INTEGRATING HYBRID PROJECT MANAGEMENT PRACTICES TO OPTIMIZE THE AGILE SOFTWARE DEVELOPMENT PROCESS IN THE IT SECTOR

MASTER OF BUSINESS ADMINISTRATION IN MANAGEMENT OF TECHNOLOGY

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the Masters dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Prof. (Mrs.) T.C. Sandanayake

Signature of the Supervisor: Date: 29/07/2024

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ABSTRACT

Sri Lanka's Information Technology industry is a key export earner, influencing various industries and directly impacting the nation's economy. To ensure a project's success, firms must select Project Management approaches that are appropriate for the project. Agile is a popular and widely used methodology in the IT sector due to the countless benefits it provides, while it offers precedence in terms of flexibility, there are also definite drawbacks as well.

This study examines on enhancing the agile software development process by incorporating traditional methodology factors, coming together in a hybrid manner to overcome the issues faced in agile resulting in project effectiveness. A comprehensive analysis of theoretical models and empirical results in the literature review has led to identifying of six key constructs. Namely delivery strategy, software development techniques, team capability of agile and requirement clarity, efficient communication in traditional methodology. Later the impact of the moderator, project duration was examined to see the moderating effect of three constructs on project effectiveness. The study adopts a quantitative research methodology and a deductive approach. This study has employed convenience sampling technique, and the structured questionnaire was distributed among them. With a total of 150 responses, using primary data the analysis was conducted.

The data analysis recommends that agile constructs and traditional methodology constructs can come together as a hybrid project management methodology to resolve the identified agile issues and achieve project effectiveness based on time, cost, quality, team, and client satisfaction. The research would be significant for medium to large-scale IT companies currently using the agile since it would help to mitigate issues in agile by developing a hybrid project management approach to achieve higher project effectiveness. Future research opportunities are proposed to explore the enhancement of agile software development process while taking other success methodologies into account.

Keywords: Agile methodology, Traditional methodology, Hybrid project management, Project effectiveness.

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LIST OF ABBREVIATIONS

Abbreviation	Description
IT	Information Technology
PM	Project Management
TPM	Traditional Project Management
HPM	Hybrid Project Management
SD	Software Development
SPSS	Statistical Package for Social Sciences
Sig.	Significance

LIST OF APPENDICES

CHAPTER 1 - INTRODUCTION

1.1 Background of the study

Sri Lanka's Information Technology (IT) industry is one of the country's top export earners, with over 500 registered firms fueling the country's economic growth, technological improvement, and job creation (Sri Lanka export development board, 2023). Considering IT influences numerous industries, it plays a vital part in the everyday operations of the country, and the success or failure of such initiatives dismissed by corporations would have a direct impact on the nation's economy.

To ensure a project's success, firms must select Project Management (PM) approaches that are appropriate for the project. There are numerous PM approaches that can be employed in medium to large-scale IT firms, each with its own set of positive and negative aspects. Agile approach is one of the most popular and widely utilized project management strategies in the IT sector (Kumar, Bhatia, 2012).

Agile methodology is a more adaptable and efficient approach to bringing things to market. It focuses on iterative progress, flexible planning, and client collaboration. This methodology prioritizes delivering functional and valued results quickly and regularly, allowing teams to respond to changes and improvements as they occur. However, despite its popularity, agile has several downsides when it comes to handling IT projects (Sharma, Sarkar, Gupta, 2012).

In order to handle agile-based projects successfully and increase customer satisfaction, collaboration, and adaptability to changing market conditions, this study aims to identify such weaknesses and explains how to overcome them by implementing Traditional Project Management (TPM) methodology practices.

1.2 Research problem

The IT industry is renowned for its quick changes and unpredictable nature, making project management challenging for the most part. These uncertainties include constantly changing requirements, the technology being utilized, and team members' reluctance to change. In 2008, industry officials has reported a 70% failure rate in delivering project requirements in the Sri Lankan IT industry (Fonseka, 2011). Hence, the IT sector is constantly looking for ways to satisfy these demands while adhering to PM standards and enhancing the current software development process.

Since Agile can adapt and deliver solutions in small increments, Agile has acquired great traction in IT projects in recent years. Despite its widespread use, the Agile methodology has drawbacks and challenges of its own.

IT organizations are losing billions of dollars annually due to project failures that never attain operational maturity (Varajão et al. Magalhães, 2018). Companies are encouraged to search for better approaches to be successful in medium-large scale projects because the average success rates of projects utilizing agile processes are 54%, while those utilizing traditional-waterfall processes are 35% (Khalil, 2017).

