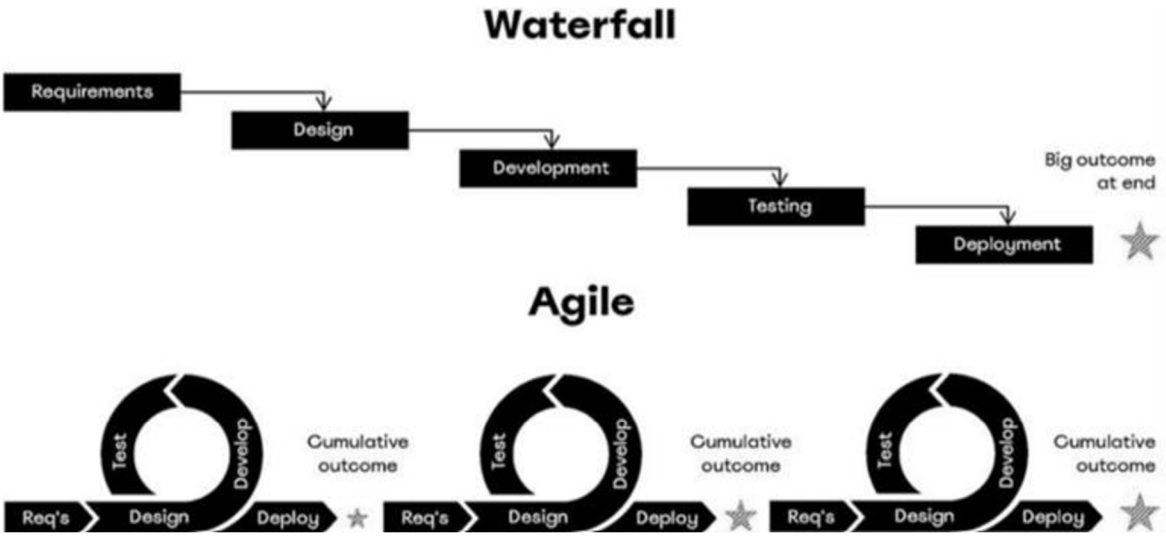

Figure 18: Waterfall and Agile models. (Park & Cho, 2022)

The link among agile and more competent methods of development and the triple constraint is a pretty straightforward approach to comprehend the differences between the two.

The project team generates the customer's needs and distributes them to the timeframe and estimated costs in the conventional idea, which results in a plan. The scope is the factor that matters most to the project owner. The project frequently experiences delays and expense increases in order to complete it.

In agile projects, the order is reversed. We are not quite certain of the final product's shape at this point. The range is constantly being expanded and modified. This is why it starts off with a set structure of expenses and duration. The objective is to deliver a project to the client that will have the greatest added value feasible. The image below demonstrates these facts. (Buchalcevova,2009)

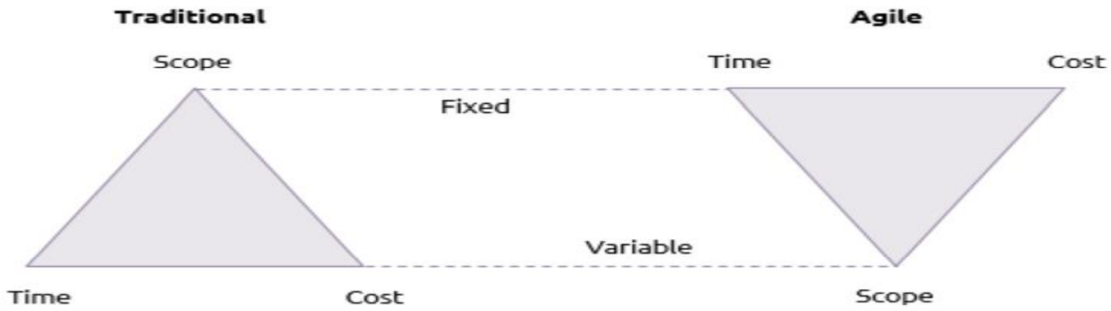

Figure 19: Comparison of traditional and agile methodology through triple constraint. (own)

Table 5: Some of the typical differences between Agile and Traditional methodologies. (JanKopia,2019)

Project Characteristics	Agile Methodology	Traditional Methodology
Customer / Stakeholder interactions	Often / Constant Feedback-Loops	Rare / Milestone-based
Team responsibility	Empowerment of team and team decision making, intrinsic motivation of team members	Usually low, responsibility lays in management
Planning	Based on self-managed teams and incremental short sprints, experimentation	Complex project planning, estimations, and requirement documents
Learning	Constant learning of new methods, technologies, exchange	Learning is secondary and behind defined project goals
Time for delivery	Rapid Prototyping, quick working parts /products as early as possible	Long delivery time after finishing the production

4 Practical Part

The actual work contains the examination of two IT projects that have previously been finished and the formulation of methodology suggestions that will influence how far the project accelerates in the future. For projects, it shall be specified why a certain technique should be used. Understanding when traditional or agile project management approaches are appropriate for IT projects is the aim of this effort. Because proper technique selection will lower the probability of project failure in the future and prevent unnecessary money waste. Both projects follow the same format: initially, a company that executes a certain IT project will be introduced. The project sponsor is then introduced, and the project's contents are explained.

The information gathered and the customer's needs will be used to decide the structure of the next step-by-step process. Methodology will be used to provide the grounds for the conclusion in favor. Following that, the process will be described and an approximate description of the project management will be given. For this project, it is less significant how the project was managed than the factors that influenced the choice of this technique. To avoid interfering with the business' operations, certain important material was purposefully deleted.

