An explorative analysis of effective Project Management of Research and Research-Related Projects within a newly formed Multi-Campus Technology University

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Declaration

I, Aidan Higgins, declare that everything in my thesis is my work and research and has yet to be presented. I have used the Harvard reference style, which fully complies with ATUs policy on referencing.

Signed: _____*Aidan Higgins*_____

Date: _____

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Abstract

Higher education will be crucial in the coming decades in helping to make Ireland a nation known for innovation, competitive enterprise, and ongoing academic success, as well as a desirable location to live and work with a high quality of life, vibrant culture, and inclusive social structures. Higher education institutions will actively connect with each student community, society, and business; they will help students develop a sense of place and identity in Ireland and provide the tools they need to contribute significantly to the global community.

It will also serve as a catalyst for novel ideas through research, many of which will become the foundation for long-lasting innovative businesses in the future as part of the 2030 National Strategy on Education. This strategy focuses on changing and developing our education system and how we conduct research. The emphasis is central to knowledge transfer and a consistent research framework while exploiting opportunities and having the necessary expertise. The newly formed Technological Universities in Ireland are based on a government initiative to create a new type of higher education institution focusing on applied and industry-focused research and education. The basis of the Technological University is to bring together two or more existing Institutes of Technologies to create a larger, more comprehensive institution that offers a broader range of programs and services to students and industry partners. The Technological University model promotes collaboration between academia, industry, and community organisations to foster innovation, research, and economic development. The Technological University is designed to emphasise applied research, technology transfer, and entrepreneurship to foster innovation and contribute to economic growth. Therefore, effective Project Management of research projects within the newly formed Technological Universities is central to ensuring the Technological University objectives are fulfilled.

A project is a collection of organised tasks to produce a singular output (product or service) within a given time frame. Project Management is a set of activities that facilitates the successful implementation of a project. The significant differences between research projects and development projects are the (lack of) precise requirements and (the inability to) plan an outcome from the beginning of the project. The evaluation criteria for a research project must consider these and other "particularities" in works; for instance, proving something cannot be done may be a successful outcome.

This study intends to explore how a newly established multi-campus Technological University manages research projects effectively. The study will identify the potentials and difficulties of managing research projects, the tools, resources and processes available in a multi-campus Technological

University context and the methods and approaches employed to deal with these difficulties. Key stakeholders like Project Managers, academics and administrators will be surveyed as part of the study, which will also involve an explorative investigation of current literature and data. The findings of this study will contribute to creating best practices for Project Management in this setting and offer insightful information about the efficient management of research projects within a multi-campus Technological University.

Keywords: Technological University, Project Management, Project Management Methodologies, Research, Project Management of Research, Project Manager, Skills, Qualities, Tools, and Techniques.

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Abbreviations

Abbreviation	Definition
PMT	Project Management
TU	Technological University
TUs	Technological Universities
PMM	Project Management Methodology
PMMs	Project Management Methodologies
PMO	Project Management Office
PM	Project Manager
PMs	Project Managers
BIM	Building Information Modelling
PMBOK	Project Management Book of Knowledge
HEI	Higher Education Institute
IOT	Institute of Technology
IoTs	Institute of Technologies
UCD	University College Dublin
RSO	Research Support Office

Chapter 1. Introduction

1.0 Introduction

Higher education will be crucial in the coming decades in helping to make Ireland a nation known for innovation, competitive enterprise, and ongoing academic success, as well as a desirable location to live and work with a high quality of life, vibrant culture, and inclusive social structures. Higher Education Institutions (HEI) will actively connect with each student community, society, and business; they will help students develop a sense of place and identity in Ireland and provide the tools they need to contribute significantly to the global community.

It will also serve as a catalyst for novel ideas through research, many of which will become the foundation for long-lasting inventive businesses in the future as part of the National Strategy on Education. This National Strategy on Education focuses on changing and developing our education system with a focus on how to conduct research (Department of Education and Skills, 2011). The emphasis is central to knowledge transfer and a consistent research framework while exploiting opportunities and having the necessary expertise. The newly formed Technological Universities (TUs) in Ireland are based on a government initiative to create a new type of higher education institution focusing on applied and industry-focused research and education. The basis of the Technological University (TU) is to bring together two or more existing Institutes of Technology (IoT) to create a larger, more comprehensive institution that offers a broader range of programs and services to students and industry partners. The TU model promotes collaboration between academia, industry, and community organisations to foster innovation, research, and economic development. The TUs are designed to emphasise applied research, technology transfer and entrepreneurship to foster innovation and contribute to economic growth. Therefore, effective project management (PMT) of research projects within the newly formed TUs is central in ensuring the TU objectives are fulfilled.

The distributed structure of the research teams and resources within a multi-campus TU can make managing research projects challenging. The success of the research initiatives depends on efficient communication and coordination between the many campuses, departments, funding bodies and stakeholders. PMT approaches like Waterfall, PRINCE2, PMBOK, Six Sigma, Agile, Kanban, Lean, Extreme project management, and Scrum are examples of PMT processes and tools that can help ensure the completion of projects on schedule, within budget and to the stakeholders' satisfaction.

Effective administration of financial resources, human resources, and equipment is also a part of PMT of research projects in a multi-campus TU. Project managers (PMs) must know the opportunities and

difficulties associated with overseeing research projects across many campuses and devise plans to address these difficulties.

Additionally, a centralised Project Management Office (PMO) or Research Support Office (RSO) can assist in managing and coordinating research projects throughout the various locations. Project planning, execution, monitoring, controlling, and closing can all be aided by the PMO or RSO. It can also help with project prioritisation, resource allocation, training, and support for PMs and teams.

Careful planning, efficient communication, collaboration and a unified PMT approach and tools are necessary to research PMT within a multi-campus TU effectively. Furthermore, a centralised PMO or RSO is essential to manage research projects across several campuses and divisions.

1.1 Higher Education System Within Ireland

Ireland's higher education system has a distinctive two-tier structure. In the top tier, you have colleges and universities such as University City Dublin (UCD), Trinity College Dublin (TCD), University of Galway (UOG), University College Cork (UCC), along with new entrants such as University of Limerick (UL), Dublin City University (DCU) and Maynooth University (MU). A TU is a type of institution of higher education that focuses on providing industry-relevant teaching and research in science, engineering, technology, and related disciplines. Typically, these universities offer a variety of bachelor's and master's degree programs, as well as professional development courses and certifications.

In 2018, Technological University Dublin (TU Dublin) and Munster Technological University (MTU) became the first two TUs formed in Ireland. Three existing Institutes of Technologies (IoT's) merged to form TU Dublin: Dublin Institute of Technology, Institute of Technology Blanchardstown, and Institute of Technology Tallaght. Cork Institute of Technology and Institute of Technology Tralee merged to form MTU. In 2021 both Technological University Shannon (TUS) and South East Technological University (SETU) were formed, and in 2022, Atlantic Technological University (ATU) was formed.

In many nations like the UK, Norway, and Australia, TUs are established by consolidating several Institutes of Technology, polytechnics, or other vocational schools (Houghton, 2020). They typically have robust partnerships with industry and government, allowing students to gain practical experience and develop professional networks.

As mentioned earlier, the education system in Ireland has a two-tier structure. Nonetheless, the fourteen Institute of Technologies (IoTs) have been in second place. This is because the IoTs have historically concentrated on delivering a more vocationally oriented education, as well as on increasing access to non-traditional students and having a more regional focus. However, despite their

evident advantages, IoTs are poorly related in measures like research outputs and financing, as well as prestige and societal regard in Ireland's binary higher education system (Hazelkorn & Moyni, 2010).

In 2011, Ireland's National Strategy for Higher Education recommended establishing TUs to enhance the country's higher education system. The TUs would combine the assets of the Regional Technical Colleges with those of existing universities to create research-intensive and vocationally focused institutions.

In 2014, legislation establishing a procedure for forming TUs was enacted. To be designated as TUs, institutions must satisfy several stipulations outlined in the law.

Their criteria are covered below:

- A strong emphasis on teaching, learning and research that meets the requirements of both students and employers.
- A commitment to providing internationally recognised, high-quality qualifications.
- A culture of innovation, entrepreneurship and industry and community involvement.
- A determination to advance social inclusion, equality, and diversity.

The new TUs must remain committed to the disposition of regional development, provide access for all and be secure and responsive to industry, business, social and cultural needs (Cunnane, 2018).

Column one in Table 2 lists the IoTs as a single entity, and column two describes the newly formed Technological University. Dun Laoghaire Institute of Art, Design and Technology and Dundalk Institute of Technology are the only outstanding IoTs yet to have been designated as universities; however, this is planned in the coming years.

Table 2 *Amalgamated Universities*

Institute of Technology	Amalgamated Technological University (TU)
Dublin Institute of Technology Blanchardstown Institute of Technology Tallaght Institute of Technology	Technological University Dublin (TUD)
Sligo Institute of Technology Letterkenny Institute of Technology Galway Mayo Institute of Technology	Atlantic Technological University (ATU
Athlone Institute of Technology Limerick Institute of Technology	Technological University of the Shannon (TUS)

Waterford Institute of Technology	Southeast Technological University (SETU)
Carlow Institute of Technology	
Cork Institute of Technology	Munster Technological University MTU)
Tralee Institute of Technology	

Currently, there are five new Technological Universities in Ireland:

- Technological University Dublin (TUD)
- Atlantic Technological University (ATU)
- Munster Technological University MTU)
- Technological University of the Shannon (TUS)
- Southeast Technological University (SETU)

The establishment of TUs has been viewed as bolstering the Irish higher education system by providing students with a greater variety of opportunities and establishing institutions that are better equipped to meet the requirements of industry and the broader community. In addition, by providing high-quality education and research opportunities outside the nation's leading urban centres, TUs are also viewed as promoting regional development.

While establishing these new TUs has been challenging, including governance, financing, and academic culture issues, they are generally regarded as a positive development for the Irish Higher Education system. As TUs continue to develop and mature, they will likely play a more significant role in the nation's economic and social development.

Ireland's TUs are essential for fostering innovation and advancing research in the nation. They are created to offer innovative, industry-focused higher education and research opportunities to address the economy's skill gaps and foster regional development. However, according to Houghton (2020), they must "redefine their roles and aspirations as Universities". Therefore, effective Project Management of research projects within the newly formed Technological Universities is central to ensuring the Technological University objectives are fulfilled.

Here are some of the main strategies TUs in Ireland are using to encourage research and innovation:

- Collaborative Research: TUs in Ireland emphasise this type of study, which entails conducting research and developing creative solutions to practical issues while collaborating with business partners, academic institutions, and governmental organisations. Emphasis on collaboration ensures that research is pertinent and has useable applications.

- Technology Transfer: This entails commercialising research outputs and transferring them to industry for practical applications. Doing this ensures that the research is beneficial to the economy and society.

- Partnerships with Industry: TUs in Ireland have solid relationships with industry partners, which helps ensure that the research applies to and focuses on the industry. Giving industry partners a platform to work with researchers and create new goods and services encourages innovation.

- Support for Entrepreneurship: Irish TUs are dedicated to fostering innovation and entrepreneurship by offering a variety of initiatives and services to undergraduates and recent graduates who are considering launching their own companies or creating novel goods and services.

- Regional Development: By collaborating with regional stakeholders to identify the local economy's needs and developing programs and initiatives to address these needs, TUs in Ireland play a crucial role in promoting regional development.

Ireland's TUs are essential to the nation's efforts to advance research and innovation. Their emphasis on teamwork, technology transfer, industry partnerships, entrepreneurship support and regional development ensures that research in the TUs has real-world applications and gains for the economy and society.

1.2 Outline of the Research

The core objective, aim, and basis of this research are outlined in this section. It will also introduce the reader to the audience of this research while outlining the research questions. Finally, it will also summarise the layout of the thesis.

1.2.1 Objectives of the Research

This research aims to explore Project Management (PMT) within research projects within a TU. The author's experience as a PM working on research projects within a TU has given them great insight into how projects are carried out in a TU, triggering the basis of this research. For example, Cicmil (1997) states that the projects should change an inadequate (existing or future) state to a better one within a specific timeframe, using minimum effort.

The proposed research on an explorative analysis of effective PMT of research projects within a newly formed multi-campus TU aims to achieve the following objectives based on the research questions:

1. Assess the critical benefits of using PMT to manage research projects in a TU. This objective involves identifying and analysing the benefits of PMT in managing research projects in a TU, such as improving project efficiency, reducing project risks, and enhancing project outcomes.

2. Investigate what PMT methodologies are used in higher education to help drive research projects. This objective involves identifying and analysing project management methodologies used in higher education to manage research projects, such as Waterfall, PRINCE2, PMBOK, and Six Sigma. Agile, Kanban, Lean, Extreme Project Management and Scrum, and assessing their effectiveness in managing research projects.

3. Analyse PMs tools and techniques to manage research projects. This objective involves identifying and analysing PMT tools and techniques used by PMs in research projects in TU, such as Gantt charts, risk management, and communication tools and assessing their effectiveness in managing research projects.

4. Identify the skills and qualities needed to be a Project Manager (PM) in a TU. This objective involves identifying and analysing the essential skills and qualities required for a project manager to effectively manage research projects in a TU, such as leadership, communication, problem-solving and technical skills.

Overall, the research aims to provide insights into the practical PMT of research projects in a TU and to inform the development of best practices for managing research projects in such a context.

1.2.3 Basis of the Research

The proposed research is based on improving academic research institutions' PMT practices. The rapid pace of technological development and the complexity of research projects in higher education make effective PMT crucial for successful project outcomes.

Forming a new multi-campus TU also presents unique challenges in PMT, including coordinating activities across multiple campuses, managing diverse project teams and ensuring effective communication and collaboration.

Thus, this research project aims to identify current PMT practices in the university's research projects and evaluate their effectiveness in achieving project goals. The study also seeks to explore the challenges PMs face in the university's research projects and identify factors that contribute to these

challenges. Ultimately, the research aims to contribute to the broader understanding of effective PMT practices in academic research institutions and provide recommendations for improving PMT practices within the university's research projects.

1.2.4 Audience of the Research

The following stakeholders are among the target audience of this research project on efficient PMT of research projects at a newly established multi-campus TU to ensure that their policies and strategies for managing research projects are effective:

- University administrators, who are in charge of overseeing the university's research initiatives and managing the overall operation of the university, would be interested in the research's findings.

- Research PMs: Those overseeing research projects daily would be interested in the research findings to ensure their procedures align with successful PMT techniques and to learn new strategies that might boost their performance.

- Researchers: Those involved in research projects would be interested in the findings to ensure their projects are managed adequately, enabling them to accomplish their research objectives.

- Students: The research findings would interest students engaged in research projects or pursuing research careers to understand the best practices for managing research projects and the competencies required to be an effective PM.

Overall, a wide range of stakeholders involved in research, education and industry partnerships would be interested in the findings of this research.

1.3 The Structure of the Thesis

Chapter 1 - Introduction: This provides an overview of the research question, background information on the topic, and the rationale for the study. The introduction should also clearly state the thesis's research question and objectives.

Chapter 2 - Literature Review: This is a critical analysis of the relevant literature on the research topic, highlighting key themes, debates, and gaps in the existing research.

Chapter 3 – Research Methodology: This describes the research methods used to collect and analyse data, analysing the research design, sample size, data collection methods, and statistical analysis techniques.

Chapter 4 – Analysis of Data: This presents the research findings, including any statistical analyses or visualisations.

Chapter 5 – Discussion: This interprets the findings considering the research question and the relevant literature, identifying key themes, and discussing study limitations.

Chapter 6 – Conclusion and Recommendations: This summarises the vital essential findings and contributions of the research and provides recommendations for future research. Figure 1 demonstrates each of the phases below.
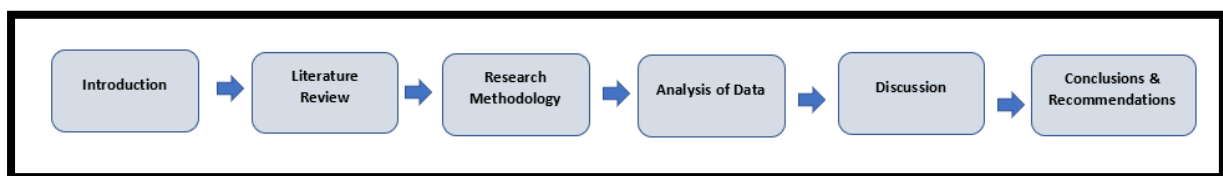
Figure 1 Structure of a thesis

1.4 Research Questions

A thesis uses research questions to direct and concentrate the research study. They help to ensure that the study remains on course and addresses the research problem by giving the investigation a clear and precise direction. Because each research query can be related to a particular section or chapter of the thesis, they also aid in organising it.

Additionally, research queries aid in defining the study's scope and establishing distinct parameters for the topics that will be investigated. This is crucial to ensuring the survey can be carried out and managed within time and quality constraints.

More importantly, research questions aid in framing the study appropriately and significantly to the study area. The study can substantially advance our knowledge and understanding by developing research questions that address current gaps or problems in the field. It is also essential to take the time to think about your research questions. Farrugia et al. (2010) quoted, "Without devoting appropriate resources to developing the research question, the quality of the study and subsequent results may be compromised".

Overall, research questions are essential to a thesis because they direct the research process, specify the study's scope, and ensure the research has a tangible impact on the subject.
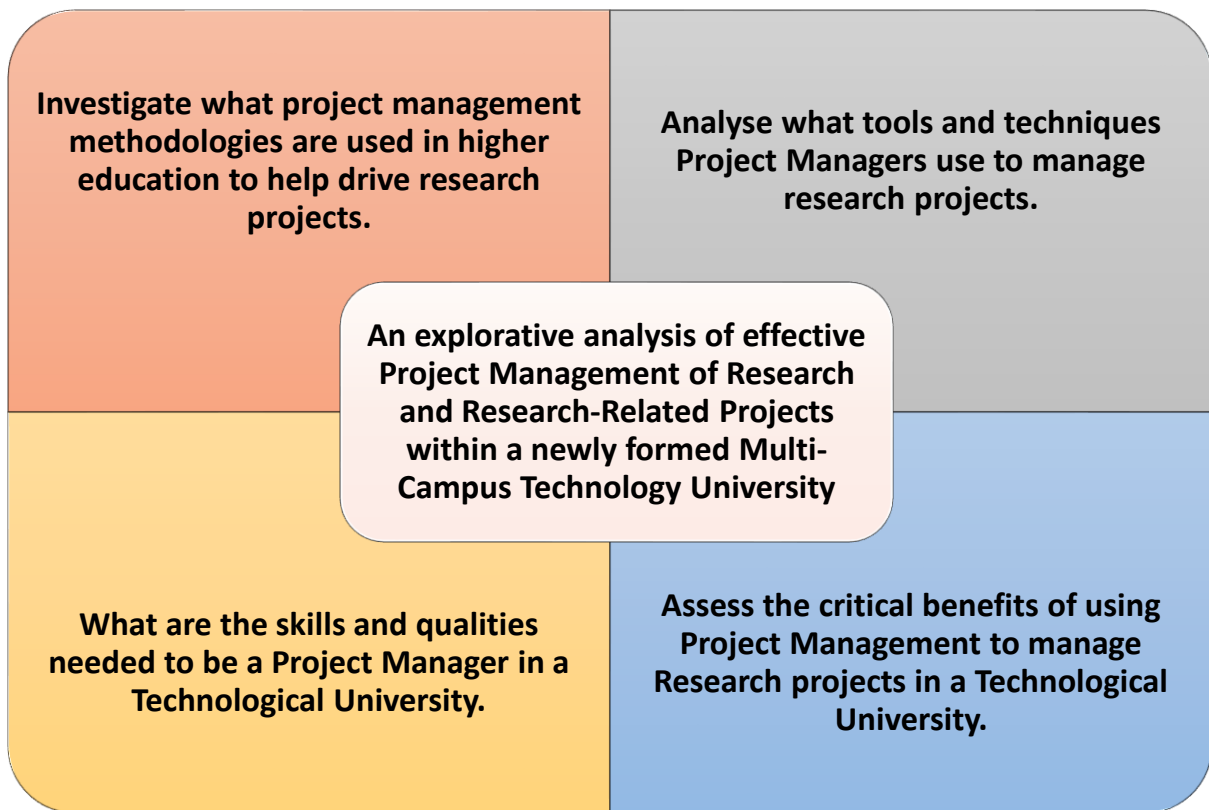
Figure 2 *Research questions*

1.5 Summary

The above chapter outlines what this research entails, gives a brief history of the TUs in Ireland and their mission, and introduces the reader to the research questions and the layout of the Thesis.

Chapter 2. Literature Review

2.1 Introduction

A review of the literature provides a basis for this research project. It permits the researcher to understand trends that have evolved and are pertinent to prior studies regardless of the discipline; the foundation of all academic research efforts is drawing on and connecting to existing knowledge. Therefore, accuracy in doing so ought to be a top priority for all academics. However, the difficulty of this endeavour has risen. The knowledge production rate in the research field is increasing dramatically, yet it is still fragmented and interdisciplinary. This makes it challenging to stay on top of cutting-edge research, to be at the vanguard and to evaluate the body of evidence in each field of study. This makes the literature review a more helpful research technique than ever. A practical and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Snyder, 2019).

2.2 What is Project Management

Project Management (PMT) is a set of activities which enables the successful implementation of a project, where a project may be defined as involving a group of interrelated activities that are planned and then executed in a specific sequence to create a unique output (product or service) within a particular time frame. The process of arranging, planning, and supervising the completion of a specific short-term project with specified goals and deliverables is known as PMT. Guarantee that the project is finished on time, within budget, and to the satisfaction of all stakeholders entails selecting and managing project tasks, resources and schedules and interacting with stakeholders. Adhering to the PMBOK Guide PMI (2013), the phases of PMT are involved: initiation, planning, execution, monitoring and controlling and closing.

- Initiation: Determining the project's need, outlining its aims and objectives, and securing the necessary funds and approvals.
- Planning: Creating a thorough project plan that includes the project's goals, tasks, schedule, and resource needs.
- Execution: Includes implementing the project plan, managing and organising the tasks and resources and monitoring the outcome.
- Monitoring and controlling: Following the project's development, spotting and resolving problems, and making appropriate adjustments to keep it on course.

- Closing: Finishing the project, summarising the findings, and reviewing the task to find any lessons that can be applied to future endeavours.

PMT is becoming a required leadership and management skill in many Industries (Mengel, 2008; Leybourne, 2007). Utilising tools and approaches to manage project risk, quality, and stakeholder communication are further aspects of PMT. PMT approaches, including Waterfall, PRINCE2, PMBOK, and Six Sigma. Agile, Kanban, Lean, Extreme Project Management and Scrum frequently govern the PMT process. However, PMT is sometimes neglected in Education and, according to Chanelle et al. (2013), "is prevalent in many industries but is seemingly overlooked in higher education". In another journal which surveyed 12 universities in the UK, Neary et al. (2011) concluded that a faculty or department within a university could significantly contribute to developing learning and research spaces but felt constrained by the PMT processes. Throughout the review of literature on PMT in research projects or not, the common theme that normalised PMT can hurt research projects, and this is backed up by an extract from Huljenić et al. (2005) states that stringent rules around research projects where a particular result must be achieved is no longer research because you cannot make excessive promises beforehand. These last couple of arguments are further backed up by Dowling & Rodney (2011), that stricter controls around research projects are increasingly imposed on the academic sector by broader concerns for public sector accountability. However, PMT has its benefits. A four-year investigation of a research and development project within a telecommunications company revealed that the appropriate implementation of project management processes and tools assisted the project team in achieving its objectives (Engwall & Westling, 2004).

And again, a quote from Albert Einstein (Stedman & Beckley, 2007). "If we knew what we were doing, it would not be called research, would it?"

2.2.1 The History of Project Management

To give some basis to the discipline of PMT, it is understandable to go back to its origins. According to Seymour & Hussein (2014), throughout history, ingenious architects and engineers have delivered impressive projects such as the Great Pyramid of Giza, The Great Wall of China, the Coliseum, the hanging gardens of Babylon and Stonehenge.

The formalisation of PMT as a discipline is a relatively recent development, but PMT has been an essential component of human endeavours throughout history. In ancient civilisations, the construction of monumental structures and infrastructure required meticulous planning, organisation and coordination. For instance, the ancient Egyptian pyramids required the mobilisation of large

labour forces, the acquisition of resources and materials and the application of sophisticated engineering and design techniques (Seymour & Hussein, 2014).