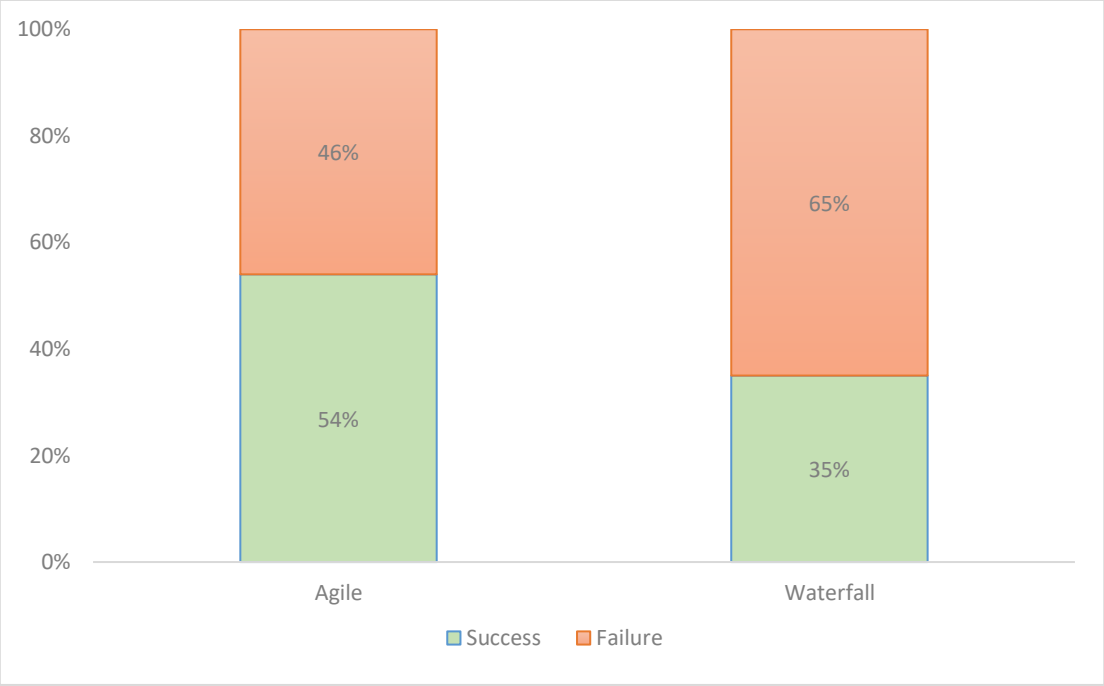


Figure 1.1: Success and failure rates of Agile and Waterfall methodologies. Adapted from (Khalil, 2017)

In medium-sized to large-scale IT companies, poor resource planning, underuse of collaboration and communication, lack of management support, ongoing requirement changes, unclear definition of done, and insufficient documentation are just a few of the common issues with agile methodology (Sharma, Sarkar, Gupta, 2012).

Although agile methodology embraces requirements modifications, scope creep can occur resulting from improper management and resource allocation. Scope creep is where project scope grows beyond its initial limits and predetermined requirements. Establishing a reliable project plan and definition of done for user stories can also be challenging when there are frequent changes. Agile teams often struggle with defining clear criteria for when a user story or feature is considered as "done." Such lack of clarity may result in miscommunications and incomplete tasks.

Agile values individuals and interactions over processes and tools. However in large organizations, it might be difficult to follow this idea when it comes to teamwork and communication. There would be a mismatch of team effort and resources without allocating enough time for team communications, which would result in lower code quality and overlooked issues.

Agile favors working software over comprehensive documentation. Although it might increase productivity, a lack of documentation could cause issues in knowledge transfers during project or resource changes, and maintenance tasks.

Agile’s focus on in-person communication can be difficult in distributed remote teams or when stakeholders are disengaged. This may result in a lack of empowerment and misaligned expectations.

Among these recognized global reasons for project failure, Sri Lanka encounters similar issues despite the significant progress in Sri Lanka's IT industry (ICTA, 2020). Inadequate communication, overlooking the role of individuals, lack of good planning and management were recognized as the primary causes of this failure (Gamage, 2017). So, this study aims to utilize existing, effective TPM approaches to incorporate them with Agile to overcome the gaps and issues in it.

1.3 Research questions and objectives

The following series of questions will be addressed by this research:

1. In what ways do agile practices differ from theory in medium – large scale IT companies?
2. What limitations of the existing agile methodology are overcome by incorporating traditional PM as a hybrid project management approach?
3. What ways can a project modify their agile project management approach currently being used to achieve project effectiveness?

The following series of objectives will be attempted to accomplish by this research:

1. Identify the existing issues in managing IT projects using an agile-based methodology.
2. Examine the best practices to consider in managing IT projects in an agile-based methodology.
3. Identify the suitable traditional PM practices that could be incorporated with the agile methodology.
4. Provide recommendations on utilizing both traditional and agile based hybrid project management practices in software development to achieve project effectiveness.