NN IT HUB

For the commercial partners in Europe, “NN IT HUB” develops enterprise software. In fact, “NN IT HUB”., the IT division of the parent company of the NN Group of insurance company, is an IT firm that develops all enterprise-related software on its own as a software provider company.

Since NN Group is mainly an insurance or asset management company, it is “NN Group” itself that uses “NN IT HUB.” 's software to secure all of its clients' data.

The foundation of the business is trust, and they approach you as a partner in an endeavor to create a long-lasting connection with the client. In addition to realizing the partner's vision, the objective is to create any potential improvements with the help of a highly skilled team. Cooperation is unlikely to occur if the customer's aim doesn't make sense, particularly from an economic standpoint.

The offered services can be arranged using three teams. The first team called "Solaris" is composed of strategy services. Research, analytics, and other services are examples of the team's offerings. The firm offers creative services, which are provided by the "Aptitude" team, in the form of information graphics, digital design, print design, video, and other creative mediums. Search engine optimization, sometimes known as "Polar," is the last team and entails modifying websites so that search engines will find them more easily. Project management plays a key role in this.

4.1 Project 1 – Traditional Methodology Driven

Implemented with Waterfall Methodology

“NN Group” company had to offer a smart system of each client's financial policy data as well as the working process of workers with yearly vacation, bonus, etc., a mobile application must be built for both clients and employees. And the project has been designed using waterfall approach.

The reasons of using waterfall methodology behind this project are as follows:

- At the start of the project, requirements from stakeholders and customers are gathered, analyzed and a sequential project plan is then developed to take those needs into account.

- The overall time required for app development was anticipated to be five months, and a specific, confidential budget was also established.
- The project's objective is quite straightforward, the requirements are fully defined, and it is only a simple project plan for the organization.

Therefore, the waterfall methodology steps for this project are as follows:

Requirements:

The primary stage according to the waterfall approach is that all customer needs are gathered at the outset of the project, allowing for uninterrupted planning of following stages all the way through to the completion of the final product. All needs are gathered throughout this waterfall management phase, it is predicted.

Design:

The logical design and physical design subphases were the ideal ways to divide the company's mobile app project's design phase. The logical design subphase is when theories and brainstorms for potential solutions are conducted. Those conceptual frameworks and concepts are translated into tangible requirements during the physical design process.

Implementation:

Programmers are developed real code during the implementation phase by assimilating the requirements and specifications from the preceding phases.

Verification:

Clients and employees established initial needs. Once all criteria were met and approved by clients, the finished product was then handed to the end users.

Maintenance:

During the maintenance phase, the customer routinely uses the product and finds defects, insufficient features, and other production-related mistakes. The production team makes these adjustments as necessary until the customer is completely satisfied.

Project Sponsor

Despite the fact that the "NN Group" has ten more registered branches around Europe, the "NN IT HUB." of the "NN Group" in the Czech Republic has declared a selection control

over the layout of the visual components of webpages that have previously been built. However, "NN IT HUB." was initially chosen to design the graphical user interface for the mobile application, and in the end, "NN IT HUB." was chosen for the entire project, from the project proposal through the production and launch stage with the customer's feedback by "NN Group." Due to the well-defined needs, users expected wide-ranging options.

4. 1. 1 Methodology Selection

Project management was represented by a traditional methodology since it was a well-defined procedure that could be repeated with no issues (Waterfall). The "NN Group" designated its application design process on numerous times in the past, but this time, the insurance company was expecting the desired outcome with predictable adjustments. The fact that it was viewed as a smaller project, allowing for the creation of a more precise estimate, also benefited in the selection. The decision of the "NN IT HUB." team was supported in reality by the identification of a qualified team. Part of the selection process included a sharply defined scope. The mentioned points made it feasible to create a thorough plan as well as an estimated timeline and work schedule. The chosen team were familiar with what to accomplish, what to anticipate from it, and what they had to concentrate on because they had already worked on projects of this type of several times in the past. Production started implementing after the approval of the design and idea, along with a few modifications for further acceptance.

4. 1. 2 Project Planning

Since it was a smaller project, the team framed it with the understanding that the scope could be carefully planned. The sourcing paperwork, which was created by the designers, served as the foundation for determining the scope. It had goals and specifications that had to be achieved. The team was given a framework to follow that was associated to a mobile site. The mobile application documentation was given back to the users with the hope that they would provide feedback on any unique requirements that might be taken into account for future adjustment. The entire project team generated these observations, which included solutions for particular features as well as requirements that needed additional information. There were a few minor issues with the app's connection to the database, but these will be resolved during the scheme. A risk management plan was not made since it was not anticipated that there would be significant changes from the plan. The WBS, which mostly relies on terms and conditions that had previously undergone some changes, was used to

calculate the scope estimate. The project schedule was represented graphically by a Gantt chart. Mutual dependencies and connections between tasks were included in the schedule, particularly those of the "finish to start" and "start to start" categories. For some activities, lead times or delays are also added.