In ancient Rome, PMT was utilised to construct an extensive network of roads, aqueducts and other infrastructure projects that contributed to the empire's dominance over its rivals. The Roman approach to PMT included using standard design and construction techniques and deploying specialised engineering and construction teams to manage specific projects (Seymour & Hussein, 2014).

Those architects and engineers were serving their primary roles of engineers and architects as well as PMs. For these projects to succeed, these engineers turned into PMs. They had to carefully think about all the project processes, from initiation and planning phases to execution and monitoring to closing the project. For each of these projects, someone had to manage the hundreds to thousands of workers for many years, ensure there was enough supply to sustain the project, make sure the project was on track, and of course, the result had to fulfil the expectations of the commander. This last statement clearly defines that PMT is thousands of years old. Over time, the PMT knowledge base expanded, evolving into modern PMT with several tools, methodologies, and technological aids.

The emergence of large-scale public works projects, such as the construction of cathedrals and palaces, in Europe during the Renaissance led to the development of more sophisticated PMT techniques (Huljenić et al., 2005). These included using Gantt charts, which enabled PMs to monitor progress and manage resources, and the development of software for PMT, which allowed more efficient planning and communication among team members (Seymour & Hussein, 2014).

The Industrial Revolution marked a significant turning point in the history of PMT, as the development of new technologies and manufacturing processes led to the creation of large-scale industrial projects that necessitated the application of sophisticated PMT techniques (Huljenić et al., 2005). In the nineteenth century, the construction of railroads, canals and other transportation infrastructure projects necessitated sophisticated PMT tools and techniques, such as risk management frameworks and project governance structures (Seymour & Hussein, 2014).

The expansion of the aviation industry in the early 20th century led to the development of new PMT techniques that emphasised the administration of complex, high-risk projects. These included using PMT software and other technologies and creating formal PMT methodologies, such as the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT) (Seymour & Hussein, 2014).

After World War II, governments and corporations around the globe looked to manage increasingly complex projects with greater precision and effectiveness. This resulted in the developing of new PMT methodologies, such as the Project Management Body of Knowledge (PMBOK) and the PRINCE2 framework, which offered standardised approaches to PMT applicable to various industries and sectors.

In the latter half of the 20th century, the development of new PMT tools and techniques, such as online PMT software, collaboration platforms and agile methodologies, resulted from the expansion of the technology sector and the rise of the internet. These new approaches to PMT emphasise the significance of adaptability, flexibility, and continuous improvement, and they have been extensively adopted across various industries and sectors.

Today, PMT is integral to every industry, from construction and manufacturing to information technology and healthcare. As a result, new tools and techniques are constantly being developed to aid PMs in managing projects more effectively and efficiently as the discipline continues to evolve and adjust to changing circumstances.

The history of PMT is lengthy and intricate, spanning many centuries and civilisations. PMT has been a crucial component of human endeavours throughout history, from constructing ancient monuments to managing complex technology projects in the contemporary era. Today, PMT is an essential discipline that plays a crucial role in the success of organisations of all types. Its evolution and development continue to influence how to approach complex challenges and achieve our objectives. Although PMT is universal, implementing it can be challenging, and there is no universal PMT, and no one-size approach works for all projects. This is backed up by an article by (Ibbs & Kwak, 2000) "Although there are several different methodologies available, one issue that faces any organisation is the lack of well-defined processes for impartially measuring PM practices in any one organisation."

Al-turf (2019) identified four historical periods: before 1958, 1958–1979, 1980– 1994, and 1995 to the present. He also states that the development in 2011 of the BIM and other PMT Technologies paved the way for a fifth period.

2.2.2 What is a Project

A project is a temporary, one-of-a-kind endeavour with a clear beginning and finish that aims to accomplish objectives and goals. Projects are often carried out by a team of individuals with well-defined roles and duties designed to achieve a specific product, service or result. According to the Project Management Institute, a project is a temporary endeavour to produce a unique product,

service, or development (PMI, 2013). This definition emphasises the transient character of a project and the particular outcome it seeks to achieve. Similarly, Kerzner (2013) states that a project is any series of activities and tasks with a specific objective to be completed within specific specifications; has a defined start and end date; has funding limits; consumes money; employs people and is unique.

As a result of the complexity and sheer number of stakeholders involved in a project, successful PMT is essential. Therefore, methodical planning, implementation, and control are part of PMT to accomplish a project's goals and objectives.

With the advancement of new PMT processes and strategies, the definition of a project has changed over time. In contrast to a temporary endeavour with a clear goal, the Agile methodology, for instance, sees projects as continuing endeavours to deliver value to stakeholders.

2.2.3 The Role of a Project Manager

A PM in an organisation is responsible for planning, executing, and closing initiatives. In addition, PMs are accountable for ensuring that initiatives are completed on time, within budget and to the stakeholders' satisfaction. PMI (2013) states that project managers use their PMT expertise to initiate, execute, and complete projects across various industries. They also say they are skilled in leadership, effective communication, organisation and time management, creative problem-solving, adaptability, motivation and team management (PMI, 2017)**.**

PMs have several essential responsibilities, including:

- PMs must plan and define the project's scope, objectives, and deliverables. Then, they develop a project plan that includes a schedule, budget, and allocation of resources.
- Resource Management: PMs manage personnel, materials, and equipment. They must effectively allocate resources to keep the endeavour on track.
- Risk Management: PMs must identify and manage project-related risks. This entails developing a risk management strategy and proactively mitigating risks.
- Throughout the project lifecycle, PMs must communicate with all stakeholders, team members and management. Everyone must know the project's status, issues, and hazards.
- Monitoring and Control: PMs must monitor project progress and make necessary adjustments to the project plan. They must also ensure that the project's budget is adhered to and that quality standards are met.

A PMs contribution to achieving a project and the organisation is indispensable. They ensure initiatives are completed on time and within budget constraints.

2.2.4 Project Management Methodologies

Methodologies for PMT are a collection of structured and organised approaches used to plan, execute, and complete projects consistently and efficiently. These methodologies provide a framework for PMT, including planning, implementation, monitoring, and evaluation.

Each methodology for PMT has its own set of guiding principles, tools, and techniques. Among the most prevalent PMT methodologies are the following:

Types of Methodologies

There are various widely used PMT approaches, including:

1. Agile: This method is adaptable and iterative, relying on the cooperative effort of self-organising and cross-functional teams to develop requirements and solutions.
2. Scrum is an agile PMT system for software development projects. It stresses collaboration, responsibility, and incremental improvement.
3. Kanban is a visual method for controlling workflow through a process. It aids teams in limiting their available work and concentrating on providing minor, incremental modifications.
4. Scrumban is a mix of Scrum and Kanban and
5. Lean: This approach emphasises maximising value while minimising waste and is based on the tenets of the Toyota Production System.
6. EXtreme Programming: Robustly developing to ensure quality and feels that "extreme project management is a bit of a wild card, and it is not too commonly applied".
7. Waterfall: This method is linear and sequential, requiring each project stage to be finished before moving on to the next.
8. Prince2: A structured PMT approach called PRINCE2 emphasises segmenting a project into manageable and controllable stages. It is primarily employed in the UK and Europe.
9. PMI's PMBOK: Applying the international and universal standards to the traditional waterfall PMT.

9 Popular Project Management Methodologies

1. **Agile** – collaborating to iteratively deliver whatever works
2. **Scrum** – enabling a small, cross-functional, self-managing team to deliver fast
3. **Kanban** – improving speed and quality of delivery by increasing visibility of work in progress and limiting multi-tasking
4. **Scrumban** – limiting work in progress like Kanban, with a daily stand up like Scrum
5. **Lean** – streamlining and eliminating waste to deliver more with less
6. **eXtreme Programming (XP)** – doing development robustly to ensure quality
7. **Waterfall** – planning projects fully, then executing through phases
8. **PRINCE2** – controlled project management that leaves nothing to chance
9. **PMI's PMBOK** – applying universal standards to Waterfall project management

Figure 3 Nine Popular Project Management Methodologies (Ben, 2022)

The most effective technique will rely on the requirements and limitations of the project. Each methodology has strengths and disadvantages of its own.

2.3 Project Management in Research Projects

A survey of the maturity of project management in higher education revealed that project management could address the need for greater efficiency, reduce reliance on public funding and generate revenue through contract research and consulting (Bryde & Leighton, 2009). Research projects differ in many ways from development projects, the most significant being (lack of) precise requirements and (in) the ability to plan an output from the start of the project (Huljenić et al., 2005).

Effective PMT has been acknowledged as a must as businesses rely more on technology to develop and deliver high-quality projects on time and within budget. The application of a PMT approach is one potential choice in research projects. The fundamental concept of PMT is to deliver projects on time and within budget with an agreed scope. Research projects within a TU or any other university can sometimes differ, especially concerning the PM. The PM within a research project may not consistently be qualified but an academic who applied for funding (Brocke & Lippe., 2015). As the literature review concluded, limited literature was available regarding the PMT landscape in research projects in Ireland or internationally.

2.3.1 Types of Project Management Methodologies Used in Universities

Due to a lack of cohesiveness and coordination between the many campuses, multi-campus technical institutions frequently need help with research and innovation and implementing any system. In addition, a fragmented approach to research could result from each campus having its priorities and funding sources. For example, a journal article by Groenwold (2018) stated that they "identified challenges unique to leaders of multi-campus colleges or universities where the mission of each campus is common, and there is a central office or no main campus."

A study completed by Johnson et al. (2007) in 500 Universities in the US stated that 57% of small institutions and 100% of large institutions use some format of PMT. Which PMT is most frequently employed in universities is difficult to determine because it varies based on the country, department, program, or project. However, many colleges may mix various techniques depending on the project's requirements. Based on research completed by May (2011), the top five PMT are "Project Management Body of Knowledge (PMBOK), Projects in Controlled Environments Version 2 (PRINCE2), Association for Project Management Body of Knowledge (APMBOK), International Project Management Association (IPMA) and the British Standards (BSI) BS6079-1:2002". Furthermore, Thomas et al. (2012) stated that positively implementing and embracing PMT in organisations remains a global paradox for researchers and practitioners.

Because Agile and Scrum are suitable for projects that change quickly and require flexible procedures, they are frequently employed in software development, IT, and engineering departments.

The waterfall methodology is also employed in academic projects, particularly building, architecture and civil engineering, when the criteria are clear, and the process is more linear.

Since the PRINCE2 methodology is ideal for large, complicated projects with numerous stakeholders and a significant level of risk, it is primarily employed in UK and European institutions. University

operations that entail much work in progress and involve several teams, such as laboratory work, research projects, and other processes, can be managed using Kanban.

The Lean methodology also helps to optimise value-adding processes and reduce waste, which is why it is primarily employed in management, manufacturing, and service-related projects.

It is essential to remember that every university may have its preferences, and many choose to use a hybrid strategy that mixes various techniques. Finding any literature on PMT used in a university is difficult. This statement is backed up by Johnson et al. (2007). A historical literature review must show whether higher education institutions have responded as enthusiastically as businesses to the call for sound PMT practices. Again Dowling & Rodney (2010) states that given the broad spectrum of projects that can be carried out in academia, a standard approach to PMT would be difficult and ill-advised.

2.3.2 What is a Research Project

A university research project is a methodical, well-organized investigation seeking solutions to a question or issue. Individual researchers or teams may conduct research projects, typically carried out within a more comprehensive academic program or field of study. A university research project aims to expand knowledge, comprehend complex phenomena, and help create new theories, technologies, and applications.

University research initiatives frequently adhere to a clearly defined research methodology, including identifying the study question, performing a literature review, gathering and evaluating data and presenting findings. The institution may support research initiatives domestically or receive external funding from foundations, government agencies or other private or public groups. Huljenić et al. (2005) stated that the most significant differences between research and development projects are (the lack of) defined requirements and (the in) ability to plan from the beginning of the project.

Studies in the natural sciences, social sciences, humanities, engineering, medicine, and technology are a few examples of research initiatives carried out in universities. The results of university research initiatives can affect public opinion and decision-making and aid in creating new technologies, regulations, and practices.

In conclusion, a project is a short-term endeavour to offer a particular good, service, or outcome. A group often undertakes it with clear roles and duties. The methodical planning, implementation, and control of projects are necessary for effective PMT. For example, unlike development projects, where actual customer requirements and output expectations are discussed, research projects typically begin with a discussion or a funding advertisement of an idea (Huljenić et al., 2005).

A journal compiled by Cohen et al. (2013) implies that various project types require distinct planning and management approaches. Therefore, the more you try implementing a PMT or activity-based plan and control types 2, 3 and 4, the greater your chance of failing.
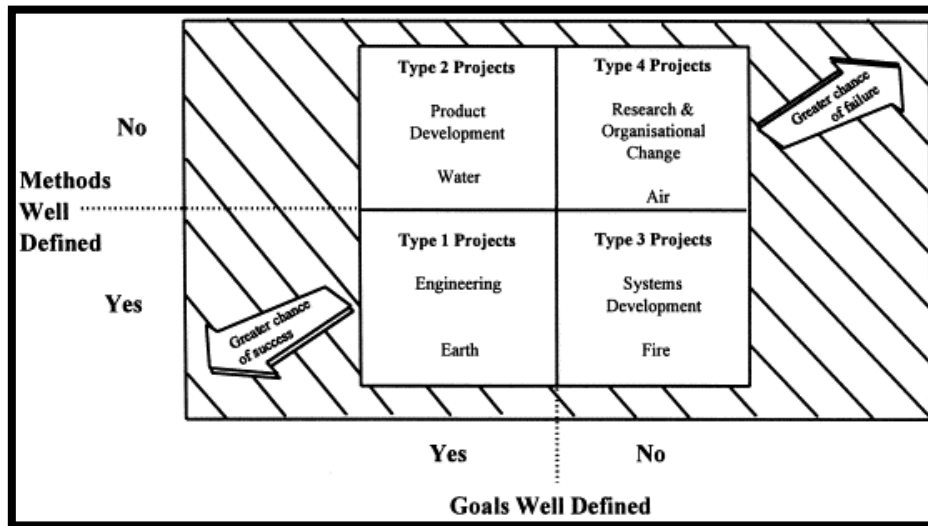
Figure 4 Turner and Cochrane's Goals and Methods Matrix (Cohen et al., 2013)

2.3.3 The Role of a Project Manager in a Technological University

In a university, a PM organises and directs the many elements of a particular project or program. This can involve creating project plans and budgets, gathering resources, managing deadlines, contacting team members and stakeholders, tracking progress, and adjusting as necessary to guarantee successful completion. PMI (2023) states that project managers are organised, goal-oriented professionals who design successful initiatives through passion, creativity, and collaboration. Assuring that the work of other team members, such as researchers or support personnel, aligns with the project's overall aims and objectives may fall under the project manager's purview. They might also be in charge of updating management at the university or outside funding organisations on the project's status. A journal completed by Cohen et al. (2013) states that one of the most critical decisions for the success of a project is the selection of a project manager whose personality profile suits the project they will be leading. Also stated in the same journal by Cohen et al. (2013) and shown below in Figures 5 & 6, there are more female project managers in the education and finance sectors but fewer in the construction and software industries.
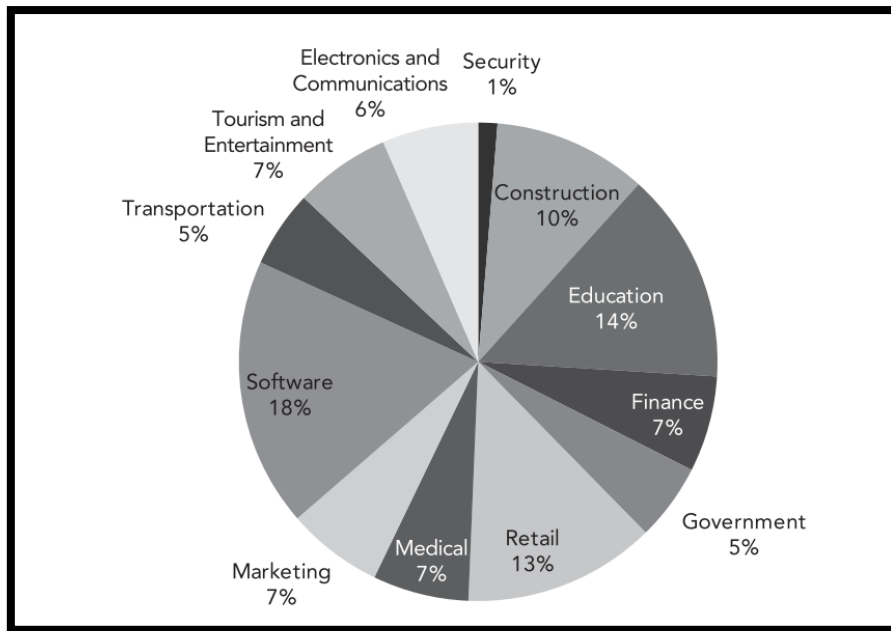
Figure 5 *Distribution of the female project manager industry sector (Cohen, 2013)*
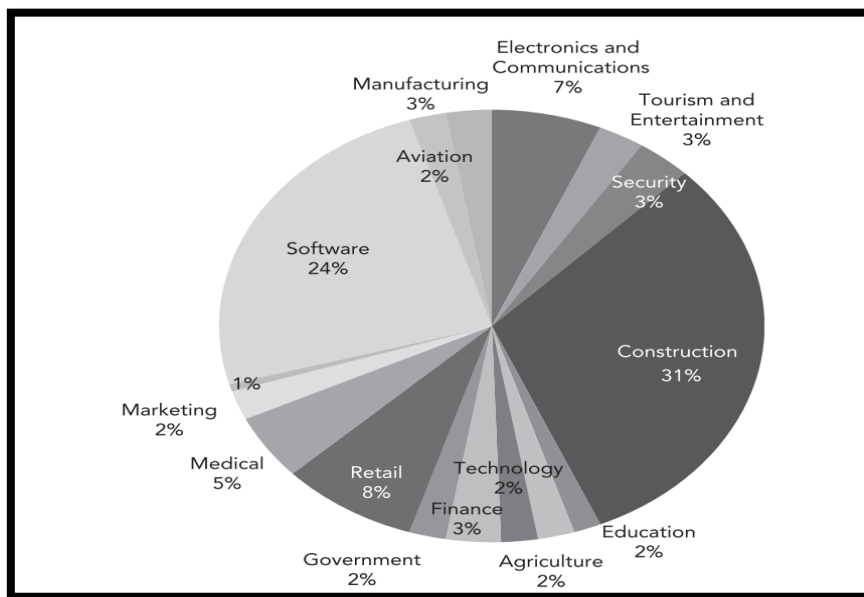
Figure 6 *Distribution of the male project manager by industry sector (Cohen, 2013)*

Types of PMs within a TU

Various types of PMs may be involved in managing projects inside a university, including:

- Academic PMs are often researchers or faculty members overseeing research initiatives within their department or school. They could also oversee the work of research assistants and graduate students.

- Centralised PMs: They work in centralised project management offices (PMOs) and are often in charge of overseeing cross-functional initiatives involving several departments or faculties. They could also be in the order of assisting and educating academic PMs in PMT.

- IT PMs: Can oversee technology-related projects such as software development, network infrastructure, and data management. They are often a component of the university's IT department.

- Infrastructure PMs: Oversee construction and renovation projects and maintenance and repair work on campus infrastructure and buildings. Typically, these PMs are members of the university's facilities management department.

- Administrative PMs: Projects about student services, human resources, and other administrative duties are managed by executive PMs, who are ordinary members of the administrative staff of the university.

- Consultant PMs: PMs hired as consultants typically work outside the university and oversee initiatives. The institution could hire them to supervise unique or specific projects or offer PMT consultancy services.

It is essential to remember that a PMs job and duties may change based on the situation and the type of project. The most crucial feature is that PMs can manage projects successfully and collaborate with other project team members and key stakeholders.

2.3.4 Current State of Project Management in a Technological University in Ireland

The current state of PMT in Irish TUs is centred on developing and implementing effective PMT practices to support achieving strategic goals. In recent years, TUs have become more cognizant of the significance of PMT in attaining their objectives and delivering successful projects. According to a report by the HEA, engagement must be an institution-wide initiative, not limited to specific academics or initiatives. It must encompass teaching, research, students, faculty, and the entire spectrum of support services. All universities must develop engagement strategies, manage themselves accordingly, and collaborate with external partners to measure their success (Department of Education and Skills, 2011).

A shift has occurred towards employing formal PMTs, such as Prince2, Agile, and Scrum, Waterfall, PMBOK, to manage projects in a structured and efficient manner. This has led to a greater emphasis on communication, risk management, and project governance in TUs and increased collaboration between departments and stakeholders.

In addition, TUs in Ireland have acknowledged the need for staff and students to develop PMT skills. Numerous universities now provide training and certification in PMT, and some have established specialised PMT offices to support the delivery of large-scale projects (UCD, 2023).

However, TUs in Ireland still need help with the project management of research projects. One of the most significant obstacles is balancing project management methodologies with the need for flexibility and adaptability in a swiftly changing environment. Additionally, it is necessary to ensure that PMT practices are aligned with the university's strategic objectives and that projects are prioritised based on their strategic significance.

Government guidelines and frameworks, including the Public Spending Code and the PMT Guidelines for the Public Sector, have been devised to guide PMT best practices (OGP, 2011). Technological universities in Ireland are expected to adhere to these guidelines and frameworks when managing publicly funded initiatives.

Overall, the current state of PMT in TUs in Ireland focuses on developing and implementing effective PMT practices to facilitate achieving strategic goals (PMI, 2017).   While universities continue to face obstacles in this area, there is a growing recognition of the significance of PMT and a commitment to enhancing PMT procedures.

Figure 7 shows the support structures at a traditional university (University College Dublin) to assist in projects. From the pre-award stage right through to post-award and then project completion. The whole research project ecosystem helps the PM through the project life cycle. Compared to traditional universities, the newly formed TUs have ground to catch up in managing research projects. Although, as stated by the Department of Education & Skills (2011), TU's need to attract the finest researchers and develop world-class capability in high-value niche areas and TUs must conduct high-quality research and achieve critical mass in our research capacity.
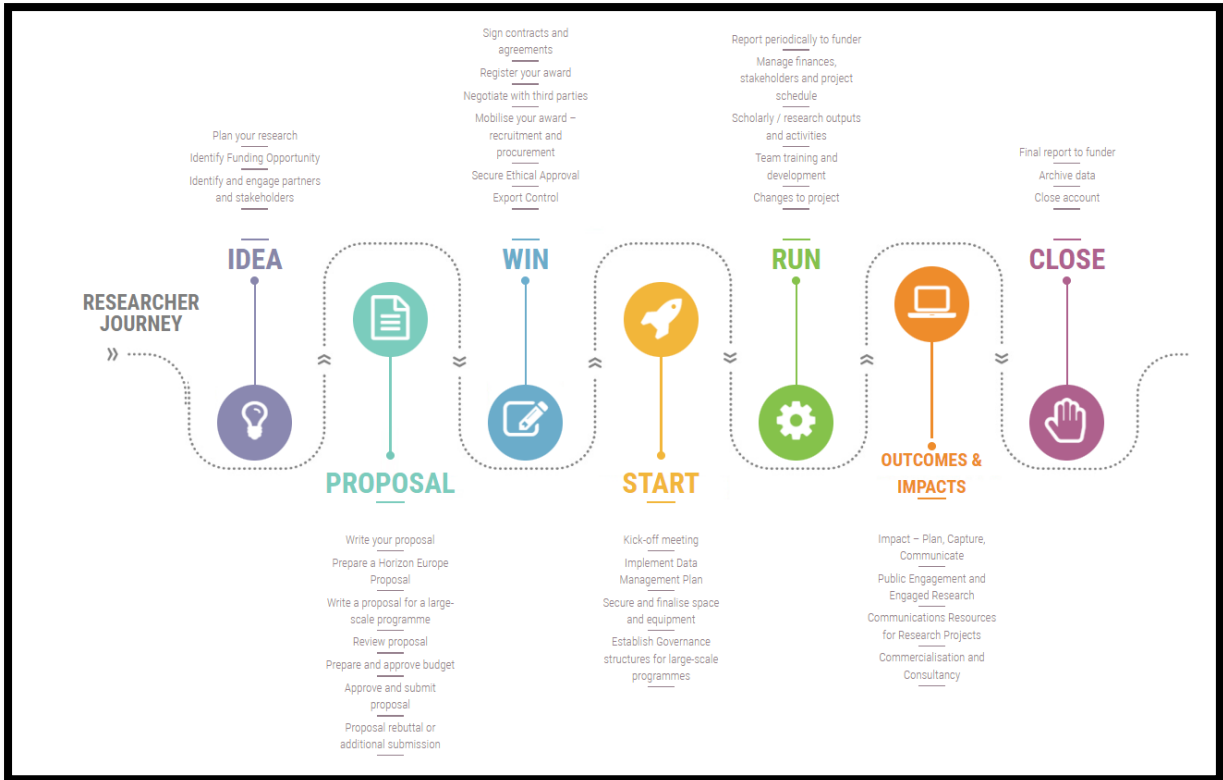
Figure 7 *UCD Project Journey (UCD, 2023)*

2.4 Skills, Qualities, Tools, and Techniques to Assist a Project Manager

PMT is an essential skill set for success in any field. However, critical to the context of TUs, where projects may entail cutting-edge research, the creation of new technologies, and the collaboration of interdisciplinary teams. Therefore, a PM must possess various skills, qualities, tools and techniques that enable them to plan, organise and supervise the successful completion of complex projects to manage them.

