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Master's Degree: Management Engineering

Master Thesis:

Applying the PM approach to the academic context, building thesis projects management framework. The Product Owner perspective.



**Politecnico
di Torino**

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Abstract

Thesis is a longer academic paper required to complete a degree program. The thesis process often requires months (or even years in case of Doctoral program) of research to construct a final defendable thesis. Process of developing a thesis is one of the mandatory requirements of the university to achieve and complete the degree program. Traditional approach of developing a thesis requires the student to send a proposal to the professor or convey his/her interest in already proposed thesis titles by the professors. The thesis process begins after the acceptance of the thesis proposal by the professor. The main drawback of the traditional approach was that there was no proper way to monitor the progress of the thesis development and there is no standard approach to carry out the thesis development. In this thesis, we carried out an experiment set up for building a thesis management web application that implements thesis production as a project to be delivered according to ISO 21500 methodology and the web application was developed using Scrum methodology. This thesis paved a way for viewing the thesis management process from the project management point of view and using the PM approach to carry out the thesis production process.

Keywords: Thesis development and management, Scrum Methodology, ISO 21500

1. Introduction

The most common way to conclude a master's degree is by successfully conducting a research project and writing a thesis. The process of conducting a research project and writing the thesis report can take up to sometimes a year, but most of the cases it is equivalent to 5 to 6 months of full-time study, which is required to conduct the project, inscribe the findings, to be examined by the internal or external supervisor, both in some cases, and to finalize the results and outcome before the end of graduating period. While this tight timeframe limits the scope of inquiry and constant monitoring of the progress, it also places pressure on the student and supervisor to manage the thesis development and their rapport well.

Before discussing more about thesis development process, it is important to define and understand what thesis means. Thesis, also known as a thesis statement, is the sentence that introduces the main argument or point of view of a composition (formal essay, nonfiction piece, or narrative). It is the main claim that the author is making about that topic and serves to summarize and introduce that writing that will be discussed throughout the entire piece**[b]**. In academic point of view, a master's thesis is a piece of original scholarship written under the direction of a faculty advisor. A master's thesis is like a doctoral dissertation, but it is generally shorter and more narrowly focused. As a rule of thumb, a master's thesis should be publishable as a single article, though it might be longer than a typical article **[c]**.

Thesis is more than just an upgrade of undergraduate study. The master's thesis often is the student's first academic experience of learning in a one-to-one setting under the supervision of an experienced researcher or a subject matter expert. The assigned supervisor is expected to guide the students by directing them in what they should be reading, conducting the assigned experiments, and submitting the clearly defined deliverables at each stage of the thesis development, so that the thesis is completed on time and to the level of quality is adhered to defend the thesis and pass the final examination.

1.1 Purpose

Thesis development process in Politecnico di Torino have been pretty much the same from long time. The process of developing thesis consists of 3 stages:

a. Selection and approval thesis topic. b. Conducting the assigned research and thesis report writing along with report review by the supervisor which may result in re-writing based on the comments received. c. Final thesis conclusion and report submission.

According to Badenhorst and Guerin's [1] argument that research writing's complexity is often invisible to students and to academics; that academic writing remains deeply conservative despite graduate profile calls for creativity; and that the historic privileging of 'detached' scholarship causes psychological hardship for many. This calls and opens the scope to rethink the process of thesis development as a whole.

The purpose of this thesis is to experiment with the existing thesis development process and to provide a platform more like a web application to help develop a thesis for students and help professors to monitor the thesis progress all along the development process.

This work will be part of an iterative cycle, the future researcher can use the obtained data and continue the work to change, evolve, and adapt according to the future requirements of the stakeholder. As a result, we will be creating a virtuous circle of improvement.

1.2 Objective

The main objective of this thesis is to set up an experimental study on the agile project management, especially with scrum, with the aim of obtaining a record set of sprints performance and, in general, lessons learned. And to test the thesis development process by treating it as a project by following ISO 21500 principles and by carrying out thesis development through undergoing various stages like a project life cycle.

In other words, the main research rationale is therefore building a thesis management web application, that implements thesis management as a project to be delivered according to ISO 21500 project management approach and the web application is developed using the scrum approach.

This experimental set up will follow a full-scale scrum implementation by understanding the principles of agile manifesto and following the same to carry out the project. The scrum collaboration tool used to extract data is taiga, which is the chosen platform to implement the

scrum methodology, through the platform it is possible to have precise information about the user stories, epics, tasks, and sub tasks; it is also possible to maintain and record start and completion date and respective resources assigned to the particular tasks. This allowed us to obtain some crucial velocity metrics, which was helpful to analyse the quality of the work. These metrics can be used to make the better estimation of the effort required to finish the task and the productivity of the all the assigned resources.

1.3 Research Question

It is a known fact that students in the academic set up are required to develop their thesis to graduate. Each year plethora of students take up thesis work under professors or in some cases in collaboration with the companies. Students have been using the same old method to write, structure, and submit the thesis which makes it difficult for supervisors, both internal and external, to monitor the progress of the thesis.

This research will be conducted by creating a platform using scrum methodology which will allow students to develop thesis by treating thesis as a project according to the ISO 21500 methodology which will improve the efficiency and quality of the thesis. The efforts to achieve this goal will be guided by trying to answer the following research questions:

Research Question 1: What are the lessons learned in using the Scrum to develop a platform and ISO 21500 to develop a constructive thesis?

Research Question 2: What is the process of delivering the research and, therefore, of delivering a thesis?

Research Question 3: What will be the architecture of the digital PM based thesis development platform?

The focus of this thesis is to endeavour around to answer the **research question 1** by carrying out the full fledged scrum project along with the real time defined roles and resources, meaning and responsibilities of each role are explained in the scrum roles section of this report. For this experimentation, we have well defined roles and responsibilities as follows:

Prof. Paolo Eugenio Demagistris: Stakeholder, Prof. Paolo is a professor of Project Management in Politecnico di Torino. He was the Co-founder of construction consulting company and was the director of the company spanning for almost 20 years. Prof. Paolo took the role as stakeholder throughout the project and communicated the requirements to product owner.

Mohammed Salman Pasha: Product Owner, took up the role of product owner. I was in contact with stakeholder communicating the requirements and conveying the voice of customer to the scrum team.

Scrum Team- Product owner was in contact with scrum team to communicate all the requirements shared by the stakeholder which were the voice of customer. Scrum team is as below:

Chiemerie Ezechukwu: Scrum Master & Back End Developer, is the full-time student of Engineering Management in Politecnico di Torino. Chiemerie as a back-end developer played a crucial role in sharing his knowledge and expertise to develop the platform

Saidbek Samigjonov: Front End Developer, is the full-time student of Engineering Management in Politecnico di Torino. Saidbek as a front-end developer took care of the UI/UX design of the platform.

Giorgio Spadaro: Testing, is the full-time student of Engineering Management in Politecnico di Torino. Giorgio was responsible for testing the codes deployed by the front and back end.

2. Project Management Methodology and approach

According to the standard guide of Project Management Book of Knowledge (PMBOK) guide, Project is defined as *a temporary endeavour undertaken to create a unique project service or result*. Project are temporary and close on the completion of the work for which they were chartered to deliver.

The term project refers to a complex, single enterprise with a fixed duration, aimed at achieving a clear and predefined objective through a continuous process of planning and control of differentiated resources and with interdependent constraints on costs, time and quality. Regardless of the field and scope, all projects share key elements that define them as such

- Temporary nature: a project always has a pre-established beginning and end, therefore, a predetermined duration.
- Specificity of the objective: a project is aimed at producing a unique result/product.
- Specific resources (time, money, and people) assigned.
- Development in phases: beginning idea, planning, implementation, end.
- The employment of a team of professional figures.
- Monitoring and adaptation activities to ensure the achievement of the goal.

All projects follow a path divided in distinct and subsequent phases that start from the initial idea of developing a product, and end with its realization. The life cycle of a project is characterized by five phases that connect the beginning and the end. [a]



Fig 1: Project Management phases

1. **Start or Initiating**, in which the objectives, the recipients, the work plan, the products, the expected results, the partners, the times, the places, and the resources are determined. This process group includes the basic groundwork necessary to create the project and define the guidelines and criteria under which it will operate. Authorizations from the performing organization are given and funding is put in place. An initial scope statement can be made because executives generally have an idea what the project should accomplish when they authorize it. Any initial project boundaries are determined, and stakeholders are identified. This phase ends when the main aspects of the project are outlined and shared by the project team through a document, the Project Charter. All this information gets placed into a Project Charter. The purpose of this document is to commission the project and authorize the project manager. For small projects where lines of reporting are clear, the project charter is optional.

2. **Planning**, in which the structure, strategy, process and resources necessary for the realization of the project are detailed. In this phase, the project idea is analysed in all its aspects and broken down into a definitive plan of the activities to be carried out, determining time, team and budget constraints. This phase produces a document called a Project Management Plan. This is the master planning document which establishes stakeholder expectations and makes it clear how the project will be managed. In the PMBOK, all ten knowledge areas are covered within the planning phase. It should outline the project's scope, cost, deadlines, milestones, communication needs, and anything else that shows the stakeholders how the project will be managed. It is highly specific to individual industries and organizations. It should be distributed to the major project stakeholders, including the project sponsor. This phase is usually the most underrated and underutilized. Planning is the most intense part of the project management process because a lack of planning can result in cost and schedule overruns as well as other project changes which look bad on the project manager and sponsor. Because of the potential for problems, it is important that the project manager carefully follows each item in the knowledge areas throughout the project planning phase.

3. **Execution**, which is configured as a process of activities aimed at following the plan and the set objectives. Some activities are continuous throughout the project (such as management, communication, monitoring and evaluation), while others are a constituent part of the

specificity of the project and its originality. This phase is where the project's technical work takes place. The project team is assembled and put to work, and the production of the project deliverables are put into motion.

The execution of the project requires coordination of human resources, managing stakeholder expectations, and dealing with project changes. The project manager must be on top of issues that arise, as well as making regular forecasts of future schedule and cost problems to deal with changes as far in advance as possible. Change requests must be handled and documented throughout this phase, and stakeholders must be kept informed.

Status updates and other project communications are sent to the relevant stakeholders according to the project management plan. Documents are stored and archived, and stakeholders are managed according to the plan.

4. Monitoring & Control during the entire life cycle, in order to verify that actual progress accomplishes with the planned one. Throughout the project, the project manager must monitor and control the project work to ensure that project deliverables are on time, on budget and of acceptable quality. Also, stakeholders must be kept satisfied and the project team must be kept motivated and coherent. Monitoring and controlling the project work occurs concurrently to the Execution phase, therefore the two Process Groups occur in parallel.

Tracking of time (deadlines, milestones, etc.) and cost are most done via Earned Value Analysis, which provides a strong early warning of deviations in those areas. Quality of deliverables, stakeholder communication, and high-risk potential problems are other areas of regular monitoring. At any time, monitoring can result in changes to the project.

If changes are required to any part of the project as documented in the project management plan, they need to be documented and result in an updated plan. This includes changes to deadlines, costs, deliverables, and any other change to the project as envisioned.

5. End or Closing, which is intended as delivery of products / services and administrative closure of the project. The administrative end of the project is the phase in which the work done for the future is capitalized with the recapitulation and the sums of the entire path.

A project management methodology is described by PMI (Project Management Institute) as *'a set of methods, techniques, procedures, rules, templates, and best practices used on a project. Project management methodology has been often described as set of guidelines and principles that are applied to a specific situation, or as a knowledge set about tasks, roles, tools, techniques, and deliveries used over the course of a project and tailored specifically for it'*. Cockburn (2003) defines project management methodology in a very broad way, which is any principal project management team relies on to deliver successfully project results [7]

In addition, PM methodology can be defined by its scope and goals. Its goals are reaching the desired quality of the project result, as well as control and process improvement. From a higher-level perspective, the final goal is to increase the probability of success when delivering a completed project [4].

A good and well-defined methodology will guide the project manager through a set of activities that will achieve project results in a managed and controlled way. Characteristics that lead to a good methodology is an appropriate level of details, standardized planning, usage of templates, cost, and time management techniques, reporting, flexibility for quick development and usage on most projects, standardized project lifecycle phases. These elements need to be understandable, accepted, usable and based on guidelines and must reflect the business ethic. [4]

A project management approach is a set of principles and guidelines which define how a specific project is managed. A similar term, comparable to approach, can be the term project management framework, that represents set of rules, methods, templates, and process to be used during the project lifecycle [4]. The distinction among a traditional, or prescriptive, approach and an agile, or adaptive, approach can be helpful to select the best one depending on the project and its characteristics and the competence and knowledge of the organization. Depending on the approach used, there are different success factors to be considered. It is recommended to discuss about the project management approach at the start-up of the project and the relevant success factors are decided accordingly with the approach selected [5].

3. [ISO 21500:2012\[e\] Guidance on Project Management](#)

Before diving into the discussion of why we are using ISO 21500, it is very logical to know what is ISO and what does ISO 21500 mean? ISO or International Organization for Standardization is a worldwide association of national standards bodies whose main role is to set up international standards which can later be used by various entities. The process of standardization is normally taken care by the technical committees. Each standard member body interested in a specific subject for which a technical committee has been established has the right to be represented on that committee.

ISO 21500 is an international standard which provides guidance on concepts and processes of project management that are important for, and have impact on, the performance of projects.

[6]

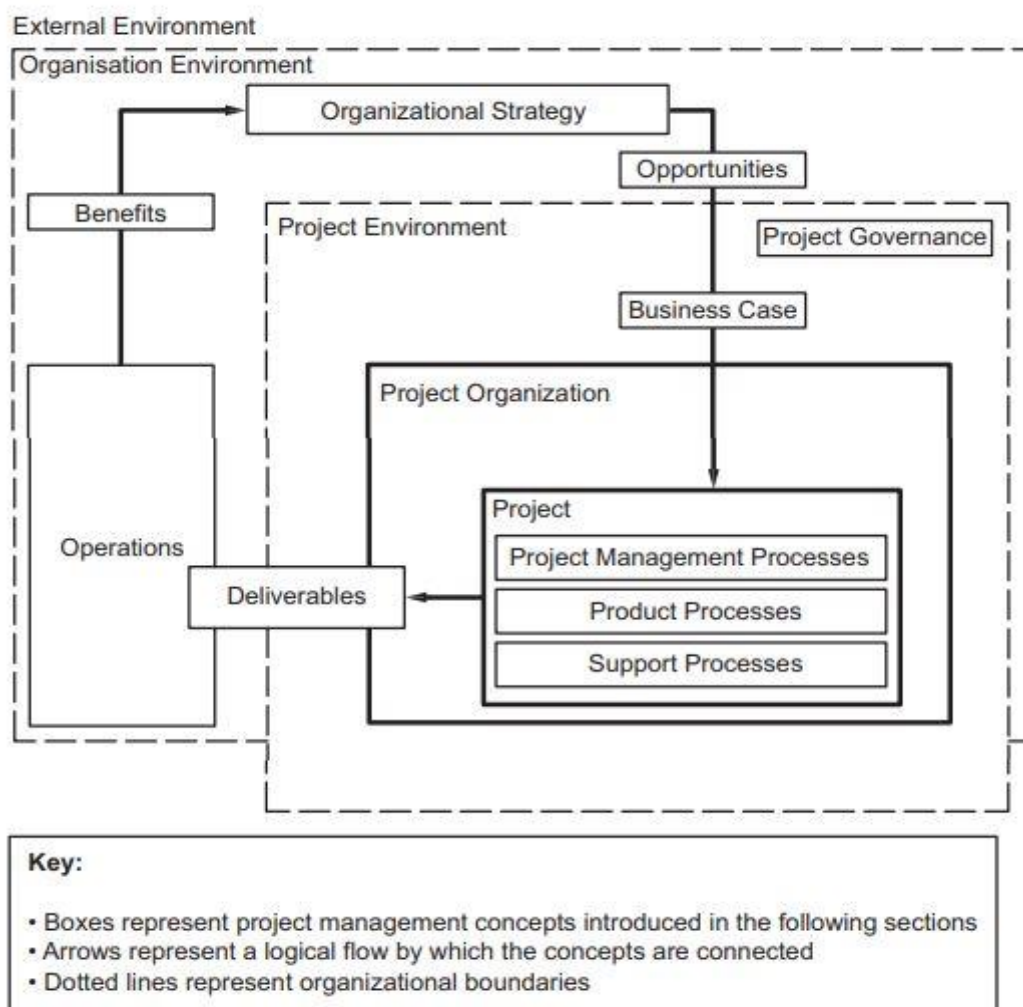


Fig 2: Overview of project management concepts and their relationships

As depicted in Fig, it is quite evident to say that project management concepts relate to each other. The organizational strategy identifies opportunities. These opportunities are evaluated and should be documented. Selected few of these evaluated opportunities are further developed in a business case or other similar document, and this results in a project which will provide certain deliverables. These deliverables can be used to realize benefits. The benefits can be an input to realizing and further developing the organizational strategy. It is worth to have a look into each component to better understand the concept.