Task Name	Start Date	End Date	Duration (Day)
Gather Data	6/1/2020	6/12/2020	11
Create Charts	6/16/2020	6/22/2020	6
Create Budget	6/25/2020	7/10/2020	15
Write Proposal	7/12/2020	7/14/2020	2
Meet Stakeholders	7/17/2020	7/24/2020	7
Create Plan	7/28/2020	8/13/2020	16
Design	8/14/2020	8/26/2020	12
Schedule Work	8/30/2020	9/5/2020	6
Implementation	9/15/2020	10/25/2020	40
Testing	10/27/2020	11/10/2020	14
Verification	11/13/2020	11/18/2020	5
Maintenance	11/20/2020	11/30/2020	10

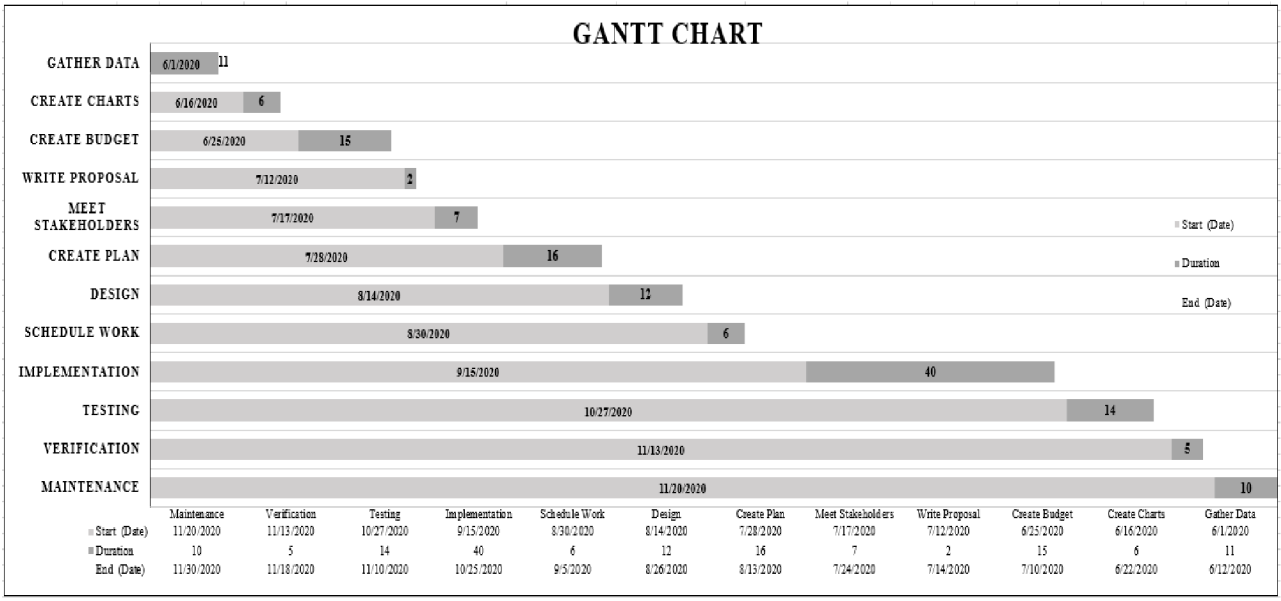

Figure 20: Gantt chart for implementation of mobile application of "NN IT HUB".

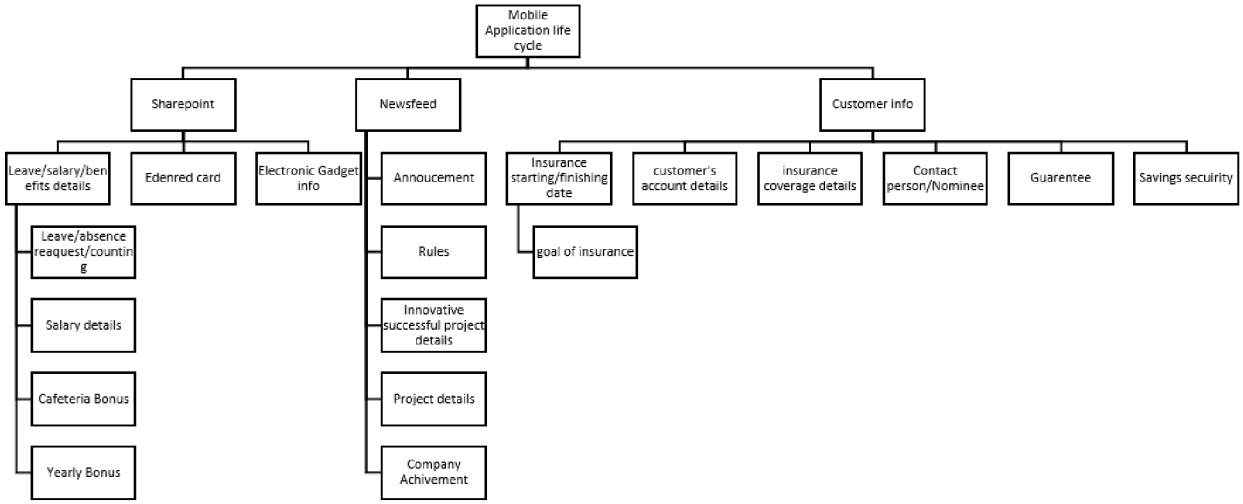

Figure 21: (A) Work breakdown (WBS) structure of mobile application life cycle. (own)