A strong understanding of PMT principles and methodologies, technical knowledge and expertise in the relevant areas required for effective PMT. Moreover, PMs must be strong communicators, negotiators, and problem-solvers, able to collaborate effectively with team members, stakeholders and external partners.

Successful PMT in a TU environment also requires leadership, adaptability, and resiliency. A project manager must inspire and motivate their team, adjust to changing project requirements, and overcome obstacles and difficulties to succeed (Muller & Turner, 2007; Alam et al., 2008; Crawford, 2005).

Various tools and techniques, including PMT software, collaboration tools, and risk management frameworks, are available to aid PMs in their work. These tools and techniques allow project administrators to effectively manage project schedules, budgets, and resources and identify and mitigate project risks.

Effective PMT is necessary for success in a TU environment. PMs with the required skills, qualities, tools, and techniques are well-positioned to deliver successful outcomes for their projects and organisations.

2.4.1 Skills and Qualities Associated with a Project Manager

Numerous studies have demonstrated a correlation between the competencies of the PM and the achievement of project success, highlighting the significance of acquiring PMT skills (Muller & Turner, 2007; Alam et al., 2008; Crawford, 2005). To successfully lead and manage projects from beginning to end, a PM in a TU needs a broad range of abilities. For example, the PMI (2013) lists eight interpersonal skills necessary for PMs: leadership, team building, motivation, communication, influencing, decision-making, political and cultural awareness, and negotiation as some of the top skills to have a PM. Again Paladugu (2019) stated in a research paper that inadequate soft skills are an essential factor in the failure of research projects. Furthermore, Lipsanen (2017) noted that effective project managers have strong leadership skills, the ability to develop people, excellent communication skills, practical interpersonal skills, the capacity to deal with stress, outstanding problem-solving abilities, and brilliant time management skills. A more definitive list is below:

- Strong leadership abilities: To successfully lead and inspire a team to complete a project, a PM needs to possess strong leadership abilities. This entails expressing project goals effectively, assigning responsibilities, and offering direction and help as required.
- Superior communication abilities: A PM must communicate clearly with all parties involved, including the team, clients, and top management. This includes the capacity to effectively communicate technical ideas to non-technical stakeholders and bargain with customers and other outside parties.
- Strong technical understanding: A PM in a TU must have a solid grasp of the projects' technical components. This involves being knowledgeable about current technology and industry best practices and being able to debug and resolve any potential technical issues.
- Strong organisational abilities are necessary for a project manager to efficiently plan, arrange, and oversee every part of a project. Guarantee that projects stay on schedule and within

budget; this involves developing detailed project schedules, managing resources, and tracking the development.

- A PM needs to be able to think critically and creatively to tackle any challenges that may come up. This entails being able to recognise and reduce risks as well as quickly adjust to shifting project specifications or unforeseen roadblocks.

- Strong attention to detail: To ensure that every step of a project is carried out correctly and that all deliverables satisfy the necessary standards for quality, a PM must pay special attention to every detail.

- Possessing excellent interpersonal relationships with team members, clients, and other stakeholders is essential for a PM. This entails resolving disputes amicably and communicating clearly with all parties involved in the project.

- Strong decision-making abilities: A PM must make decisions quickly and wisely, even under time constraints. This includes having the capacity to analyse the advantages and disadvantages of many solutions and decide what is best for the project and the business.

- Flexibility: A PM must be adaptable and flexible in a changing workplace. Changing course and adjusting as necessary is crucial because projects rarely go as planned.

- Technology-related passion: A PM in a TU should be interested in the field. Thanks to this, they will be better able to perform their job and stay current on the most recent developments.

A PM in a TU needs to have a solid awareness of PMT approaches and processes, such as Agile, Waterfall, or Scrum, in addition to these technical talents and traits. This entails working knowledge of PMT software and tools, such as JIRA or Trello and Microsoft Project, and the ability to use them efficiently to organise project tasks and track progress.

In conclusion, a PM in a TU needs many abilities and traits to lead and oversee projects successfully. Strong leadership, communication, technical, organisational, and problem-solving skills are among them, as is good attention to detail and interpersonal and decision-making abilities. They should also be adaptable and passionate about technology and the field.

2.4.2 Tools and Techniques Project Managers Use to Manage Research Projects

The PMI (2013) defines PMT as 'applying knowledge, skills, tools, and techniques to project requirements'. This previous statement confirms that tools and techniques are a large part of the profession of PMT. PMs in a TU in Ireland employ various tools and strategies to manage research

projects efficiently. Much of the literature on tools and techniques in PMT focus on large multinational organisations outside higher education. A research journal completed by Murphy & Ledwith (2017) on tools and techniques in SMEs determined to what extent various PMT tools and approaches were used. These outcomes are displayed in Figure 8. They demonstrate that few SMEs employ the more sophisticated PMT methods, such as Earned Value or Critical Path Method, even though many businesses use project teams and plan projects. The information also poses the question of how SMEs use Microsoft Project if they are not doing so to carry out the various PMT methods shown in Figure 8.
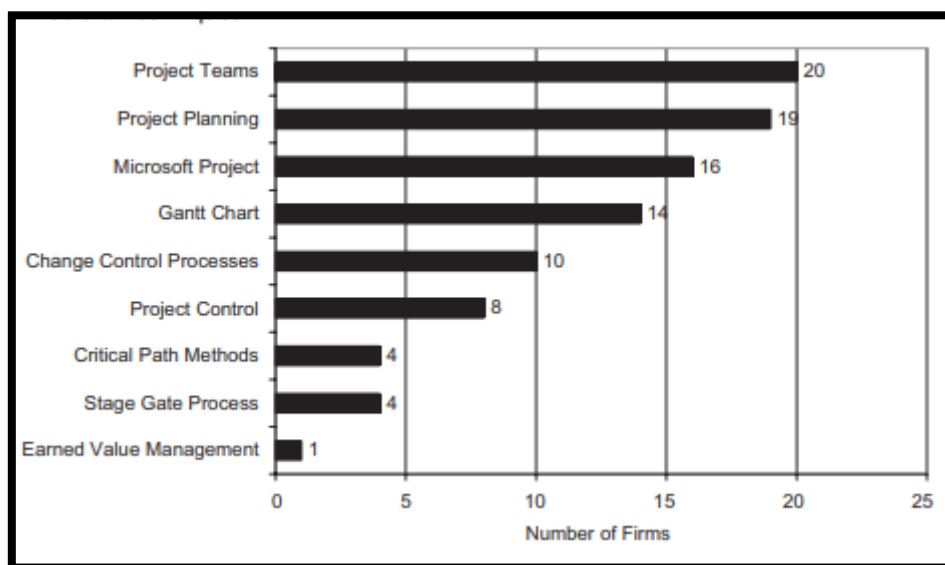
Figure 8 Tools & Techniques (Murphy, 2007)

These consist of the following:

- Software for PMT: To plan projects, assign tasks, and keep track of their progress, PMs utilise programs like Microsoft Project, JIRA, Asana, and Trello. These tools make it simple for team members to collaborate, communicate, and keep track of project deadlines and milestones.
- Tools for managing project money and budgets include MS Excel. PMs use these tools. This includes creating financial reports and keeping tabs on project spending and revenue.
- PMs assess possible hazards and create methods to mitigate them using tools like risk matrixes and SWOT analyses.

- Gantt charts: PMs utilise Gantt charts to visualise project schedules and timeframes. This makes it easier to spot any delays and make the necessary adjustments to keep the project on schedule.

- PMs organise and conduct meetings with team members and stakeholders using solutions like Zoom, GoToMeeting, or Skype for Business.

- PMs connect with team members and stakeholders using applications like Slack, Microsoft Teams, or Google Meet. This makes it possible to guarantee that every team member is informed of the status of the project and any potential problems.

- PMs can manage research projects using agile approaches like Scrum, Kanban and Lean. These iterative approaches emphasise producing tiny, incremental deliverables that can be tested and improved as the project progresses.

- Tools for data analysis: To analyse data and assemble insights, PMs utilise programs like R, Python, MATLAB, or SPSS. This supports decision-making and contributes to project direction.

- Tools for quality assurance: To make sure that project outputs adhere to the necessary quality standards, PMs use tools like Six Sigma, ISO 9001, or CMMI.

- Collaboration tools: PMs utilise collaboration technologies like Google Docs, OneDrive, or SharePoint to exchange and work together on project materials.

In conclusion, PMs in an Irish Technological University employ various tools and strategies to oversee research projects efficiently. These include software for PMT, tools for managing finances and budgets, tools for managing risks, Gantt charts, meetings tools, means for communicating, Agile techniques, tools for data analysis, QA tools, and tools for teamwork. As a result, PMs may efficiently plan, coordinate, and manage research projects to ensure they are finished on time, within budget and to the required quality standards by combining these tools and procedures.

2.5 The critical benefits of Using Project Management in a Technological University

Many organisations are changing their business and moving away from traditional approaches to management and moving to PMT to run their operations. As described by Ibbs & Kwak (2000), some of the benefits of this management style have led many organisations to protect their operations. As stated by Cicmil (1997), organisations are increasingly seeking ways of effective creation development and market growth – management by projects provides a disciplined approach to gaining competitive advantage by getting the right product, in time, to market. PMT is a methodical way of planning and carrying out projects. A PMT approach can have several significant advantages in a research project at

a TU. PMT can be measured in results based on cost, time, quality and other metrics; however, in academia and research projects, this can be determined by another measurement and backed up by a journal by Gomes & Romao (2016) states that what decides if a project is a success is based on whether it meets or fails the criteria for time, cost and quality is outdated.

- A PMT technique offers a framework for efficient planning, organisation, and execution of research projects, increasing the likelihood of project success.
- Increased Productivity: A PMT technique can boost efficiency and productivity by standardising processes and procedures, reducing the time and resources needed to accomplish projects.
- Better Communication: A PMT technique helps research team members and stakeholders communicate clearly and consistently, which lowers misconceptions and boosts collaboration.
- Better Resource Allocation: A PMT technique can help guarantee that resources are distributed effectively and efficiently, resulting in better utilisation of resources and cost savings. This is done by offering a disciplined approach to project planning.
- Better Risk Management: A PMM offers a systematic strategy for identifying and managing risks, reducing their impact and raising the likelihood that the project will succeed.
- Enhanced Stakeholder Involvement: A PMM can contribute to developing trust and raising stakeholder satisfaction by offering defined processes and procedures for stakeholder engagement.
- A PMT technique encourages cooperation and teamwork among research team members, improving collaboration and integration, and coordinating project activities.
- Better Data Management: A PMM offers a methodical approach to data management, ensuring that crucial data is recorded, arranged, and saved in a consistent and accessible way.
- Better Research Quality: A PMM ensures that research is conducted rigorously and methodically, enhancing research quality and validity. This is done by offering a structured approach to research PMT.

One fundamental discovery from empirical research into the PMT practices of academic researchers in Ireland was that PMT increased the quantity and quality of research (Dowling & Rodney, 2010). In addition, there is evidence of tangible benefit enhancements. Areas include cost savings, increased returns, improved efficiency, intangible benefits such as organisational development, better use of human resource assets and management enhancements (Lappé & Spang, 2014). Lappé & Spang's (2014) research demonstrates a direct correlation between investments in PM and organisational

benefits. Mainly investments are made in dedicated resources PMO, PMT Teams, PMT Training, and Processes). Figure 9 illustrates the relationship between costs, associated benefits, and effects on return on investment. One could state that to align our organisation strategically by using PMT as a product for improvement. Pollack & Adler (2018) stated that a fundamental assumption of project management practice and research is that using PM to achieve organisational objectives improves organisational performance. This is another point demonstrating the use of PMT to benefit an organisation.
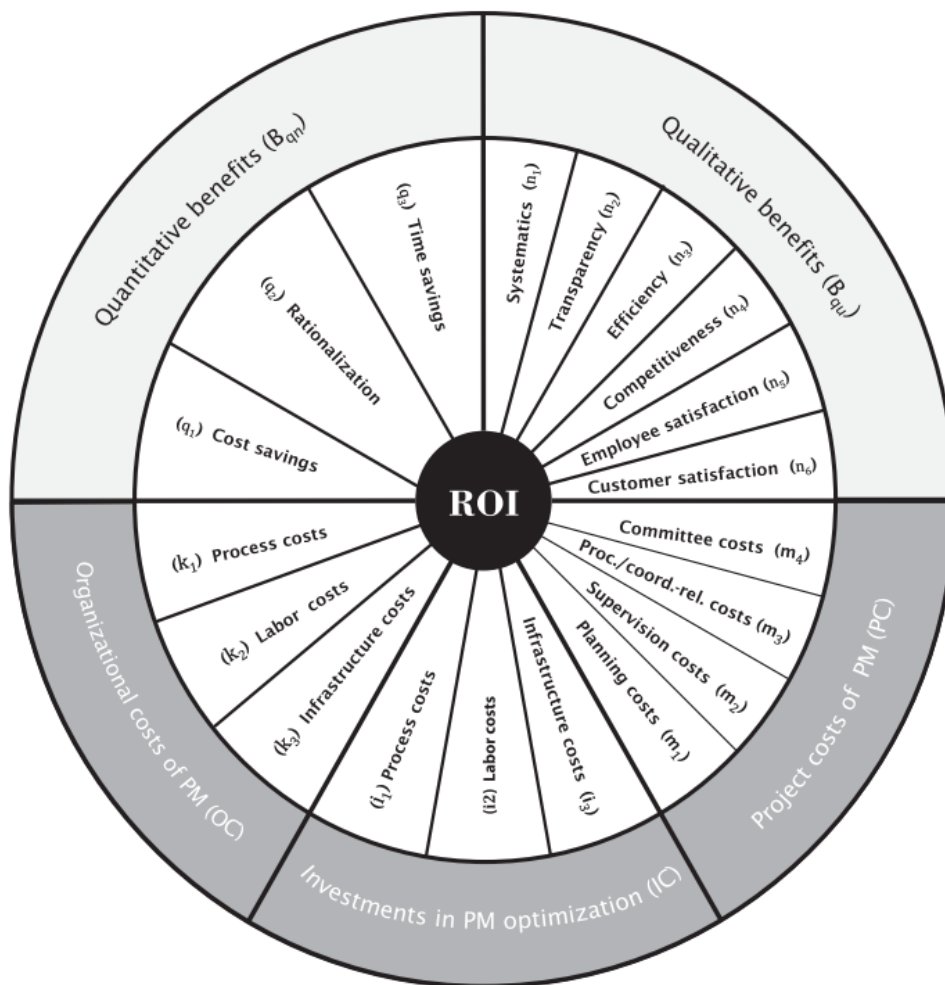
Figure 9 Components of return on investment on PMT (Lappé & Spang, 2014)

In summary, applying PMT techniques to a research project at a TU can have a variety of positive effects, such as better planning and organisation, increased productivity, improved communication, better resource allocation, improved risk management, increased stakeholder engagement, improved collaboration, better data management and enhanced research quality. In addition, TUs can increase the likelihood of their research projects succeeding and improve the quality of the research findings

by implementing a PMM to ensure that their research projects are planned, carried out, and managed consistently and efficiently.

2.6 Summary

Reviews of the available literature serve as an essential starting point for all research studies. Literature reviews provide evidence of an effect, set standards for policy and practice, serve as a foundation for knowledge development, and, if done correctly, have the potential to spark new ideas and directions for a particular field. They thereby provide the foundation for further investigation and theory. This literature review offers some straightforward suggestions on how to do better, more thorough literature reviews and, ultimately, better research because conducting and evaluating a literature review may be difficult. For example, it will be far simpler to detect fundamental research gaps rather than just running the same research repeatedly, to establish better and more accurate hypotheses and research questions, and, as a result, to raise the overall quality of research as a community.

The researcher has a vested interest in this area as they have worked in different roles in the Research department of a TU as a PM and project coordinator and hopes that this research can improve the overall PMT of the TU. Following the previous point, Chanelle et al. (2013) state that stakeholders in Higher Education Industry (HEI) have a vested interest in improving processes, procedures, and workflows within the HEI space to build further their research capacity. Furthermore, the types of PMT work for academics and management, whether a formalised PMM like Agile or PMBOK or a hybrid version developed internally by stakeholders to help manage research projects. This is further supported by Hanney (2021), who stated that the primary objective of these approaches was to provide a regularising framework for the management of task-oriented activities within a focused command and control hierarchy to deliver the organisational benefit.

Little or no research could be found in Ireland around PMT in HEI. This statement is backed up by Dowling & Rodney (2010), "Limited research has been conducted in the area of academic research PMT." This view is further supported by Johnson & Wierschem (2007), who stated that since the mid-1990s, extensive general research had been conducted on all aspects of PMT in both the United States of America and internationally, without mentioning the higher education industry.

2.6.1 Gaps in Literature

Based on the literature review conducted as part of this research, the following gaps were evident:

- No apparent use of a particular type of PMT methodology used in research projects in universities in Ireland or internationally.

- Little or no formal training in PMT for PM. Usually, an academic applies for funding and manages the project.

- The formalised PMT hampers flexibility, creativity, and learning capacity, limits interpersonal connections and negatively affects research projects. The balance between the governance of projects and flexibility for researchers hurts using PMT.

- The lack of qualities and skills needed to be a PM is evident in the private industry, but no research in the higher education sector has been completed.

- A PMO or RSO is a requirement if projects are going to fail or succeed. No support for Principal Investigators, PMs, Managers, or researchers who work in research.

- Lots of benefits of using PMT for other organisations but no real literature to support benefits in higher education.

Below are some key findings from the literature review presented in Table 3. The critical conclusions of the literature review directly relate to the research questions. Some of the above findings are directly related to this research question. Therefore, the survey as part of this research will focus on these areas to determine the above outcomes.

Table 3 *Themes from my Review of the Literature*

Authors	Origin	Purpose	Type of Source	Major Themes from Literature
Dowling & Rodney, (2010)	Ireland	Application of PMT in the academic sector	Conference Paper	PMT can increase the quantity and quality of research projects.
Lappé & Spang, (2014)	Germany	Investments in PMT are profitable	Journal	Using PMT in research projects can significantly benefit the organisation as a whole.
OGP, (2011).	Ireland	Governance over public funding	Report	Public funding needs to be managed appropriately, and using PMT can improve project governance.
Johnson et al. (2007)	USA	PMT Practices in the Institutions of Higher Education	Journal	Types of PMT used in research projects vary on the size and nature of the project.
Dowling & Rodney, (2010)	Ireland	Application of PMT in the academic sector	Conference Paper	The broad spectrum of research projects in a university varies, making implementing one type of PMT difficult.
Murphy & Ledwith, (2007)	Ireland	PMT tools and techniques	Journal	What tools SME's are used in PMT to deliver research projects successfully
PMI, (2013).	USA	Overview of PMT and PMs in the PMBOK	Book	Analyses the tools and qualities that a PM needs in projects
Lipsanen, (2007).	Germany	Skills and qualities associated with PMs	Thesis	PMs need to have skills and qualities that successfully deliver research projects.
PMI, (2013).	USA	Overview of PMT and PMs in the PMBOK	Book	Analyses the soft skills and qualities a PM needs to deliver projects

Chapter 3. Research Methodology

3.1 Introduction to Research Methodology

This research aims to explore PMT in research and research-related projects within a Technological University in Ireland. According to Kothari (2004), a research methodology is a systematic approach to solving the research problem. It may be understood as the study of how scientific investigation is conducted. The methodical and scientific approach to conducting research is called research methodology. It entails identifying the research problem, developing potential research questions or hypotheses, gathering and analysing data, and then summarising and presenting the results. A research technique describes the steps researchers take to collect and evaluate data to find answers to research questions or test hypotheses.

There are various research methodologies, such as mixed-methods, qualitative, and quantitative research. To comprehend and explain events, quantitative research uses numerical data and statistical analysis. It aims to measure variables and test theories and frequently requires extensive experiments or surveys. In contrast, qualitative research seeks to comprehend and explain phenomena by analysing non-numerical data, such as words, images, and observations. This frequently uses participant observation, focus groups and in-depth interviews. Finally, mixed methods research aims to comprehend a phenomenon better or study a subject by combining quantitative and qualitative methodologies.

The type of research problem, the required data, the accessible resources, the research questions or hypotheses, and the nature of the research problem all influence the methodology used. Researchers should use the most appropriate research approach to answer their research questions and produce reliable and valid data. The subject matter, the purpose of the research, the abilities and experience of the researcher, the availability of resources, the time constraints, and the target audience must be considered when selecting a methodology.

3.1.1 Research Philosophies

Ontology, epistemology, and axiology are significant philosophical concepts in research. Muller & Turner (2007) refer to ontology as hypotheses regarding the essence of reality. Ontology is the study of the substance of existence or reality. It concerns what exists, what can be known, and its categorisation. In content inquiry, ontology investigates the essence of the studied phenomena,

including whether they are objective, subjective, or provable assumptions that underpin the research design, methods, and analysis and can influence the categories of questions researchers pose.

In the same book, Saunders et al. (2019) refer to knowledge assumptions, acceptable, valid, and legitimate knowledge and how to communicate knowledge to others. In contrast to ontology, epistemology focuses on the nature of knowledge and how it can be acquired. It investigates the origins, processes, and standards of knowledge and the relationship between the knower and the known. In the research context, epistemology examines how knowledge is generated, what constitutes evidence, and the criteria for determining whether a claim is true or false. Epistemological assumptions may influence the selection of research techniques and the interpretation of data.

Saunders et al. (2019) state that "*refers to the role of values and ethics*".   Axiology studies value and how it influences human conduct and decision-making. It examines what is desirable, valuable, and worthwhile to pursue and how individuals and societies make decisions based on these values. Axiology is the study of the importance of research, the values and interests that influence research questions and priorities, and the ethical considerations that must consider Axiological. Assumptions can impact the selection of research topics, the interpretation of results, and the conduct of research in an ethical manner.

Ontology, epistemology, and axiology are critical philosophical concepts in research because they influence the researcher's perspective and approach to the research question, methodology, and interpretation of results. By grasping these concepts, researchers can make informed decisions regarding their research design, methods, and interpretation of data, as well as ensure that their work is based on sound philosophical principles.

3.1.2 Research Onion

Saunders introduced the research onion as a metaphorical model of research methodology in their book "Research Methods for Business Students." The research onion model is a layered, systematic approach to conducting research, with each component contributing to the overall research design (Saunders et al., 2019).

- First layer – Philosophy - This is the initial layer of the onion and consists of the researcher's foundational beliefs regarding the nature of knowledge and how it is acquired. The research philosophy directs the selection of research techniques and methods.
- Second Layer – approach to theory Development - This stratum entails the selection of either a deductive or an inductive general research strategy. Inductive research begins with

observations and then constructs a theory, whereas deductive research begins with an idea and then tests it.

- Third layer – Methodological choice - This layer entails selecting the appropriate research methodology for conducting a study. It includes mono/multi qualitative research, mono/multi quantitative research and mixed-methods simple and complex research.

- Fourth layer – Strategy - An overall research strategy can be experimental, survey-based, case study-based, action research-based, action-based, grounded, narrative or ethnographic.

- Fifth layer – Time horizon - This layer determines the research's time frame, which can be cross-sectional (data collected at a specific time) or longitudinal (data collected over time).