3.1 Organizational Strategy and opportunity

3.1.1 Organization Strategy

Organizations generally establish strategy based on their mission, vision, policies, and factors outside the organizational boundary. Projects are often the means to accomplish strategic goals. An example of a value creation framework is shown in Fig

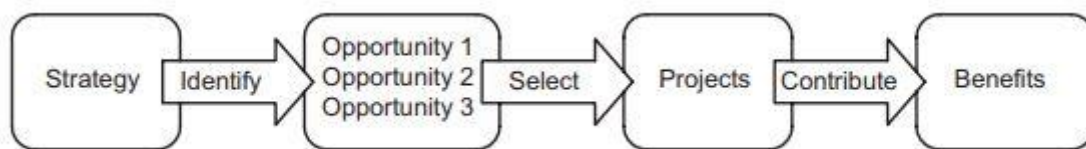


Fig 3: Value creation framework

Strategic goals may guide the identification and development of opportunities. Opportunities selection includes consideration of various factors, such as how benefits can be realized, and risks can be managed. The project goal is to provide measurable benefits that contribute to realizing the selected opportunities. The project objective contributes to the project goal by creating the required deliverables. Project goals are achieved when the benefits are realized. Goals might not be achieved until a period after the objectives are achieved.

3.1.2 Opportunity evaluation and project initiation

Opportunities may be evaluated to support informed decision-making by responsible management, to identify feasible projects that could transform some or all these opportunities into realized benefits. These opportunities may address, for example, a new market demand, a current organizational need, or a new legal requirement. The opportunities are often evaluated through a set of activities that provide formal authorization to start a new project. The organization should identify a project sponsor to be responsible for project goals and benefits. The goals and benefits may result in a justification for the investment in the project, e.g., in the form of a business case, and that may contribute to a prioritization of all opportunities. The purpose of the justification is usually to obtain organizational commitment and approval for investment in the selected projects. The evaluation process may include multiple criteria, including financial investment appraisal techniques and qualitative criteria, such as strategic alignment, social impact, and environmental impact. Criteria may differ from one project to another.

3.1.3 Benefit realization

Benefits realization is generally the responsibility of organizational management, which may use the deliverables of the project to realize benefits in alignment with the organizational strategy. The project manager should consider the benefits and their realization as they influence decision-making throughout the project life cycle.

3.2 Factors in Internal and external organizational boundary

3.2.1 External Environment factors

These are normally out of control of the project manager and the stakeholders, despite they have a great impact and influence on the project by creating new opportunities as well as imposing limitations or introducing risks. External factors include such as socio-economic, geographical, political, regulatory, technological, and ecological factors.

These above-mentioned factors may have huge impact on the project, but they are out of control of project manager and stakeholder involved in the project.

3.2.2 Internal Environment factors

These are the factors which are usually in control. Factors in the internal environment include strategy, technology, project management maturity, resource availability, organizational culture, and structure.

A project usually part of a larger project or belongs to an organization that has other activities. Building a certain relationship between project and its internal environment will make sure that the project stay aligned with the organization business.

3.3 Project Governance

Project Governance is a framework applied by the concerning organization to direct or control, project activities, including, but are not limited to, structure definition, policies, processes and methodologies identification, interaction such as reporting of risks.

3.4 Stakeholder and Project Organization

Identifying stakeholders is an important procedure to the project. Each stakeholder has its roles and responsibilities toward the project goals. The picture below describes a typical project stakeholders' relationship. The most common stakeholders are customers, suppliers and project management office.

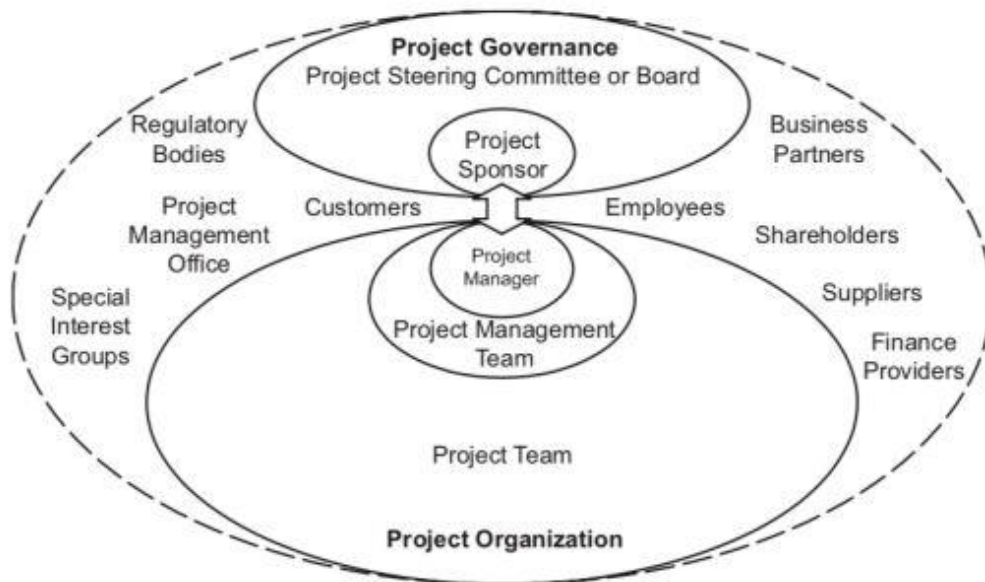


Fig 4: Project Stakeholders

The project organization is more like a temporary structure that decides project roles, responsibilities and boundaries that are defined and communicated to all the stakeholder of the

project. This includes various roles such as project manager, project management team and the project team.

The project Governance is the authoritative structure which involves roles and entities who takes crucial project decisions. This body consists of roles such as project sponsor and the project steering committee or board.

3.5 Project Life Cycle

Any given project is carried out into phases that are determined by the project governance and control needs. Typically, project life cycle spans through the period from the start of the project to its closing. These phases in the project are determined and categorized via decision points, which in turn gives rise to project governance. By the end of the final phase, the project should have provided all deliverables.

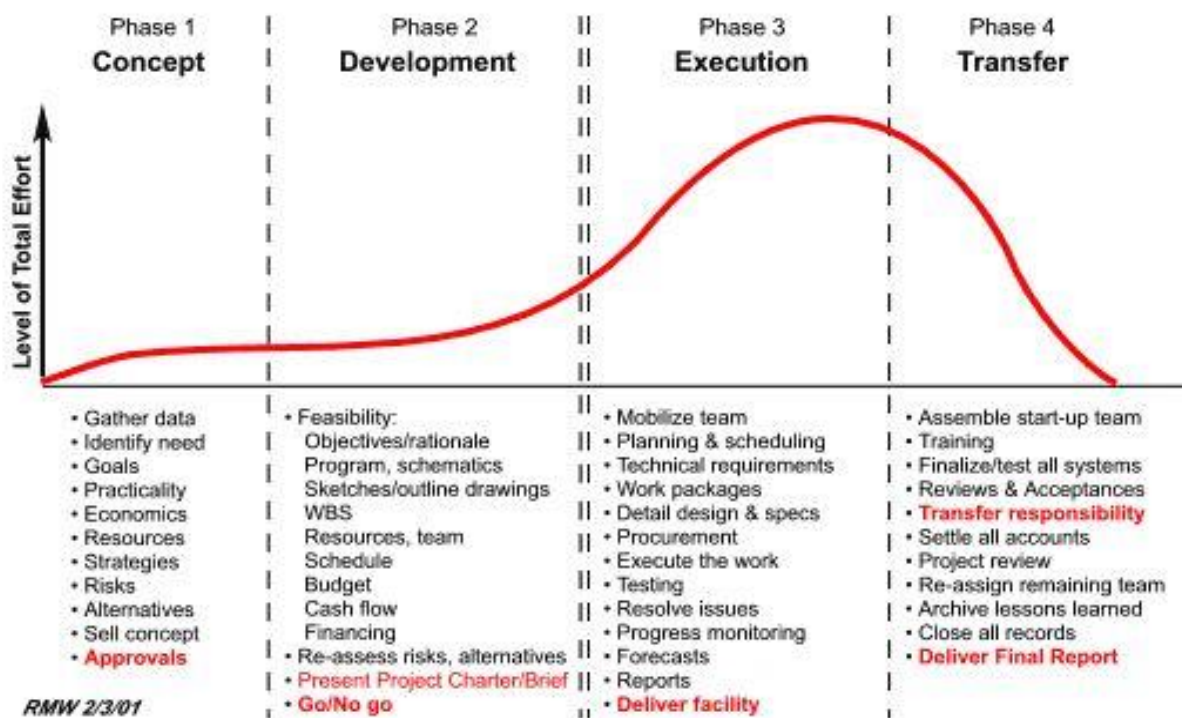


Fig 5: Typical Project Life Cycle

3.6 Project Constraints

These are usually the hurdles or the aspects which limits the flexibility of the project. It is quite important to manage the balance between a particular constraint against the others. Usually in a project, constraints are tied up to one another that is, change in one of the given constraints can affect the one or more of the other constraints. So, it is quite important to handle the constraints as these may have impact on the decisions made within the project management processes.

Some of the constraints could be:

- The duration of the project
- The availability of certain resources
- The project budgets
- Government laws, rules, and regulations
- The level of acceptable risk exposure

3.7 Project Management Process

ISO 21500 generally identifies the recommended project management processes to be used during the project. The project management processes are defined and described in terms of the purposes they serve, the relationships among the processes, the interactions within the processes and the primary inputs and outputs associated with each process. In the interest of brevity, this International Standard does not indicate the source of all primary inputs or where primary outputs go. The project management processes can be viewed from two perspectives first as process groups and second as subject groups.

Subject groups	Process groups				
	Initiating	Planning	Implementing	Controlling	Closing
Integration	4.3.2 Develop project charter	4.3.3 Develop project plans	4.3.4 Direct project work	4.3.5 Control project work 4.3.6 Control changes	4.3.7 Close project phase or project 4.3.8 Collect lessons learned
Stakeholder	4.3.9 Identify stakeholders		4.3.10 Manage stakeholders		
Scope		4.3.11 Define scope 4.3.12 Create work breakdown structure 4.3.13 Define activities		4.3.14 Control scope	
Resource	4.3.15 Establish project team	4.3.16 Estimate resources 4.3.17 Define project organization	4.3.18 Develop project team	4.3.19 Control resources 4.3.20 Manage project team	
Time		4.3.21 Sequence activities 4.3.22 Estimate activity durations 4.3.23 Develop schedule		4.3.24 Control schedule	
Cost		4.3.25 Estimate costs 4.3.26 Develop budget		4.3.27 Control costs	
Risk		4.3.28 Identify risks 4.3.29 Assess risks	4.3.30 Treat risks	4.3.31 Control risks	
Quality		4.3.32 Plan quality	4.3.33 Perform quality assurance	4.3.34 Perform quality control	
Procurement		4.3.35 Plan procurements	4.3.36 Select suppliers	4.3.37 Administer procurements	
Communication		4.3.38 Plan communications	4.3.39 Distribute information	4.3.40 Manage communications	

NOTE The purpose of this table is not to specify a chronological order for carrying out the activities. Its purpose is to map subject groups and process groups.

Fig 6: Project management process groups and subject groups

3.7.1 Develop project charter

As defined earlier A project charter is a "document issued by the project initiator or sponsor that formally authorizes the existence of a project and provides the project manager with the authority to apply organizational resources to project activities"[8]

The importance and benefits of a project Charter[d]

- a. It allows the project organization to formally authorize and give a green signal to a project to start
- b. It establishes the authority of the project manager and the project sponsor
- c. It helps to assure that the projects are approved based on the proposed business case rather than any subjective opinions
- d. It allows the project selection committee to consider whether the project aligns with the company's strategic plan
- e. Provides the preliminary information needed to orient team members into the project at later stages
- f. It serves as a revising tool so that team members can review the approved charter whenever required
- g. It helps to document the business needs,

Inputs to develop a project charter: Project statement of work and Business case

3.7.2 Develop project plans

Project plans are composed of project plan along with the project management plan. These project plans regardless of their composition should integrate scope, time, cost, and other subjects.

The project management plan is a document or set of documents that defines how the project is undertaken, monitored, and controlled. This document usually defines the roles, responsibilities, organization and procedures for the management of risk, issues, change control and other subjects as needed.

Project plans are important part of the project, and they are usually used to document the following:

- Why the project is being undertaken
- What will be provided and by whom
- How it will be provided
- What it will cost

- How the project will be implemented, controlled, and closed.

Inputs for the project plan and Project Management Plans:

- Project Charter
- Business Case
- Lessons learned from previous projects
- Approved changes

3.7.3 Direct project work

The main purpose of this process is to manage the performance of the work as defined in the project plans, to provide the approved project deliverables. Direct project work is the management interface between various entities within the project organization such as the project sponsor, project manager, project management team and project team.

The performance of the planned project activities will be directed by the project manager and also manages the various technical, administrative and organizational interfaces within the project.

The outcome of this process is obtained through the integration of the various processes performed as defined in project and project management plan.

This is one of the most crucial process which is part of the implementing process group, and it makes sure that the activities which are planned are executed as defined. The primary inputs in the direct project are project plans and approved changes. The input approved changes are the changes requested by either the project manager or the project team working on a particular task. In order to take any decision, concerned team member is obliged to send a request for change in any of the pre-defined tasks. After analysing and reviewing the change request, approved changes can be used to implement in the current phase of the project. Each change request and approved change should be registered in the change management log which we will see in detail in the control change process.

The primary output of this process are progress data, Issue log and lessons learned.

3.7.4 Control Project work

The purpose of the process control project work is to primarily complete the project activities in an organized and integrated manner in accordance with the project plans. This process should be performed throughout the project and includes measuring performance, assessing measurements and trends that may affect process improvement and triggering process change to improve performance.

The primary inputs required to kick start and carry out the control project work process are project plans, progress data, Quality Control measurements, Risk register, Issues log.

The quality control measurements are used to analyse as well as evaluate the quality of the different processes involved in a project against the standards of the organization or on the requirements specified during the project management planning phase [e].

This measurement can also be used to compare the processes that are used in making the measurements. It is also used to validate the actual measurement to determine their degree of correctness [e].

Since quality control measurements are documented results, it is crucial that they be captured in formats that are specified through the Plan Quality Management process. It is also important to take note that this particular document is also an important input for the Perform Quality Assurance. It is one of the inputs needed to generate change requests, project document updates, project management plan updates and the organizational process assets updates. This is to ensure that the quality standards, as well as operational definitions, are satisfied. [e].

Risk register on the other hand is the component of overall risk management framework created during the early stages of the project. It is a log file which works as a master database of all risks ever captured and other related information like Qualitative Analysis, Quantitative Analysis and risk response. [f]

Another most common input in this phase, issues log is a simple list or spreadsheet that helps managers track the issues that arise in a project and prioritize a response to them. [g]

3.7.5 Control Changes

The main purpose of the process control changes is to steer and implement changes to the project and deliverables and to formalize acceptance or rejections of these changes before subsequent implementation.

Throughout the project it is necessary to record change requests in a change register, evaluate them in terms of benefit, scope, resources, time, cost, quality and risk, assess the impact and obtain approval prior to implementation. A change request may be modified or even cancelled in light of the impact assessment.

Once the change has been approved, the decision should be communicated to all the relevant stakeholders for implementation, including updating of project documentation as appropriate. Changes to deliverables should be controlled through procedures such as configuration management. [6]

The primary inputs for this process are project plans and changes requests. According to PMBOK, change request is a formal request to bring about a change that will require revising the documents, a project baseline, a deliverable, or some combination of all three. Implementation of these requests to change certain parameters of the project may incorporate either corrective actions or preventive actions.

3.7.6 Close Project phase

The purpose of close project phase or whole project is to confirm the completion of all project processes and activities, to close a project phase or a project. [6]

In some cases, project may have to be prematurely terminated prior to the completion due to various reasons like if the project stakeholder no longer requires the project deliverables or when it becomes quite clear that the project cannot meet the objectives within the time frame set for the project. Terminating a project is almost like closing a project following all the activities in a project closing phase, even though there may not be any deliverables available

to release to the interested stakeholders. All the activities must be documented and collected in accordance with the organizational requirements.

The primary inputs required in this process are the progress reports, contract documentation and project completion report and the outputs of this process are the closure report, completed procurements and released resources.

4. Agile Project Management approach

The Agile methodology originated in the Information technology field somewhere around the '90s as a replacement to the waterfall methodology. It is an innovative method based on continuous communication with the stakeholders, whose satisfaction is crucial for the success of the project and the development of the organization.

The “movement Agile” in the software industry was introduced in 2001 with the “Manifesto for Agile Software Development” published by professionals and consultants in the IT sector. As it has been stated in the Manifesto [h], the values that are respected are:

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

According to the Manifesto, the values on the left are valued more than those on the right side of the sentences, although both must be appreciated.

The Agile method can be pursued under various and more flexible conditions to meet ever changing customer requirements and expectations. Agile method gives more emphasis on the customer satisfaction, business needs and value creation. Agile, in a broad sense, means to plan and execute more flexible development methodologies based on a collection of specifications and on a structuring sequential software development. Agile methodologies, in general, allows users to continuously review the specifications, adapting them during the progress of software development, through an iterative and incremental framework, and a strong exchange of information and opinions between the developers and with the interested stakeholders such as customers.

Agile project management is an iterative approach to delivering a project throughout its life cycle[i].

Iterative or agile life cycles are composed of several iterations or incremental steps towards the completion of a project. Iterative approaches are frequently used in software development projects to promote velocity and adaptability since the benefit of iteration is that you can adjust as you go along rather than following a linear path. One of the aims of an agile or iterative approach is to release benefits throughout the process rather than only at the end. At the core, agile projects should exhibit central values and behaviours of trust, flexibility, empowerment, and collaboration [i].