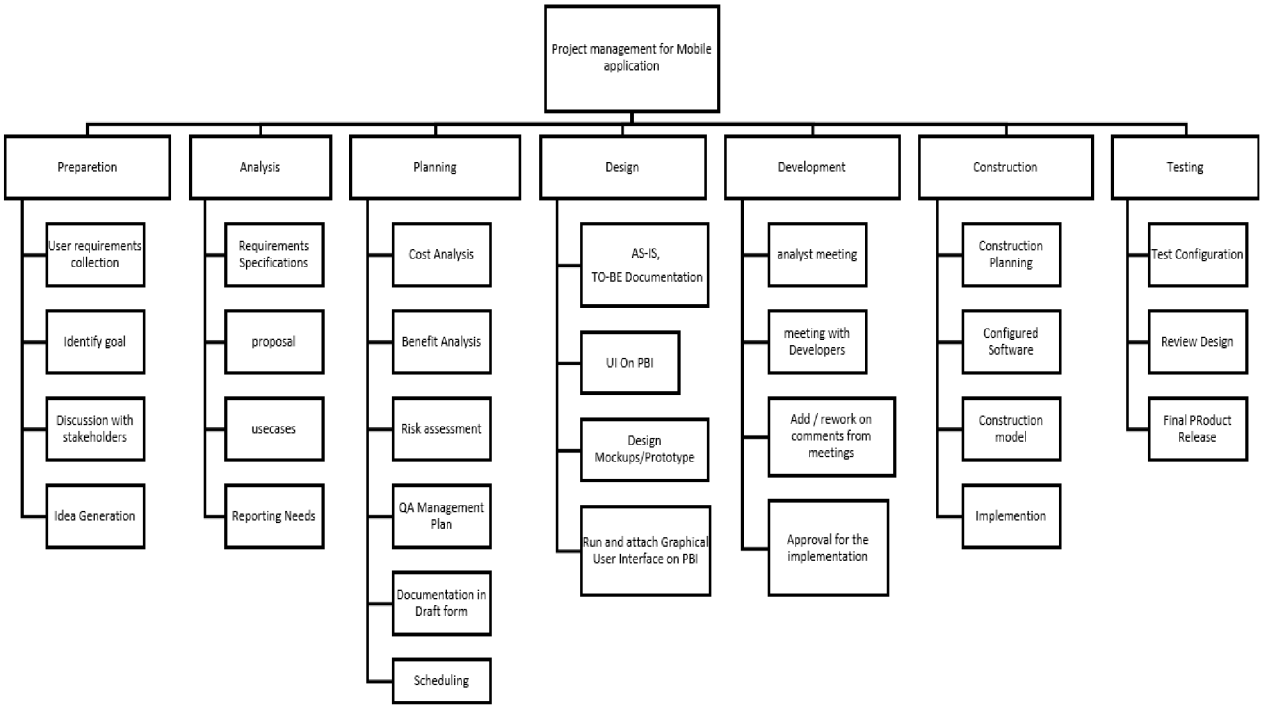

Figure 22: (B) Work breakdown (WBS) structure of Project management for mobile application. (own)

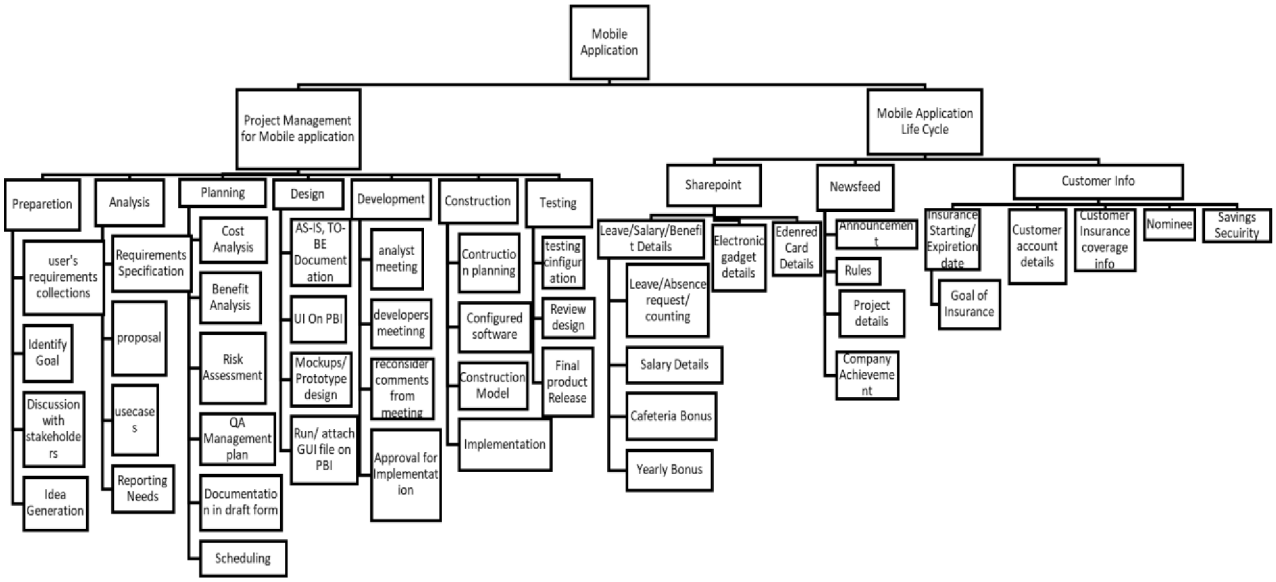

Figure 23: Work breakdown (WBS) structure of mobile application of "NN IT HUB." (Figure 21: (A) & Figure 22: (B) together.

4. 1. 3 Project Realization

The project's real implementation officially started when the product backlog item document was approved, and it was constructed as planned. The test environment, to which it had been approached and a customer, was used to create the application. In this situation, the client participated in both the tool's development and the app's goal fulfillment. The new web portal may have been hosted on the business's server or by the customer themselves, depending on their preference. The complete application was created using the Kotlin language for android application, which are presently the most popular editorial platforms for mobile applications and also for iOS application, swift programming language had been developed. As a result, the " Mobile Application" was installed and set up, including basic modules, for devices that supported the Android operating system and the iPhone. The installation process itself then proceeded to define the site's structure, which was also subject to its design components. Coding was used to create the design to guarantee a consistent appearance throughout the major browsers, including Internet Explorer, Firefox, Chrome, Opera, and Safari. The actual exchange of information with the database developer began in the midst of the functionality realization phase. It was possible to suggest a design for the tables and forms after defining the data that is contained in the database. A segment of

functional acceptability testing came next when the database and website were connected, and this is when the project could have been closed.