- Sixth layer – Data collection and analysis - This layer entails selecting a sample from the population under study and making judgments regarding sample size, sampling technique and representativeness.
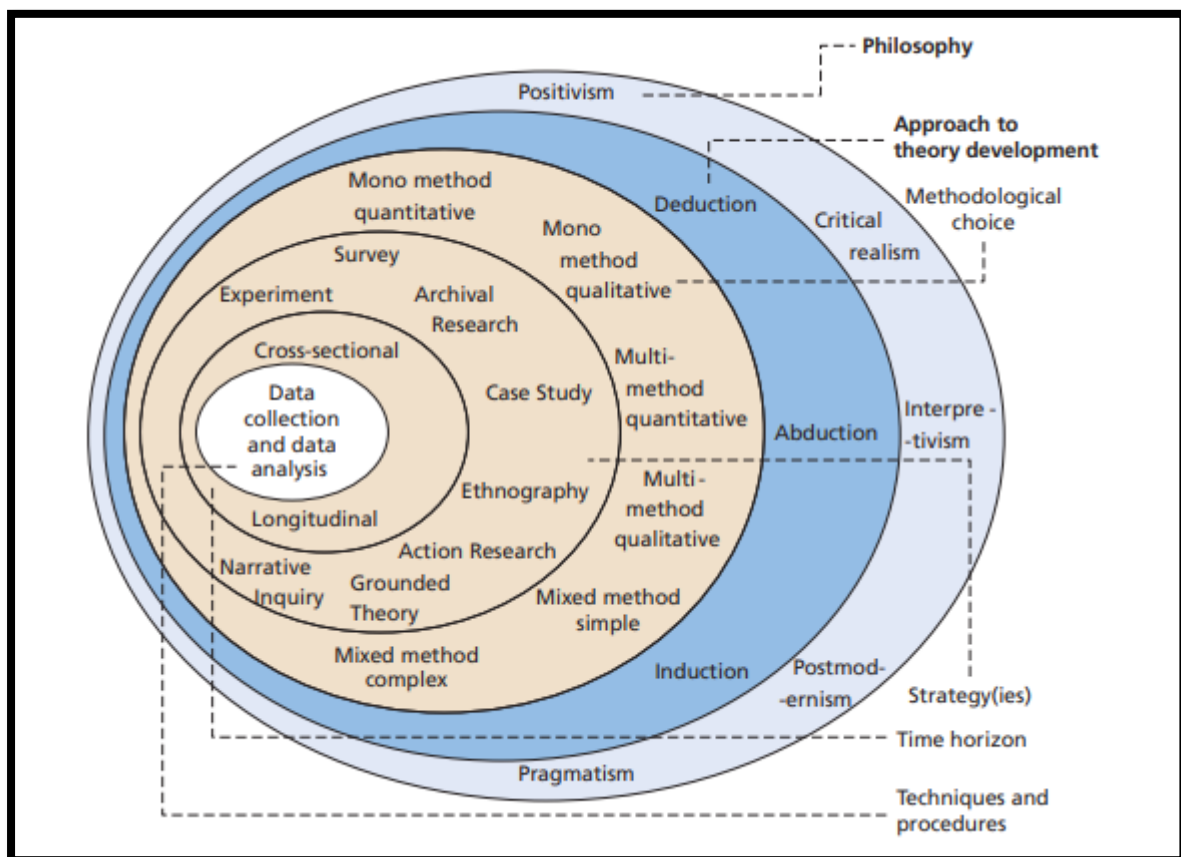
Figure 10 The 'Research Onion (Saunders et al., 2019)

3.1.3 Research Process

It seems appropriate to provide a concise overview of the research process before delving into the specifics of research methodology and techniques. The research process comprises a series of actions or steps to conduct research effectively and in the desired order. Figure 11 is an excellent illustration of the research procedure (Kothari, 2004). As depicted by I to VII, the research process comprises a series of interdependent steps. Rather than adhering to a predetermined order, these activities overlap continuously. Occasionally, the first action determines the nature of the final step. If subsequent procedures are not accounted for in the early stages, significant complications may arise that may prevent the study's completion. It must be remembered that the numerous stages of the research process are not mutually exclusive or distinct. They do not necessarily follow one another in any particular order, and the researcher must continuously anticipate the requirements of the subsequent steps at each stage of the research process.
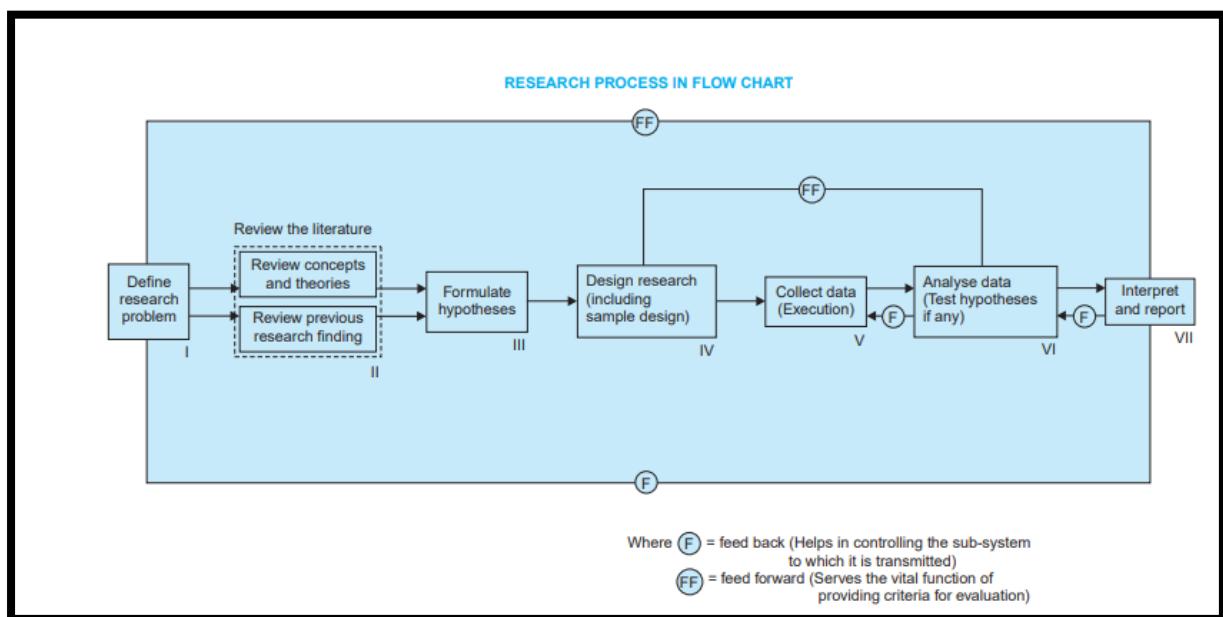
Figure 11 Research Process Flowchart (Kothari, 2004)

3.2 Data Collection

Primary data collection refers to collecting new information directly from the source or the target population for a specific research endeavour. Surveys, interviews, focus groups, observations, experiments and case studies are all examples of primary data collection techniques. Primary data are collected for the first time and are original, exclusive, and relevant to the research query.

Secondary data collection, however, involves utilising data already collected for a different purpose by someone else. Various sources, such as government publications, research reports, academic journals, and online databases, can provide secondary data. For example, secondary data can be utilised to provide context for the research query and conduct a literature review.

3.2.1 Primary Data Collection

Boeije (2015) states that primary data are gathered for the research problem using appropriate procedures. Instead of relying on extant data sources such as literature reviews or secondary data sets, collecting primary data entails collecting original data directly from the start. Various techniques, such as surveys, interviews, focus groups, observations, and experiments, can utilise primary data. The direct benefit of collecting primary data is that it gives researchers more control over the data collection process, allowing them to tailor their methodologies to their specific research questions and objectives. Moreover, primary data collection frequently yields more specific and detailed information than secondary data sources. However, collecting primary data can be more time-consuming and costly than utilising existing sources and may require specialised knowledge or apparatus to collect and analyse the data effectively.

3.2.2 Secondary Data Collection

Secondary data are information gathered for a purpose other than the researchers. It was compiled from various scholarly journals, books, articles, research papers, and other publications. Boeije (2015) believes that secondary data is data collected by researchers for other purposes in the past. When secondary data is utilised, the source is cited. Using secondary data has the benefits of accessibility and availability but the drawback of a lack of control. Therefore, it is essential to consider both the collection method and the research objective when designing templates for secondary data. This study contextualises and supplements the primary data with secondary data.

Typically, a mixed-methods research design is characterised by collecting primary data through a survey and secondary data through a literature review for a thesis. It uses quantitative (survey) and qualitative (literature review) data to answer research questions. The primary data collected through the survey will provide numerical data that can be analysed statistically. In contrast, the secondary data collected through the literature review will provide a qualitative analysis of existing research and theoretical frameworks related to the research topic. Combining these methods can provide a more thorough comprehension of the research topic, allowing for a more in-depth investigation of the research questions and objectives.

3.3 Research Questions and Outcomes

Research Question 1:

Assess the critical benefits of using PMT to manage Research projects in a Technological University

Research Outcome 1:

This research question examines the advantages of employing PMT to manage research projects at a Technological University. Defining what "critical benefits" means and studying successful PMT applications in this context would be essential.

Research Question 2:

Investigate what PMT methodologies are used in higher education to help drive research projects.

Research Outcome 2:

This research question seeks to identify the various PMT methodologies used to drive research initiatives in higher education. This could include traditional methods such as Waterfall or Agile, as well as methodologies tailored to the specific requirements of research initiatives.

Research Question 3:

Analyse what tools and techniques PMs use to manage research projects.

Research Outcome 3:

This research question concentrates on PMs ' specific tools and methods to oversee research projects. For example, it could involve examining case studies or conducting interviews with project administrators to identify effective strategies for managing research projects.

Research Question 4:

What are the skills and qualities needed to be a Project Manager in a TU

Research Outcome 4:

This research query investigates the abilities and characteristics required for a project manager to be successful in a technological university. This could include general PMT skills and specialised research

PMT skills. To comprehensively comprehend the requirements for this role, it would be essential to solicit input from various stakeholders (e.g., PMs, university administrators, and researchers).

3.4 Piloting and Testing

Following ethical approval in January and February of 2023, pilot studies were conducted to pre-test the survey questions.

Two questions posed a challenge for all respondents, and one suggested an explanation option would be helpful for further elaboration on the two questions. In addition, my supervisors cautioned against dichotomous questions. Instead, they guided how questions and scales should be structured to provide a clear comprehension of the meaning of each scale point and to organise the survey from general to specific.

3.5 Limitations of the Research

Conclusions are always subject to several qualifications when conducting studies of this type, regardless of how well-crafted the study may appear. First, the selection of participants for the survey was spread across five Universities. The Muster Technological University was hit with a cyber-attack, which significantly impacted the participants for this survey.

Due to the time of year and the ongoing activities within the Universities, these participants could not participate in the study. In addition, due to time constraints and the maximum number of words allowed for submissions, the scope of this study was limited. A larger-scale study should be conducted to optimise our understanding of integrating two disciplines. While the associated institutions have paid attention to this topic, it has received limited academic attention. A study with a broader scope and a larger, more diverse sample size would be highly beneficial.

3.6 Sample Survey Size

A random sample must be sufficient to generalise from a sample while avoiding sampling errors or biases. However, what is adequate depends on several factors that frequently confound individuals conducting their first survey.

Several factors, such as the intended level of precision, confidence level, population size, and population variability, determine the appropriate sample size for a survey.

Here are some items that were considered in determining the survey sample size:

1. Determine the error margin or the level of precision desired. This is the acceptable margin of error for your survey results. For example, if you want a margin of error of +/- 5%, you can accept a 5% deviation from the actual population value.

2. Determine the level of assurance you desire in your results. The confidence level is the likelihood that your sample results lie within the error margin. The typical level of security is 95%.

3. Determine the magnitude of the population. If surveying a limited population, you may need to interview more individuals to obtain a representative sample. For large populations, however, a reduced sample size may be adequate.

4. Determine the population's variability. A larger sample size may be required to capture this variation if the population is highly variable.

5. Utilize a calculator or statistical program to determine the sample size. You can also manually calculate the sample size using a formula.

Based on a sample size calculator (see Figure 12), it was calculated that a minimum of ninety participants was required to get a 95% confidence level. The survey targeted research-focused staff at the TUs, utilising the author's networks. Unfortunately, as Munster Technological University was hit with a cyber-attack, some respondents could not open the survey link in the email.

Figure 12 *Sample Size Calculation*

3.7 Learning Styles

Learning styles are individual characteristics in how people learn and refer to the preferred knowledge intake and processing methods. The three most typical learning preferences are kinaesthetic, auditory, and visual.

Pictures, diagrams, and videos are among the visual learning tools that visual learners prefer to use to absorb information. Lectures, conversations, and podcasts are all excellent sources of knowledge for auditory learners. Kinaesthetic learners like to learn through practical or experienced activities like simulations, fieldwork, and lab experiments. A research paper by West et al. (2007) specified that Learning Style is based on the premise that people have consistent preferences for particular methods of acquiring and processing language and that a student's ability to develop a research interest and be confident in their research may depend on their learning style.

Research on learning styles has been hotly contested. While some studies have shown little to no evidence to support the assumption that adapting instruction to a student's learning style might increase learning results, other researchers have found the opposite.

It is vital to note that many experts contend that adopting various teaching approaches that may accommodate many learning types is more beneficial than concentrating on one particular learning style. This method referred to as "multimodal instruction," can help fulfil all pupils' various needs and improve their chances of learning successfully.

Furthermore, combining teaching strategies that can be effective for all learning styles, such as visual aids, lectures, and hands-on activities, can help to boost student engagement and motivation and improve learning results.

While the idea of learning styles is widely accepted, the evidence supporting it is mixed, and it is crucial to consider its limits when developing educational initiatives or research projects.

3.8 Bias

Any systematic error or deviation in the planning, carrying out or analysing of a study that has the potential to produce false or deceptive conclusions is referred to as a bias in research. In research, prejudice can take many different forms, including:

1. Selection bias: When the sample of participants is not typical of the group under study, selection bias causes incorrect generalisations about the population.

2. Confirmation Bias: This is known as confirmation bias when researchers subconsciously seek out or interpret in a way that supports their theories or beliefs rather than unbiasedly assessing all plausible answers.

3. Publication bias disturbs the overall body of data when research with positive or statistically significant outcomes is more likely to be published than studies with null or negative results.

4. Observer bias: When a researcher's expectations or beliefs affect their observations or measurements, it is known as observer bias and can provide inaccurate or untrustworthy findings.

5. Data Analysis bias: When the researcher's decisions or data analysis techniques result in false or deceptive results, this is known as data analysis bias.

Researchers must be aware of potential sources of bias and take precautions to reduce them because bias can be introduced at any stage of the research process, from study design to data processing and interpretation. This may entail employing suitable sampling methods, putting blinding or masking into place, applying appropriate statistical tests, and disclosing all findings, including null or negative results.

Having a diverse team of researchers is also a good idea since they may uncover and reduce potential sources of bias by critically evaluating the research design, data collection, and analysis.

3.9 Conclusion

This research process involves several decisions that have to be made to develop a sound and robust study. This thesis has outlined the various choices in the research process and presented a study that employs a particular set of decisions. Specifically, the research is based on an interpretive philosophy, a deductive approach, a mixed method simple methodology, a survey strategy, and a cross-sectional time horizon, with data collection and analysis techniques appropriate to this design.

The interpretivism research philosophy is based on the notion that social reality is subjective and context-dependent. This philosophy allows for a deep exploration of individuals' attitudes, beliefs, and experiences and provides an understanding of the social world from their perspective. This contrasts with a positivist philosophy, which assumes that social reality can be objectively measured and understood.

Using a deductive method, a researcher begins with a theory or hypothesis that is then tested through empirical observation. This method is appropriate when a well-defined research query and a testable theoretical framework can be determined through data collection.

The mixed method methodology incorporates qualitative and quantitative data collection and analysis techniques. This enables a thorough examination of the research query and provides a deeper comprehension of the phenomenon being investigated. When the research query is complex and requires multiple perspectives, using mixed methods is particularly appropriate.

Using questionnaires, the survey strategy entails the collection of data. This strategy is appropriate when a large quantity of data from many respondents is required to answer the research question. Surveys are frequently used to collect quantitative data but can also collect qualitative data if they include open-ended queries.

Collecting data at a singular point in time constitutes the cross-sectional time horizon. Contrast this with a longitudinal time horizon, which entails data collection over time. The cross-sectional time horizon is appropriate when the research query focuses on a specific moment and when collecting data over a more extended period is impractical or impossible.

This study's data collection methods include questionnaires suitable for a survey strategy. Questionnaires are a fast and effective method for gathering information from many respondents. This study makes use of descriptive statistics and thematic analysis for data analysis. Descriptive statistics were used to summarise the quantitative data collected via a questionnaire.

In conclusion, using an interpretive philosophy, a deductive approach, a mixed method simple methodology, a survey strategy, a cross-sectional time horizon, and appropriate data collection and analysis techniques provides a comprehensive and dependable research methodology. This study demonstrates this method's utility for investigating individuals' attitudes and experiences in a specific context. Using this method, researchers can ensure that their work is rigorous, pertinent, and adds to their field's existing knowledge.

Chapter 4. Analysis of Data

4.1 Introduction

The use of online surveys for data collection has grown in popularity due to their convenience, usability, and ability to reach a large population rapidly. This chapter will analyse the data acquired from a Microsoft Forms online survey with a 120-person population and 90 respondents. The survey was designed to collect information about respondents' attitudes, opinions, and behaviours regarding PMT in a Technological University. The survey was distributed by email to direct email access and, in some instances, sent to a research manager to be distributed by them.

This survey's data provides significant insights that can be utilised to make informed decisions. This analysis will examine descriptive statistics, inferential statistics, and regression analysis, among others, as data-analysis techniques. The limitations of surveys and the implications of the findings will also be discussed.

Numerous studies have demonstrated the reliability and validity of data collected through online surveys (Gosling et al., 2004; Manfreda et al., 2008). In addition, Microsoft Forms are user-friendly and effective for data collection (Daikeler & Bosnjak, 2016).

Analysing data collected from online surveys is crucial in comprehensively comprehending a population's attitudes, opinions and behaviours. This chapter will provide a comprehensive overview of the data analysis process, emphasising the strengths and limitations of the survey methodology and offering suggestions for future research. Please see below a list of questions that were asked in the survey. Also, Appendix 1 has the whole survey.

Table 4 Survey Questions

No	Question
1	What is Your Gender Identity?
2	What is Your Age Category?
3	Please Identify Your Technological University (TU).
4	Which of the Following Best Describes Your Department?
5	What Type of Projects are You Involved in?
6	What would be Your Typical Project Duration?
7	Which of the Following Best Describes Your Role at Your University?
8	Which of the Following Professional Project Management Qualifications do You have, if any?

9	Which of the Following Academic Project Management Qualifications do You have, if any?
10	How Many Years Are You Working in Project Management?
11	Have You Been Offered Project Management Training and Support Within Your University?
12	In Your Opinion, what are the Skills, Knowledge and Competencies Needed to be an Effective Project Manager?
13	In Your Opinion, what are the Personal & Professional Qualities Needed to be an Effective Project Manager?
14	Which of the following Project Management Tools are Used to Manage Research Projects in Your University?
15	Are any of the Following Techniques Available Within Your University to Help You Manage Research Projects?
16	Does Your University have a Project Management Office (PMO)?
17	What Level of the Following Categories of Resources, dedicated to a PMO or Project Management Initiatives, are in Place at Your University?
18	Which of the Following Stage(s) of Your Research Project do You think Requires Assistance or Support in Terms of Project Management?
19	Which Project Management Methodologies, if any, are Used in Your University to Help Drive Research Projects?
20	Which Project Management Templates, if any, are Available in Your University, to help drive research and research-related projects?
21	In Your Opinion, what are the Benefits of Using Project Management Frameworks/Methodologies/Tools, and/or Trained Personnel, to Manage Research Projects at Your University?
22	Do You Think that Using a Project Management Framework or Methodology in Research Projects Limits the Creativity and Flexibility of the Research Process?
23	Any other comments or feedback?

4.2 Demographics

In a survey, demographics refer to the characteristics of respondents, such as age, gender, ethnicity, income, education, occupation, and location. In surveys, demographic information is essential because it can provide insights into the target population and help researchers comprehend how different groups of people may respond differently to the survey questions.

Segmenting survey results and comparing responses across population subgroups using demographic information is possible. For instance, a survey on consumer behaviour may ask respondents about their age, income and level of education to determine how demographic factors may affect purchasing decisions.

In addition, demographic information can be utilised to guarantee that the survey sample is representative of the target population. This is crucial because if the survey sample is representative, the results may only apply to some populations. By obtaining demographic data, researchers can ensure that the sample is diverse and representative of various perspectives and experiences.

Overall, demographic information is a crucial component of survey design and analysis, as it helps researchers better comprehend the target population and ensures that survey results are accurate and pertinent.

4.2.1 Gender Identity

Based on the survey results, 50% of the respondents identified as men, 49% as women, and 1% as non-binary. This indicates a relatively equal representation of men and women in the sample, with a slight but notable representation of non-binary individuals. The equal representation of both genders in the sample ensures that the findings are generalisable for both men and women.