Agile project management focuses on delivering maximum value against business priorities in the time and budget allowed, especially when the drive to deliver is greater than the risk. Agile methodology is a way to manage a project by breaking it up into several phases. It involves constant collaboration with stakeholders and continuous improvements at every stage. Once the work begins, teams' cycle through a process of planning, executing, and evaluating. Continuous collaboration is vital, both with team members and project stakeholders[j].

Agile methodology covers a broad spectrum of frameworks and values, few of them such as Scrum, Kanban, Adaptive Project Framework.

4.1 Extreme programming (XP)

Extreme Programming (XP) was created in response to problem domains whose requirements change. Customers may not have a firm idea of what the system should do. You may have a system whose functionality is expected to change every few months. In many software environments dynamically, changing requirements is the only constant. This is when XP will succeed while other methodologies do not. [j]

XP was also set up to address the problems of project risk. If your customers need a new system by a specific date the risk is high. If that system is a new challenge for your software group, the risk is even greater. If that system is a new challenge to the entire software industry the risk is greater even still. The XP practices are set up to mitigate the risk and increase the likelihood of success. [j]

XP came into existence from the problems caused by the long and strenuous development cycles in the traditional development models. XP started as an opportunity to perform the work with practices that were found efficient in the software development processes in the previous years or decades.

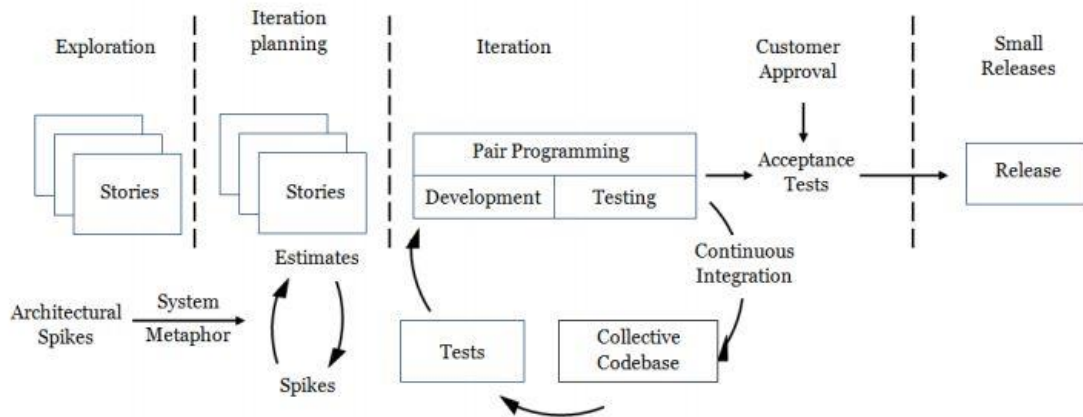


Fig 7 Extreme Programming at a glance

Above figure depicts a high-level view of the lifecycle of the XP development process. Although the term phase is an immediate indication to the waterfall SDLC model, here the fact is that the phases can occur iteratively, which is evident in the figure, precisely, with the fact that it is possible to move back and forward between phases of planning, iteration to release and production.

The general characteristics where XP is appropriate were described by Don Wells[j]

- Dynamically changing software requirements
- Risks caused by fixed time projects using new technology
- Small, co-located extended development team
- The technology you are using allows for automated unit and functional tests

4.2 Adaptive project framework

Adaptive Project Framework (APF), also known as Adaptive Project Management (APM), accommodates the unknown factors that can crop up during a project. It prepares teams to

anticipate the unexpected and respond. Think of its core principle as "learning by doing."

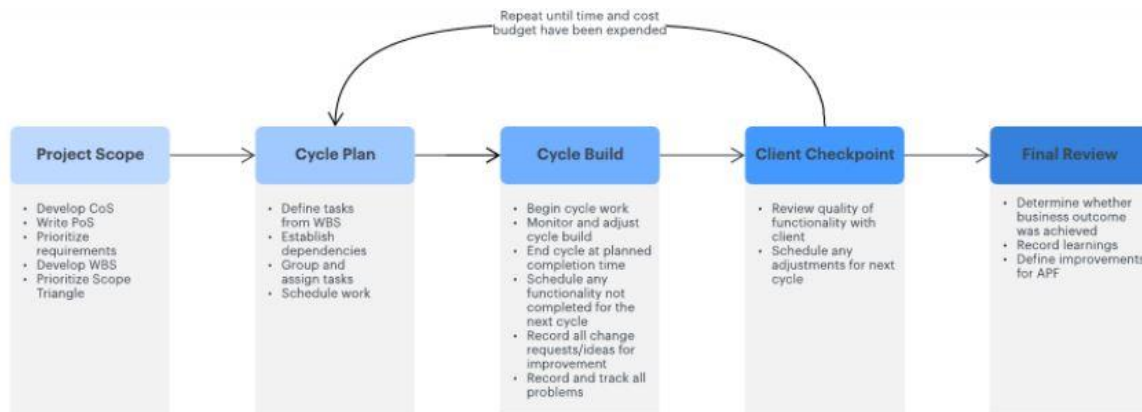


Fig 8: Adaptive project framework overview[k]

By approaching projects with the understanding that key components are constantly in flux, teams can adopt a flexible mindset to continually learn by re-evaluating results and decisions throughout a project. This requires regular communication with stakeholders at every level for the team to effectively adapt. [k]

4.3 Scrum Methodology

Agile is focused on adapting to the changes and to the needs that emerge in the day-by-day projects, characterized by short-term planning. Scrum is the most popular Agile method: it is a framework which divides the project management process into sprints to coordinate the product development with the needs of the client. The theory behind this method is that of empirical process control, according to which, on the one hand, knowledge derives from experience, and, on the other hand, decisions are based on what is known. For this reason, the process is iterative with an incremental approach sprint after sprint.

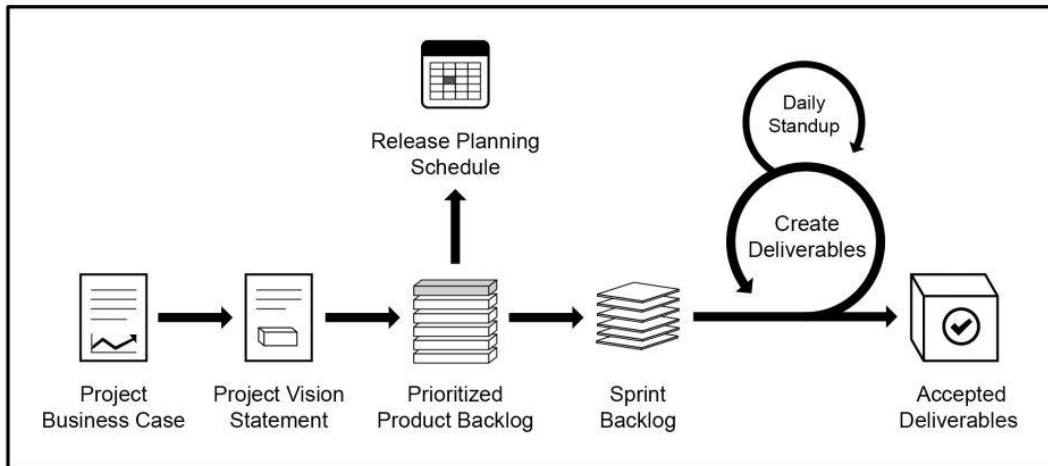


Fig 9: Scrum flow for one sprint

A scrum project involves a collaborative effort to create a new product, service, or other result as defined in the project vision statement. Scrum is one of the most popular agile methods used in the recent time for software development projects. It is an adaptive, fast, flexible, fast, and effective framework designed to deliver significant value quickly and throughout a project.[9]

The scrum cycle as depicted in the fig starts with a meeting among stakeholder and product owner in which project vision statement is created. The product owner after analysing the requirements from the stakeholder develops a prioritized product backlog which contains a prioritized list of business and project requirements through user stories.

Each sprint is planned, and it begins with a initial sprint planning meeting during which high priority user stories are considered for inclusion in the sprint. A typical sprint generally lasts between one and six weeks and involves the scrum team working to create potentially shippable deliverables or product increments.

Towards the end of the sprint, a sprint review meeting is held during which the product owner and relevant stakeholders are provided a demonstration of the deliverables. The product owner accepts the deliverables only if they meet the predefined acceptance criteria. The sprint cycle ends with a retrospective sprint meeting where the team discusses ways to improve processes and performance as they move forward into the subsequent sprint. [9]

4.3.1 Roles

In a scrum project, there are 3 main roles to be covered to maintain and balance the responsibility load and to successfully implement scrum projects. This ensures that everyone is in connection to ensure a continuous and fast flow of information among the members involved in the project.

Roles are categorized into two different types based on the involvement in the project and obligation.

1. Core Roles

Product owner

The product owner is the person responsible for maximizing business value for the project. Product Owner is responsible for articulating customer requirements and maintaining business justification for the project. The product owner represents the voice of the customer. [9]

Product owner generally knows all the product requirements and communicates the requirements defined by the stakeholders to the scrum master and scrum team by converting the customer requirements into technical requirements.

Scrum master

The Scrum Master is a facilitator who ensures that the Scrum Team is provided with an environment conducive to completing the product's development successfully. The Scrum Master guides, facilitates, and teaches Scrum practices to everyone involved in the project; clears impediments for the team; and ensures that Scrum processes are being followed. [9]

Scrum master is the person who works as a facilitator and is at the same hierarchical level as anyone else in the scrum team. Scrum master ensures that the scrum methodology is successfully understood and executed. Scrum Master ensures that the team works consistently with the development of the project, organizing and facilitating team meetings.

Scrum team

The Scrum Team is a group or team of people who are responsible for understanding the business requirements specified by the Product Owner, estimating User Stories, and final creation of the project Deliverables.

Scrum team is generally a cross-functional and self-organized professionals, the number of which usually remains from 5 to 9 members. It deals with the product development and functionality testing and is responsible for organizing priorities by transforming them into task to be completed to finish the sprint.

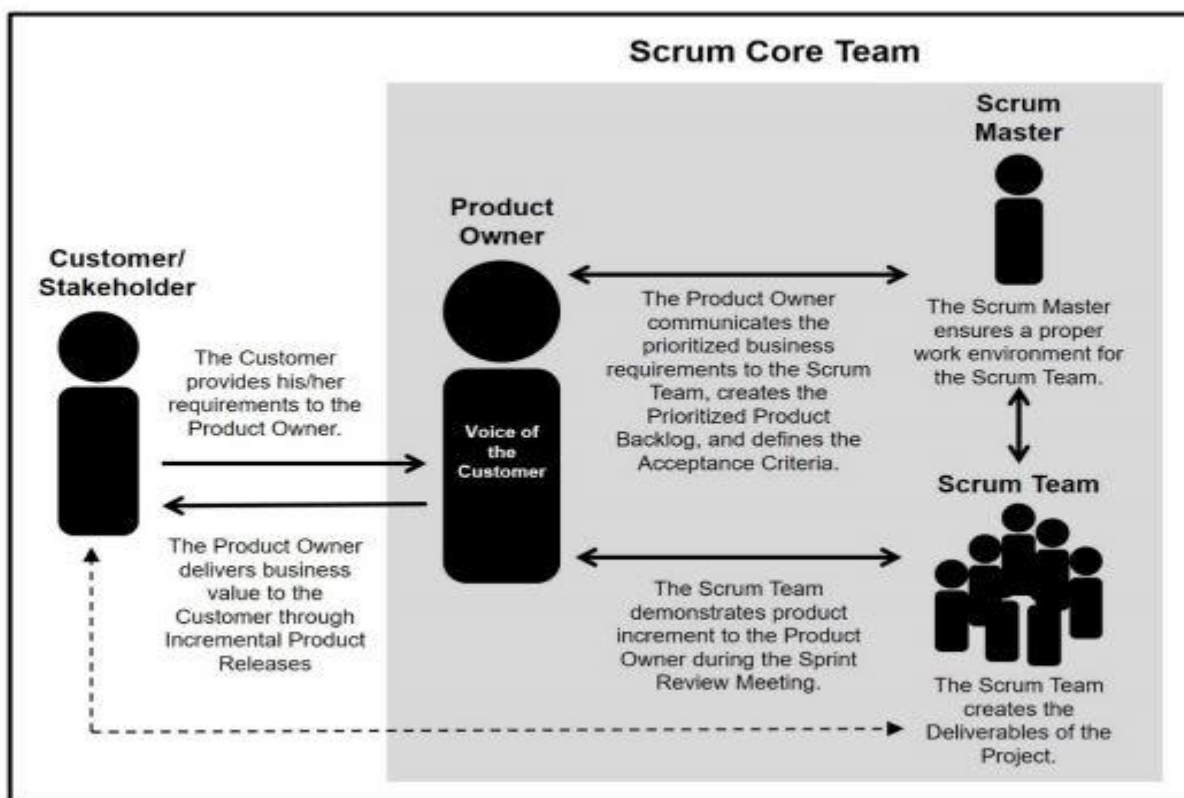


Fig 10: Overview of Scrum Roles

2. Non-Core Roles

2.1 Stakeholders

Stakeholder(s) is a collective term that include customers, users, and sponsors, who frequently interface with the Product Owner, Scrum Master and Scrum Team to provide them with inputs and facilitate creation of the project's product, service, or other result. Stakeholder(s) influence the project throughout the project's development. Stakeholders may also have a role to play during the Develop Epic(s), Create Prioritized Product Backlog, Conduct Release Planning, Retrospect Sprint, and other important processes in Scrum. [9]

2.2 Customers

Customer can be an individual or the organization that acquires the projects product, service or any other relevant outcome.

2.3 Sponsor

The project sponsor is the individual or the organization that provides resources and support for the project. The sponsor is also the stakeholder to whom everyone is accountable in the end.

[9]

2.4 Vendors

Vendors are the external entities that provides and outsources product or services that are not within the core competencies of the project organization

4.3.2 Elements of Scrum

- **Product Backlog**

This is created by the product owner which consists of prioritized list of high-level business and project requirements. These product backlogs have much smaller but detailed user stories that can be estimated and committed by individual scrum teams.

- **Sprint backlog**

This is a document that defines all the tasks to be completed in the individual sprints. It is an estimated forecast made in the meeting along with the development team in relation to the prioritized requirements indicated in the product backlog.

- **Epics**

An Epic can be defined as a big chunk of work that has one common objective. It could be a feature, customer request or business requirement. In backlog, it is a placeholder for a required feature with few lines of description. It tells compactly about final output of user needs. In the beginning, it may not contain all the details that team needs to work on. These details are defined in User Stories. An epic usually takes more than one sprint to complete. [1]

- **User stories**

The Basic unit of work defined in Scrum is User story. But very often, when Product Owner writes a user story for a feature or against customer request, that looks simple in the beginning. But, while covering all related work and scenarios, same user story expands so much that it cannot fit either in a week or a sprint timeframe. It is the time to consider this big user story as epic and start slicing it in smaller user stories. This way, Agile teams get better effort estimate and get smaller but concrete output in single sprint. [1]

- **Events**

In any given scrum project, there are 4 formal events used to create a regularity, synchronize activities, and minimize the need for undefined meetings. The aim of these events is to allow critical transparency and inspection on the progress of the project.

- **Sprint planning**

This is generally a meeting in which the product owner creates and shares the product backlog in presence of the development team and the scrum master. Product Owner describes the crucial items and objectives to be achieved in the following sprint.

- **Daily scrum:**

A small and brief everyday comparison between the scrum team and scrum master who usually checks about the activities carried a day before and also creates a plan for the next 24 hours, until the next daily scrum.

- **Sprint review:**

This is a usual review meeting at the end of each sprint to evaluate whether the defined set of goal has been achieved and with what results and the level of quality and efficiency adhering to the defined requirements. Usually, scrum team participates in this review and in some cases, stakeholders, attends the review to check the work done up to a given sprint.

- **Sprint retrospective:**

It is more like a detailed review and a retrospective analysis which is carried out with the scrum team to the set of activities and deliverables. To discuss, what to keep doing, what to stop and what to improve in the next sprint to obtain even more efficient performance.

4.3.3 Monitoring tools in Scrum projects

Projects in scrum are usually fast paced and iterative. Continuous and timely monitoring of each task in the respective sprint is quite crucial to analyse the efficiency of the resources and to make necessary changes to improve the performance based upon the actual results.

- **Sprint Burndown and burnup chart**

According to SBoK, a sprint burndown chart is “*a graph that depicts the amount of work remaining in the ongoing sprint*”. It shows the amount of work that has been processed by the scrum team, which should be regularly updated at the end day or end week as work is completed and it is also allows for the detection of forecasts that may have been over- or under-estimated. If the scrum team is not on track, the scrum master is accountable to identify impediments or obstacles to successful complete and try to cancel them[9].