The project's final report was created during this phase, and after it was delivered and the project was declared complete, it was considered to be officially finished.

Advantages of the Chosen Methodology

The advantage of the waterfall methodology is in making it possible to make estimates of terms, scope, and resources that are more accurate, not just for this project but also in general. The next step may be predicted because we are aware of the stage of the project, we are in. In addition, the system provides clear introduction with the fewest alterations possible. The production of website design prototypes combines the time between establishing requirements and also by delivering the product. The project time estimate is not computed with a significant amount of delay, nevertheless, based on how it was determined. Another advantage is the necessity of understanding the entire project because moving on to the next phase needs the outputs from the prior phase. The completion date of the site may be more easily determined according to these factors, and it is also possible to estimate its cost.

4. 1. 4 Recommended Methodology

Although it would seem at first that this is a project that cannot fail, its initiation phase should not be undervalued. There was no need to employ agile technique because all requirements were provided with great specificity. The connection of the websites to an already-existing database, about which the company had little knowledge, and which was dependent on the performance of the new website, did, however, raise some minor doubts. This will help the database developer in the future to better understand the problem with which the project was begun. It was not anticipated that it could have a significant impact on how the project evolved. This fact was further supported by the absence of information regarding potential multitasking and their manner of funding in the project document, notably in the section pertaining to the budget. The advice is to not undervalue the initial phase of initiation and the subsequent phase of competency delineation, in this case between the database developer and the development team.

4.2 Project-2 Agile Methodology Driven

Nowadays, practically all insurance providers around the world provide one of these applications and give customers a little discount for simply installing it. The insurance business NN Group sought to introduce a similar application to stay competitive in the market, particularly in Europe. They intended to create a project that would supply the driving speed information because they were so focused on this named “Telematic App”. This app like this fit into the tendency among insurance companies to base underwriting decisions on behavior rather than just demographics. The software tracks customer's driving behavior and gives customers a "save driving score." The insurance company say that if somebody drives more safely, they can give the person behind them a bigger discount – up to 20% off on the cost each year.

The "Telematics App," which must be downloaded and given location access on every registered client's phone within seven days. It works to automatically identify when the client will be driving and then provides a score for braking, acceleration, speeding, and cornering when she/he will be done. It also provides detailed location data that tracks the client's journey as they travel. The functionalities that currently offered for this application are the number of approaches in response to the needs of the customers, end users, and market demands. With this in mind, “NN IT HUB." added new ideas to the app while also combining all currently available and requested customer functionalities. As a result, end users' needs and budgets had been changed, requiring the hiring of more qualified employees in the application development field. Due to all of these problems, the launch date for the application was also being delayed. Therefore, it is evident that the Agile approach would be best suit to guide this project.

A wide range of features of the app, including GPS data, distance traveled, accelerometer access, time of the day, app usage data, individual device IDs, battery status, getting roadside help, locating nearby repair and fuel facilities, car accident checklist, viewing policies, making claims, checking the status of the claims, uploading images and connection information for Bluetooth and Wi-Fi, driving speed, drivers unconsciousness level like sleeping, listing song or having conversation over cell phone is transferred from the client's phone to the company's servers via the app. Although it's unknown how long the company stores the data or whether it has a process for deleting it from the company server.

This data collecting is not only extensive, but it is also hard to refuse because insurance would be more expensive each month for any of the customers doesn't use the app. Some functionality of the app that was directly came through the agile methodology could not be finished due to the team's limited collaboration with the agile methodology. Consequently, app's additional functionalities, which couldn't be planned in advance and must be adjusted as the project progresses. A fixed variable, namely time, was produced by the customer's need that the website be completed within twenty months plus. Every sprint delivery has seen an increase in functionality, providing the consumer with more value.

Project Sponsor

For "NN IT HUB. "It was crucial to develop an efficient marketing plan and support it with a sizable budget as they wanted to compete successfully in this industry. Budget ought to be sufficient to produce the results required to meet business objectives, that is why the company followed the rules which is the marketing expenditure should be between two and three times what it cost to produce the product for the best results. In other words, if the budget for design and development is 1X, the marketing budget should be between 2X to 3X.

4. 2. 1 Selection of Agile Methodology

Due to constantly changing needs from customers, end users, and the market, it was thought appropriate to utilize an agile methodology because it was impossible to completely plan the project in advance. This choice was also reinforced by the launch of "NN Group's" own product, which will be solely dedicated for their own clients. other elements that helped with the decision to use an agile strategy:

- At the start of development, specific requirements weren't known.
- The development team had the chance to meet in person and work with the client's specifications.
- The client had the opportunity to work with a group he/she completely trusted.
- The project was large to medium-sized, which took to accomplish twenty months and three days, and was also divided into separate sections, each of which was produced by thirteen to fifteen employees.

- The project was sprint driven because each section had to be deliverable for at least two weeks.
- There were product backlog items for upcoming sprints because the entire project was completed with priority-based completed tasks.

Out of the numerous current agile approaches, SCRUM was selected. Because the customer was their own client when it came to app development, they were able to meet their criteria and adapt to the arrival of new capability, which made it feasible to react rapidly to changes during the project that were anticipated. These requirements had to, however, fall within the maximum permitted budget and finish date, which were increased subsequently after the product launches. The entire development process was facilitated by the development team's prior SCRUM meetings. The key SCRUM principles required to be explained to the client, along with its responsibilities for the project.