To support the above research questions and objectives, this research will adopt a quantitative research methodology following a deductive approach to focus on enhancing of agile software development process using hybrid PM practices. Research designs, sampling techniques, and data collection methods will be considered prior to the data analysis. Data analysis would be done with statistical techniques comprising of data screening, demographic data analysis, reliability, validity, diagnostic tests followed by correlation and regression analyses.

1.4 Significance of the study

The study would be significant for medium to large-scale IT companies that currently employ agile methodology since it will emphasize issues that the project teams are now facing while embracing the methodology. Then the study will contribute to reduce that gap and assist Sri Lankan IT companies to explore other TPM approaches and determine the most effective approach to combine with agile to achieve project success.

An effective Agile PM methodology can lead to quality project outcomes, higher client satisfaction, enhanced flexibility in the face of change, and maintain an engaged and empowered team. These advantages support a project delivery process that is more robust, successful, and efficient, which eventually fosters organizational success.

Finally, the IT and academic industry will likewise benefit from this study due to the research contributions. The results and analysis of this study would promote industry expansion and result in the creation of a hybrid project management (HPM) methodology that would be more appropriate for medium-sized to large-scale IT firms.

1.5 Thesis outline

There are five chapters in this research, and each chapter has multiple sections. This study's chapters and sections aim to comprehensively address all relevant information and data in an orderly way.

Chapter one provides a comprehensive description of the research. The background of the study, the research problem that’s being addressed, the questions that prompted the research, and the objectives that the author is trying to accomplish with the significance of the study.

Chapter two represents a conceptualization framework supported by the literature review conducted, assessing the past body of research on Agile and traditional project management approaches in the software development (SD) process. Followed by identifying the independent, dependent, and mediator variables and hypotheses development.

Chapter three represents the research methodology comprising of the operationalization of variables, research design, population, and sampling method followed by the data collection techniques.

Chapter four represents the data analysis obtained through the use of statistical techniques comprising of data screening, demographic data analysis, reliability, validity, diagnostic tests, and finally correlation and regression analyses.

Chapter five represents the critical discussions based on the research findings to accomplish the predefined research objectives.

Chapter six concludes the main findings of the study and gives a broad summary of the investigation. It also goes over the research's recommendations, shortcomings, and what can be considered for future research.

CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

The literature review examines how Agile approaches are becoming more and more significant for project management, especially when it comes to IT projects. Since its introduction in 2001, Agile's adaptable and customer-focused style has impacted PM techniques in a variety of industries. This literature review explores the benefits and challenges of using Agile principles in project management. This section also examines the TPM methodology's success elements, which can be merged with Agile to create a hybrid PM approach.

The goal of the literature review is to identify best practices for deploying hybrid approaches for an agile project and to emphasize the advantages that these approaches offer by examining academic articles, research studies, and industry reports. In the end, this evaluation of the literature helps to pinpoint knowledge gaps, highlights areas of agreement, and guides practitioner choices to fully utilize Agile's potential for effective project results.

2.2 Project management in IT sector

Project management is a set of guidelines and practices that need to be adhered in order to complete a project. It is one of the key factors determining whether a project succeeds or fails, and just 2.5% of companies are able to finish their projects and attain a 100% success rate within the project duration (Rasnacis & Bērziša, 2015). Therefore, choosing an appropriate project management strategy is crucial.

Enhancing the likelihood of project completion success is the ultimate goal of project management. This purpose stems from a few of their numerous other objectives, which include process improvement and completing the project with the necessary level of quality (Špundak, 2014).

In the IT industry, there is currently a vast array of PM methodologies in use. This section looks at two such different methodologies that are widely used in medium-to large-scale IT companies namely, Agile and traditional methodologies (Coursera, 2023). To adapt to the ever-changing needs of industry projects, IT organizations must continuously evolve (Nerur, Mahapatra, Mangalaraj, 2005). Owing to this continuous

evolution, the management methodologies also need to adapt in order to push beyond the challenges preventing the project team from rolling out smoothly.

2.2.1 Theories influencing project management

A theory provides a comprehensive explanation for conclusions and observations drawn over time and under various conditions (Dorin, Demmin, & Gabel, 1990). The theoretical foundation of this research will focus on theories related to both project management and the success criteria identified in the models employed in this thesis.

2.2.1.1 Theory of triple constraints

Project management can be used to improve the success of a project. Over the last 50 years, the three constraints of time, cost, and quality have been closely linked to measuring project success (Navarre & Schaan, 1990). These constraints were later identified as the iron triangle (Atkinson, 1999), which are crucial for the project managers, who are usually associated with attempting to achieve the project's target successfully (Jha & Iyer, 2007).