Additionally, the presence of non-binary individuals in my sample highlights the importance of including and acknowledging gender diversity in research. Figure 13 gives you a clear graphic of the breakdown of gender. For example, a journal by Cohen et al. (2013) stated that in the PMT industry, 2% were women, and 14% were men who worked PM in the education sector. This is a positive for gender balance within the workplace and shows that all the work universities do with Athena Swan is helping.
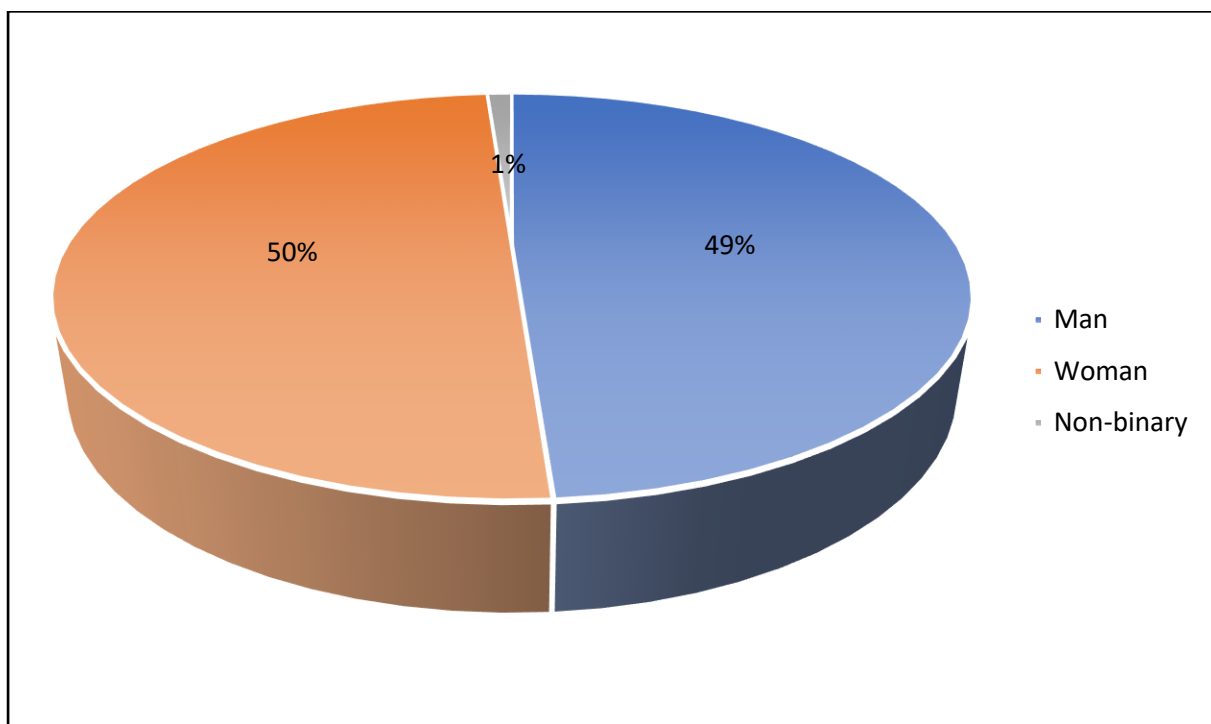
Figure 13 Gender Balance

4.2.2 Age Category

Figure 14 shows that the age category of the people surveyed in this research project ranges from 35 to 64, with 85 respondents out of 90 or 94% in that category. This is also backed up in a study by Muller & Turner (2007), where over 73% of their survey fitted into the age category of 35 to 64. Further evaluation of the survey data suggested that four respondents aged 25-35 have some of the highest academic and professional qualifications like PRINCE2, Six Sigma, Private in-house qualification, and master's Level 9 in PMT and Manufacturing Management. Furthermore, over 50% of the respondents, 35 to 64, had, no academic or professional qualification. This further clarifies that early-stage university researchers are getting some qualifications in PMT to manage research projects.
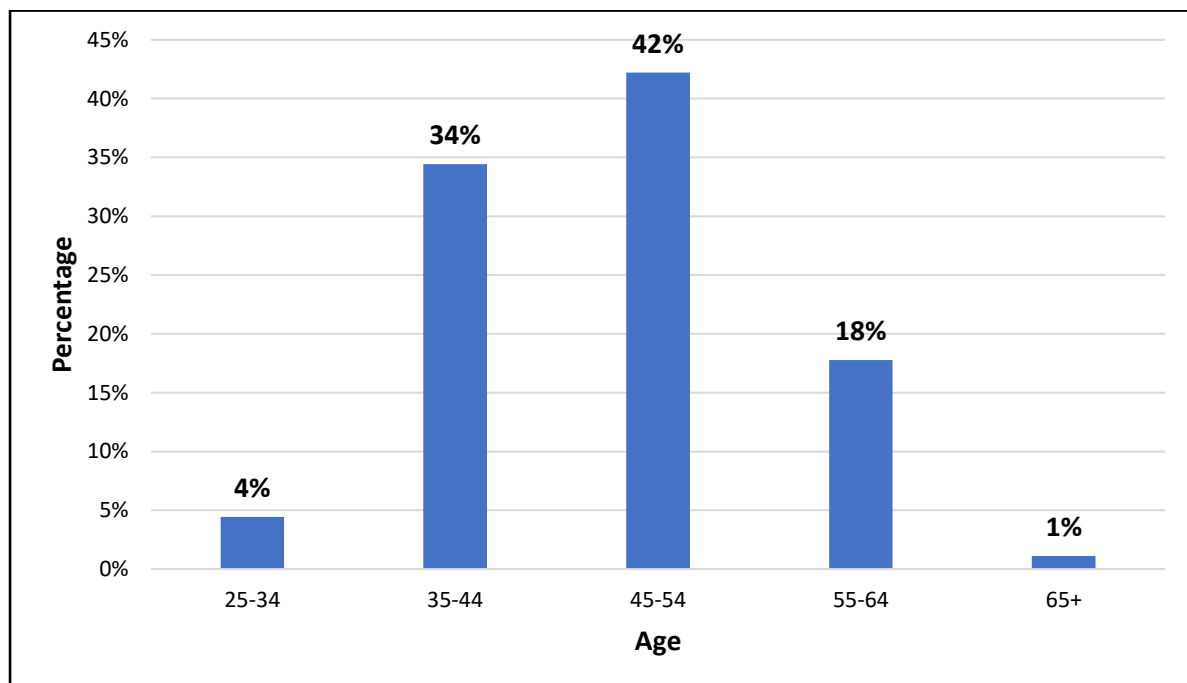
Figure 14 Age Categories

4.2.3 Technological University Location

The following query in the survey asked respondents to identify their TUs. This is a typical survey question style designed to collect respondents' demographic information. This question helps comprehend potential differences in PMT practices across universities and identifies critical improvement areas at specific institutions.

Table 4 provides a concise and organised overview of the distribution of respondents among technological universities. There were sixty-nine respondents between the age of thirty-five and fifty-four, 37 of them women and 31 of them women, and one non-binary.

Table 5 Breakdown of University, Age and Gender

Universities	ATU			MTU			SETU			TUD			TUS		
	Men	Women	Non-Binary	Men	Women	Non-Binary	Men	Women	Non-Binary	Men	Women	Non-Binary	Men	Women	Non-Binary
18-24		0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-34	2				1									1	
35-44	6	12	1	2	1		2	2		1			2	2	
45-54	15	12			4		1	1			2		2	1	
55-64	7	5								2			1	1	
65+	1														
Total	31	29	1	2	6	0	3	3	0	3	2	0	5	5	0

4.3 Department and Project Information

The following tables and figures present what area (school, department, or research centre), type of project, project duration, role at the university and number of years of experience working on research projects.

4.3.1 School or Department

Table 5 breaks down the research area by gender. Overall, the percentage between men and women is very even and contradicts previous research presented earlier in the thesis on men vs women in educational research. The School of Science and Engineering has some of the highest numbers, which would be standard practice for research projects. It is also positive to see the high numbers in the school of business, usually outside research.

Table 6 *Role in Your University*

Area	Men	Women	Non-Binary
Research Office	6	13	
School of Health Sciences	8	5	1
School of Engineering and Computing	12	2	
School of Business	9	11	
School of Humanities	1	2	
School of Creative Arts			
Research of centre or gateway	3	1	
IT Services	1		
PMSS	1	5	
Other	3	6	
Total	44	45	1

4.3.2 Types of Projects

This question was asked to respondents to identify the type of project they were currently involved in. This question was designed to gather information about different projects by survey participants and provide insights into the nature of PMT practices across various disciplines and departments.

57 out of 90 respondents were involved in Academic research; out of these 57 participants, 33 were men, 23 were women, and 01 was non-binary.

The remaining 33 respondents were involved in other research like ATU process developments, Erasmus+, European Funded projects, Enhancement projects and post-graduate projects. Figure 15 demonstrates the breakdown of projects in research.
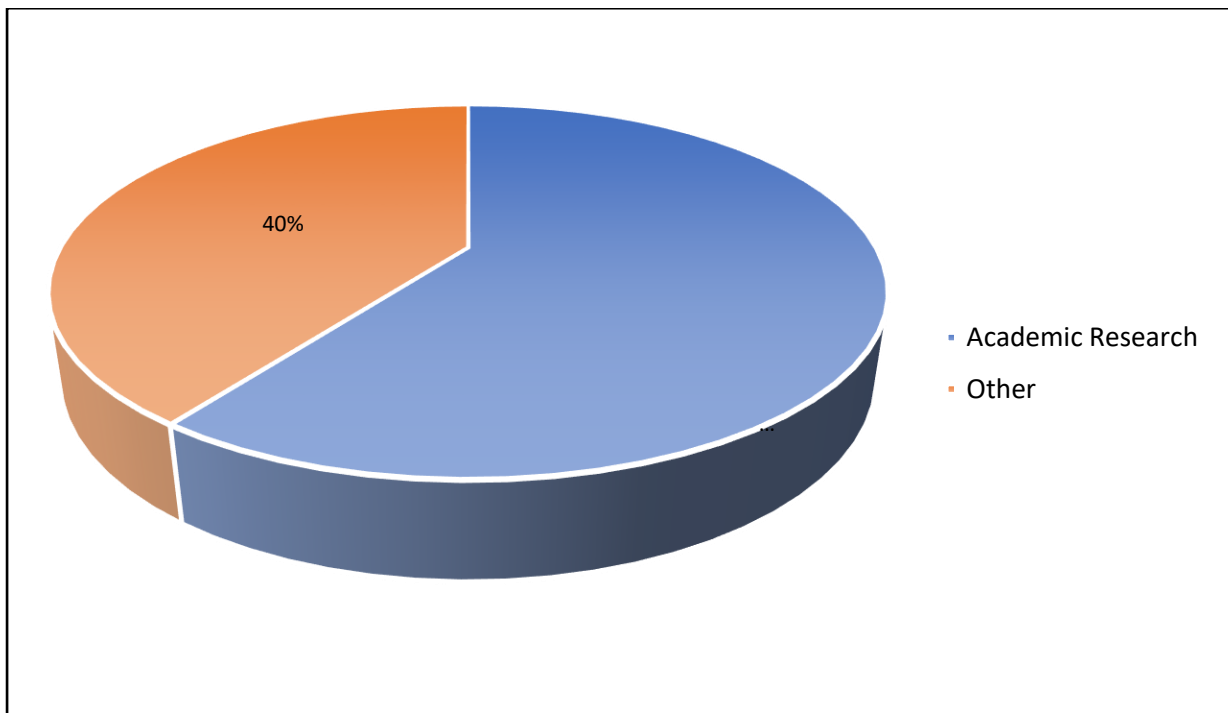
Figure 15 *Type of Research*

4.3.3 Project Duration

This question in the survey asked respondents to indicate the expected duration of their project. This question was designed to gather information about the timeline of projects across different disciplines and departments and to provide insights into the time management practices in PMT. The responses gathered from this question are as under:

1 to 3 months.

Only one woman from ATU, associated with the Department of Business, has this project duration.

3 to 6 months.

Four men belonging to MTU and ATU, associated with the School of Business and IT services, are involved in academic research with this project duration.

1 to 2 years.

12 men and 11 women belong to different universities (ATU, MTU, TUD, SETU), having associated with other departments (Research Office, School of Health Sciences and Teaching etc.) doing academic research with a project duration of 1 to 2 years.

2 to 3 years.

13 men and 11 women belong to different universities (SETU, ATU, TUS, TUD) majorly associated with research offices doing academic and other research and have a project duration of 2 to 3 years.

3+ years.

1 man, 4 women and 01 non-binary belong to ATU and are associated with the School of Businesses doing academic research and have a project duration of 3+ years.

Most survey respondents indicated that their project duration would be 1 to 2 years or 2 to 3 years and 3+ years. These results suggest that most projects undertaken by survey participants are relatively long-term. This has important implications for PMT practices, including ensuring that projects are effectively planned, executed and completed within tight timelines. Figure 16 outlines the breakdown of the survey that was conducted.
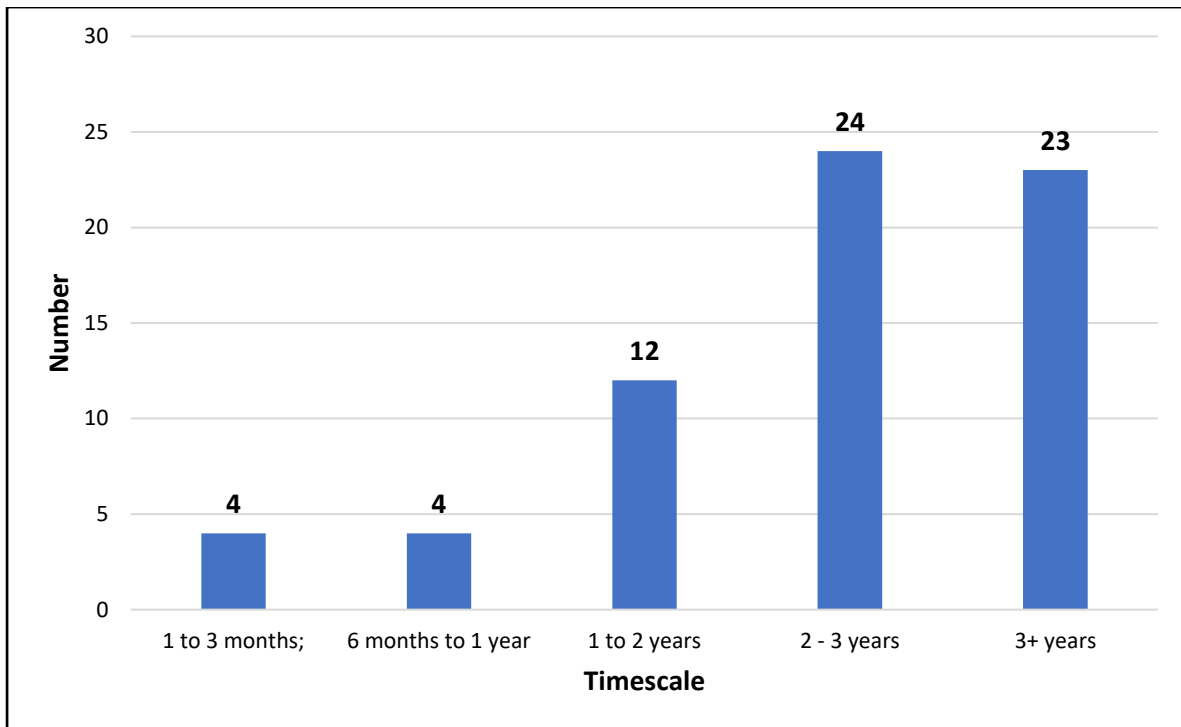
Figure 16 *Project Duration*

4.3.4 Years Working in Project Management

Figure 17 outlines the number of years that the participants in the survey have worked in PMT. Out of the 90 participants in the survey, 47 of the participants had two-plus years working in PMT, with another 12 participants with 1 to 2 years of experience. This demonstrates that relatively experienced people manage research projects.
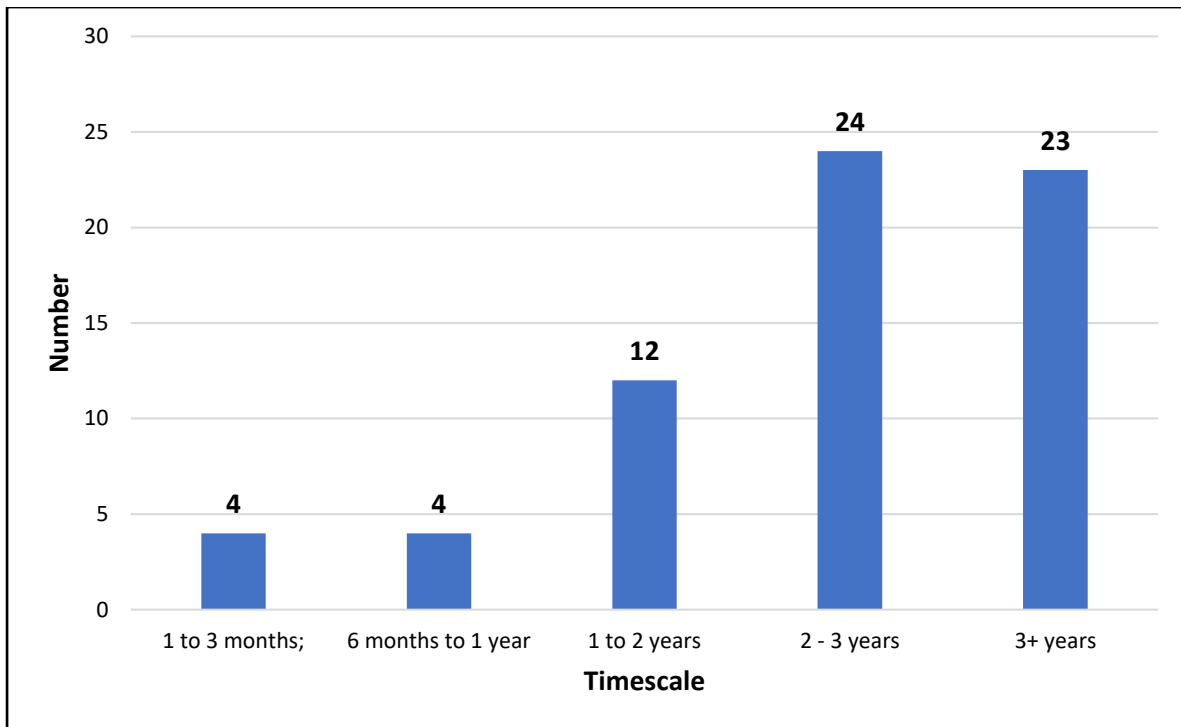
Figure 17 *Years Working in Project Management*

4.3.5 Role at Your University

Out of the total 90 participants, 46 participants (51%) selected "Lecturer" as the best description of their role at the university. 17% of the respondents chose the part of researchers. The remaining respondents selected other roles, including project manager, head of the faculty, head of the department, research manager, technical support, etc. These metrics suggest that lecturers are carrying out most of the research projects. Traditional universities have employment contracts with lecturers that associate with a mix of teaching and research. TUs traditionally only cater for teaching hours with additional time for research either bought out or added to your weekly hours. To scale up capacity in research at the newly formed TUs, employment contracts will have to cater for research as part of the contract.
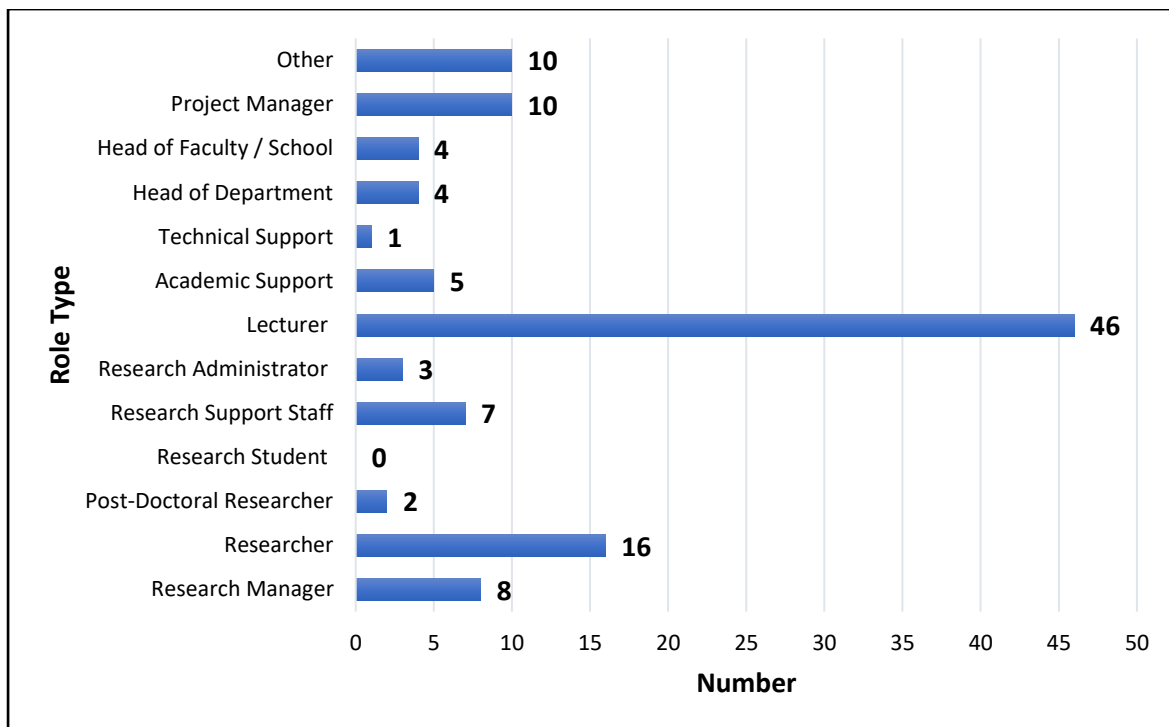
Figure 18 Your Role at Your University

4.4 Professional and Academic Qualifications in Project Management

Professional and academic qualifications in PMT can be obtained at different levels, dependent on the individual's educational and professional objectives. Some familiar qualifications include the following:

Undergraduate Qualification in PMT: Typically offered at levels 6, 7, or 8, this qualification provides students with a comprehensive understanding of PMT principles and practices. It can be earned independently or as part of a more extensive degree program.

Postgraduate Qualification in Undergraduate Qualification in PMT. Typically offered at levels 6, 7, or 8, this qualification builds on the knowledge and skills acquired during an undergraduate program. In addition, it provides students with a deeper comprehension of the theory and practice of PMT.

Postgraduate Qualification in PMT (Masters Level 9): Typically offered at level 9, this qualification equips students with a thorough understanding of PMT theory and practice. It is intended for those wanting to specialise in PMT or pursue a career.

Postgraduate Qualification in PMT (PhD Level 10): This qualification is typically offered at level 10 and is intended for PMT professionals who wish to pursue a career in research or academia.

In addition to these formal qualifications, numerous professional certifications, such as the Project Management Institute's (PMI) Project Management Professional (PMP) certification, are available in PMT. These certifications can demonstrate expertise and proficiency in PMT and are frequently required or preferred by employers.

4.4.1 Professional Project Management Qualifications

63 out of 90 respondents stated they had no professional PMT qualification. Most remaining participants have PMT Institute Qualifications like PMP, PMI, PRINCE2 and Six Sigma. Figure 19 clearly defines the breakdown by qualification. TUs need to look at their PMs and researchers to qualify them in areas of PMT qualification betters. Muller & Turner (2007) suggests that having PMT professional academic accreditations lead to project success. However, they indicate that PMs that do not have accreditations usually have other competencies that lead to project success.
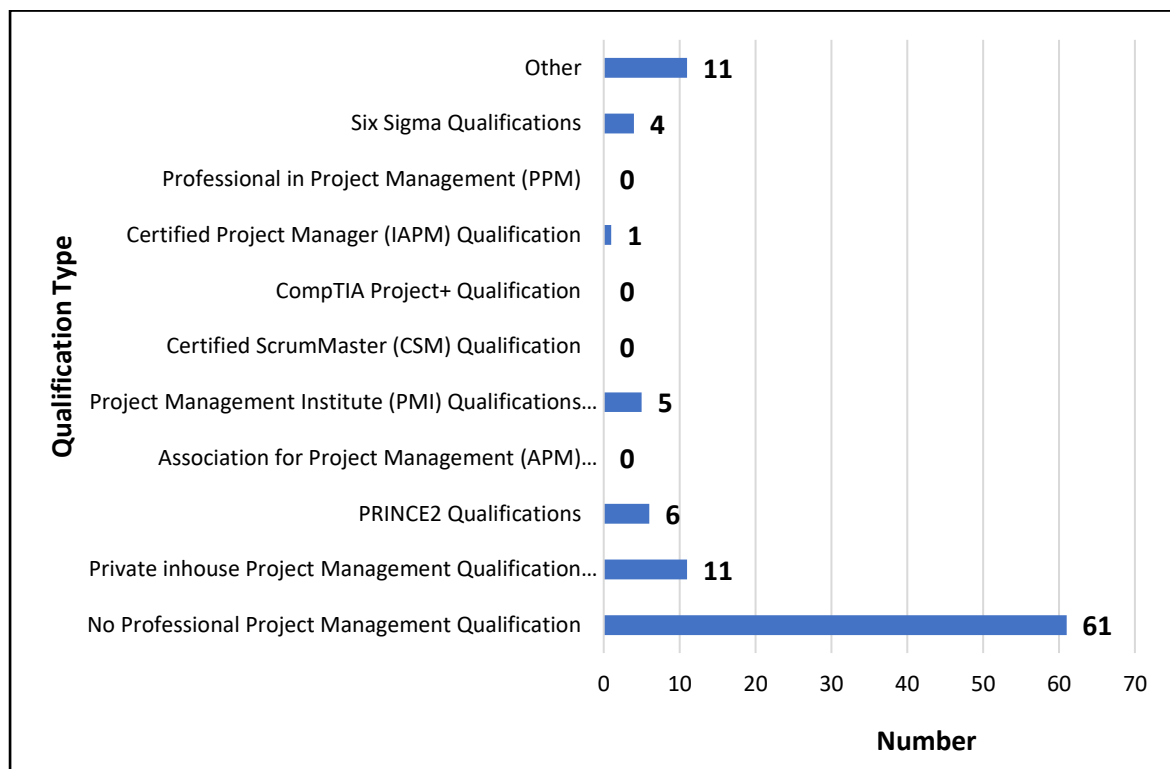
Figure 19 PMT Qualification

4.4.2 Academic Project Management Qualifications

Approximately 64 out of 90 respondents have no academic PMT qualification. A further 20 of the remaining population have a post-graduate qualification (Master level-9 and PhD. Level-10) and undergraduate professional qualification (Level 6,7,8). Figure 20 clearly defines the breakdown by

professional qualification. The TUs need to look at their PMs and researchers better to equip them in areas of PMT academic qualifications. Muller & Turner (2007) believes that having PMT professional academic accreditations lead to project success. However, they suggest that PMs that do not have accreditations usually have other competencies that lead to project success.
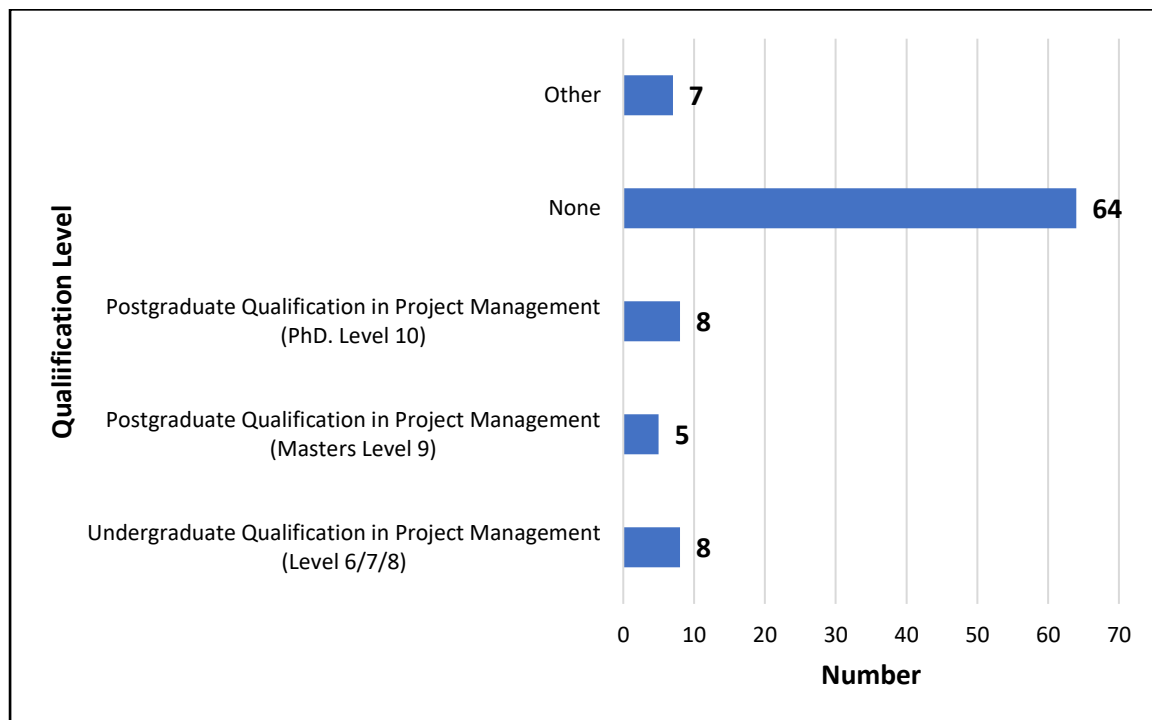
Figure 20 Academic Project Management Qualifications

4.5 Skills, Knowledge, Competencies, Personal and Professional Qualities

The following tables and figures present what the respondents felt were the skills, knowledge and competencies needed to be an effective PM. Then, finally, the survey respondents are asked open questions about what they think is required to be an excellent PM.