4. 2. 2 Project Progress

When a meeting with the customer resulted in the creation of a framework list of the vehicle insurance app's functional requirements, the project could be launched. The project team's makeup could be established using the information that had been gathered. The meeting's results included determining a ballpark cost estimate, a potential delivery date, familiarizing with potential dangers to the project, and preparing ourselves to cope with them should they materialize. Additionally, the customer was introduced to the SCRUM tenets and found them to be agreeable. To fit the requirements of the project, the chosen technique was modified. Evidently, in order to update the work progress, it was needed to have daily meetings between product owner, manager, and analysts and also between developers, manager and product owner.

The project team was made up of a development team that of five business analysts, three backend developers, four frontend developers, and three testers. A Product Owner (who was directly affiliated with the owner company) and SCRUM Master were on the team (he himself was sometimes involved in the development of the application). Among the interested people involved in the project but not actively working on it.

Usually, the daily meeting with the client (another business unit) was conducted through the Microsoft Team Meeting application like "SpoC Call" meeting. The sprint length was

determined to be two weeks because to the market's rapid change and the car insurance application's rapid development. It was able to respond to customer-defined improvements because to the Sprint duration that was ultimately selected. This method of selecting the Sprint's duration enabled us to adapt to changes that the administrator and customer had defined.

Each completed Sprint was followed by a meeting of the entire team (the "sprint review meeting"), where the review of the completed Sprint was conducted, and the next Sprint was decided. Changes that might be made were also taken into consideration and scheduled for the upcoming Sprints. Additionally, a maximum point difficulty of 50 points was established for this project, up to which each Sprint had to fit.

4. 2. 3 Project Planning

For the clarity, I'll present the product backlog Items board with several sprints not all the sprints were included in the table. And from this table I have selected the Sprint No. 92 course, whose objective was to develop a burndown diagram. So, The Sprint PBI and Burndown diagrams are as follows:

Product Backlog Item(PBI)						
User Story			Status	Estimated Effort	Sprint Number	Priority
As a	Want to be able	So that				
Administrator	to see all the members access	can keep the events happening records	To Do	24 hours	89	1
Administrator	to upload company's policy	customer remains update to company's rule's and regulation	In progress	12 hours	89	9
Administrator	to measure average driving speed	possible to make alert the driver through app	Commited	8 hours	91	4
Administrator	to track customer's current location	known about the accidental issues	Done	6 hours	88	3
Administrator	to show the discount & offers	make clients inform about their benefit	Done	10 hours	87	10
Administrator	to see clients credential	company keep client's data safe and usable	Done	12 hours	87	2
Member	to see the time of the day	keep himself/herself updated with the time	To Do	6 hours	85	15
Member	change the contact details	keep in touch with administrator	Done	20 hours	82	3
Member	change the password	can have access anytime into the app	Done	16 hours	85	6
Member	place the claims	get facilities with more value added app	To Do	8 hours	92	18
Member	to get nearby repair & fuel facilities	avoid unwanted situation and keep staying safe	In progress	22 hours	90	30
Member	to have battery status & distance traveled	having well preparetion before outgoing with car vehicle	To Do	10 hours	89	8
Administrator	generate current traffic status on current route	avoiding wastage of time	To Do	20 hours	88	6

Figure 24: PBI for the car Insurance mobile application. (own)

Table 6: Sprint 92 product backlog for Burndown diagram. (own)

Sprint 92			
As a	Want to be able	So that	Priority
Member	to place complain	possible to have more useful	5
Member	to check complain status	having update about the feedback	2
Member	to add suggestions	increase communication between clients and company	1
Administrator	response against customer claims	clients priority proven	3
Administrator	take necessary actions for fullfillment of customer suggestions.	work for customer satisfaction and app development	4

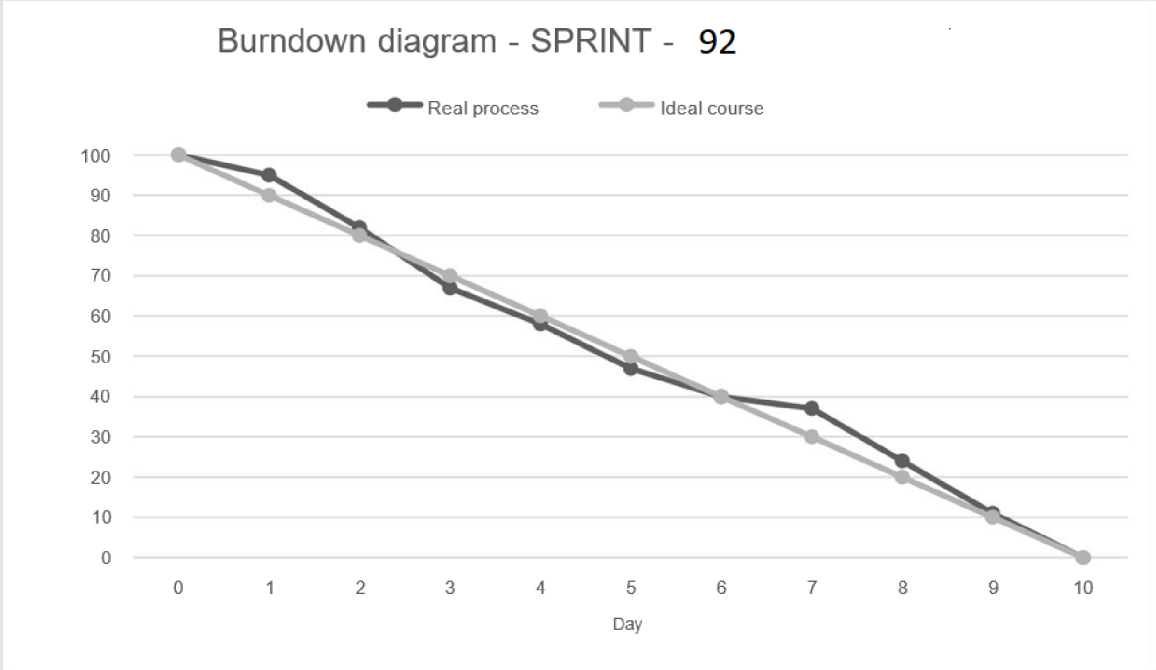

Figure 25: Burndown Diagram for Sprint 92 (own)