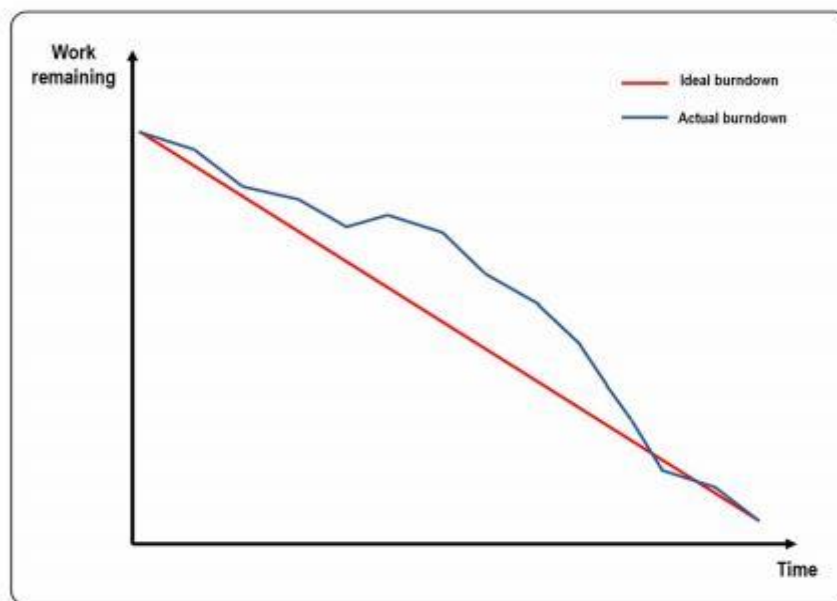


Fig 11: Burn down Chart

The above figure shows a burndown chart which depicts the estimation of the remaining work until the iteration is completed, otherwise it can represent an estimation of the releases delivered. Burndown chart compares the planned effort with the actual remaining effort or work to understand whether there is the need to modify the user stories which were planned to be delivered in that sprint [20]

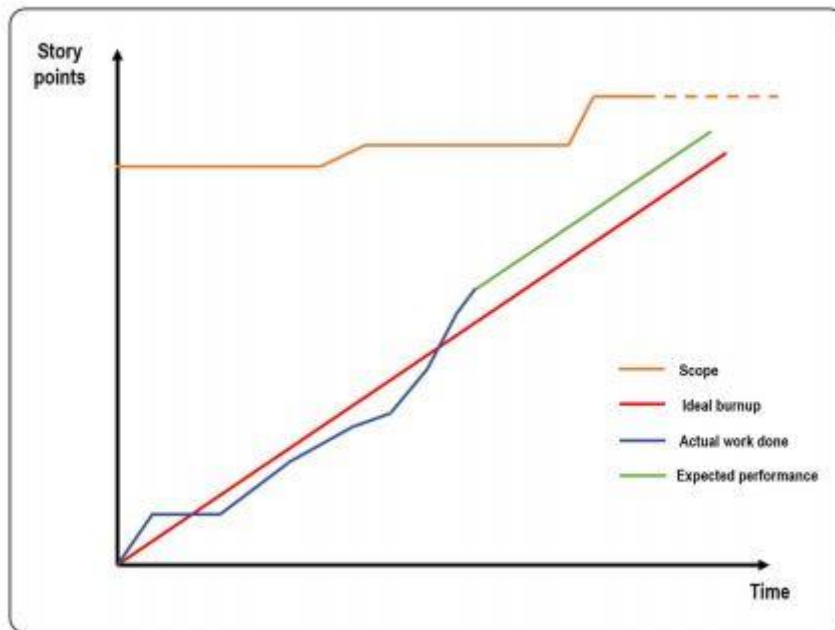


Fig 12: Burnup chart

Burnup chart is like the burndown chart, instead of showing the amount of work remaining it depicts the amount of work completed. As an agile project does not have predetermined size, it is used to show the amount of work performed and it eventually allows to perform forecasts based on past performances, keeping the scope fixed.

- **Velocity chart**

Velocity in scrum measures project progress in terms of number of user stories completed per sprint by the team, and it is useful to estimate the remaining effort until the project is completed. Velocity in scrum is used as a measure of productivity of scrum team, it depicts how much can be or has been done per sprint.

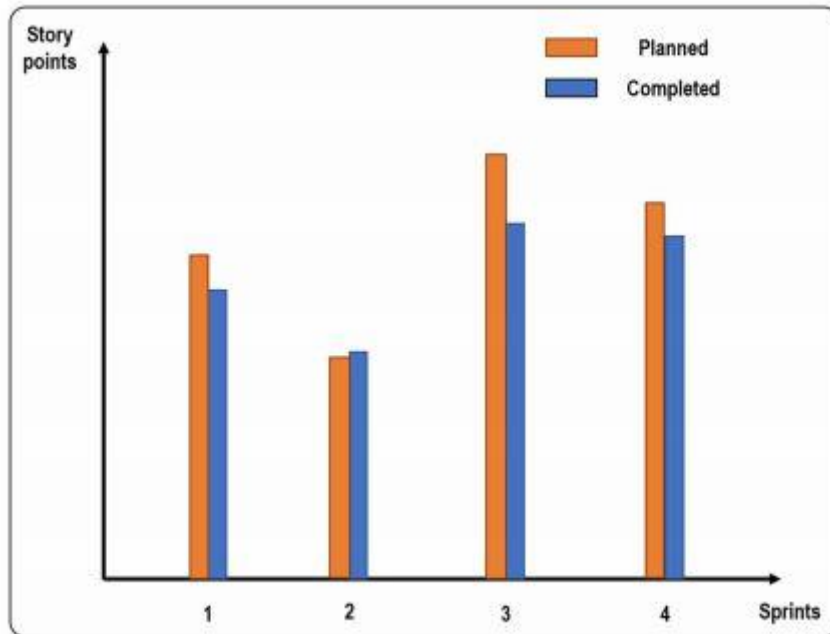


Fig 13: Velocity chart

- **Cumulative flow diagram**

The cumulative flow diagram, also known as, CFD, is a tool used to track the overall performance of the project and shows the amount of work done, in progress and to be finished at a given time. CFD is used to monitor the whole project instead of a sprint. CFD is used to detect and eliminated the bottlenecks in the project, as well as reducing lead time while responding to customer requests and keeping track of new requirements, which will increase the project scope [20]

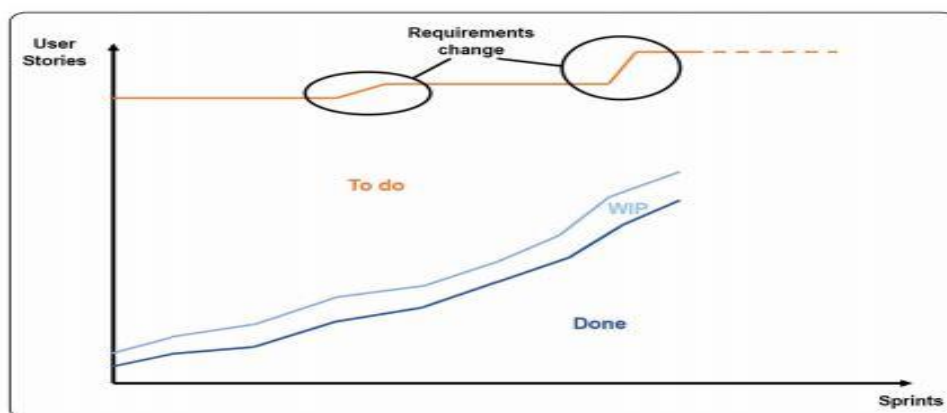


Fig 14: Cumulative flow diagram

The x-axis in CFD chart shows the time-period in terms of sprints in chronological order, while the y-axis displays the cumulative number of user stories completed in a particular time frame.

5. Use of Project Management in thesis development

Project Management is often used in the long term, big budget, multi-party manufacturing, construction and/or software development projects. There was very little need of or value in applying the project management methodologies to thesis development which are usually run by a student with less or self-help using the existing university resources.[10]

A typical thesis development process goes through the following phases as shown in the table below.

S.no	Stages in Thesis development	Time required
1	Project definition outcome: research proposal and/or ethics application	0 to 2 months
2	Research activities, supervision and meetings	1 to 2 months
3	Thesis submission and examination outcome	1 to 2 months

Usually, a thesis manual in any institution advice the students to manage the report development by breaking it down into stages, which may correspond to the specific thesis chapters. Students use the earlier stages of the thesis development to write the easiest chapters. For example, the method or Literature review and reserve the introduction chapter until a much later stage [11]. Students have been using the traditional IMRD (Introduction, Method, Result and Discussion) approach for thesis development based on the premise that the number of months to devote to each chapter is proportional to its length [12].

Time management with the structure of the thesis, it is noted that it is a common practice to devote majority of the time to ‘lead-in materials’ at the expense of the value-added contribution of the research.[13]

5.1 Project Management phases in thesis development

It is quite evident that the projects are well managed when carried out and monitored in phases rather carrying it out in one shot. It is well established that the quality of the project significantly improves when carried out in well planned and organized phases. Like this, thesis development usually follows the similar pattern of IMRD approach, but the lack of principled planning and execution makes it difficult for both student and supervisor to monitor the thesis progress

altogether. The stages through which a large-scale project pass can be used to structure the management and supervision of small scale thesis development as proposed in tab. [14]

Phase	Project Management definition	Corresponding stage in thesis development	Time period
Planning	Project is scoped: milestones and deliverables; budget and deadlines	Project definition outcome: research proposal and/or ethics application	0-2 months
Implementation and monitoring	Project tasks commence, Regular team and stakeholder meetings to track progress	Research activities, supervision and meetings	2-8 months
Completion and evaluation	Project concludes with the submission of final deliverables and report	Thesis submission and examination outcome	8-12 months

6. Digitalizing the Project Management Methodology

In the recent times, most of the industries and companies go through solution crunch and find themselves puddled in between non-integrated and disconnected solutions that are no longer viable to sustain and manage the ever-increasing number and kinds of projects [16]

Competition in the service and IT sector is becoming tirelessly pressing resulting in companies taking extreme measures to excel and attain the competitive advantage over their competitors with the help of tools, techniques, and information systems [17]

In IT industry, software packages and solutions have been considered very important tools for programming, monitoring and control. The software packages and solutions that helps companies in the execution and development of projects are called **Project Management Information Systems [18]**.

According to the PMBOK [15], An information system consisting of the tools and techniques used to gather, integrate, and disseminate the outputs of project management processes. It is used to support all aspects of the project from initiating through closing and can include both manual and automated systems.

While every implementation of PMIS differs from others in terms of scope, design, and features, software applications are considered an indispensable component of each implementation. The optimum utilization of a PMIS depends heavily on the way critical information is made available to all stakeholders and the level of process automation. Many project managers are apprehensive about the effectiveness of their PMIS, in part because of wrongly configured software, and because of ROI concerns. [m].

PMIS are the documents that contain information about the project, but also the procedures regarding preparation, maintenance, and use. These procedures are then used for project management in all its phases, from execution to monitoring to scheduling and planning. In this technologically complex era in which IT company systems are working, makes the PMIS a crucial element in the field of Project Management. [19]

Moreover, one of the main advantages of PMIS is that it allows teams to follow the progress of projects by providing immediate visibility and a consistent flow of information through the vision of the various levels of task completion, the overall status of the project itself plus a whole range of more detailed information such as scheduling, budget, resources, costs, time

etc. [16]. All this through a wide and varied range of reports, graphs, tables, and formats that can be produced in a very simple way through these electronic solutions [18]

The digitized, cloud-based project management solution enables individuals to collaborate more naturally and more closely all the time. This development also supports the connectivity and usability of virtual project teams. [21]. The process of selecting the most suitable solution to support the project management needs of a specific organization can be a challenging and highly complex task. The choice of these cutting-edge project management solutions is wide, but even these solutions differ in many respects. [18]

To digitize project management, it is important to define the user needs in order to evaluate the solution of a specific organization or company. This requires sufficient analysis to understand the current organizational needs and requirements, but also the future needs and requirements of the organization. Selecting or designing a feasible solution for a specific organization requires a systematic and organized research and analysis to make sure the best possible decisions are made during the project management digitization process.

7. Scrum project and proposed thesis methodology

7.1 How research idea came into existence?

It all started with an introductory meeting with the professor about the thesis. After explaining the thesis business case or thesis idea, professor asked assigned me as a product owner for this thesis project and asked me to form a scrum team. Invitations were sent to students regarding the project and thesis opportunity explaining the requirements and openings. Few of the interested students responded to the call and showed interest in the opportunity.

A series of video call interviews were carried out to understand the technical capabilities, availability and to briefly explain the idea of the thesis opportunity. At the end of the interview series, 3 students were shortlisted for this project and roles were not yet defined.

In the project kick off meeting, professor defined and explained the basic idea about the project to the team members. We had a small discussion on project methodology and communication plan. Each member of the group was assigned a scrum role based on the interest and technical capability. I was assigned role of product owner and my main responsibility was the software functionality specification and to solve any doubts that arise during development. I was the client's representative and was closely involved in the project and I had to make sure that project was being implemented based on the clients need.

Chiemerie was assigned the role of scrum master because of technical background, and he also took responsibility as back-end developer. As a scrum master, Chiemere was responsible to lead the team and to avoid any hurdles that might arise during the process. Saidbek Samigjonov and Giorgio Spadaro were part of scrum team. Usually scrum team is composed of developers in which each member has a specific skill. Saidbek was assigned the role of front-end developer and Giorgio took up tester role in the scrum team.

Prerequisites for the research

List of pre-requisites for the research are listed below:

1. A SCRUM management platform is used so metrics are tracked, such as taiga.io
2. Team has scrum competences and have followed training and obtained the SFC certificate

3. Basic SCRUM roles are defined, artifacts are developed, and events are attended and recorded

7.2 Tools used during the project

Taiga:

Taiga is a project management application that can handle both simple and complex projects for start-ups, software developers, and other target teams. It tracks the progress of a project. With Taiga, you can use either Kanban or Scrum template, or both. Backlogs are shown as a running list of all features and User Stories added to the project. [n]

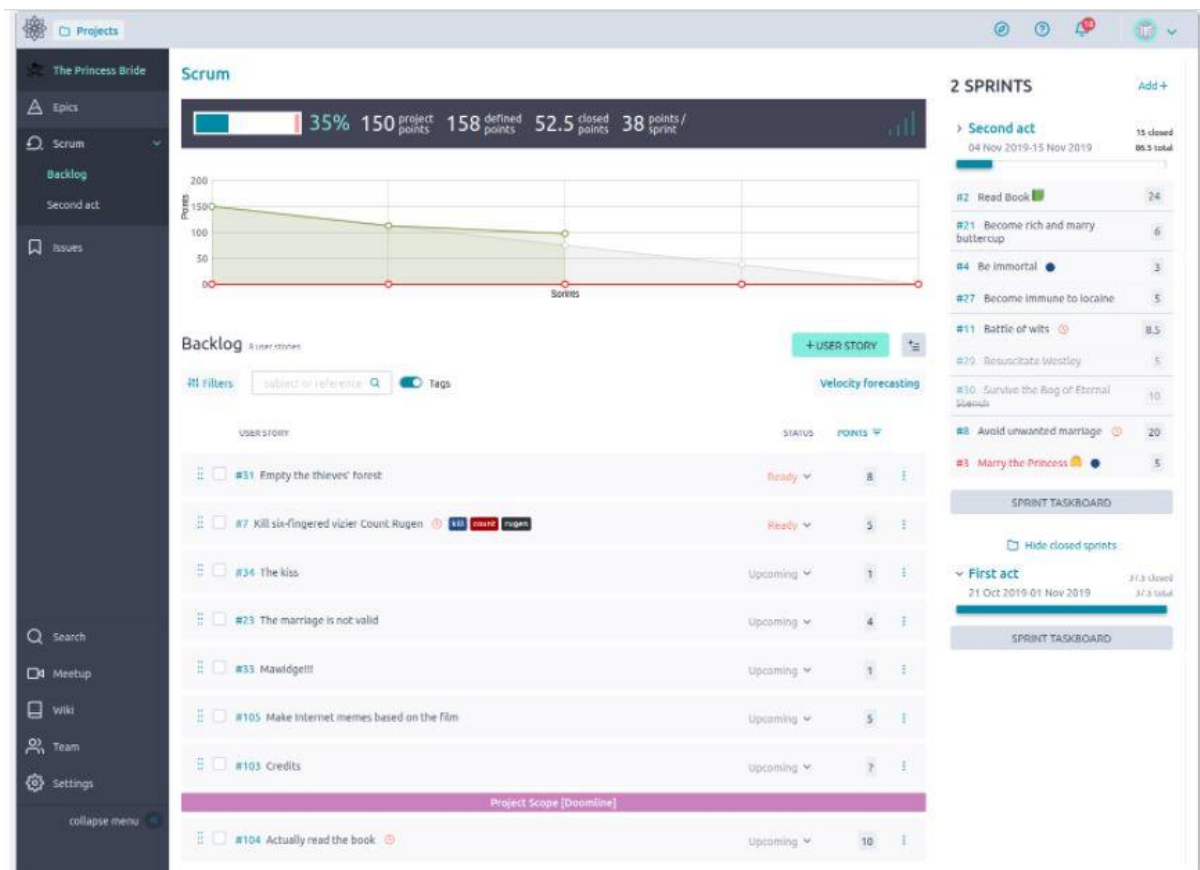


Fig 15: Taiga Platform

We chose taiga platform because of its ease of use, very good performing in scheduling and monitoring, adaptability and visibility to the user ensuring the ability to manage various tasks by assigning priorities, estimated execution times and a overall view of the progress of the work among all the users connected.