4.5.1 Skills, Knowledge, and Competencies

The question focused on soliciting respondents' perspectives regarding the personal and professional skills required to be an effective project manager. The survey's response would reflect the respondent's outlook on what qualities make an effective manager, and their outlook reflects the qualities they would look for in a manager.

57% of the respondents felt it was essential, and 38% thought PMs must have all the necessary skills, knowledge, and competencies to be competent PMs. This further clarifies an earlier point that PMs need to be skilled in leadership, effectively communicate, have excellent organisational and time management skills, be problem-solvers, adapt, be good motivators and be team managers PMI (2023). Table 6 demonstrates the respondent's choices in the different categories asked of them.

Table 7 *Skills, Knowledge and Competencies*

Skills, knowledge, and competencies	Not Important	Important	Essential	Not Sure
Strong Leadership	0	27	62	1
Decision-Making	1	15	74	0
Organisational Skills	1	11	78	0
Business Acumen	15	53	14	8
Problem-Solving	2	23	65	0
Critical Analysis	3	33	53	1
Oral Communication	1	19	69	1
Written Communication	2	21	66	1
Public Speaking	9	54	24	3
Negotiation Skills	1	46	43	0
Meeting Management	3	40	46	1
Risk Management	1	41	45	3
Strategy Development	2	48	37	3
Stress Management	2	43	38	7
Total %	3%	38%	57%	2%

4.5.2 Personal & Professional Qualities

This question focused on eliciting responses regarding the personal and professional qualities necessary for an effective PM. The answer to the survey would reflect the respondent's perspective on the qualities that make an effective manager, and their viewpoint reflects the qualities they would seek in a manager. For example, 57% of respondents felt this is essential, and 41% felt an excellent PM must possess exceptional personal and professional qualities. In Table 7, the respondent's selections for the various categories inquired of them are presented clearly.

Table 8 Personal & Professional Qualities

Personal & Professional Qualities	Not Important	Important	Essential	Not sure
Committed to Delivering Results	0	26	63	1
Proactive in Accepting Project Challenges	2	34	54	0
Skilled in Problem-Solving	0	29	61	0
Strong Leadership	0	28	61	1
Open to Feedback and Criticism	0	41	49	0
Decisive in Decision Making	0	34	56	0
Flexibility in Dealing with Project Goals	0	37	53	0
Ability to Avoid Miscommunication	1	32	56	1
Ability to Furnish a Project Roadmap	1	40	48	1
Ability to Remain Positive	4	43	43	0
Strong People Management Skills	0	61	29	0
Agile Management Style	0	36	43	11
Total %	1%	41%	57%	1%

4.6 Tools, Techniques and Methodologies at the Technological University

In the next section of questions in the survey, the participants were asked about tools, techniques and methodologies that they have used in research projects in their TU. The choices given to the participants are tools and techniques used commonly in other industries, as elaborated earlier in the literature review section of this thesis.

4.6.1 Project Management Tools Used to Manage Research Projects

This question aimed to ascertain how efficiently and effectively the respondents use the PMT tools and in what variety. Different universities adopt different methodologies to execute PMT, reflecting the degree of flexibility and adaptation with which the respondents utilise the tools to their favour.

Each tool caters differently to each TU, depending on the demands and requirements of their research projects. Therefore, specific projects require a degree of tailoring to meet specific needs. The same can be seen when each university implements different tools to cater to the other and multiple sets of requirements as the project demands.

However, confident respondents quickly answered where they needed to gain knowledge of the tools being utilised. Moreover, confident respondents said no devices were being used to manage projects.

In Figure 21, the Microsoft platform was the most used, with 74 respondents saying they used Teams and 38 saying they used Project. Both Trello with 12, Jira with seven and Teamwork with eight shows that quite a few participants had used other tools to manage research projects. Overall, it was quite a good response to the survey around this question, and further research by the TUs should be undertaken to see what type of tool works best and to provide training for all research teams.
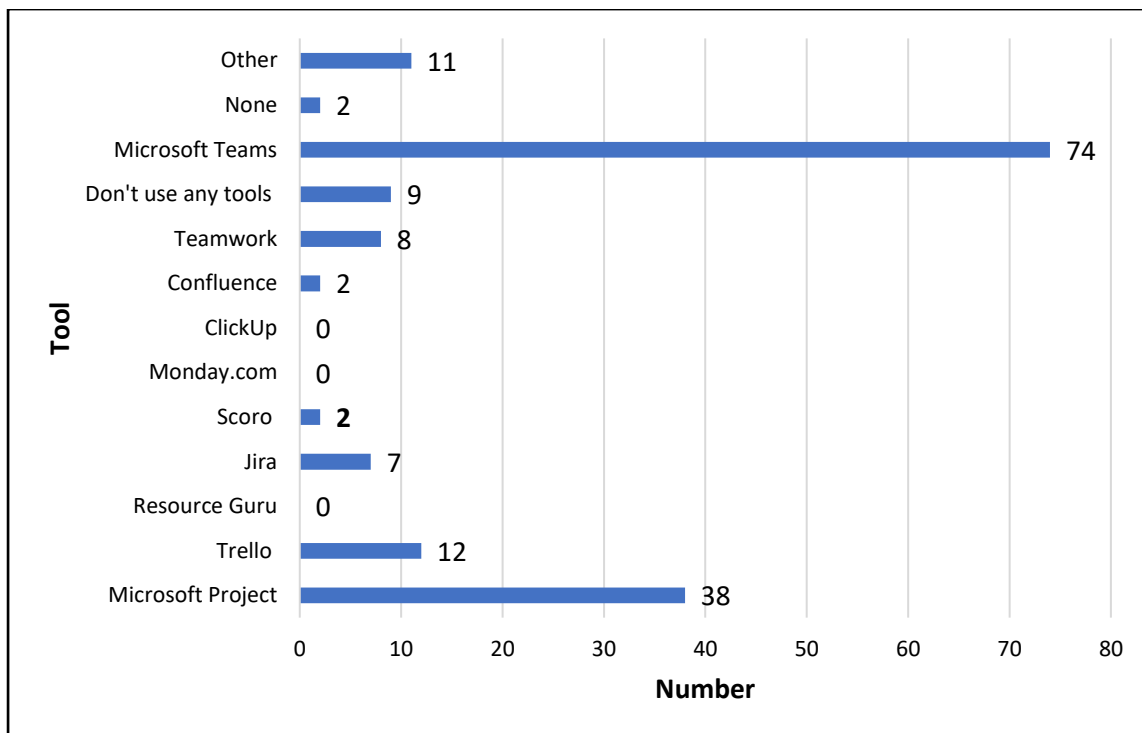
Figure 21 *PMT Tools Used to Manage Research Projects in Your University*

4.6.2 Project Management Methodologies

This research question seeks to identify the various PMT methodologies used to drive research initiatives in higher education. This could include traditional methods such as Waterfall or Agile, as well as frameworks tailored to the specific requirements of research activities.

In Figure 22, the participants were asked about the PMM used at their TU. The worrying statistic for this question was that 53 participants answered the do not know and 19 answered no PMM at their TU. Over 65% of the respondents knew what PMM was in their TU. This is one of the sections discussed further in the conclusion section on implementing a PMM in their TU, whether an off-the-shelf package or a hybrid version built in-house.
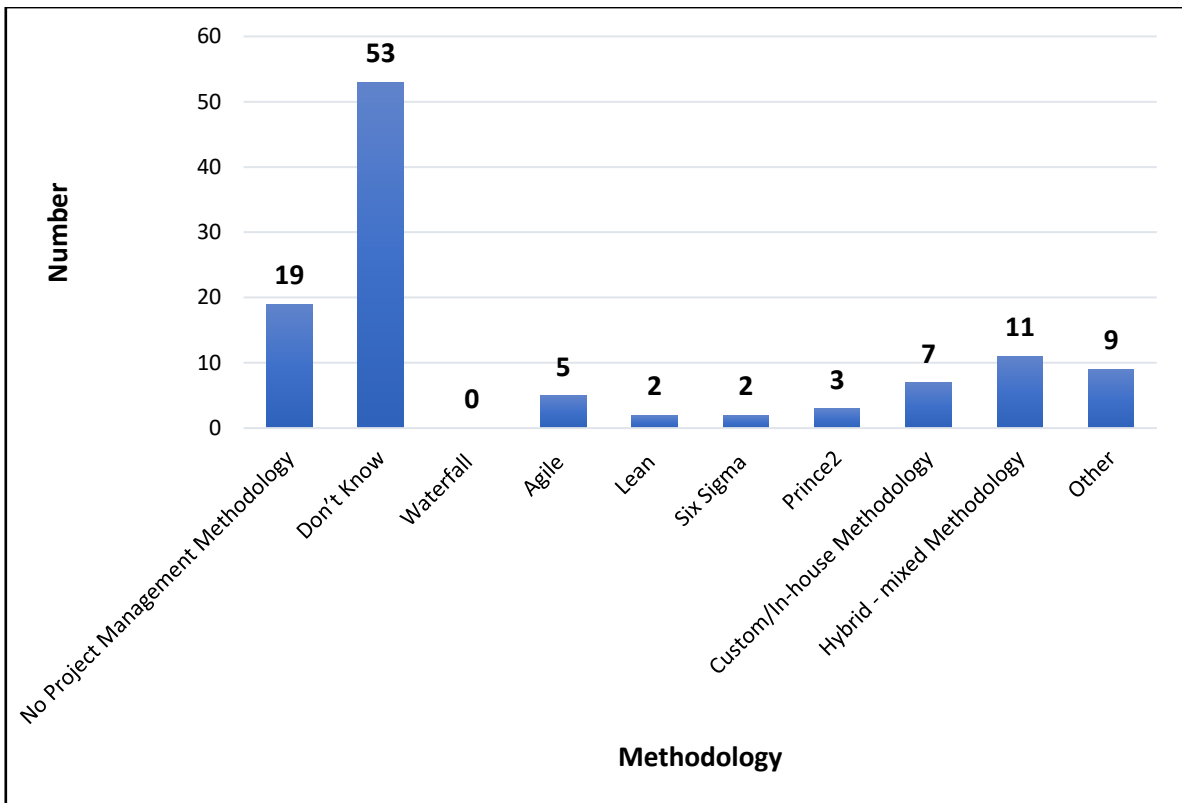
Figure 22 *PMT Methodologies used at your university.*

4.7 Supports at the Technological University.

The following questions in the survey revolve around what supports, if any, are provided in their university. As described in an earlier chapter, traditional universities' PMO or Research Support Office (RSO) outlines the type of support and what stage the support is provided at pre-award or post-award or project closure. It also asks where the resources are explicitly provided around work, material, financial or time. So, for example, one of the questions focuses on training on research projects and whether your university offers it.

4.7.1 Project Management Office at the Technological University

A PMO or RSO is widely used in traditional universities to support research projects. The link provided shows the current support for research by University College Dublin. This support that UCD provides outlines the research ecosystem from idea to closure. The process outlines specific assistance at each stage gate to help in a research project. In Figure 23, the participants were asked if they had a PMO or RSO; over 34 said they did not have either, and 45 did not know. Over 79 participants do not know whether they had any support offices, which is not very good statistics, which will be discussed in the

recommendations chapter. This further clarifies that TUs need to start providing a PMO or RSO to support the research projects.
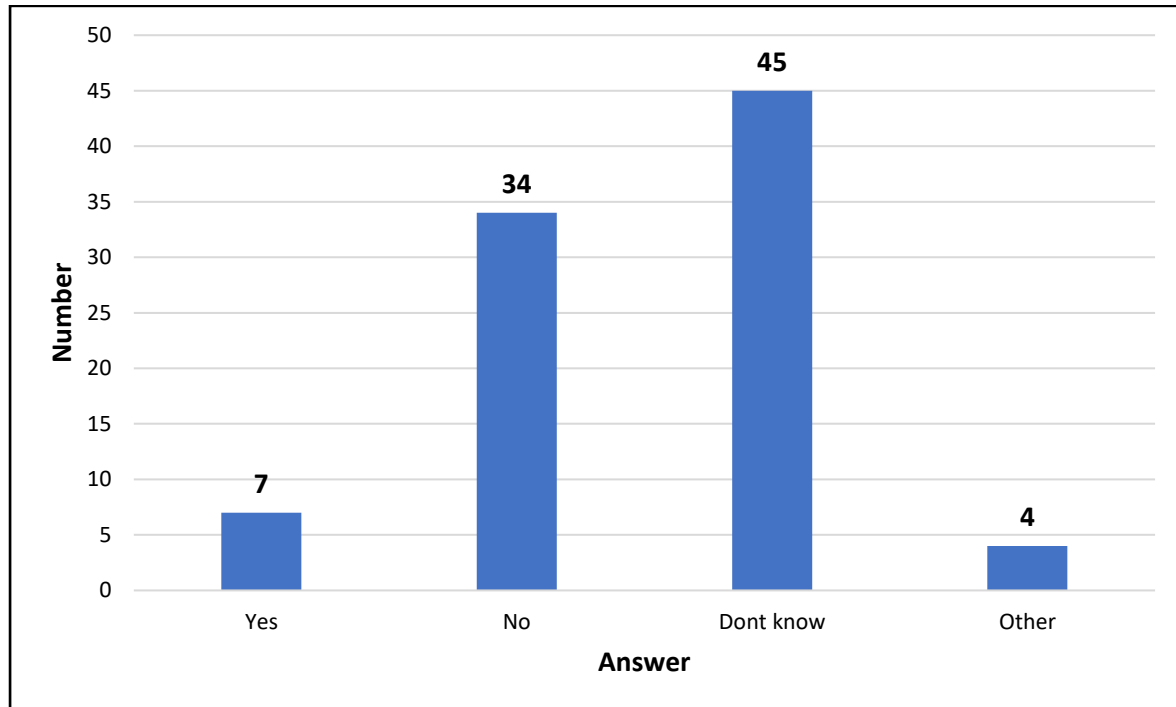
Figure 23 *Project Management Office*

4.7.2 Resources Dedicated to a PMO or Project Management Initiatives

Table 8 represents a question in the survey that asked the participants if their TU provided resources to a particular area to aid in research projects. The data suggest that 63% felt they did not give enough, and others did not know. Different skill sets are associated with an area throughout the project life cycle. For example, pre-award determines resources from a legal and financial perspective to provide governance over contracts and budgets. In contrast, post-award requires experience from financial and technical resources to aid in monitoring and controlling a research project. Therefore, TUs must invest in resources with the expertise and knowledge to assist PMs and researchers with research projects. This relates to a different area in the survey where it was asked about training provided, and this data collected further clarifies the need for more training for research staff.

Table 9 *Resources dedicated to the PMO office.*

Rating	Work Resources	Material Resources	Financial Resources	Time Resources	%
Never enough	27	26	31	41	35%
Adequate	24	24	25	21	26%
Well resourced	9	11	14	5	11%
Over resourced	0	0	0	0	0
I don't know	30	29	20	23	28%

4.7.3 Has the University Provided Project Management Training and Support

In Figure 24, 45 respondents of the 90 surveyed said that their TU provided no training or support in research projects. Furthermore, 34 respondents said some training is provided, and nine respondents said the training was satisfactory. Support by a TU in research projects, as described in an earlier chapter, is critical to the outcome. Most projects are carried out by lecturers whose primary role is to lecture and who find teaching and running a project hugely challenging. The potential benefits of having a PMO or RSO to assist PMs and researchers with research projects will be discussed later.
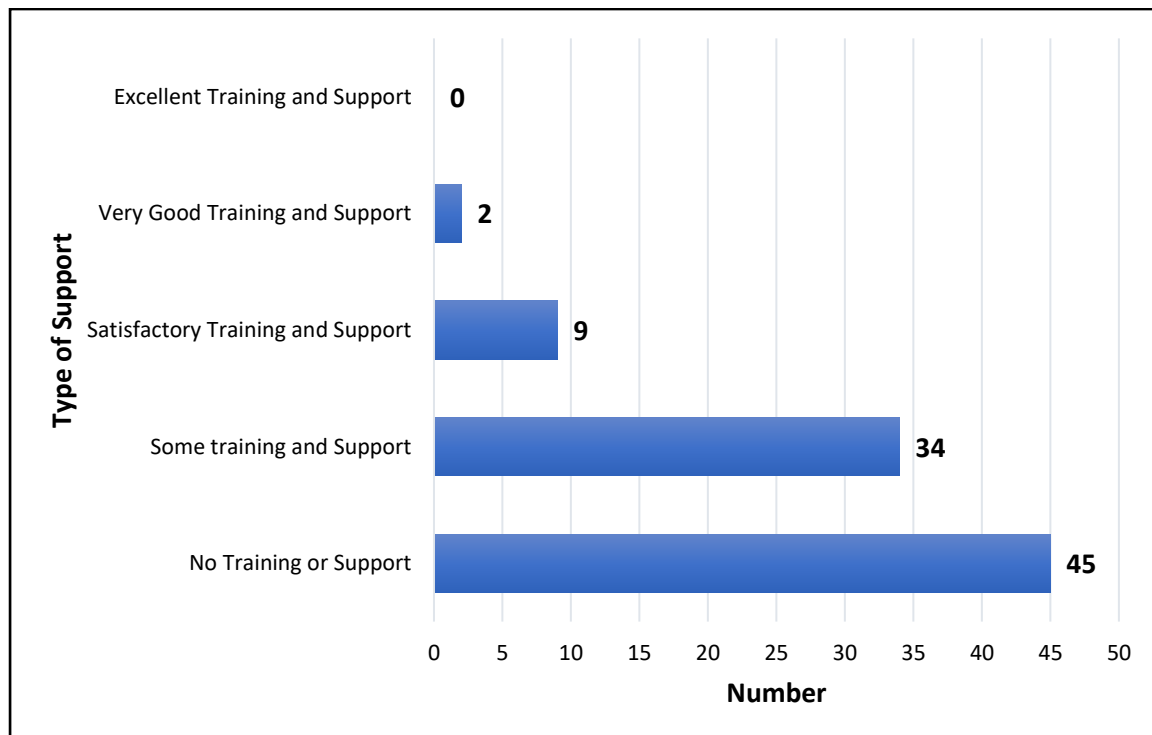
Figure 24 *Support from your University*

4.7.4 Stage of Project Support

In Figure 25 below, the participants were asked where they required the most assistance in the research project journey. Overall, the participant scored each of the areas relatively equally. When you determine the metrics of the overall question, the assistance is spread right across from pre-award to post-award and through to closure. As mentioned in an earlier chapter, UCD support in their research journey supports the project life cycle at all stages. To build capacity in the research area, the TUs must develop their methods, systems, and processes to help assist in research projects.
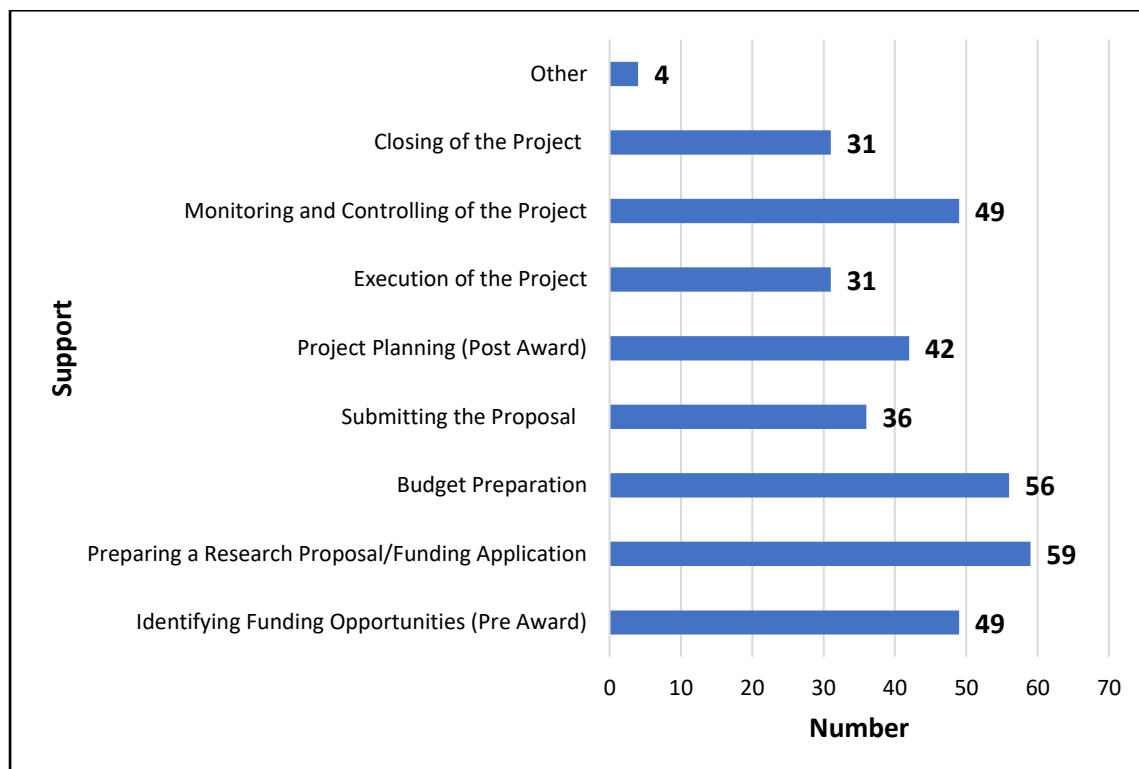
Figure 25 *Stage of Support*

4.7.5 Project Management Templates at the Technological University

In Figure 26, the participants were asked about the templates that might be used in research projects in the TUs, 42 of the participants claimed that no project templates were used in research projects in their TU to assist in their project journey. Basic requirements like project charters are standard procedures in PMT, but only five participants answered yes. The TUs providing templates and training for each area of the research project journey would improve the governance of projects immensely. Furthermore, the funding agencies who provide the funding for research projects demand project governance over the fund they offer and as alluded to by Ahola et al. (2014), the "*primary purpose of*

project governance is to ensure that the project will meet the goals and expectations subjected to it by various stakeholders."
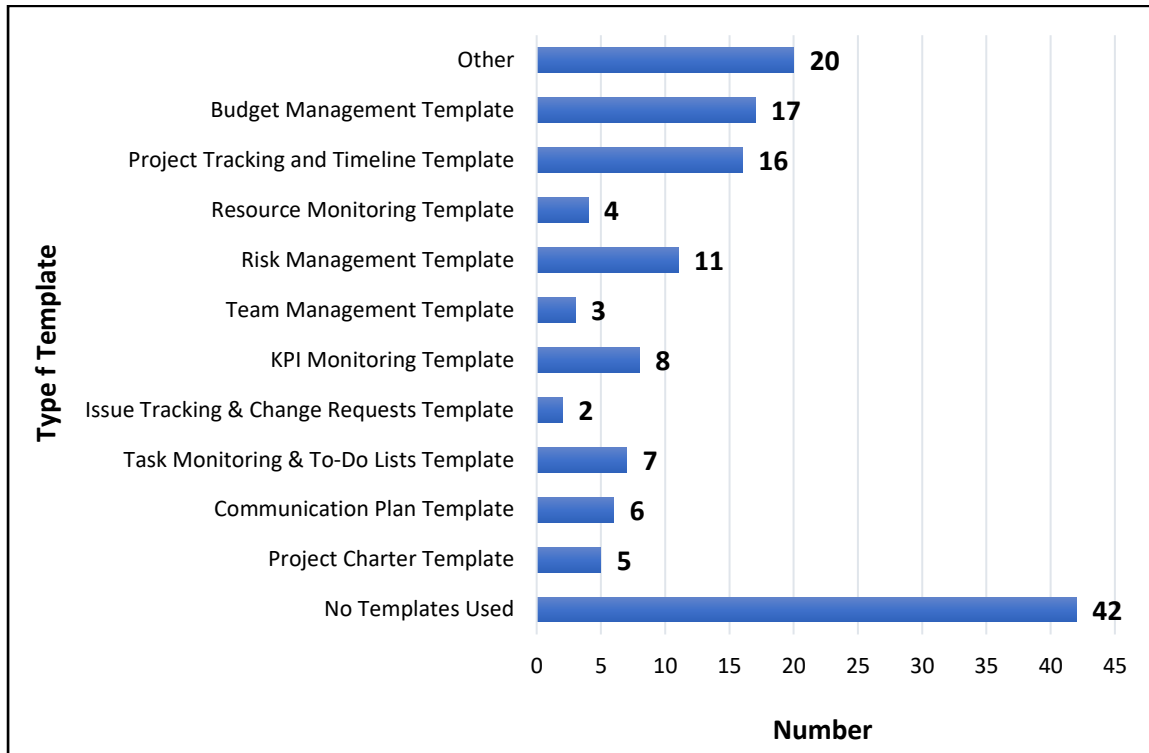
Figure 26 PMT Templates used at your university.