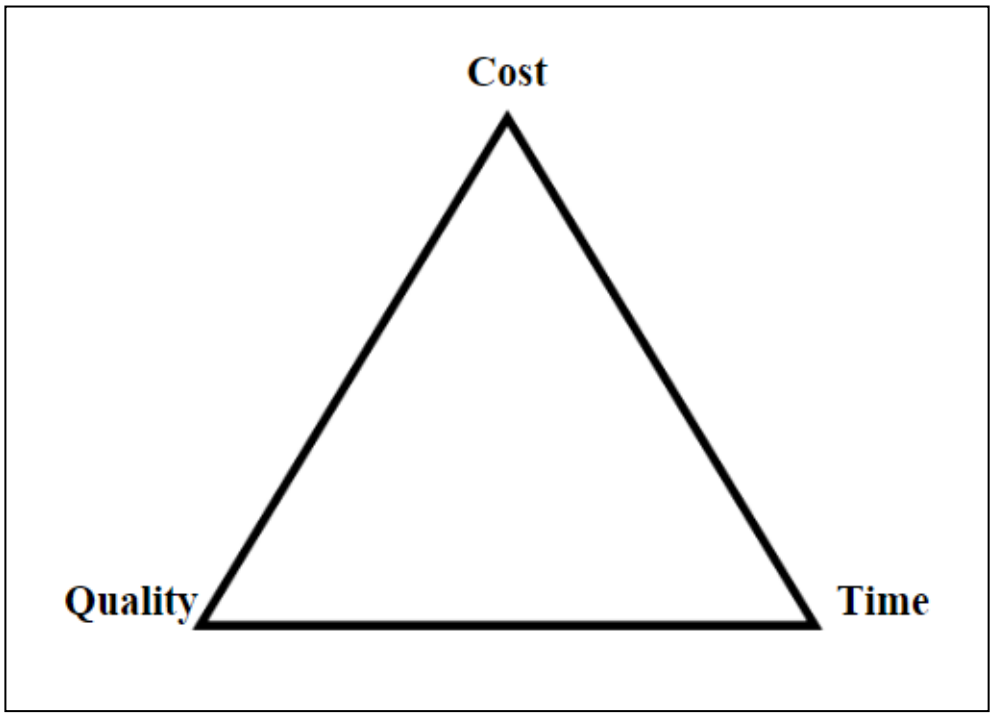


Figure 2.1: Triple constraints. Adapted from (Navarre & Schaan, 1990)

Time refers to the amount of time required to complete the job at hand, which can range from days to months. The budget is the project's total cost, which includes the cost of resources, people, and software platforms utilized during the project duration. The

scope of the project relates to the objectives that the client hopes to achieve through this project (Venkataraman & Pinto, 2008). The triple constraint theory is crucial in this study because, in order to achieve project effectiveness with a hybrid methodology. All three primary elements play an important role, and so each project must be acquainted with the essential skills in the management of these constraints.

However, as agile methodologies and alternative perspectives have emerged, the triangle's significance as a solitary determinant of project success has begun to be called into question (Ika, 2009). Clearly, the three traditional constraints still play a crucial role in achieving project success, However, more subjective soft variables, such as client satisfaction, should also be considered when determining project success (Ika, 2009) (PMI, 2017) (Lee & Baby, 2013).

2.2.1.2 Stakeholder Theory

The Stakeholder Theory describes how management should satisfy the needs of project stakeholders. It states that for a project to be successful, it must generate value and satisfaction for consumers, employees, suppliers, communities, financiers, shareholders, banks, and other stakeholders (Freeman, 1984).

Failure to follow stakeholder theory by not delivering client and team satisfaction in many projects can lead to project failures, especially if Stakeholder A (Client) is unaware of what Stakeholder B (Team) is doing. The integration of client and team satisfaction in project procedures is widely acknowledged as a critical component in project success (Freeman, 1984).

Considering client satisfaction as a success constraint leads to quicker reaction times, and more effective project work resulting in project success (Lee & Baby, 2013). Good teamwork can also lead to greater project success, demonstrating the value of team satisfaction as a project success constraint. This element has become increasingly relevant throughout the years. Showing gratitude, raising morale, increasing responsibility, and providing recognition can all contribute to team happiness and project success (Müller & Turner, 2007). Both triple constraints and stakeholder theories aim to improve effectiveness within projects and are prominent in the field of project management. So, to measure the success of the HPM approach, the researcher considers the theory of triple constraints along with the stakeholder theory.

2.3 Agile project management

Agile procedures suggest the ability to thrive in a constantly changing environment because the word "agile" itself denotes flexibility and responsiveness (Anderson, 2003). In order to stay in business, software must not only be released with fewer errors but also by continually monitoring evolving user and marketplace demands (Cockburn, 2002). Therefore, the agile methodology was established to deliver the project to end customers in an iterative manner within a specific timeframe in order to offset the constantly changing nature.