GitHub:

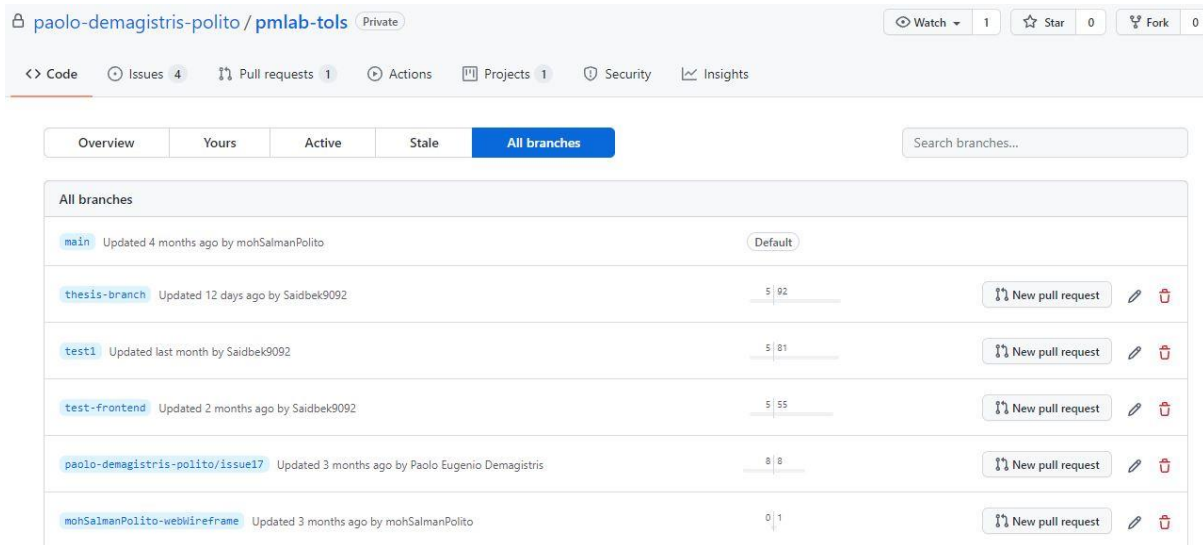


Fig 16: GitHub

GitHub is a Git repository hosting service which was used as a version control system and to manage the documentation. In GitHub each change was monitored through an external tool 'Telegram' on which team was receiving notification of each and every action on GitHub. This platform helped the team to work remotely and collaborate their work smoothly. If anyone in the team member wanted to make any changes to the source code, he would send a 'pull request' to the original owner. After approving the changes, user can then, within a click of a button, can 'merge' the changes requested into the original code. Another feature called 'forking' can also be used to copy a repository from user's account to another.

Draw.io:

Draw.io is an online platform on which you can design and prepare your use case diagrams and activity diagrams. This platform was convenient and easy to use, and it did not require login or registration, and was able to save files to the local hard drive. It was also possible to integrate with various cloud services such as Dropbox and Google Drive.

Confluence:

We used confluence as a platform to fulfil the requirements of a project knowledge management system, in which all the information about the business case of the project was documented.

7.3 Proposed thesis development process

Usually, Thesis development process as described in the previous chapters always have been orthodox and the steps to develop a thesis in any given academic environment is almost similar. In this research, we proposed to integrate project management principles especially, ISO 21500 in the thesis development process.

We started the research with a basic and most likely assumption, that is assuming and treating thesis as a project to be delivered. As defined in ISO 21500 standard,

‘A project consists of a unique set of processes consisting of coordinated and controlled activities with start and end dates, performed to achieve project objectives’

A project in any sense should have a start date and end date within a realistic period. It is also comprised of a set of activities, objectives, and milestones. Thesis can also be subdivided into a logical set of activities with start and end dates. As explained in the previous chapter, a project goes through a series of processes or phases to successfully claim a project is completed. The management of a project starts with the initiating process group, then planning, implementing, and controlling being the intermediary process group through which a project goes through. Finally, a project finishes with the closing process group. The interaction between different process groups is shown in the fig. The process groups are repeated within each project to drive the project to completion. Each phase of the project life cycle should have specific deliverables. These deliverables should be regularly reviewed during the project to meet the requirements of the sponsor, and the stakeholder [6].

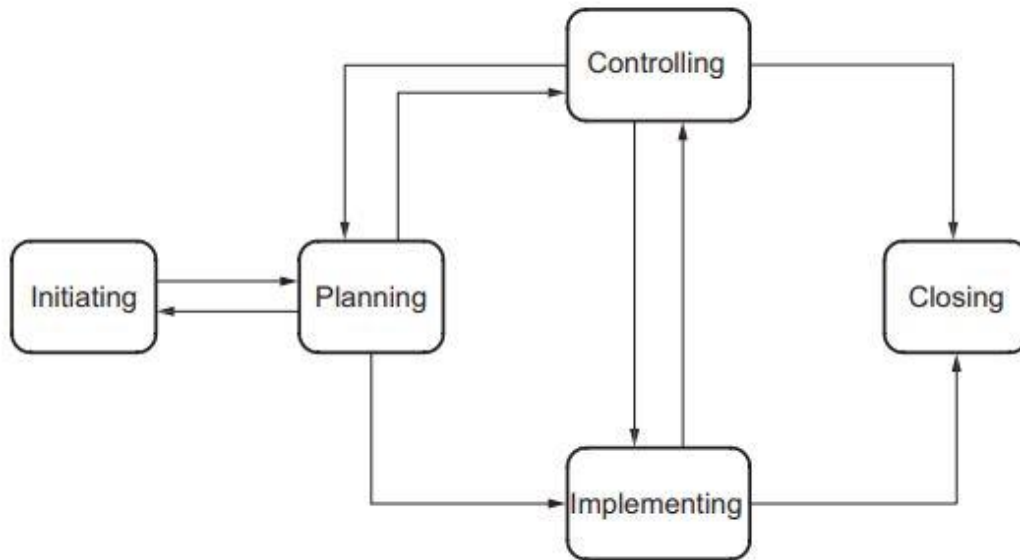


Fig 17: Process group interaction

Inspired by the process group interaction explained in ISO 21500 standard, similar path is made to follow during the thesis production. We came up with a process group interaction for thesis development along with the respective inputs and outputs for each process group. Fig 17 shows how each of the process group interact with the other process group by taking the inputs from the different process groups and churning out the relevant output.

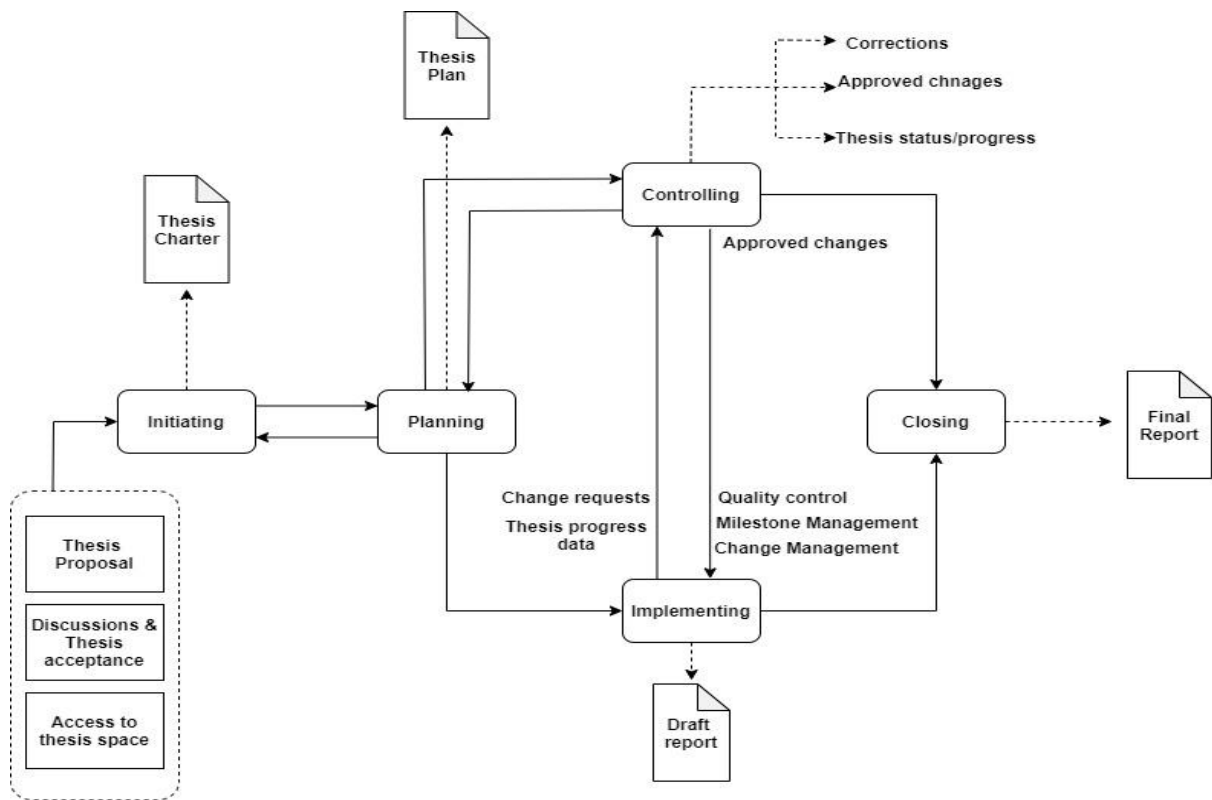


Fig 18: Thesis process group interaction

The proposed thesis production process is explained along with the activities, inputs, and output of each process group.

7.3.1 Initiating:

In this phase, student starts searching for the suitable thesis topics based on area of interest, and availability in the thesis platform. Student sends a thesis proposal to the concerned professor, or he/she can send the thesis proposal of their own.

Inputs: Thesis Proposal, Discussion, Thesis acceptance, Access to thesis space

As shown in the process group interaction, student submits the thesis proposal to the professor either from the portal or thesis idea. After checking the eligibility of the students and considering the professor’s interest and availability, professor gets back to the student with either proposal acceptance or rejection. Once the thesis proposal is accepted by the professor, a physical meeting or online meeting can be arranged to discuss about the topic selected or proposed to the professor. After discussing with the student, professor can finalize the thesis

topic with a draft thesis title which can be changed at the later stages. Student gets access to the thesis space on the platform by the professor after getting the thesis acceptance.

After receiving thesis acceptance and access to thesis space, student shall now proceed to prepare the thesis charter. Thesis charter is a document which serves as a preliminary document that describes the thesis in its entirety which includes purpose, objectives, scope, and stakeholder information. Once thesis charter is prepared, student can get it approved by the professor which marks the official initiation of the thesis. This is more like a green signal to kick start the thesis writing. Once the thesis has been accepted by the tutors, students should explicitly declare acknowledgment to regulation detailed to define the thesis context.

Output: Thesis Charter and thesis approval

Thesis Charter			
Thesis Title:			
General Information			
Prepared by			
Matricula no.			
Course			
Thesis Stakeholders			
<i>List all applicable project stakeholders.</i>			
Position	Title/Name/Organization	Phone	E-mail
Student	<i>John doe/PolITO</i>		s2xxxxx@studenti.polito.it
Supervisor	<i>ABC/PolITO</i>		abc@polito.it
Co-Supervisor	<i>xyz/PolITO</i>		xyz@polito.it
Thesis Purpose			
<i>Business Need / Problem</i>			
<i>The Business Need / Problem is an issue or opportunity pertaining to the business which needs to be resolved / acted upon. State in specific terms the issue or opportunity this project will address. Often, the Business Need / Problem is a critical business issue or initiative in the Sponsoring Organization's Strategic Plan.</i>			

Thesis Overview		
<i>Project Description</i>		
<i>Scope</i>		
<i>The Project Scope addresses the who, what, where, when, and why of a project.</i>		
<i>Assumptions</i>		
<i>Assumptions are statements taken for granted or accepted as true without proof. Assumptions are made in the absence of fact. List and describe the assumptions made in the decision to charter this project.</i>		
Thesis potential Risks		
Roles & Responsibilities		
<i>R- Responsible A-Accountable C-Consulted I-Involved</i>		
Stakeholder	Name	Matrix RACI
Student	<i>John doe/PolITO</i>	Accountable
Supervisor	<i>ABC/PolITO</i>	Responsible
Co-Supervisor	<i>xyz/PolITO</i>	Responsible

Fig 19: Proposed Thesis Charter

7.3.2 Planning:

In this phase, student sets up the plan to execute and carry out the thesis by setting up realistic timelines and deadlines. The main objective of this phase is to prepare a thesis plan which will act as a guide during the entire thesis development process.

Thesis plan includes the following information:

- **Activities:** This consists of the list of possible activities student will carry out throughout the thesis development process. These set of activities must align with the requirements of the thesis topic.

- Estimation of activity durations: After identifying the list of activities to carryout, student should estimate the duration to complete each activity. These estimates are not the exact time limits but are the probable deadlines in which student shall try to complete the activities. These estimates may fluctuate during the execution of activities due to various factors. But student should try to complete the activities within the decided deadlines.
- Communication Plan: This is not required in all cases but setting up communication plan helps both student and professor to maintain transparency and to communicate in case there are any hurdles or queries in the process. Usually, students and professors communicate through emails, but they can also choose any other convenient platforms such as WhatsApp, or telegram based on the convenience of both parties.

7.3.3 Implementing:

This phase of thesis production is the main part where the student starts working on the thesis. This is the phase of thesis production where student carryout the research or the respective thesis work where the data is collected for the report writing.

Professor have proposed a general outline of thesis which students have to follow while writing report. The proposed thesis outline consists of following components

- **Thesis title:** The draft thesis title must be elaborated under the guidance and approval of the supervisor. It should concisely reflect the research problem finalized and decided by both parties.
- **Abstract and Keywords:** This part of thesis should be drafted at the end of the thesis report because this part of the report consists of the introduction to the research problem and the research findings.
- **Background:** This section briefly outlines the following information
 - What is the already known about the subject, related to the research problem?
 - What is not known about the subject and hence what the study is indented to examine?
- **Literature review, Literature gaps and planned originality:** Before concluding the research purpose, it is always recommended to spend some time on literature review.

This scoping exercise is important to confirm that your research question has not been answered already. Furthermore, a thorough understanding of the state of the evidence will provide context to the research question and it helps to identify gaps in the literature.

- **Research Purpose:** This must answer the following question, ‘How you will develop the subject against the situation in the background and therefore contribute value to the intended audience?’
- **Methodology/approach:** It should contain the information about what was done during the research, and how.
- **Findings:** The results section in the report is one of the crucial and important part. It should be made sure not to compromise with its range and quality. This part consists of the findings and observation during the research work. Students should make sure to maintain the quality of the findings.
- **Research limitations/implications:** This section of the report suggests how the findings may be important for policy, practice, theory, and subsequent research. The limitations of the study are the characteristics that impacted the interpretation of the findings. These are the constraints generalization, applications to practice, and/or utility of findings. Research implications are basically the conclusions that author draw from the results and explain how the findings may be important for policy, practice, or theory.
- **Originality/Value:** This section should contain the most important new contributions to the subject to take-home, expressed in a few precisely worded sentences. Usually, the finding highlighted here relates to the primary outcome measure; however, other important or unexpected findings should also be mentioned.

Other processes involved in the implementation phase are milestone management and quality assurance. In which, student completes the set of activities to achieve a milestone. After completing the milestones, student reaches the conclusion part of thesis which will be explained in more detail in the proposed thesis platform chapter.

7.3.4 Controlling: This phase runs along the implementation phase which makes sure that the thesis is being carried out as per the requirements.

In this phase following process takes place:

- **Approved changes:** These changes are requested by the professor upon inspecting the findings or the data obtained while carrying out the research. Tutor recommends the changes to be made either in the methodology or in the experimentation based upon the situation. These approved changes are then made by the student.
- **Corrective actions-** These consists of the activities which will help students to correct the mistakes in the research which were found either by the tutor upon reviewing or by the student.
- **Quality control-** Once thesis report is drafted or while it is being drafted, students are advised to make quality check of the thesis by using the quality control check list developed based on the thesis outline. Check list consists of following steps:
 1. Title, Summary, and Keywords
 - Is the title still representing a concise statement of your research?
 - Summary: Articulate the summary of your thesis using STAR approach:
 - a) Situation Is the need for research stated in term of background and emerging problem?
 - b) Task: Is the methodology explained?
 - c) Activity: Are your research steps laid out?
 - d) Results: Are the take-away described? Are Findings, implications, and limitations clearly and concisely described?
 - Are the keywords mentioned meaning and usable to search your research?
 2. Background
 - Explain the context and what's happening in it, using as perspectives, the 3 major pillar of Polito's strategy
 - Research: Are there papers showing implications toward the title?
 - Education: Is there a need to develop a body of competence in the disciplines addressed?
 - Technological transfer: Are industries addressing the subject? And why?
 3. Literature gap
 - Have you reviewed literature?
 - What are the main findings, implications and limitations found?
 - Which gap are trying to fill?
 4. Purpose

- Is your research purposeful toward filling the gap resulting from background?
 - Is your purpose defined in terms of expected findings?
 - Are you aware of limitations?
 - Is your purpose SMART (specific, measurable, attainable, realistic and time-related)?
5. Design/methodology/approach
- Do you have a plan, and have you followed it?
 - Were there any changes? How did you manage them?
6. Findings
- What have you obtained as compared to background?
 - Meaningful takeaway for: Further research, Competences improved or solution to industries' needs
7. Research limitations/Implications
- Are they detailed?