4.8 Benefits of Frameworks/Methodologies/Tools and Trained Personnel

In Figure 27, the participants on a rating scale were asked about the benefits of using PMT over several key areas. A total of 56 participants felt that project deliverables and deadlines were crucial to them in the research project life cycle. However, one of the most worrying aspects of the answers was that cost control was only necessary for three people. This statistic is alarming as research projects have a capped budget, and who is responsible for managing the budget? Therefore, TUs need to provide experts in budgetary control at each stage of the project life cycle to aid researchers with control of their budgets.

Figure 27 *Benefits of using PMT Frameworks/Methodologies/Tools, and/or Trained Personnel*

4.9 Limiting Creativity & Flexibility, and Feedback

The following two questions in the survey were designed to leave the questions open for the participants to openly express their views on the current state of research projects.

4.9.1 Creativity and Flexibility of the Research Process

When asked this question, almost over 60% of the participants felt that if applied effectively and used to ease the project research process, it yields better than limiting creativity and flexibility. Another respondent said that it aids the understanding from a multi-stakeholder perspective if stakeholder management and analysis are used as a tool. Planning communications is an integral part of PM and of research dissemination. The PM will also allow for less stress and more transparent communication within the team letting researchers focus on research. Furthermore, it helps stay within the research parameters and stay within them. Almost 10% of the survey participants felt PMT acts as an obstacle and bottleneck to the creativity and flexibility of the project.

4.9.2 Comments or Feedback

Based on the responses, there is a mixed level of awareness and support for PMT within the academic research environment. Some respondents expressed the need for more formal PMT training and resources, while others suggested that PMT should not interfere with the research process. There were also comments regarding the importance of stakeholder engagement, communication, and motivation in PMT and concerns about the potential burden of administration and the need for adequate support staff. It is also clear that implementing PMT methodologies and tools should be accompanied by clear communication of their benefits to users. Overall, the study outcomes will be interesting to see and may provide valuable insights into the attitudes and experiences of academic researchers towards PMT.

4.10 Conclusion

This chapter's data analysis findings are consistent with the extant literature. The research questions were investigated using appropriate data analysis techniques, and the results indicated that the survey supported the hypothesis. The results have also cast light on several significant insights related to the research topic, which may have substantial implications for future practice and research.

Overall, the data analysis has resulted in a deeper comprehension of the research question and has confirmed the topic's significance. In addition, the study has added to the existing corpus of knowledge in the field and identified several avenues for future investigation. Therefore, it is anticipated that practitioners, policymakers, and researchers interested in this area will find these findings useful. To further elaborate on this point, I have added a column to Table 9, which was used in a previous chapter, to provide the reader with a comparison of the themes from our literature reviews and the main articles from our research.

In conclusion, this chapter's findings contribute to comprehending the research topic and are consistent with the existing literature. The implications of these findings are discussed in the subsequent chapter, which also provides recommendations for future research and practice.

Table 10 *Comparing the significant themes of the literature review to those of the findings.*

Authors	Origin	Purpose	Type of Source	Major Themes from Literature	Convergent Themes from Findings
Dowling & Rodney, (2010)	Ireland	Application of PMT in the academic sector	Conference Paper	PMT can increase the quantity and quality of research projects.	Over 60% of the respondents in the survey, if PMT is applied correctly, it can significantly enhance the chance of project success.
Lappé & Spang, (2014)	Germany	Investments in PMT are profitable	Journal	Using PMT in research projects can significantly benefit the organisation.	For example, 56 of the participants in the survey felt that using PMT can greatly benefit research projects over numerous areas, like cost, time, risks, team satisfaction, and scope.
OGP, (2011).	Ireland	Governance over public funding	Report	Public funding needs to be managed appropriately, and using PMT can improve project governance.	Overall, the survey was very favourable to using PMT in research projects.
Johnson et al. (2007)	USA	PMT Practices in the Institutions of Higher Education	Journal	Types of PMT used in research projects vary on the size and nature of the project.	72 out of the 90 respondents said that their TU had no PMT in place to aid with research projects
Dowling & Rodney, (2010)	Ireland	Application of PMT in the academic sector	Conference Paper	The broad spectrum of research projects in a university varies, making implementing one type of PMT difficult.	The results from the survey suggested that some PMT needs to be in place to manage research projects.
Murphy & Ledwith, (2007)	Ireland	PMT tools and techniques	Journal	What tools SME's are used in PMT to deliver research projects successfully	74 of the 90 respondents had used Gantt charts, with 17 using Kanban and 38 using Microsoft Project to assist with research projects
PMI, (2013).	USA	Overview of PMT and PMs in the PMBOK	Book	Analyses the tools and qualities that a PM needs in projects	Microsoft Teams assisted in PMT, with 74 respondents using it.

Authors	Origin	Purpose	Type of Source	Major Themes from Literature	Convergent Themes from Findings
Lipsanen, (2007).	Germany	Skills and qualities associated with PMs	Thesis	PMs need to have skills and qualities that successfully deliver research projects	57% said it was essential, and 38% said it was signed over a range of skills, competencies, and knowledge. The respondents felt that these are very important to have as a PM.
PMI, (2013).	USA	Overview of PMT and PMs in the PMBOK	Book	Analyses the soft skills and qualities a PM needs to deliver projects	Again, like above, the respondents scored 57% as essential and 41% as important

Chapter 5. Discussion

5.0 Introduction

This thesis investigated the practical PMT of research and research-related initiatives at a newly established, multi-campus TU in Ireland. This chapter will discuss the results of the exploratory analysis and the implications of research for academic PMT.

This research identified key themes and factors that influence the effectiveness of research and research-related PMT. The importance of effective PMT, the tools, techniques, skills, and qualities a PM needs, and the methodologies they need to implement good PMT practices.

In addition, potential obstacles to PMT were identified, such as limited resources, competing priorities and evolving project requirements. Finally, strategies were developed for addressing these obstacles and ensuring the success of research and research-related initiatives by analysing them.

This chapter will discuss how our findings can be applied to academic PMT, specifically within a TU with multiple campuses. It also investigated the implications of our research for PMT theory and practice, emphasising areas for future research and development. Finally, it is anticipated that the findings of this study will inform and improve academic PMT practices.

5.1 Benefits of Using Project Management to Manage Research Projects

The congruence between the literature review and the survey results provides significant evidence that applying PMT to the management of research projects can result in positive outcomes. The literature review revealed that PMT is a well-established methodology to enhance research projects' quality, efficiency, and results (Huljenić et al., 2005). This is further supported by the survey results, which show various benefits associated with using PMT to manage research initiatives. The introduction of standards, procedures, templates, and consistent methodology related to project management techniques could address the issues of improvements within the functional areas (Kalimullin et al., 2016)

The literature review and the survey identified several positive benefits, including enhanced project planning and scheduling, improved communication and collaboration among team members, increased efficiency and productivity, and improved project outcomes. These results suggest that PMT

can provide a structured framework for administering complex research projects, allowing researchers to accomplish their objectives more effectively and efficiently (Neary et al., 2011).

The congruence between the literature review and survey results demonstrates that PMT is valuable for research projects. It is suggested that researchers employ PMT principles and practices when planning and managing their research projects to increase their likelihood of success (Dowling & Rodney., 2010). It may be necessary to conduct additional research to determine which approaches and tools are most effective for managing various research initiatives.

5.2 Project Management Methodologies Used in Research Projects

The equivalence between the literature review findings and the survey is somewhat different. There is no real literature to prove that any PMM is used in a Technological University (Johnson et al., 2007). However, their review revealed that PMMs are used in other industries for project planning, execution, and control of projects. These methodologies are recognised for providing a structured framework for managing complex projects, allowing project teams to deliver high-quality results on time and within budget (Dowling & Rodney., 2010).

Respondents to the survey report various positive benefits associated with applying PMMs in research projects. These benefits include improved project planning and scheduling, communication and teamwork, efficiency and productivity, and project outcomes. In addition, this indicates that PMMs can provide a practical framework for managing the unique challenges and complexities of research projects in a TU.

Additional research may be needed into the approaches and tools most effective for managing various categories of projects in TU. Numerous universities and TUs now provide Undergraduate and Post Graduate certifications in PMT, and why can this not be a requirement for any potential researchers to participate in one of these courses before being allowed to research; some have established specialised PMT offices to support the delivery of research projects (UCD, 2023).

5.3 Tools and Techniques Project Managers Use in Research Projects.

The discrepancy between the literature review results and the survey regarding the tools and techniques PMs employ in research projects suggests that survey respondents may need more knowledge or awareness. The literature review revealed that PMs use various tools and techniques to plan, execute, and control research projects, including Gantt charts, critical path analysis, and risk

management (Murphy & Ledwith., 2017). This was further backed up by the survey suggesting the above tools would be an addition to managing research projects. These tools and techniques are crucial to the success of research projects because they allow PMs to manage project deadlines, resources, and hazards effectively.

Overall, the literature review findings indicate that PMT tools and techniques are required to manage research initiatives effectively (PMI, 2013). However, the survey results emphasise the need for greater research community awareness and education regarding these tools and techniques. Therefore, it is suggested that higher education institutions and research organisations provide researchers with training and resources to help them develop their PMT skills and knowledge. In addition, it may be necessary to conduct additional research to determine which tools and methods are most effective for managing various categories of research projects.

5.4 Skills and Qualities Needed to be a Project Manager

The comparison between the literature review and the survey results proves that the skills and qualities required to manage research projects as a project manager are necessary. The literature review revealed that PMT requires unique characteristics, such as leadership, communication, problem-solving, and organisation (Muller & Turner, 2007; Alam et al., 2008; Crawford, 2005). These abilities and traits are crucial to the success of research projects because they enable PMs to effectively manage project teams, identify and mitigate risks, and ensure projects are completed on time and within budget.

The survey results support this notion, with respondents emphasising the significance of various skills and qualities required for a practical research project manager. These include strong communication and interpersonal skills, effective leadership and decision-making, organising and prioritising tasks, and strategic and creative thinking (Lipsanen, 2017). In addition, the findings indicate that research project administrators require diverse skills and qualities to navigate the unique challenges and complexities of research projects.

The congruence between the literature review and survey results demonstrates the significance of the skills and qualities required of research PMs. Therefore, in research projects, individuals pursuing a career in PMT are advised to develop and hone these skills and qualities to ensure their success as PMs. In addition, additional research may be needed into the specific skills and qualities most essential for PMs in various categories of research projects.

5.5 Conclusion

In conclusion, applying PMT to research initiatives offers numerous advantages. It has been demonstrated that using PMMs to research projects in research projects improves project outcomes, including resource management, risk mitigation, and collaboration. In addition, the tools and techniques utilised by PMs in research projects allow for effective project planning, execution, and monitoring, which results in successful project outcomes.

PMs must possess specific skills and qualities to manage research initiatives effectively. These are leadership, communication, time management, problem-solving, and decision-making. These skills are required to ensure the success of a project, and when combined with PMMs and tools, they can substantially improve project outcomes. Effective PMT practices guarantee that research projects are completed on time, within budget, and according to the intended quality standards. Researchers and PMs can efficiently manage project resources, mitigate risks, and optimise project outcomes using PMMs and tools. In addition, they can collaborate effectively, make informed decisions, and communicate effectively with stakeholders.

The importance of PMT in research initiatives cannot be overstated, nor can its benefits. Utilising PMMs, tools, and techniques, along with possessing the necessary skills and qualities of a PM, are essential ingredients for successfully managing research projects. Furthermore, it is required to apply these practices appropriately to ensure that research projects are completed efficiently and effectively, yielding the intended results.

Chapter 6. Conclusions & Recommendations

6.1 Introduction

The research into the adoption of PM and PMT within research projects were conducted due to the significant change facing the sector in terms of the educational needs of students, the type of students enrolling in higher education, and the significant budgetary pressures requiring better resource utilisation and the development of new business areas. In addition, significant changes are occurring at TUs due to a decline in government funding, an increase in international students, and the demand for technological alternatives to traditional teaching methods. PMT is a recognised method for facilitating the delivery of necessary changes in a structured, efficient, and effective manner.

Dowling & Rodney (2010) examined the impact of PMT on the academic research conducted by professors at Irish universities in a 2010 paper. Using a case study approach based on three academic research organisations, this paper examined the relevant success factors for research projects and how PMT can enhance these areas. It was determined that a standardised approach to PMT would not align with the requirements of research management; however, with the increased needs of funding bodies, a more PMT-centred system would enable each organisation to meet its requirements better, thereby increasing funding opportunities.

The following sections will present the recommendations from this research based on the reviewed literature and the survey results.

6.1.1 The Correct Project Methodology for Research Projects

The correct project methodology for research projects can be determined by the nature and scope of the research project, the project's objectives, and the team's preferences—TUs need to research this area to see what methodology best fits their requirements (Kjolhede, 1999). The need for a methodology around projects could not be verified through the literature review for research projects. However, some mechanism needs to be in place for a framework around projects. Kjolhede (1999) further clarifies this by saying that PMT, PMM and management tools are helpful in research projects. However, they must be flexible tools continuously adjusted to fit the current project reality. They should not be regarded as a blueprint for every research project. Further research is needed in this area to ascertain what the PMM traditional universities use to carry out tasks (Riol & Thuillier, 2015).

PMMs provide a structured approach to delineating a project's objectives, scope, timelines, and deliverables. This ensures that all stakeholders understand what the project entails and what must be done to achieve the intended results. In addition, PMMs aid PMs and researchers in effectively managing project resources such as budgets, schedules, and timelines. This allows them to maximise resource utilisation, reduce waste, and optimise project outcomes (Nijhuis, 2012).

Frequently, research projects involve uncertainties and hazards that can affect project outcomes. PMMs provide a structure for identifying, evaluating, and mitigating project risks, reducing project failure probability. Many research initiatives involve numerous stakeholders and team members. PMMs offer a structured approach to collaboration, communication, and decision-making, ensuring all team members are aligned and working towards the same objectives. PMMs assist PMs and researchers in the planning, execution, and monitoring of projects. This results in better project outcomes, such as projects completed on time, within budget, and with the intended quality (Nijhuis, 2012).

Overall, the consistency between the literature review and survey results does not support using any PMMs in research projects. However, the evidence from this research suggests that some framework needs to be in place to manage research projects (Dowling & Rodney., 2010). Therefore, there may be a need for additional research into the PMMs within the TU sector and engagement with the relevant stakeholders to find a framework that fits them.

6.1.2 Provide the Correct Tools and Techniques for Research Projects

The discrepancy between the literature review results and the survey regarding the tools and techniques PMs employ in research projects suggests that survey respondents may need more knowledge or awareness. The literature review revealed that PMs use various tools and techniques to plan, execute, and control research projects, including Gantt charts, critical path analysis, and risk management. These tools and techniques are crucial to the success of research projects because they allow PMs to manage project deadlines, resources, and hazards effectively.

However, the survey results indicate that many respondents needed a comprehensive comprehension of PMs' tools and methods for research projects. This suggests that the research community may require additional education and training on PMT tools and techniques.

Overall, the literature review findings indicate that PMT tools and techniques are required to manage research initiatives effectively. However, the survey results emphasise the need for greater research community awareness and education regarding these tools and techniques. It is suggested that TUs and research organisations provide researchers with training and resources to help them develop their

PMT skills and knowledge. In addition, it may be necessary to conduct additional research to determine which tools and methods are most effective for managing various categories of research projects.

6.1.3 Training on PMT Practices to Project Managers and Researchers

Both PMs and researchers require training in PMT practices. Effective PMT is necessary for successful project outcomes, and exercise can assist PMs and researchers in acquiring the skills and knowledge needed to manage projects effectively. Here are some advantages of training PMs and researchers in PMT practices:

- Improved Project Outcomes: Training on PMT practices equips PMs and researchers with the skills and knowledge required to manage projects effectively. This can result in better project outcomes, such as projects completed on time, within budget, and with the intended quality.
- Better Resource Management: Effective PMT requires efficient resource management. Training can teach PMs and researchers how to manage resources such as budgets, schedules, and deadlines, leading to improved resource management and project results.
- Increased Productivity: Training on PMT practices enables PMs and researchers to manage their time and assignments better. This can increase productivity, as they can concentrate on tasks crucial to the project's success.
- Improved Communication: Effective communication is essential for project success. Training on PMT practices enables PMs and researchers to communicate more effectively with team members, stakeholders, and sponsors, resulting in improved project outcomes.
- Enhanced Risk Management: Effective risk management is necessary for project success. Training on PMT practices can assist PMs and researchers in identifying, evaluating, and mitigating risks, effectively reducing the likelihood of project failure.

In conclusion, PMs and researchers require training in PMT practices. It can enhance project results, resource management, productivity, communication, and risk management. Therefore, TUs should provide training opportunities for PMs and researchers to strengthen their PMT skills and knowledge.

6.1.4 The Role of the PMO or Research Support Office

A university's PMO or RSO puts PMT procedures and standards into place and keeps them there. This entails establishing and putting into PMT approaches, making, and maintaining PMT templates and tools, supplying PMs and teams with training and assistance, and keeping an eye on and reporting on

the status of projects. Along with aiding in project prioritisation and resource allocation, the PMO and RSO may offer departments and faculties advising services in PMT. The PMO's and RSO's ultimate objective is to guarantee that all projects are finished on schedule, within budget, and to the satisfaction of all stakeholders. According to Clark (2008), PMOs are designed to help organisations accomplish the work associated with their projects.

The following are some of the critical benefits of having a PMO or RSO in a university:

- PMT has improved thanks to the PMO or RSO, which works to make sure that all projects are managed consistently and efficiently, which can result in better project outcomes.
- Efficiency gains: The PMO or RSO can aid in streamlining PMT procedures and minimising duplication of work, resulting in improved productivity and cost savings.
- The PMO or RSO can facilitate communication and collaboration across various departments and faculties, resulting in more effective PMT and greater resource use.
- Better decision-making: The PMO or RSO can offer insightful information on project performance to assist decision-makers in prioritising projects and allocating resources.
- Compliance: PMO or RSO can assist the institution in maintaining compliance with the laws, rules, and standards demanded in the educational field.
- A better approach to risk management: The PMO and RSO may assist in identifying and reducing project risks, which can help guarantee successful completion.

Better support from a PMO or RSO to a PM allows them to be comfortable with the Research project and not get caught up in administrative duties. As Wedekind et al. (2018) described, the PMO approach can help ensure that information is shared across projects through the PMO, essentially acting as a knowledgeable advisor. It is, therefore, ideally suited to the academic world and research projects where knowledge generation and dissemination are paramount. To support the previous statement Clarke (2008) clearly states that the PMO provides services such as defining and maintaining PMT standards; regulating practices across projects; sourcing project documentation; and supplying overall guidance to the institution about metrics related to PMT. Figure 28 below gives you an understanding of how to set up a PMO within a TU. Early involvement of stakeholders in the below process will determine what requirements are needed, like what PMM is to be used, like PMBOK or Agile, or if it will be an in-house/hybrid version. Many Universities and Technological use Research Management systems like Elsevier Pure, Converis (Clarivate Analytics), and DSpace-CRIS (Open source), and currently, five TUs are implementing the Elsevier Pure system. Examples of this are

Queens University and the newly formed Southeast Technological University. These systems can align with PMM and help administrators, researchers, support staff, and management with projects.
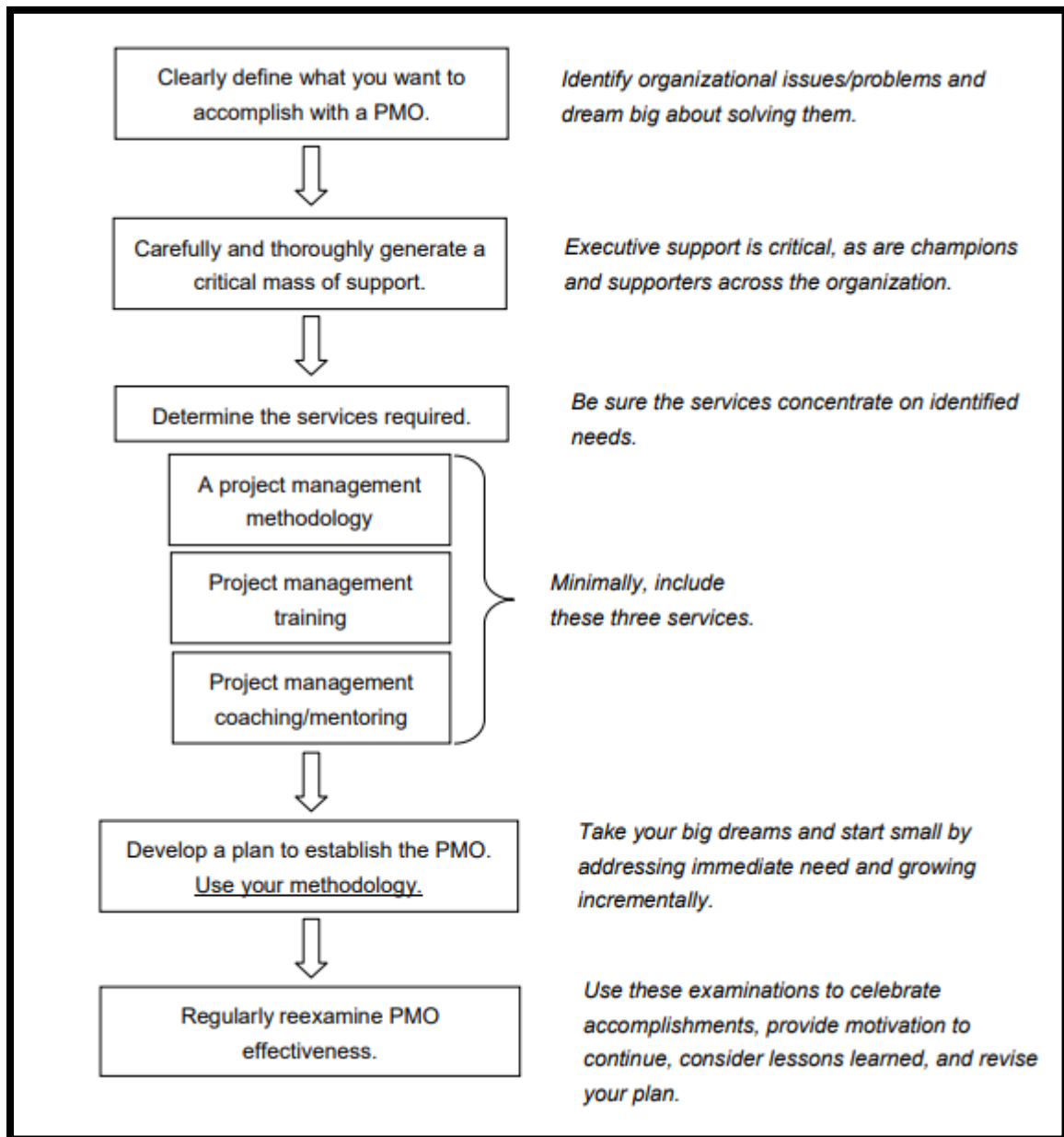

Figure 28 Steps to Establish a Project Management Office (Clark,2018)

6.2 Conclusion

Selecting the proper project methodology, providing the appropriate tools and techniques, providing training on PMT practices, and establishing a PMO or RSO, are crucial success factors for research projects.