Agile project management is based on the fundamental concepts of agility and adaptable capacity, which enable quick and effective responses to changing requirements (Paul Clarke, 2015). These concepts can be explained via the agile principles of iterative processes, responsive to change, empowered teams, continuous improvement, and incremental delivery (Omonije, 2024).

In the context of iterative processes, agility and adaptive capacities clarify that short development cycles enable teams to promptly integrate input and modify plans. In context of responsive to change, Agile values responding to change, enabling teams to adjust quickly. In context of empowered teams, self-organizing teams make rapid decisions based on real-time insights. In context of continuous improvement, regular retrospectives foster ongoing enhancements in methods and practices. And finally in context of incremental delivery delivering small, functional increments allows for ongoing adaptation (Omonije, 2024) (Prisca Amajuoyi, 2024).

The agile manifesto makes it very evident that it emphasizes people and interactions over processes and systems, which was the previous industry standard. This is the fundamental idea behind agile. Agile values functioning software more than detailed documentation, even though it is also necessary. Secondly, agile encourages customer collaboration above contract negotiations and permits an iterative approach rather than depending on a single plan (Cockburn, Highsmith, 2001).

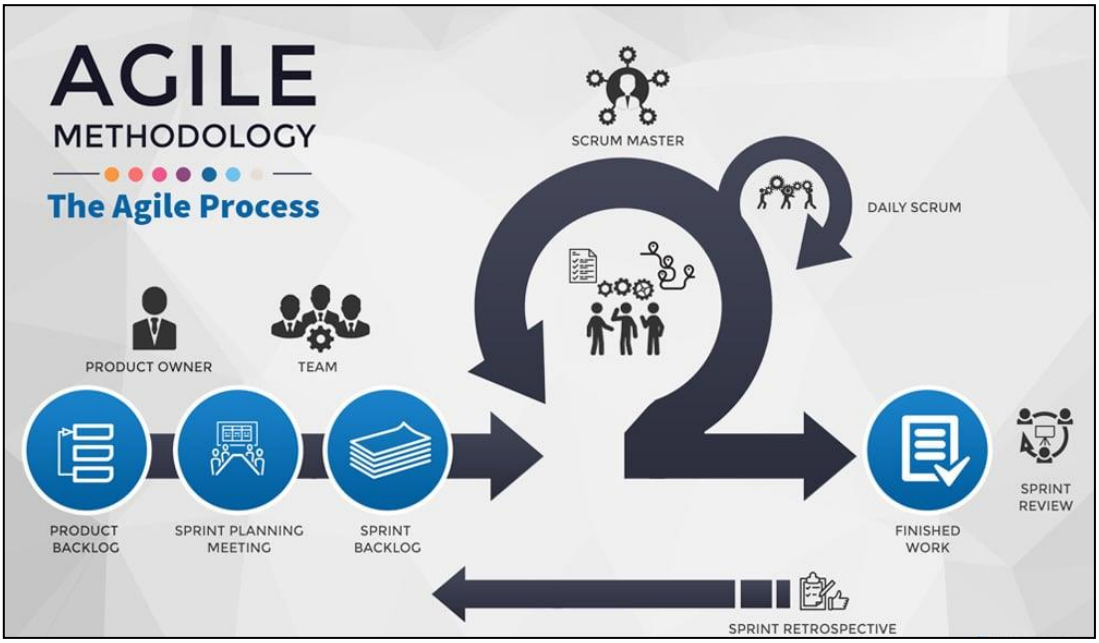


Figure 2.2: Agile process. Adapted from (Bydrec,2019)

The agile process, which plans, designs, develops, tests, deploys, reviews, and delivers products iteratively, is depicted in the above diagram. Starting with the product backlog, the product owner creates a list of tasks for the development team. The product owner allocates user stories to the sprint backlog based on the availability and priority of the requirement and gives a point of measure of effort to those stories with story points and expected completion dates after conferring with the agile team during the planning meeting. The agile team would then start working on those stories, developing, and testing them during the sprint, while participating in daily scrums to assess their progress. Once the stories are completed and the team determines what constitutes as done, they can deploy the product to live users or clients.

2.3.1 Agile methodology success factors

The agile methodology success criteria were derived using Chow and Chao's critical factors for project success (Tsun Chow, Dac-Buu Cao, 2007). Through a regression analysis, out of the twelve hypothesis mentioned in Figure 2.3, only three were found to be critical success factors for agile projects according to their analysis (delivery strategy, agile software engineering techniques, team capability).