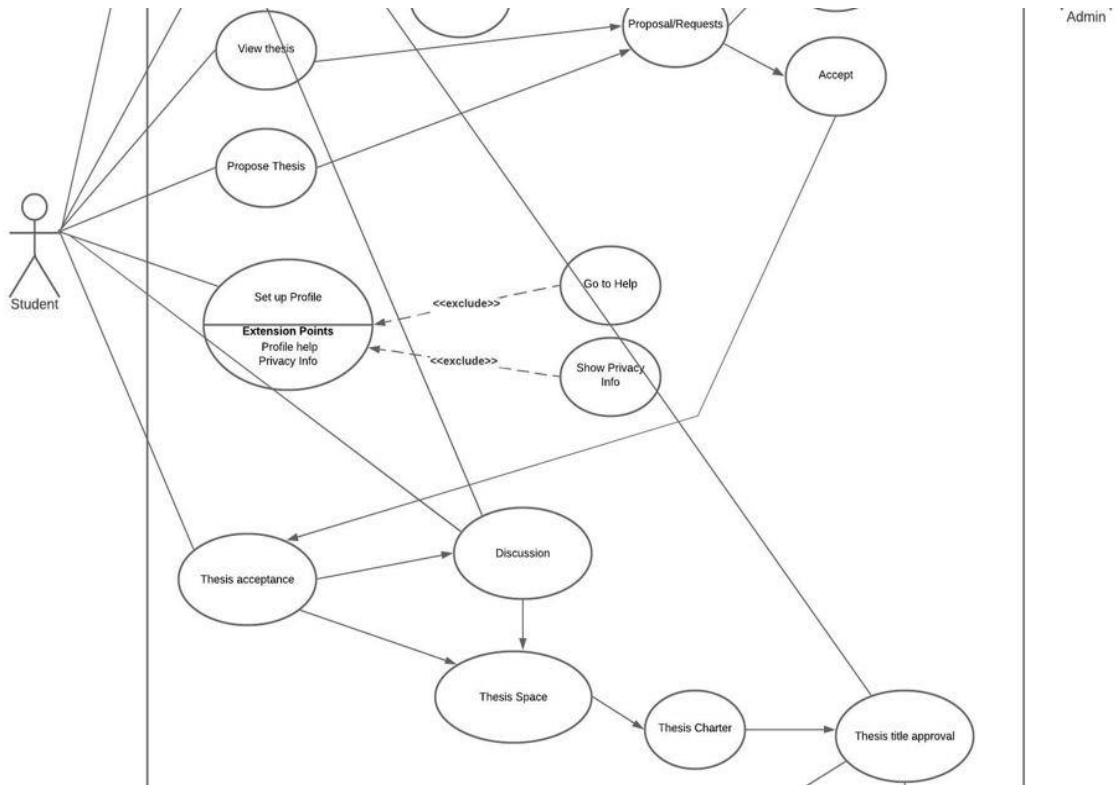
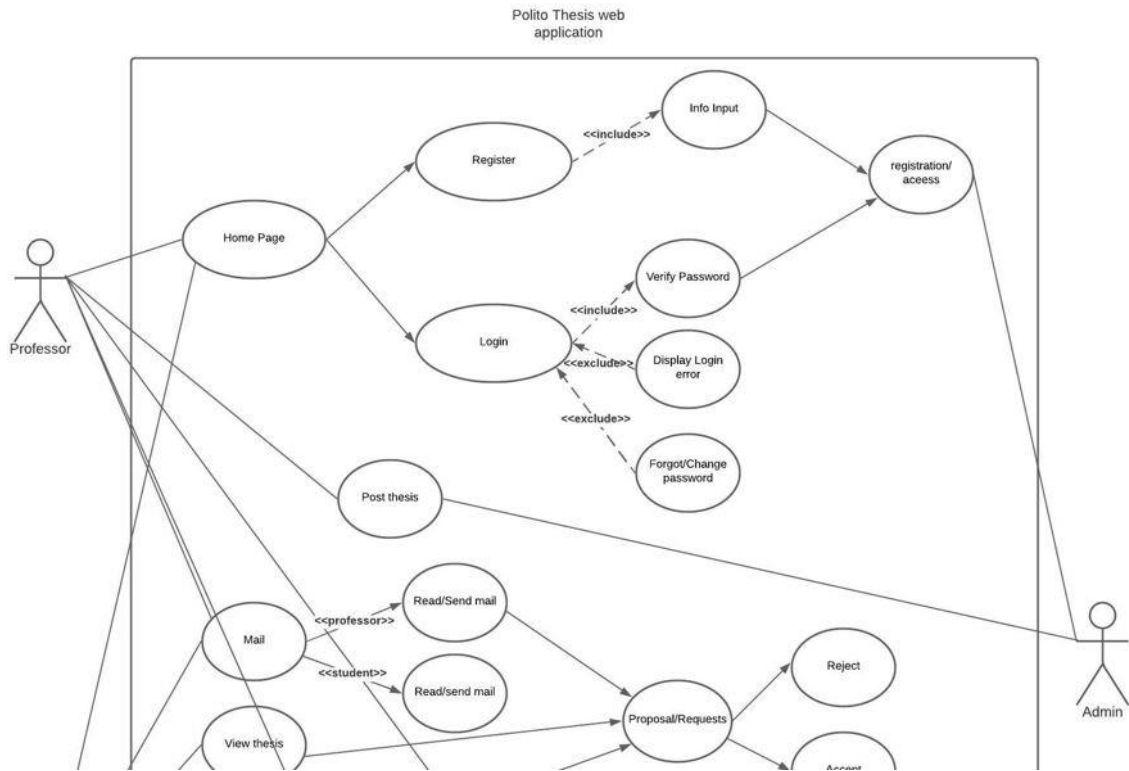
7.3.5 Closing: This phase marks the ending phase of the thesis development in which student prepares the thesis conclusion and the final thesis report. In this phase, student can also send the final report for the final review from the professor before submitting it to the committee.

7.4 Proposed thesis development platform

In this chapter, the proposed thesis development platform is explained. This web application will be used by students and professors to publish thesis proposal (for tutors), search for thesis offers (for students), communicate with each other, send thesis proposal (for students) and to develop thesis in controlled environment.

7.4.1 Web application Use Case Diagram

The use case diagram of the web application is depicted in the Fig 20, this shows how the web application works and how the actors interact with each other while using the web platform.



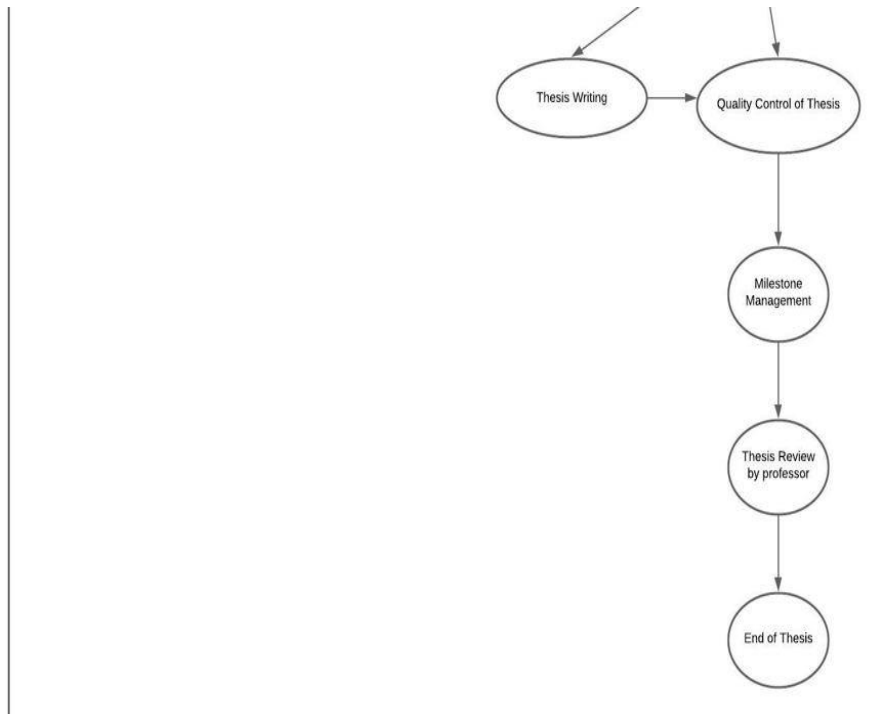


Fig 20: Web application Use Case Diagram

The activities and interactions among the users are explained by the help of Use case diagram and activity diagram. The use case is explained below for the actors:

Actor 1: Professor (Tutors)

- The initial step is to register into the platform by providing the credentials and setting up the password. The Verification process is yet to updated in the upcoming releases, but for now only institutional mail verification is being used.
- After successful registration, tutors can login to the platform using the same credentials used during the registration.
- In case of wrong credentials, login error will be displayed through a pop-up notification. User can re-enter the credentials in case of mistake during the login. In case the user forgets the password, they can use the forget password option through which they can change the password.

- Tutors after successful login can perform various action, primary being the publishing the thesis proposal on the platform.
- Tutors can also have access to a in built interaction environment where they can view the proposals submitted by the students. Through this they can either accept the proposal and arrange a discussion or meeting to discuss the proposal or they can reject the proposal by providing the appropriate reason for rejection.
- After accepting the thesis proposal, tutors can now have a meeting with the students and discuss about the research thesis idea, objectives, purpose, and requirements.
- Once the preliminary discussion is done, student gets access to thesis space where student can carry out thesis development process.
- Tutor can continuously monitor the progress of thesis as the thesis development is divided into activities and milestones.
- Milestone management in the thesis web app help the tutor to keep monitoring the progress. Each milestone is completed only after the successful review and approval by professor which helps to maintain the quality of the work being done.
- At the end of the process, after the student reaches the final part of the thesis development by clearing up all the milestones. Student submits the final version of the report for the final review by the tutor.
- Once the final thesis is reviewed and approved by the professor, student can now proceed and submit the final report to the concerned authority.

Actor 2: Students

- The initial step is to register into the platform by providing the credentials and setting up the password. The Verification process is yet to be updated in the upcoming releases, but for now only institutional mail verification is being used.
- After successful registration, students can login to the platform using the same credentials used during the registration.
- In case of wrong credentials, login error will be displayed through a pop-up notification. User can re-enter the credentials in case of mistake during the login. In case the user forgets the password, they can use the forget password option through which they can change the password.
- Students after successful login can perform various actions, such as viewing the already published thesis proposals by the professors, sending proposals, interacting with the tutors, and setting up their profile.
- Other than sending proposal of available thesis options, students can also send the original thesis research proposal to the relevant professor.
- After reviewing the proposal, professor can either accept the proposal and invite the student for further discussion or they can send the rejection mail by stating the reason of rejection.
- Once the thesis proposal is accepted, student gets access to the thesis space where students can perform actions such as thesis writing, thesis management and interact with supervisor and co-supervisor.
- Both students and professor can further discuss about the preliminary requirements for the thesis which will help the students to draft the thesis charter.
- Once thesis charter is approved by the tutor, student can now proceed with their actual research work and start writing thesis report simultaneously.

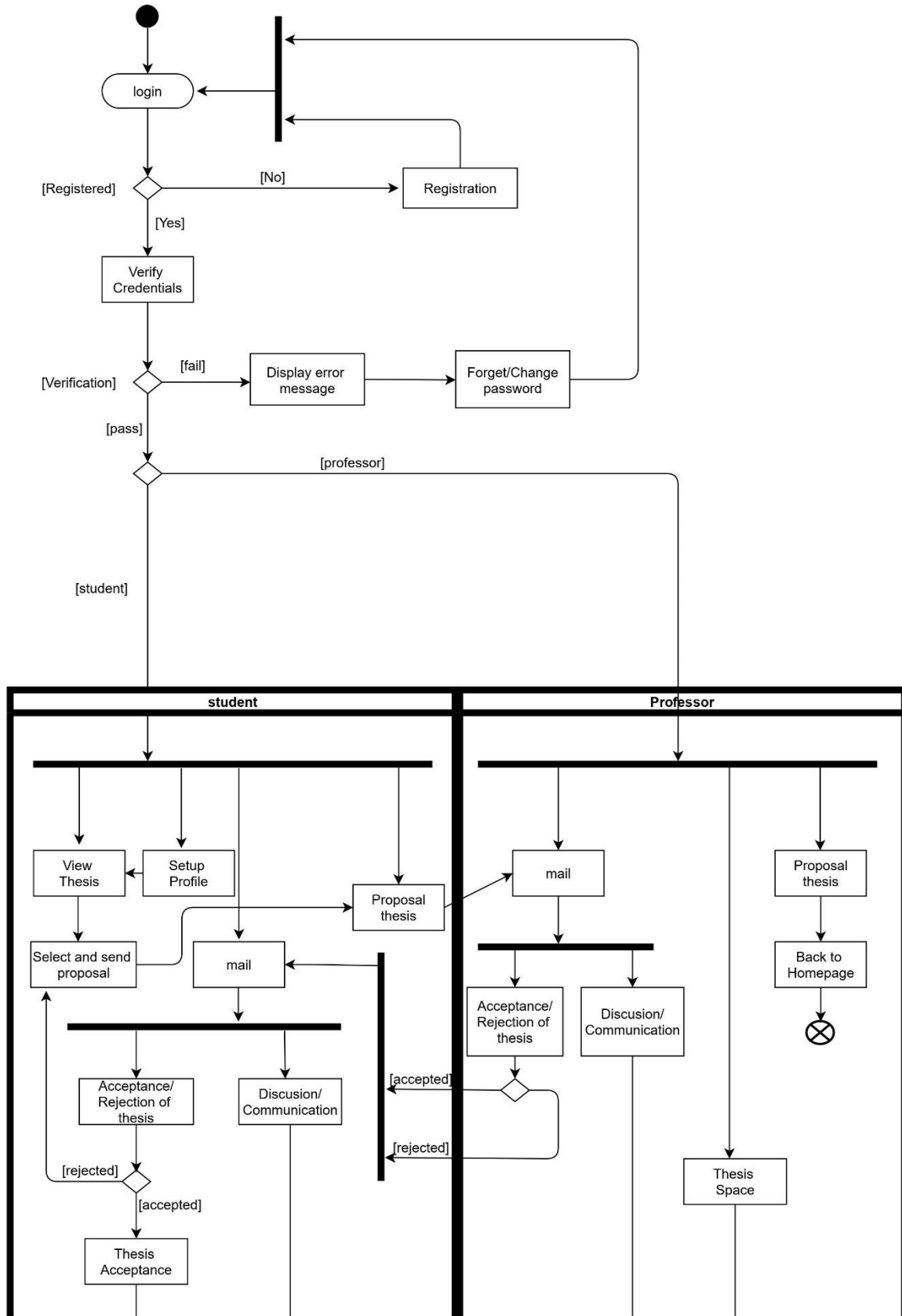
- Thesis quality control in the thesis space helps students to adhere to the quality set up by the university to meet the standards.
- Entire thesis development process is divided into set of milestones. Each milestone is completed only after the successful review and approval by professor which helps to maintain the quality of the work being done. This entire process is called milestone management.
- At the end of the process, after the student reaches the final part of the thesis development by clearing up all the milestones. Student submits the final version of the report for the final review by the tutor.
- Once the final thesis is reviewed and approved by the professor, student can now proceed and submit the final report to the concerned authority.

Actor 3: Administrator

Administrator is the one who takes care of the maintenance of the web application platform. Admin's actual role is not sketch up which is yet to be decided in the future version release of the web application depending upon the authentication process of the users.

7.4.2 Thesis platform Activity Diagram

Below activity diagram shows the behavioural usage of the web application. It portrays the control flow from a start point to a finish point showing the various decision paths that exist while that activity is being executed.