Gantt Chart

I have also created Gantt chart for overall task of the car insurance mobile application of "NN Groups". Where I have tried to visualize the task completion time over the accomplishment of the project namely "Telematics App".

Task Name	Start Date	End Date	Duration (Day)
Gathering market necessities	11/5/2019	1/12/2020	68
Define Initial specifications	1/15/2020	1/26/2020	11
Planning to meet project objectives	1/27/2020	3/22/2020	55
Requirement collection	3/26/2020	5/5/2020	40
Analyzing rough prototype	5/10/2020	6/24/2020	45
Development of automatic system	7/25/2020	9/18/2020	55
Testing automatic system	9/21/2020	10/25/2020	34
Integrate developed system	10/30/2020	1/29/2021	91
Testing the system	1/30/2021	6/8/2021	129
Demonstrating system to early birds	7/8/2021	10/10/2021	94
Launch the system	10/15/2021	12/20/2021	66

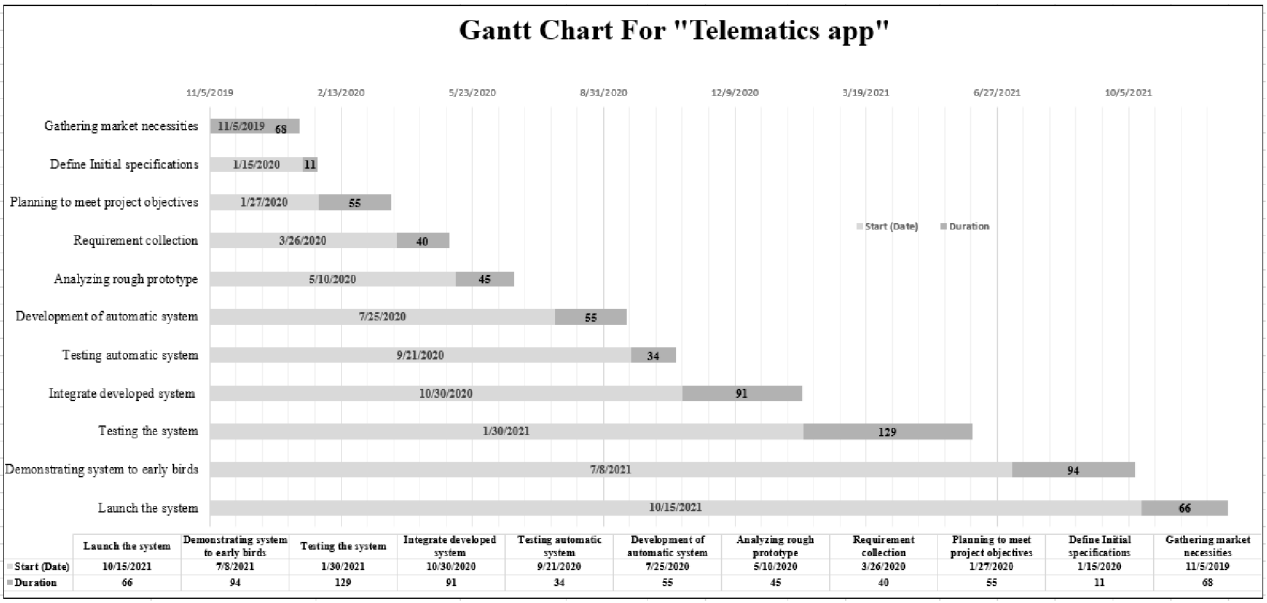

Figure 26: Gantt chart for car insurance mobile application. (own)

If the sprint was successful and every task in the backlog was finished, then the next sprint would be scheduled. after all the sprints are completed, Manager at the Final Sprint Review Meeting, the Product Owner and SCRUM Master presented the results.

In order to answer any queries that might have arisen, team members also took part in this discussion. The functionality was also evaluated by testers during this meeting.

Other Sprints were also completed in similar manner, and the finished product was delivered to the client.

Benefits of Chosen Agile methodology:

It was necessary to continually add value to this project's existing product in order to bring it into balance with the market and increase corporate efficiency. The outcome of a self-directed project was made possible thanks to agile approach. The product was actually more convenient and user-friendly as a result of this methodology's continual follow-up strategy and attention to customers' changing requirements. Although it wasn't always practicable, the team tried to incorporate user and customer feedback into the code.

Despite the fact that there were originally intended to be eleven Sprints, a fully operational car insurance mobile application was produced in just 16. Changes and maintaining market balance were the main causes of this growth. The project easily went over its given scheduled delivery, but this minor overrun can be tolerated because the customer's expectations and company's requirements were met, and they had consented to the exceedance.

Wireframe of Car Insurance Application System

Users/drivers can log in using mobile apps. Users can sign up/register using a local Wi-Fi connection or with the assistance of a company specialist. Offline mode is also supported by the application. For user identification, the mobile application can link via Bluetooth to a detection system.