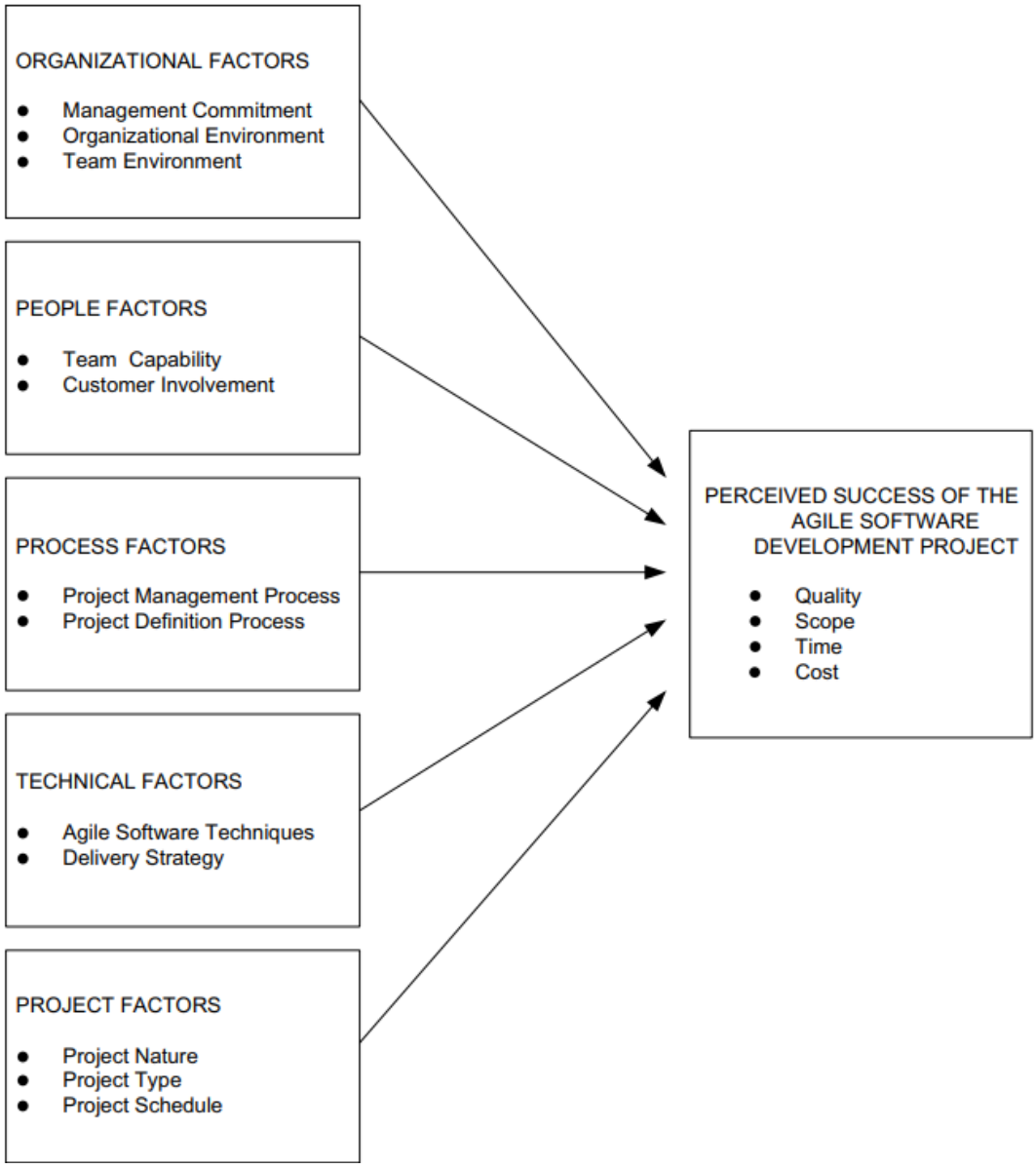


Figure 2.3: Agile Process Success Factors. Adapted from (Tsun Chow, Dac-Buu Cao, 2007)

2.3.1.1 Delivery strategy

The delivery strategy of the Agile methodology centers on the consistent delivery of software solutions, emphasizing customer satisfaction, adaptability, and continuous improvement (Tsun Chow, Dac-Buu Cao, 2007). On-time delivery strategy

is one of the most influential factors for the increase in project effectiveness (Elvan Kula, 2022). Two essential components of Agile's delivery strategy are regular delivery of software and delivering the most important features first (prioritization) (Tsun Chow, Dac-Buu Cao, 2007).

Agile emphasizes delivering working software frequently, typically in short timeframes called sprints or iterations. This contrasts with traditional waterfall methodologies where software is delivered in large batches after lengthy development and testing cycles. Regular delivery ensures that clients or stakeholders receive tangible results early and often, enabling feedback and allowing modifications based on changing requirements or insights gained from prior deliveries (Beck, 2001). By delivering software regularly, Agile teams mitigate risks associated with large-scale deployments and enable stakeholders to evaluate progress continuously. This also helps in managing expectations and maintaining transparency throughout the development process (Jain, Sharma, & Ahuja, 2018).