Choosing the appropriate PMM is crucial because it determines how the project will be carried out and managed. For example, waterfall, Agile, Scrum, Lean, or Six Sigma may be appropriate depending on the nature and scope of the research endeavour or building a hybrid version that best suits the individual TUs requirements. The TU must determine this by engaging stakeholders within their TU for feedback and external stakeholders in other universities involved in research projects.

Utilising the proper instruments and methods is essential for a project's success. For example, Gantt charts, risk management software, and PMT software can assist PMs and researchers in managing resources effectively and mitigating risks. Again, like above, proper engagement with all the relevant stakeholders can assist in picking the correct tools, techniques, and software available to manage research projects.

Training PMs and researchers on PMT practices ensure they possess the necessary skills and knowledge to manage research projects effectively. This ensures projects are completed on time, within budget, and to the intended standard.

Establishing a PMO or RSO can also play a crucial role in ensuring the success of a project. A PMO or RSO can assist researchers and PMs with the best PMT governance, resource allocation, and practices.

To conclude, the proper project methodology, tools and techniques, training, PMO or RSO are crucial to the success of research projects. To ensure the success of a project, it is essential to evaluate each factor thoroughly and employ them as needed.

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Appendices

Email sent to ATU participants:

Dear ___ ,

I hope you are doing well.

My name is Aidan Higgins, and I am currently undertaking a Master's
in Project Management at the Atlantic Technological University Sligo (ATU Sligo). I am emailing you because Dr XXXXXXX referenced you as one of the leaders in research at ATU who may be interested in giving your time and professional opinion in completing this survey.

As part of my thesis, I have created a survey to capture opinions across the Technological Universities of Ireland regarding Project Management in Research and Research-Related Projects at our University. Please feel free to share this survey with other research-focused staff.

Below is the survey link; please complete it before 25th Feb 2023.

[Project Management in Research and Research-Related Projects at your University Survey Link](#).

Kind regards,
Aidan Higgins
ATU Galway City & Sligo
E: S00017017@atu.ie

Email sent to participants outside ATU:

Dear____,

My name is Aidan Higgins, and I am currently undertaking a Master's
in Project Management at the Atlantic Technological University Sligo (ATU Sligo).

As part of my thesis, I have created a survey to capture opinions across the Technological Universities of Ireland regarding Project Management in Research and Research-Related Projects at our University. It would be great to have your professional opinion in completing this survey.

I have included the survey link below if you can complete it before 01st March 2023. Please feel free to share this survey with other research-focused staff.

[Project Management in Research and Research-Related Projects at your University Survey Link](#).

Kind regards,
Aidan Higgins

ATU Galway City & Sligo
E: S00017017@atu.ie

Survey sent to Participants:

Project Management in Research and Research-Related Projects at your University

My name is Aidan Higgins, and I am completing an MSc in Project Management at ATU Sligo. My thesis title is "An explorative analysis of Effective Project Management of Research and Research-Related Projects within a newly formed Multi-Campus Technological University".

The survey contains 23 questions, which will take approximately 7 - 8 minutes to complete.

You are being asked to complete the following questionnaire on Project Management within your University. The information collected from this study will be used as part of a postgraduate thesis and possible presentation at Conferences in 2023. Your involvement in this study is entirely voluntary. Your response, and all data, will be treated with complete confidentiality, and all information is completely anonymous. Information will be stored online in a secure password-protected space.

You can withdraw from the study at any point before the final submission of this questionnaire,

and your response will be deleted. However, once you submit the questionnaire, you can no longer withdraw and your responses will be recorded anonymously.

Thank you for your participation.

Kind regards,
Aidan Higgins
Email: S00017017@atu.ie

1. What is Your Gender Identity?

Man

Woman

Non-binary

Prefer not to say

<table>
<tr><td></td></tr>
</table>

2.What is Your Age Category?

18-24

25-34

35-44

45-54

55-64

65+

3.Please Identify Your Technological University (TU).

Atlantic Technological University (ATU)

Technological University Dublin (TUD)

South East Technological University (SETU)

Munster Technological University (MTU)

Technological University of the Shannon (TUS)

Other

4.Which of the Following Best Describes Your Department

Research Office

Faculty/School of Science

Faculty/School of Engineering and Computing

Faculty/School of Business

Faculty/School of Humanities

Faculty/School of Creative Arts

Research Centre or Gateway

IT Services

Professional Management and Support Staff (PMSS)

Other

5.What Type of Projects are You Involved in?

Academic Research

Other

6.What would be Your Typical Project Duration?

1 to 3 months

3 to 6 months

6 months to 1 year

1 to 2 years

2 - 3 years

3+ years

7.Which of the Following Best Describes Your Role at Your University?

Research Manager

Researcher

Post-Doctoral Researcher

Research Student

Research Support Staff

Research Administrator

Lecturer

Academic Support

Technical Support

Head of Department

Head of Faculty / School

Project Manager

Other

8.Which of the Following Professional Project Management Qualifications do You have, if any?

No Professional Project Management Qualification

Private in-house Project Management Qualification within an organisation

PRINCE2 Qualifications

Association for Project Management (APM) Qualification

Project Management Institute (PMI) Qualifications (PMP) (CAPM)

Certified ScrumMaster (CSM) Qualification

CompTIA Project+ Qualification

Certified Project Manager (IAPM) Qualification

Professional in Project Management (PPM)

Six Sigma Qualifications

[ ]

9.Which of the Following Academic Project Management Qualifications do You have, if any?

Undergraduate Qualification in Project Management (Level 6/7/8)

Postgraduate Qualification in Project Management (Masters Level 9)

Postgraduate Qualification in Project Management (PhD. Level 10)

None

Other

10. How Many Years Are You Working in Project Management?

Enter your answer

10.Have You Been Offered Project Management Training and Support Within Your University?

1 - No Training or Support
2 - Some training and Support

3 - Satisfactory Training and Support

4 - Very Good Training and Support

5 - Excellent Training and Support

You are required to answer. Rating.

1

2

3

4

5

12. In Your Opinion, What are the Skills, Knowledge and Competencies Needed to be an Effective Project Manager?

	Not Important	Important	Essential	Not Sure
Strong Leadership				
Decision-Making				
Organisational Skills				
Business Acumen				
Problem-Solving				
Critical Analysis				
Oral Communication				
Written Communication				
Public Speaking				
Negotiation Skills				
Meeting Management				
Risk Management				

	Not Important	Important	Essential	Not Sure
Strategy Development				
Stress Management				

13. In Your Opinion, What Personal & Professional Qualities Needed to be an Effective Project Manager?

	Not Important	Important	Essential	Not sure
Committed to Delivering Results				
Proactive in Accepting Project Challenges				
Skilled in Problem-Solving				
Strong Leadership				
Open to Feedback and Criticism				
Decisive in Decision Making				
Flexibility in Dealing with Project Goals				
Ability to Avoid Miscommunication				
Ability to Furnish a Project Roadmap				
Ability to Remain Positive				
Strong People Management Skills				
Agile Management Style				

14. Which Project Management Tools are Used to Manage Research Projects in Your University?

Microsoft Project

Trello

Resource Guru

Jira

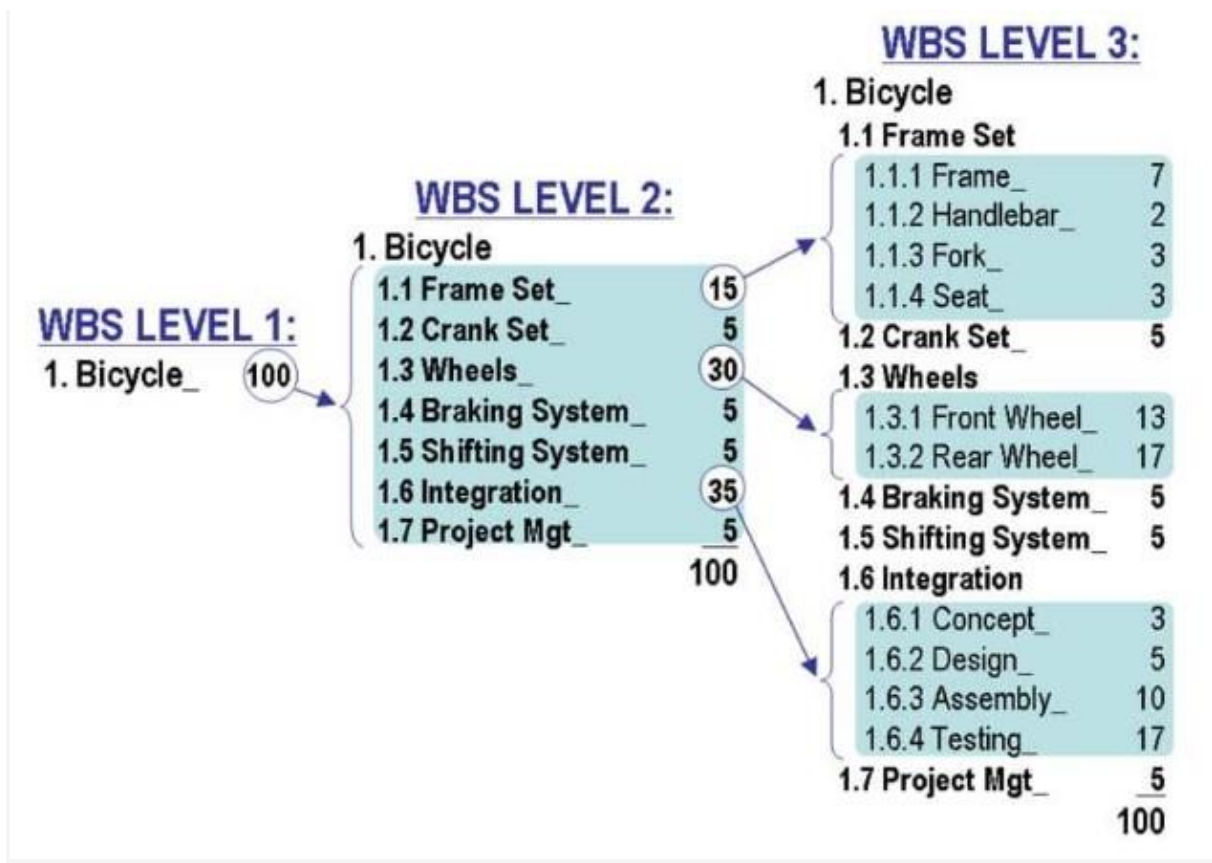Scoro

Monday.com

ClickUp

Confluence

Teamwork

Don't use any tools

Microsoft Teams

None

Other

15. Are any of the Following Techniques Available Within Your University to Help You Manage Research Projects?
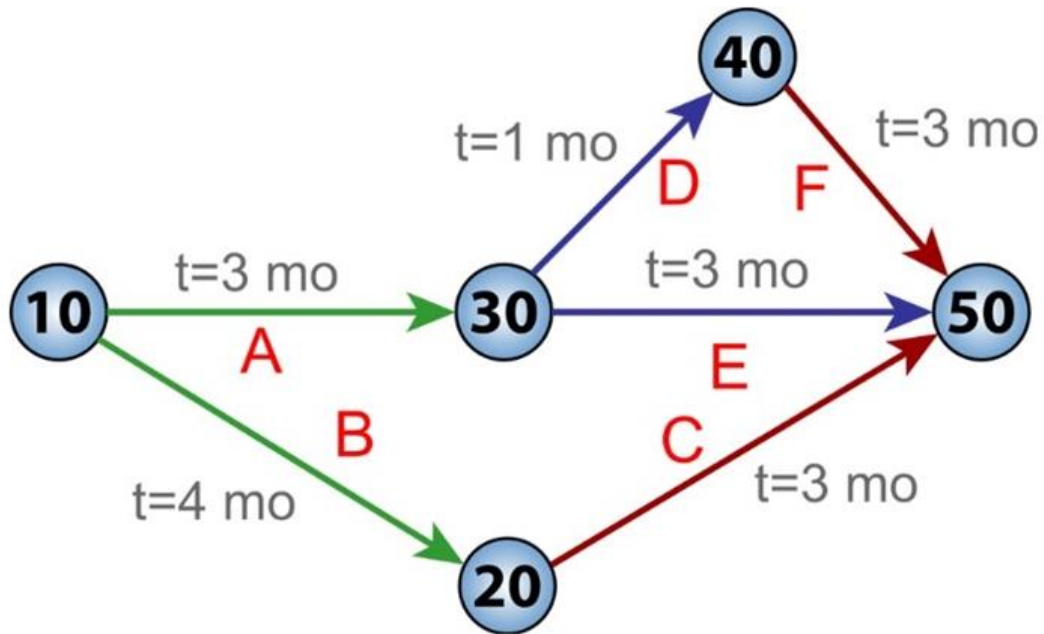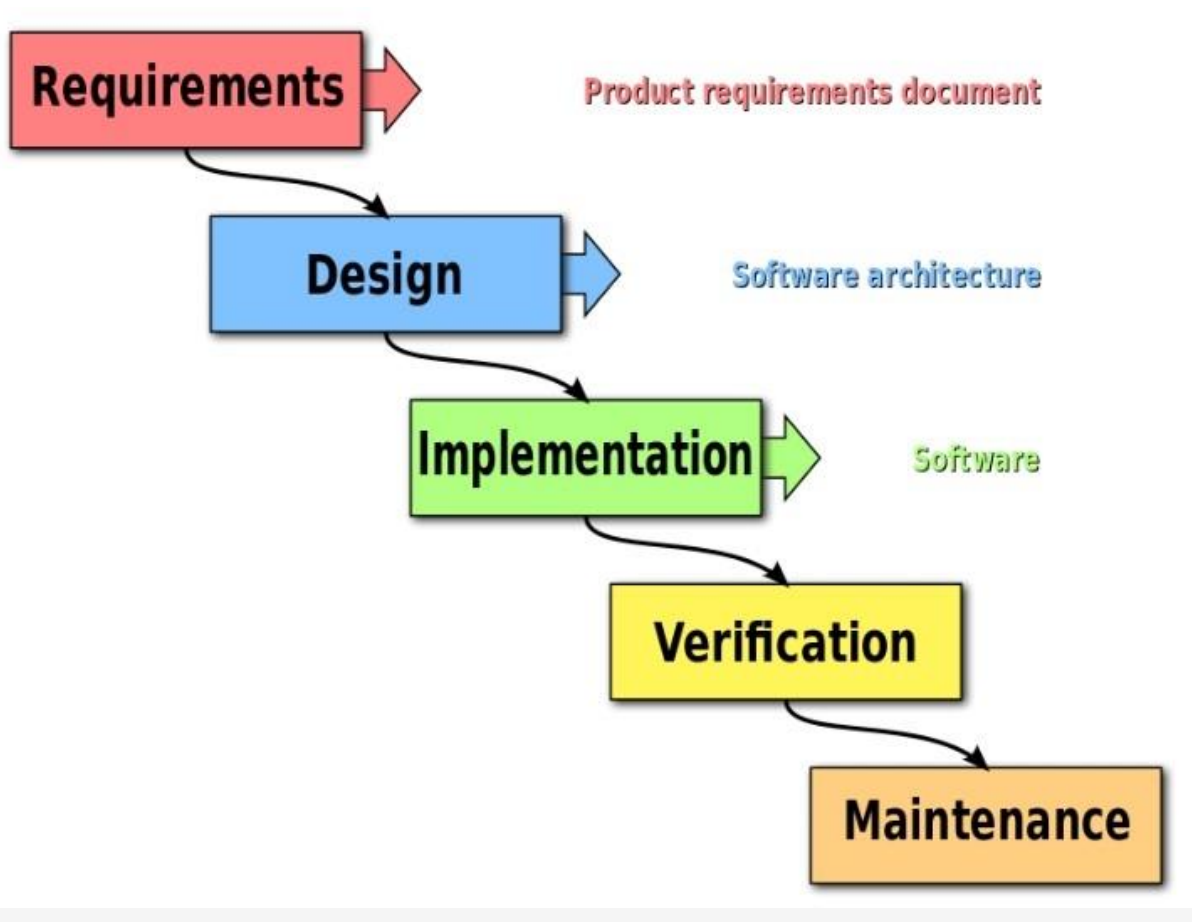

Work Breakdown Structure (WBS)

Excel Project Management Template

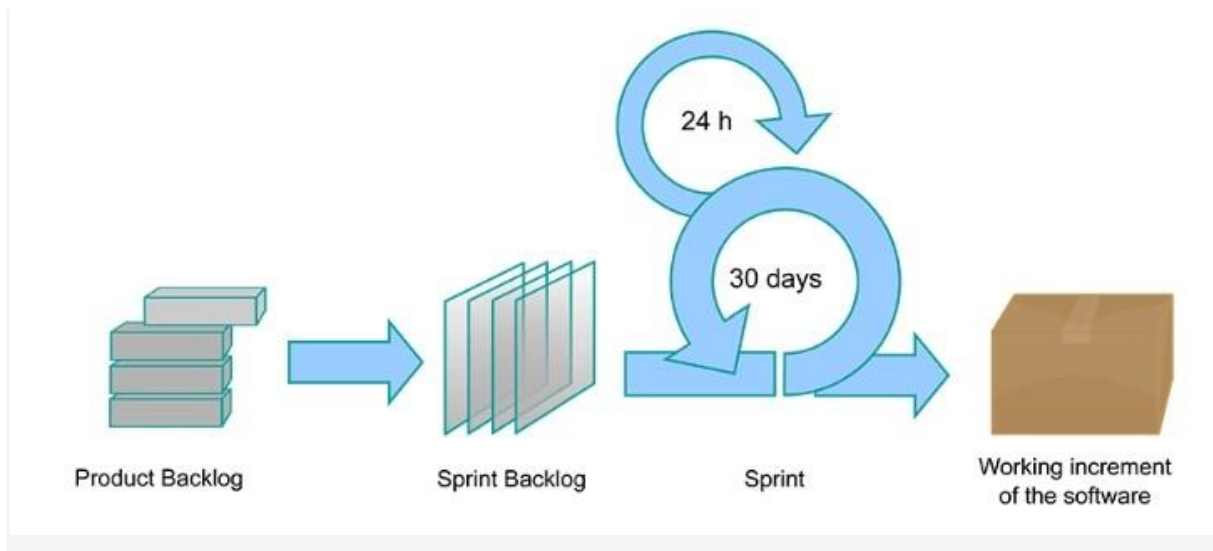|	A	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
2	**Process**	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
3	Grading and Site Preparation	■	■	■												
4	Foundation Construction				■	■										
5	Framing					■	■									
6	Installation of Windows and Doors						■	■	■							
7	Roofing								■	■						
8	Siding									■	■					
9	Underlayment										■	■				
10	Drywall												■	■	■	■	■
11	Installation of Windows and Doors															

Gantt Charts

Critical Path Method

Waterfall / Linear

Kanban

Scrum

None

Other

16. Does Your University have a Project Management Office (PMO)?

Yes

No

Don't know

Other

17. What Level of the Following Categories of Resources Dedicated to a PMO or Project Management Initiatives are in Place at Your University?

	Never enough	Adequate	Well resourced	Over resourced	I don't know
Work Resources (technical skills/knowledge/business expertise)					
Material Resources (tools/equipment/ software/raw materials/ premises)					

	Never enough	Adequate	Well resourced	Over resourced	I don't know
Financial Resources (budgets/projects grants/finance funds)					
Time Resources (project plan/project schedule/time invested)					

18. Which of the Following Stages (s) of Your Research Project do You think Requires Assistance or Support in Project Management?

N/A

Identifying Funding Opportunities (Pre-Award)

Preparing a Research Proposal/Funding Application

Budget Preparation

Submitting the Proposal

Project Planning (Post Award)

Execution of the Project

Monitoring and Controlling the Project

Closing of the Project

Other

19. Which Project Management Methodologies, if any, are Used in Your University to Help Drive Research Projects?

No Project Management Methodology

I Don't know if there are any Project Management Methodologies used.

Waterfall - projects are completed one stage at a time and in sequential order.

Agile - Project Management that is built on small, incremental steps.

Lean - aims to cut down on waste and increase efficiency.

Six Sigma - works to improve quality by identifying what is not working in the project.

Prince2 - is not like other traditional methods like a waterfall in that it's not a one-size-fits-all solution but follows seven principles, themes and procedures.

Custom/In-house Methodology

Hybrid - mixed Methodology

Other

20.Which Project Management Templates, if any, are Available in Your University, to help drive research and research-related projects?

No Templates Used

Project Charter Template

Communication Plan Template

Task Monitoring & To-Do Lists Template

Issue Tracking & Change Requests Template

KPI Monitoring Template

Team Management Template

Risk Management Template

Resource Monitoring Template

Project Tracking and Timeline Template

Budget Management Template

Other

21.In Your Opinion, what are the Benefits of Using Project Management Frameworks/Methodologies/Tools, and/or Trained Personnel to Manage Research Projects at Your University?

Please drag each of the benefits in order from top to bottom. The top is number 1 (one) most important benefit, and the bottom is number 6 (six) the least important use.

Informed Decision Making

Controlled Costs

Project Deliverables and Deadlines Met on Time

Effective Problem Resolution

Effective Risk Management

Project Team Satisfaction

22. Do You Think that Using a Project Management Framework or Methodology in Research Projects Limits the Creativity and Flexibility of the Research Process? Required to answer.

Enter your answer

23. Any other comments or feedback?

Enter your answer

Add new

Thesis Schedule

Activity	Deadline	Oct -22	Nov -22	Dec -22	Jan -23	Feb -23	Mar -23	Apr -23	May -23
Complete documentation - Ethics review & Dissertation Form	04/11/2022	▓ yellow	▓ yellow						
Programme of Action Submission	04/11/2022	▓ orange	▓ orange						
Literature Review Submission	10/02/2023					▓ light blue			
Abstract for Conference Poster Submitted - Review	17/02/2023					▓ grey			
Abstract for Conference Submitted - Final Submission	24/02/2023					▓ green			
Questionnaires & Surveys designed and agreed upon with Supervisor	10/02/2023					▓ brown			
Questionnaires & Surveys sent completed	17/02/2023					▓ blue			
Analyse results from Questionnaires & Surveys	03/03/2023						▓ purple		
Works on Thesis Submission	21/04/2023		▓ cyan	▓ cyan	▓ cyan	▓ cyan	▓ cyan	▓ cyan	
Draft Paper Submission	28/04/2023							▓ yellow	▓ yellow
Final Thesis and Paper Submission	15/05/2023								▓ red
Final Project Interview	31/05/2023								▓ dark