Figure 27: wireframe of log in page environment. (own)

5 Discussion and Result

For the First project

The first project was worthwhile to solve traditionally because it could be designed with greater accuracy to plan and, consequently, estimate the expenditures that were crucial to the selection process. Based on the precise project owner specifications, an analysis of the project might have produced a more accurate estimate of how long the project would take, how much it will cost, and what it will accomplish. The main idea behind traditional project management, particularly Waterfall, can be summarized as follows: expectations are established at the outset of the project and are carried out in accordance with those expectations. If everything went as planned, Waterfall would be the best project management methodology, Unfortunately, or perhaps even more so, changes will be present in real life. In the case of the first project, the changes happened right when web pages were scheduled to link to a database that had already been constructed. During the start phase, it was not immediately clear who would perform this connection; it was just understood that it was necessary. Upon learning of this fact, the client maintained its position, asserting that the link is the responsibility of the development team on the supplier's side of the project. But the supplier disagreed, arguing that since it wasn't explicitly stated in the documentation and wasn't even charged for, it wasn't even covered by the cost.

Because the team had already committed to the implementation effort and it was in their best interest to complete the project, the company did not want to cancel the contract because the project was already halfway through implementation. In spite of the fact that it met all of the customer's requirements, this caused the company to turn back, raising the costs of a project that the customer was ultimately willing to pay for in full. There wouldn't be these conflicts and the customer's expectations would be satisfied if this project had been managed agilely from the start, but at a significantly higher cost.

For the second project

The second project was accomplished in an agile manner, specifically with the help of the SCRUM methodology. The project's client was ready to place their cooperation in the development team and had a major involvement in how the application was made. As a result, the clients immediately became Product Owners, saving time and improving

communication because they could make critical decisions by themselves using the company survey tools provided on the company website. Due to the client's inability to provide more detailed instructions, there were a lot of revisions made. It was a product for the providing of information about the car insurance policy including all customer needs and organizational requirements, which is closely related to some company website functionalities, which could not be planned and made it impossible to make a more precise estimate of costs and time. The SCRUM approach, which operates on the basis of changes and can actively process changes, was chosen as a result. The methodology delivered exactly what was anticipated in terms of meeting all consumer and business needs. Based on this data, a table that outlines the benefits and drawbacks of the methodology in relation to several factors can be created:

Table 7: Comparison of traditional and agile methodologies. (own)

Aspect	Traditional Methodology	Agile Methodology
Responsibility of the project manager	+	-
Project development predictability	+	-
Individual performance in a team	+	-
Sticking to the plan	+	-
Product quality	+	-
Fast delivery of the product	-	+
The ability of the team to work in a changing environment	-	+
Reacting to changes	-	+
Cooperation to the customer	-	+
Gaining trust	-	+

Based on these considerations, it cannot be argued that one approach is better than the other and vice versa. Both approaches have their advantages and disadvantages. Rather, it would be more appropriate to understand them as mutual supplements that suppress the shortcomings of one or the other approach. Analyzing the project is immensely helpful in deciding on the right methodology based on these questions:

1. Does the project require a precisely defined scope?
    - **Yes**: Use Waterfall. **Do not**: Use an agile approach.
2. Does the project product need constant feedback from the customer?
    - **Yes**: Use an agile approach. **Do not**: Use Waterfall

3. Is the speed of delivery of the project product more important than the quality of the product?
    - **Yes**: Use an agile approach. **Do not**: Use Waterfall.
4. Can the teamwork in a development environment and is it able to adapt?
    - **Yes**: Use an agile approach. **Do not**: Use Waterfall.

6 Conclusion

The purpose of this work was to compare traditional and Agile project management methodologies in a selected company in order to determine when and under what circumstances it is preferable to utilize one. In the first portion of the experiment, we learned the fundamental terms used in project management, and after that, the topic of project management was introduced. An older method of project management, known as the traditional approach, was first outlined. The agile approach, which included a number of techniques, was then theoretically examined. SCRUM was chosen, and this examination was done in greater detail. Two real-world IT projects were used to illustrate how to choose an acceptable methodology. Due in large part to the availability of thorough documentation that covered all functionalities, the first project was suitable to being solved traditionally. This resulted in the project being able to be planned more precisely and have its scope defined with clarity. The planned structure application has also already been given by the project's client. The second project was more suited for an agile approach to be solved, more specifically using SCRUM, which anticipates changes. In this project, it was unclear exactly how the implementation would go because the company also had some specifications for the supply of a car insurance application that required some customization. Because it was necessary to add new values to everything already present in the market in order to survive in the real market competition. Therefore, it has been established that a method that is properly chosen will increase the likelihood that the project will be completed successfully. Additional resource savings will result from it (both financial, time and human). In conclusion, it must be remembered that because each project is somewhat unique from the others, it is impossible to determine exactly how to proceed with its development. The evaluation of the complete situation is considered an effective situation, and only the tools and activities that will develop the project and achieve project goals should be used. This is

obviously not an easy task, and in order to accurately evaluate the situation, practice and experience are more important than anything else.

Consent by,

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1. **Project Name**: Company Mobile application
Project manager: Lenka Burova
Date of approval: December 25, 2020
Project start date: June 1,2020
Project completion date: November 30, 2020

2.Project Name: Telematics App
Project manager: Alena Dinikova.
Date of approval: December 29. 2021
Project start date: November 11,2019
Project completion date: December 20, 2021

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8 List of pictures, tables, graphs and abbreviations

8.1 List of figures

8.2 List of tables