Requirement prioritization is another essential stage in the delivery strategy, since not every client requirement can be fulfilled to the same extent. The goal of requirement prioritization is to deliver functionalities that satisfy customers and adhere to project constraints using techniques like user story points, MoSCoW prioritization, or the Kano model, while eliminating requirements that are not worth delivering (Suzanne Robertson, 2015). Stakeholders can get the most out of the software as quickly as possible using this prioritization technique. Early market feedback is facilitated, basic concepts may be quickly validated, and possible risks or obstacles can be identified early on. Furthermore, early delivery of high-priority features creates momentum for the project, boosts stakeholder confidence, and lays the groundwork for later iterations or releases (F. Hujainah, 2018).

2.3.1.2 Agile software development techniques

In Agile, software development techniques are employed to facilitate iterative, flexible, and collaborative development. These techniques help Agile teams to ensure efficient coding, maintainability of the project, and a robust testing strategy so they can deliver high-quality software increments efficiently while responding to constant requirement changes and customer feedback (Tsun Chow, Dac-Buu Cao, 2007).

Coding design in Agile methodology refers to the methods and techniques that Agile teams employ to produce high-quality, flexible, and maintainable code. Most Agile teams establish clear and well-defined coding standards at the beginning of the project. These standards define rules and norms for naming conventions, formatting, coding style, and other aspects of code quality. Code reviews are an essential practice for maintaining well-defined coding designs to improve code quality, identifying issues, improve code readability, promote consistency, and identify opportunities for code refactoring (Bernhart, Mauczka, & Grechenig, 2010). Practicing well-defined coding standards promotes consistency throughout the codebase, making it easier for developers to comprehend, maintain, and collaborate on the code. Coding standards help to increase code readability, decrease errors, and raise overall software quality (Eisty & Carver, 2022).

Maintainability in Agile is fostered through iterative and incremental development, which allows to maintain continuous improvement and modification of the software (Agrawal, 2019). By splitting the development process into separate manageable increments, Agile teams can focus on delivering individual pieces of functionality at a time while ensuring that the code remains maintainable and adaptable (Agrawal, 2019). Daily scrums and progress meetings also support maintainability by encouraging communication, collaboration, and proactive problem-solving within the team. By discussing progress and potential roadblocks on a daily basis, Agile teams can identify opportunities to improve the software and resolve any blockers faced (Biely, 2024). By adopting these Agile techniques, teams may create software that is not only functional but also simple to maintain, change, and extend as needed.

Testing in Agile methodology is a crucial aspect of the SD process, ensuring that the final product meets quality standards, requirements, and user expectations. Agile testing places a strong emphasis on early testing in the development process known as "Shifting left", where testing can begin during the planning and requirements gathering stages where user stories and acceptance criteria are defined. Early stage testing helps in identifying defects and errors early in the development process, where fixing them will cost less money and take less time. It ensures that possible defects are identified and fixed before they escalate into more significant defects. Test automation is a key component of Agile testing, enabling teams to execute tests quickly, frequently, and consistently (Azarkerdar, 2018).

2.3.1.3 Team capability

Team capability and individual capability influence agile SD performance and project success. Team capability in Agile methodology refers to the combined abilities, competencies, and effectiveness of Agile team members in delivering value to their clients (Mendes, Viana, Vishnubhotla, & Lundberg, 2018). It includes a variety of topics such as team motivation, managerial influence, and agile trainings received (Tsun Chow, Dac-Buu Cao, 2007).

Agile promotes a culture of cooperation, freedom, and empowerment, encouraging team members to take responsibility of their work, make collective decisions, and continuously improve. Agile emphasizes sustainable development, which includes maintaining a healthy work-life balance for team members by encouraging reasonable working hours and time off by prior planning on timelines and resources allocated (Melo, Santana, & Kon, 2012).

Managerial influence determines the degree of a manager's adaptiveness to change and capable of facilitating collaboration while encouraging creativity of team members. Agile Managers must adopt the agile attitude, be responsive to changes in project requirements, goals, and procedures, and update plans and strategies as needed to suit changing circumstances. Agile managers should act as facilitators, enabling team members to collaborate effectively and maximize their potential. Managers should promote open communication, trust, self-organization in teams and eliminate barriers, provide resources and guidance when needed (Yang, Huff, & Strode, 2009).

Agile teams often undergo various Agile trainings to enhance their capabilities and adapt to Agile principles and practices. Agile methods are frequently ineffective when used immediately. Instead, agile coaches must grasp the context and adjust accordingly. Implementing the appropriate values is critical for agile development. Agile coaches assist projects in defining the values they wish to work with and the direction the project should pursue (Stray, Memon, & Paruch, 2020). Agile awareness training and continuous learning play an important part in project success. Before beginning a new project or when a new member joins the team, the team should receive theoretical training on agile, including an explanation of why the relevant practice is beneficial and should be adopted (Heidenberg, Matinlassi, Pikkarainen, Hirkman, & Partanen, 2010).