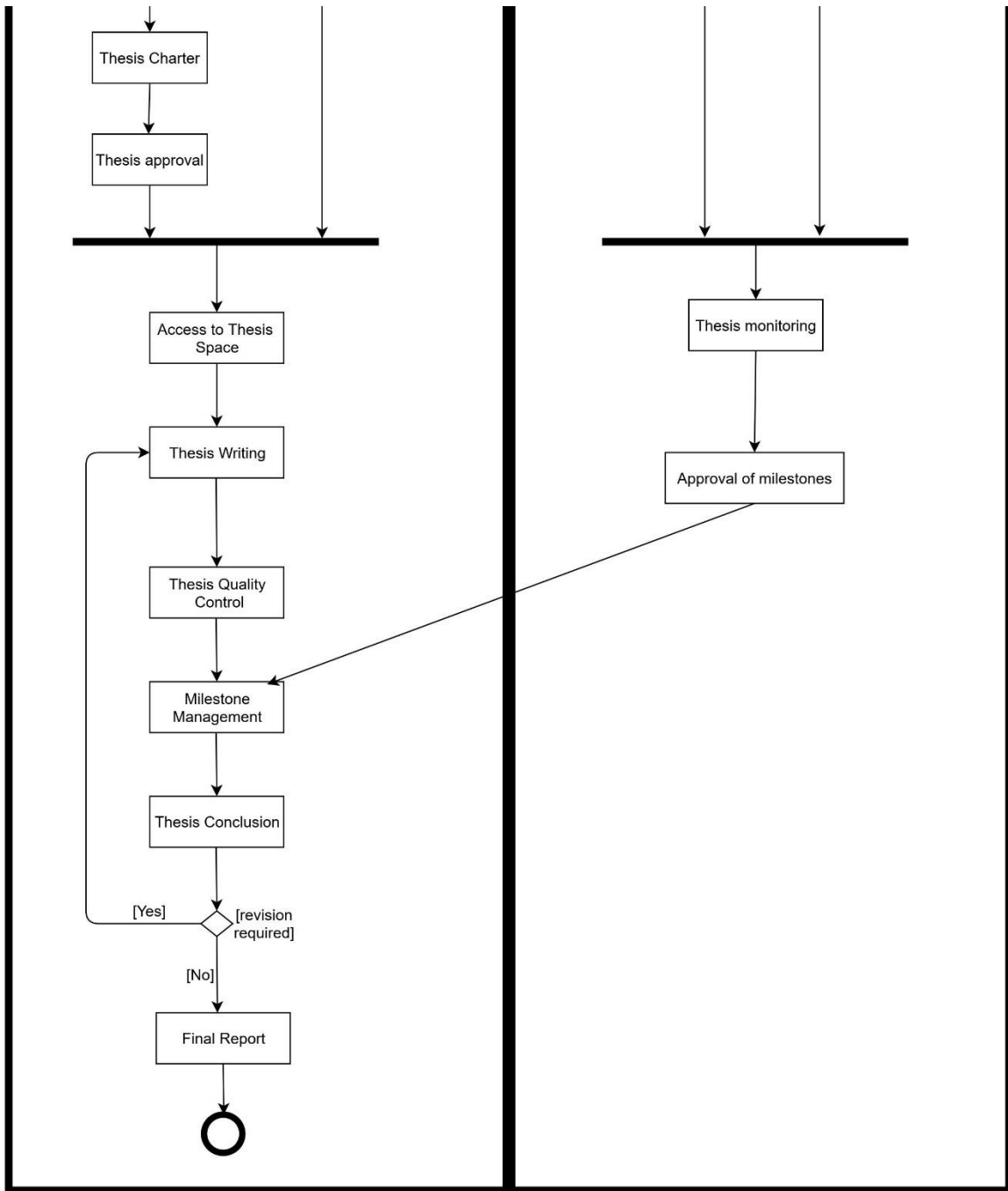


Fig 21: Web application Activity Diagram

7.4.3 Platform proposed wireframe:

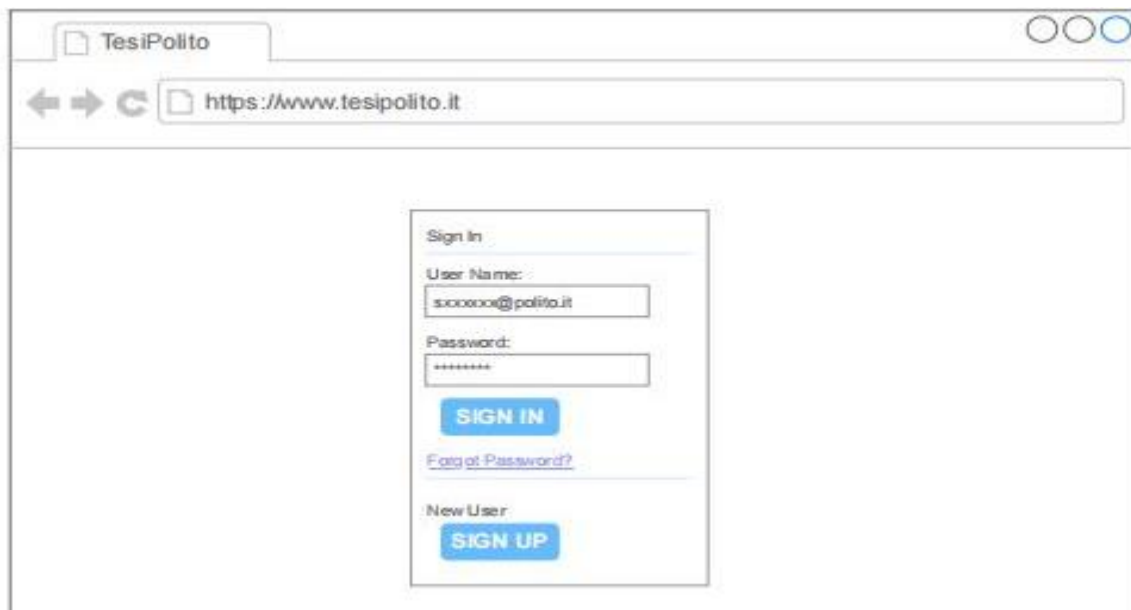


Fig 22: Login Page



Fig 23: Home Page



Fig 24: Thesis Proposal by Professors

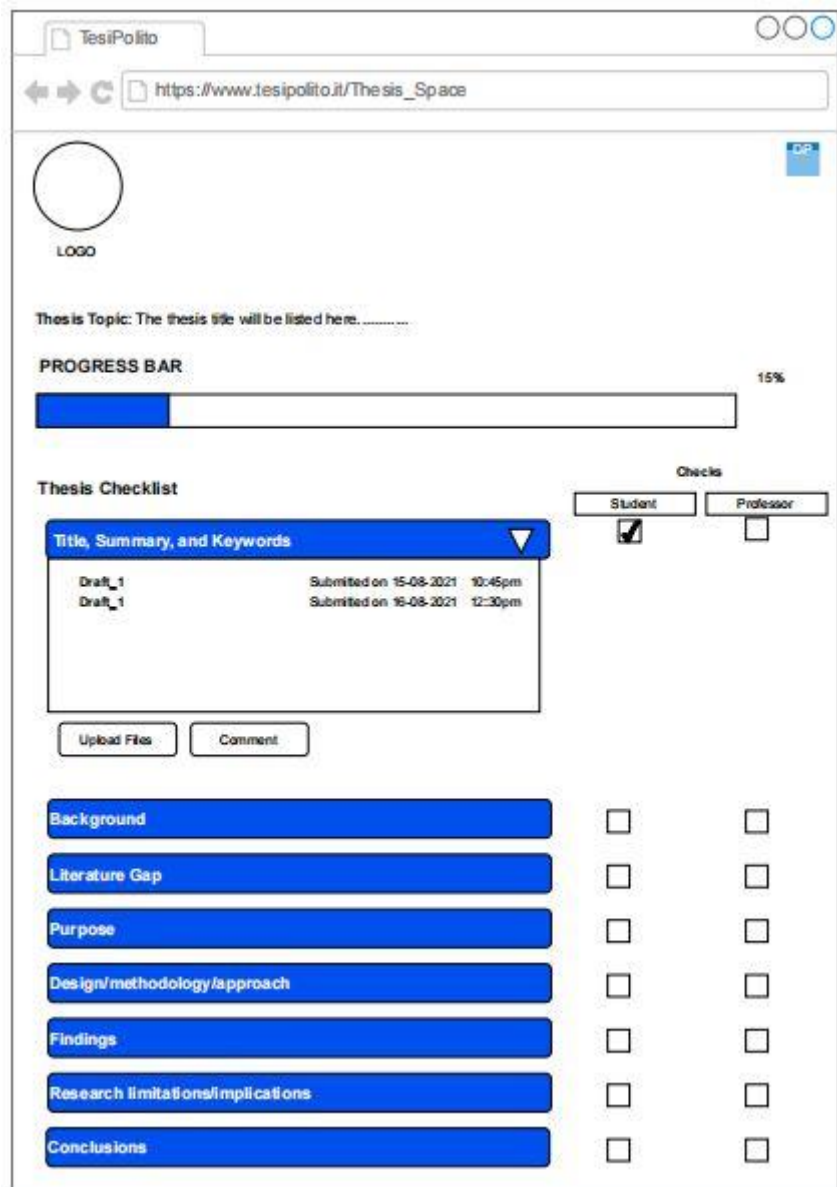


Fig 25: Thesis Monitoring and Control Space

7.5 Scrum Project- Web application development

The methodology used for project is scrum methodology as it is one of the prominent and widely used method for software development. We conducted our scrum project according to the defined scrum phases and processes in SBoK. The entire project summary is explained in this chapter:

7.5.1 Initiate:

This thesis project came to light after a meeting with the professor about the thesis proposal. After which I was asked to form the team of 4-5 students to carry out this project. I was told to form a team with certain technically capable members which I used it as a prerequisite or a selection criterion to form a team. The team of 3 members was finalized based their interest and availability throughout the period of the project. The initiating phase of the scrum project is explained below:

- **Identify Scrum Master & Stakeholder:**

Chiemerie Ezechukwu: Scrum Master & Back End Developer, is the full-time student of Engineering Management in Politecnico di Torino. Chiemerie as a back-end developer played a crucial role in sharing his knowledge and expertise to develop the platform.

Prof. Paolo Eugenio Demagistris: Stakeholder, Prof. Paolo is a professor of Project Management in Politecnico di Torino. He was the Co-founder of construction consulting company and was the director of the company spanning for almost 20 years. Prof. Paolo took the role as stakeholder throughout the project and communicated the requirements to product owner.

- **Form Scrum team:**

We decided to assign members in the scrum team based upon their interests and capabilities. Below is the list of members with their respective roles in the scrum team:

Mohammed Salman Pasha: Product Owner, took up the role of product owner. I was in contact with stakeholder communicating the requirements and conveying the voice of customer to the scrum team.

Saidbek Samigjonov: Front End Developer, is the full-time student of Engineering Management in Politecnico di Torino. Saidbek as a front-end developer took care of the UI/UX design of the platform.

Giorgio Spadaro: Testing, is the full-time student of Engineering Management in Politecnico di Torino. Giorgio was responsible for testing the codes deployed by the front and back end.

- **Create Project Vision:**

In this process, usually the project business case is reviewed but we used the stakeholder and user's requirements to create the project vision statement that served as an inspiration and provide focus for the entire project. It is common practice to create project vision before creating scrum team and identifying stakeholders but, in our project, we took the most logical pathway of forming the scrum team and then creating the vision statement.

We initiated the project by drafting the project vision statement which we used as cornerstone throughout the project. As a product owner, I drafted the project vision by considering the user requirements and stakeholders involved in the project.

- **Developing Epics:**

In this process, project vision was used as a guiding tool for developing the Epics for the project. Group meeting was held in which stakeholder, product owner, scrum master and scrum team were part of it. In this meeting, we discussed and came up with the appropriate Epics required for this project. The list of developed Epics is shown in the Fig , these Epics were flexible and were changed as project progressed.

- **Create Prioritized Product Backlog:**

In this process, the enlisted Epics were refined, elaborated, and then prioritized to create a backlog for the project. Prioritized product backlog is simply categorized as 'Epics' in the taiga platform in which the list of Epics can be managed.

7.5.2 **Plan & Estimate:**

Once the project was successfully initiated, epics were elaborated with the respective acceptance criteria. This marked the end of initiate phase and from this moment onwards our team entered plan and estimate phase of the project. Each process in this phase is explained below:

- **Create user stories:**

In this process, user stories and their related acceptance criteria were created by the product owner. These were designed to ensure that the user's or stakeholder's requirements are clearly met and can be easily understood by all stakeholders. Usually, user stories writing also can be done by involving stakeholders and scrum team members. These user stories were then listed in the prioritized product backlog. The prioritized product backlog is section in the taiga platform is categorized as backlog.

User stories were then elaborated and definition of done for each user story was drafted by the product owner by keeping the user requirements in mind.

- **Estimate User Stories:**

In this process, as a unit of measuring each user stories, we used story points. We used Fibonacci number method to story points based on the effort required to complete that user story. The sum of the story points at the end of each sprint was used to compare the performance and velocity of the sprint. This concept is important because it helped me as product owner and the team to understand if the assignment of tasks of sprint has been done properly. I faced some problems to make the scrum team to understand the actual logic behind using Fibonacci numbers for story points but later was accepted by the team.

- **Commit user stories:**

In this process, the scrum master along with the scrum team commits to deliver the approved user stories for a particular sprint. Each user story is said to be complete if and

only if it meets the definition of done. In case a user story fails to complete or match the definition of done, that user story was shifted to next sprint.

- **Identify tasks:**

In this process, the user stories in each sprint were broken down into small and specific tasks. These tasks were compiled into tasks list and then these tasks were assigned to each scrum team member.

- **Create sprint backlog:**

In this process, the scrum core team creates and categorizes the tasks that should be completed in each sprint. This grouping of tasks into the sprint was time boxed with start and end date to each sprint. We then created sprint backlog which consisted of the group of the tasks to be completed in each sprint. Few sprints of the projects are explained in the implement phase.

7.5.3. Implement:

- **Create deliverables:**

In this process, the scrum team worked on the tasks which were specified in the sprint backlog and after completing the tasks scrum team submitted the draft deliverables. Our team managed to take part in two sprints and each sprint is explained in detail in the section below.

Sprint 0

- As a product owner, I conducted the first kick-off meeting on 31st May 2021 in which we discussed the base elements for the project and planned the project activities. In this meeting, each team member introduced themselves to each other. In this meeting, we discussed 5 Ws of the project such as *what is the background of the project? Why are we doing it? What is the scope of the project? What is the action plan? Who is doing what in the project?*

- After assigning the roles in the scrum project, most of the team members including myself were not acquainted with the scrum methodology. Professor made it a pre-requisite to obtain a **Scrum fundamental certification** which would help us understand the basic principles and fundamentals of scrum methodology.
- Setting up the GitHub repository to collaborate the team and monitor the changes in the project. GitHub repo was used a central data storage for the files and documents used in the project. All the documents which were useful for the project were uploaded on GitHub repository by each team and the stakeholder.
- We decided to use telegram to communicate among each other and started a telegram group. We used this platform to share all the information, conduct polls, and post meeting schedules.
- Scrum project management platform called taiga was used to carry out the project.

Sprint 1

First sprint started with the sprint planning meeting on 21st June 2021. During the meeting, starting from what were the customer's requirements, and following the cornerstones of the agile methodology, all the team members collaborated to plan the first sprint in the most efficient way and discussed about which user stories and the respective tasks will be completed in the following sprint. We were focusing on the first Epic 'Thesis Page-Replica of PoliTo portal'.

Each user story in this project was defined by using a well-known general structure for user stories:

“As a {**User**}, I want to {**goal**} so that I {**receive the benefit**}”

In some cases, describing and defining a user story can get complicated. Each user story defined should meet certain conditions before they are finalized. We use INVEST model to define and describe user story and to make sure that the criteria is met.

According to **INVEST model**, a user story should not depend on any other user story(**Independent**); It must be possible to clarify it in all aspects through the debate until all

the actors agree on its content(**Negotiable**); it exists only if the end user benefits from its realization(**Value**); it must be possible to estimate the effort required to complete it(**Estimable**); it must be small enough not to confuse it to an Epic(**Small**) and objectively verifiable(**Testable**).

After receiving inputs from all team members, we decided to go ahead with the user story to create general project structure. We time-boxed this sprint to 2 weeks and the user story was defined as below:

“As a development team, we want to create a generic project structure file for the REACT frontend and the Django backend so that we can use this structure for the code development”

Sprint no.	1
Points	10
Period	07-06-2021 to 21-06-2021
User stories	Create a project structure

Task	Task Description	Assigned to
1	Deliberate and brain storm the suitable structure	Scrum team
2	Come up with draft general structure	Scrum team
3	Finalize the general structure	Scrum team

Fig 26: User stories and tasks of Sprint 1

The user story defined above was given the 10 points (5-front and 5-back end) as a difficulty measure to compute the velocity of the sprint. The story points have been chosen by the team members through the Fibonacci numbering, already explained in the previous chapters. Even though the velocity for this sprint was too low, we went ahead with it to get an initial start for the project.

Sprint 2:

On 28th June 2021, second sprint planning meeting was conducted to plan the upcoming sprint and respective user stories and tasks to be completed in that sprint. In this sprint, we decided to work on 3 user stories.

Sprint no.	2	
Points	13+20+6=39	
Period	28-06-2021 to 09-08-2021	
User stories	Authentication-Back end-20	
	Authentication front end-13	
	Email notification-6	

Task	Task Description	Assigned to
1	Create Custome user model	Chiemerie
2	Create view sets	Chiemerie
3	Add API authentication End points	Chiemerie
4	Create Serializers	Chiemerie
5	Configure smtp email	Saidbek
6	Manage and assign permission levels	Saidbek
7	Configure email templates	Saidbek

Task	Task Description	Assigned to
1	Create Sign up page	Saidbek
2	Create login page	Saidbek
3	Create Sign up success page	Saidbek
4	Create a hidden field-resend activation mail	Saidbek
5	Create password reset page	Saidbek

Task	Task Description	Assigned to
1	Configure and integrate polito mail to thesis listing page	Chiemerie
2	Configure and integrate polito mail to thesis proposal page	Saidbek
3	Design a interact page and integrate it with polito mail	Saidbek

Fig 27: User stories and tasks of Sprint 2

- **First user story of this sprint** was authentication back end and it was defined as:

“As a professor and/or student, I want to be able to register and login so that I can get access to the thesis web application”

Depending on the level of difficulty, we assigned 20 points to back end making it 20 points to this user story.

- **Second user story of this sprint** was authentication frontend-UI/UX and it was defined as:

“As a professor and/or student, I want to be able to register and login so that I can get access to the thesis web application”

Depending on the level of difficulty, we assigned 13 points to front end making it 13 points to this user story.

- Finally, *the third user story* which was to be completed in this sprint was Email notification and it was defined as:

“As a professor and student (User), I should be notified about new messages via Polito's email platform so that I can exchange the messages regarding the thesis.”

Depending on the level of difficulty, we assigned 3 points to front end and 3 points to back end summing up to 6 points for this user story.

Overall, this sprint came down to a velocity measure of 39 points which is much better compared to first sprint.

Sprint no.3:

On 16th August 2021, third sprint planning meeting was called, and this was a crucial meeting given the circumstances. The main wireframe of the web application on which this whole project was based on was still under development by the product owner and team member found it difficult to understand how the ISO 21500 was going to be translated and incorporated into thesis development and management process. Few sessions were conducted in which professor himself explained the basic principles of the ISO 21500 and how it is being used to design the framework to produce and manage thesis. After a couple of meeting between product owner and scrum team, we finally decided to work on the skeletal features of the web application which are defined in the sprint below. Finally, 3 user stories were chosen to be completed in the 3rd sprint. They are defined as follows:

Sprint no.	3	
Points	10+8+5=23	
Period	16-08-2021 to 30-08-2021	
User stories	Thesis topics listing	
	Thesis information viewing and request	
	Thesis proposal by students	
Task	Task Description	Assigned to
1	Design layout for thesis listing page	Saidbek
2	Add accept and reject functionality for professor end	Saidbek
Task	Task Description	Assigned to
1	Design thesis topics viewing page for students	Saidbek
2	Add appropriate filters to categorize thesis	Saidbek
Task	Task Description	Assigned to
1	Add/Design student thesis proposal page	Saidbek
2	Integrate the proposal page to polito mail	Saidbek

Fig 28: User stories and tasks of Sprint 3

- **First user story of this sprint** was Thesis topic listing by professor, and it was defined as:
“As a professor, I should be able to list the thesis proposals in the web application so that students can view the thesis listings and send the thesis proposals”

Depending on the level of difficulty, we assigned 10 points to front end making it 10 points to this user story.

- **Second user story of this sprint** was Thesis Information viewing and request and it was defined as:

“As a student, I should be able to view all the thesis listings on the web application so that I can send the request to the professor”

Depending on the level of difficulty, we assigned 8 points to front end making it 8 points to this user story.

- **Third user story of this sprint** was Thesis topic proposals by students, and it was defined as:

“As a student, I should be able to submit a thesis proposal idea that is not listed on the portal so that the professor can go through the proposal and can accept or reject it.”

Depending on the level of difficulty, we assigned 5 points to front end making it 5 points to this user story.

Overall, this sprint came down to a velocity measure of 23 points which is much lesser compared to second sprint. The main reason for accommodating less story points and tasks was the back-end developer and testing Engineer had external commitments such as internship and work due to which they had to leave the project.

3.2 Groom prioritized product backlog

In this process, the product backlog was continuously updated and maintained by the product owner.

3.3 Conduct weekly scrum meeting:

In this process, each week on Mondays, a highly focused, time boxed meeting was conducted which was referred to as weekly scrum meeting. In this meeting, every team member, product owner and the stakeholder took part in it. This was used as a forum for the scrum team to update each other on their progress and any hurdles they faced during the work. Each weekly scrum meeting was time-boxed to 45 minutes.

7.5.4. Review and Retrospect Phase

- **Demonstrate and validate sprint:**

In this process, the scrum team show cased the sprint deliverable to the product owner and the relevant stakeholder in a meeting. The main purpose of this meeting is to secure approval and acceptance from the product owner for the deliverables created in the sprint.

- **Retrospect Sprint:**

In this process, the scrum master, product owner and scrum team conducted meeting to discuss the lessons learned and discuss the impediments throughout the sprint. This information was relayed to the concerned stakeholder. Often, because of this meeting, there was a recommended list of actionable improvements which were to apply in the following sprints.

Usually, retrospect meeting is not as engaging as it should be and to collaborate the entire team is a tricky business. Few of the proven steps to conduct productive and collaborative retrospectives were adapted. The activities helped during the retrospectives are explained in this chapter:

- ***EVSP- Explorers, Shoppers, Vacationer, Prisoner***[o]

This model is used to kick start the retrospective and it's a fun way to keep the team engaged. Start by asking each team member to choose any one role anonymously. It is again an anonymous way to find out if team really want to be there or not.

- Explorers wants to learn as much as they can about the project, product release, or iteration.
- Shoppers will examine all the information and will be delighted if they can walk away with one actionable idea
- Vacationers are comfortable with the idea of getting away from their desk but aren't there for the meeting.
- Prisoners would rather be doing something else rather than attending the retrospective.

This activity can help us understand how engaging the team members are and we can have a conversation about how to continue with the whole group. For instance, if few of the team members chose prisoners, as a product owner I may ask the group if they would prefer to reschedule the meeting. Retrospectives are more effective with more engaged participants.

7.5.5. Release Phase

In this phase, accepted deliverables were reviewed and delivered or transitioned to the stakeholder. Review and comments from the stakeholder were then noted to make necessary changes in the following deliverables.

8. Research Approach and Method

8.1 Research approach

Mainly, any given research can be classified into two categories or types; one is qualitative and the other is quantitative. They have their pros and cons. They don't have any apparent superiority over one another and the research approach to be used depends on the type of research to be performed. Quantitative research is the best research approach by some because of the appropriate methodology in data acquisition led to suitable calculated information. The processes which can be used to collect data can be questionnaires, surveys, and coded synthetic monitoring.

While on the other hand qualitative research can be interpreted as the acquisition of knowledge that should be examined, analysed, and completely understood through the medium of a concise point of view. Researchers claimed that qualitative research is mostly based on interviews and interactions which are open-end and on the data of other fields, sometimes can also consist of quantitative data or disruptive statistics.

The broad quantitative approach would be a better choice for the research, *but due to unavailability of capable resources* for the acquisition of real data to access real information, a qualitative approach is widely adopted. **In this research mostly qualitative and some quantitative approach has been used.**

8.2 Research method

The research method is a scientific term used for the nature of research conduction, to evaluate how the facts have been derived in the research work, it is a label to research based on the procedure of work done in research.

According to definition constructive research is based on the theories and its evaluation and feasibility or possibility to apply in some technology, it does not need that research must be as per solidity, this type of research may be some case studies, may be based on hypothesis and supposition, while on the other hand Empirical research should be based on reality, must be solid observations, and proofs of theories, in which real data should be utilized to obtain the results. This research is constructive research as this mainly focuses on the feasibility of project management principle in the thesis development.

9. LESSONS LEARNED

Now in the light of above proposed framework and a well-documented scrum project, we try to discuss lessons learned and try to answer some advanced yet fundamental questions.

The main idea to document the lessons learned is to group up all the challenges faced, knowledge gained and implemented solutions to mitigate the problems. Below I have listed the challenges faced, lessons learned, and mitigation steps taken.

1. To begin with less, we decided to go ahead with scrum methodology in our distributed project as it is one of the well-known frameworks with proven results. For most of us, scrum was a totally new method, thus training was needed. Professor recommended to get Scrum Fundamentals Certification as a pre-requisite for the project which turned out truly beneficial for the project.
2. Scrum Framework expects open communication and interaction which was difficult due to pandemic and other professional commitments of team members. Thanks to the technology, especially Google meet, we were able to conduct our weekly scrum seamlessly. In case any team member was unable to attend the meeting, they would be briefed about it in the telegram thesis group which was really helpful to keep everyone on board.
3. The main reason to use agile specifically scrum was because it was well suited for our distributed project, and it paved a way for smooth and structured way of communication. The flexibility of scrum to be open for the changes in requirements was one of the standout features of scrum methodology.
4. Scrum emphasized on the fast and frequent problem solving which was encouraging distributed team members to talk and discuss about the issues more openly. Each team member was involved in collaborative teamwork and open discussions which are important in the work culture where problems are not used to be discussed openly.

Lesson learned:

1. Proper training of scrum fundamentals is needed in the beginning of the project even if one member has not used or not familiar with scrum before. Scrum Fundamentals Certification was found to be useful to understand the basics enough to start the project. As they say in agile, *“You are as fast as the slowest in the team”*
2. Open communication and discussion are the backbone of the scrum framework. Create and promote a work environment in which each and every team member can put their

views forward and discuss them openly with the team. As great Albert Einstein himself said, ***“Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning”***. Scrum loses its value if open communication and discussed are not ensured and encouraged.

3. Frequent scrum meetings and retrospectives help to understand and detect problems well before, which may save a lot of time wasted in correcting the mistakes. Scrum meetings should be held as frequently as possible to keep team members engaged and in the loop. But make sure that the scrum meetings are strictly time boxed so that team members should lose interest. As said by well known agile coach, Woody Zuill, ***“If you adopt only one agile practice let it be retrospectives. Everything else will follow”***
4. Communication platforms are very crucial in the scrum project. Decide and come up with a communication plan well before the project. Choose specific platforms for group discussions, video conferencing, and documentation of the project.
5. Try to keep stakeholders in the loop and keep them well informed so that the team can receive change requests well before rather than in the later stages which may result in loss of interest and decision fatigue.

10. Conclusion with future aspects

Based on the scrum project, we can draw several theoretical as well as managerial conclusions that support the change in thesis development process and the transition in the digitization and implementation of project management into thesis development. In fact, from the scrum project we found that the lack of knowledge of agile methodology and scrum framework had a huge impact on the velocity of the project. The learning curve throughout the project remained steep. As the project progressed both the team members and me, the product owner got acquainted with the process.

The study was based on the possibility of coming up with a heuristic and simple process of thesis development which was based on the project management approach. The process which could be easily understood by the students and to make easy transition from the traditional way of thesis development to the proposed way of thesis development. It is important to specify that the case study analysed and experimented in this dissertation is limited to only internal thesis development in which students can develop their thesis with the internal supervisors (professors from PoliTo). This research paves a way for future extension of this heuristic approach of thesis development to include external supervisors (or actors) such as research centres and companies.

Quality of research and its documentation through thesis is a very crucial part of graduating student as well as the university's reputation. Most of the students cannot keep up with the quality requirements due to lack of monitoring and knowledge. Theoretically, this approach is more engaging, and it keeps the students on their toes to focus on their research quality.

For this reason, further research on this topic should be done to provide support to the academic institutions. Also, the development of the thesis platform can be carried out to make it much more identical to the proposed thesis development platform.

In conclusion, this work could be taken into account in the future projects through which thesis development platform can be streamlined and built in much more efficient way by taking ideas from the lessons learned throughout this scrum project.

As Mr. Ralph Stayer, CEO of Johnsonville Foods said, "***Change is hard because people overestimate the value of what they have and underestimate the value of what they may gain by giving that up***"

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APPENDIX

1. PROJECT LOG

Roles		Names	
Stakeholder		Prof. Paolo Eugenio demagistris	
Product Owner		Mohammed Salman Pasha	
Scrum Master		Chiemerie	
Scrum team		Saidbek Samigjonov	
Scrum team		Giorgio Spadaro	

Applying the PM approach to the academic context, building thesis project management framework. The Product Owner perspective.

Sl no.	Date	Description	Outcome/comment
1	24-05-2021	Thesis request sent to professor	Received response from the professor on the same day and scheduled a meeting 11:30 am
2	24-05-2021	Meeting scheduled to discuss thesis	Discussed about the thesis proposal and agreed to go ahead with the thesis
3	25-05-2021	Thesis title approved on portal	This proposal and title was accepted and approved by the professor on Portale della Didattica
4	26-05-2021	Google forms shared to prospective co-authors	Received response from 8 candidates showing interest to take up the thesis
5	27-05-2021	Meetings with 4 candidates-1	2 students agreed and were found suitable for the available roles
6	28-05-2021	Meetings with 4 candidates-2	2 students agreed and were found suitable for the available roles
7	31-05-2021	Kick off meeting with the team	Professor explained about the thesis proposal and assigned different roles to each team member
8	02-06-2021	Created Github repository of the thesis project	Professor created a Github repository of the project as a collaboration and contribution tool
9	03-06-2021	Provided access to Github repository to the project team	Project team members were granted access to the private repository
10	03-06-2021	Created telegram group for communication	Team decided to use Telegram Group to use as communication tool for rest of the project
11	04-06-2021	Project Vision Statement drafted	Professor provided the draft of Project vision statement for the project team
12	04-06-2021	Scrum fundamentals Certification	Project team members were instructed to complete and attain SFC course as a pre requisite for the thesis
13	07-06-2021	Sprint Planning Meeting	Discussed about the progress and selected online taiga agile tool for the project
14	08-06-2021	Access to the taiga agile online platform	Product Owner and professor set up the project on the taiga and granted access to the team members
15	10-08-2021	Created Epics and User stories of the project	PO created user stories to completed for the particular and assigned tasks to the respective team member
16	11-06-2021	Meeting with the TRIN-Polito	This meeting was scheduled to discuss the licensing and Intellectual property rights of the web application
17	14-06-2021	Weekly Scrum meeting	Discussed about the Use Case Diagram of the web application
18	15-06-2021	First Draft of Use Case Diagram	Professor uploaded the first draft of the use case diagram of the web application
19	16-06-2021	Updated Use Case diagram	Uploaded the updated use diagram on Github repo
20	19-06-2021	Project Vision Statement on GitHub	Professor uploaded project vision statement on Git repo which was used as guide for the rest of the project
21	21-06-2021	Sprint review and retrospective	Discussed the project progress
22	24-06-2021	Sprint review and retrospective	Special team meeting was organized for the development to discuss about the general structure of the web application
23	28-06-2021	Sprint Planning Meeting for 2nd sprint	User stories and tasks to be focused on second sprint were defined
24	05-07-2021	Weekly Scrum meeting	Discussed the project progress
25	09-07-2021	Taiga Platform expired	Taiga free access expired and professor provided access to the other full version account
26	10-07-2021	New taiga account re instated	Dump file was uploaded to the new taiga platform and project was resumed
27	11-07-2021	Front integration and creating pipeline	Meeting with UI/UX developer to know the progress
28	12-07-2021	Weekly Scrum meeting	Agenda was to discuss about the integration of front end with back end
29	15-07-2021	Testing front end	Meeting with UI/UX developer to check the front end project delivery and progress

30	19-07-2021	Weekly Scrum meeting	Meeting was cancelled due to unavailability of project team
31	23-07-2021	Weekly Scrum meeting	Meeting to discuss project progress
32	23-07-2021	Published updated Use Case Diagram	Product Owner uploaded the updated Use Case following the principles of ISO 21500
33	26-07-2021	Weekly Scrum meeting	Meeting to discuss project progress
34	30-07-2021	Prepare Framework and ISO 21500 session	Professor organized an informative session on ISO 21500 and cleared doubts regarding the same
35	02-08-2021	Weekly Scrum meeting	Discussed the project progress
36	06-08-2021	Professor meeting with Product Owner	Meeting was scheduled to discuss project progress and upcoming tasks
37	07-08-2021	Thesis charter updated	Project thesis charter was updated
38	08-08-2021	Further Epics and User stories were updated	PO updated the epics and user stories
39	09-08-2021	Sprint review and retrospective	Discussed the project progress
40	11-08-2021	Weekly Scrum meeting	rescheduled team meeting to discuss project progress
41	16-08-2021	Sprint Planning Meeting for 3rd sprint	User stories and tasks to be focused on third sprint were defined
42	22-08-2021	Wire frame uploaded	Basic Wire frame for web application was uploaded
43	23-08-2021	Meeting with professor	Meeting to discuss availability of project team and project progress
44	30-08-2021	Sprint review and retrospective	Discussed the project progress
45	31-08-2021	U/UX developer meeting with professor	Discussion on usage of Odoo platform
46	07-09-2021	U/UX developer meeting with professor	To discuss project progress
47	10-09-2021	U/UX developer meeting with professor	To discuss project progress and doubts clearing session
48	14-09-2021	Updated front end code and design	Updated the front end design of the web application
49	15-09-2021	Halted Weekly meeting	Weekly meetings were halted due to thesis conclusion submission
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2. Project Vision Statement

Project Vision Statement
<i>Project Title: Applying the PM approach to the academic context, building a thesis projects management framework</i>
Stakeholder (For)
Masters Students and faculty at Politecnico di Torino, Italy
Target Users (who)
<ul style="list-style-type: none">Jointly produce high academic quality thesis, within a limited and planned time frame, under limited resources and effortplan, monitor and control both thesis' management and product processes
End Product (The)
<i>The web application allows to apply the methodological framework of ISO21500 to carryout thesis development</i> That
Allows End users to Plan, Execute, Control, and Close the Thesis development as an integrated effort respecting time, effort, and quality requirement
Unlike the existing solution The 'Portale della didattica', that allows only basic submittals and approvals.
Our Product Allows to use all processes described in the ISO21500 and has educational results, as it Allows to demonstrate the implications of developing a project. Allows the foundation of an open-source library and JS frontend to manage projects with: <ul style="list-style-type: none">an open source and open data applicationthat is fully documented, both in terms of code, UML formal models and classes and subclasses references

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Everyone says that the journey of developing your master's thesis is one of the crucial and important part of your graduate life because it puts you in front of the brink of desperation. I experienced the same, and I am pretty sure that without the encouragement and support of some people I wouldn't be writing this acknowledgment after successfully developing my thesis.

First of all, I want to thank Allah for granting me this auspicious opportunity to study in such a prestigious university and providing me the chance to work with amazing minds all across the globe. This thesis is a result of the guidance and support of many people, and I would like to offer my sincere thanks to all of them from bottom of my heart.

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Finally, I would like to dedicate this thesis to my lovely mom, to myself, to my sacrifices, and to the tenacity that has allowed me to get this far.