2.3.2 Agile methodology challenges

While the agile methodology offers benefits in terms of flexibility, there are also definite drawbacks. It is essential to acknowledge and address these drawbacks in order to ensure the achievement of project success. These commonly identified challenges are recognized as the gaps that need to be filled in the structure of this study. A lot of companies struggle to operate in a fully agile manner due to the three factors listed below (Sharma, Sarkar, Gupta, 2012).

2.3.2.1 Limited customer interaction

Customer participation is the foundation of the agile process, since the entire project is produced in accordance with the requirements provided by the clients. Consequently, in the event that the client representative is uncertain about the product feature changes, the development process will deviate (Sharma, Sarkar, Gupta, 2012). A misalignment of team effort and resources would result in lower code quality and undetected defects if the entire team wasn't included, and enough time wasn't scheduled for team discussions with the customers or clients.

2.3.2.2 Lack of documentation

Agile, as we all know, puts working software ahead of extensive documentation. Since the internal design is always changing based on user requirements, it is impossible to maintain complete documentation of design and execution due to the project schedule (Boehm, Port, 2001).

Although this can increase productivity, lack of documentation makes it difficult to carry out maintenance tasks, accurately modification of requirements, new joiners recruited for the project, and transfer knowledge during project or resource shifts (Sharma, Sarkar, Gupta, 2012).

2.3.2.3 Constant requirement changes

If the clients consistently alter their requirements and are not happy with the partially built software in a given iteration, there is no use in developing the incrementally developed piece of the project. As a result, all of the time, energy, and money expended would be in vain, and the team would also be financially impacted. Furthermore, developing and testing the project anew would need a substantial amount of rework (Sharma, Sarkar, Gupta, 2012).

2.4 Traditional project management

The TPM methodology involves completing a project in a step-by-step manner, working towards a final release to end users, and the client (see Figure 2.4). In anticipation that there won't be any changes to the plan, a thorough plan is made beforehand to cover the release and then execute linearly.

The model is sequential, as shown below, and it begins with a thorough requirements analysis and collecting where project demands are precisely recorded. The design phase then precisely specifies the project's architecture and user interface. Using the design guidelines, coding, and development are carried out during the implementation stage. Afterwards, testing is done to identify and address any issues before deployment. To ensure the product operates efficiently, once it is deployed into the production environment, continuous maintenance and support are provided.

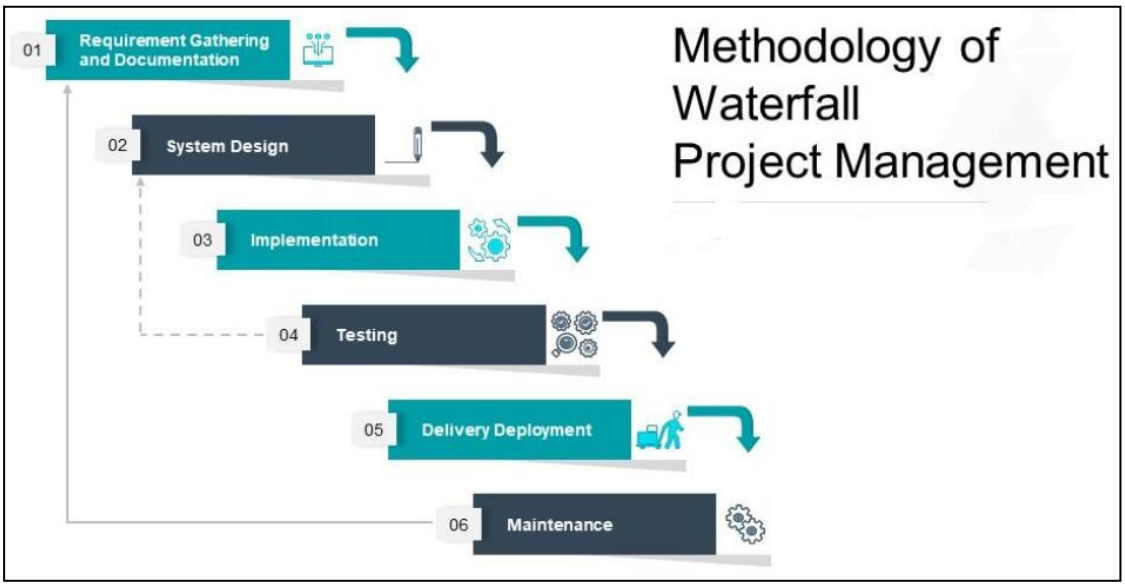


Figure 2.4: Traditional PM process. Adapted from (SlideTeam, 2024))

The aim of traditional project management is to finish the project within the projected triple constraints of time, scope, and budget by adhering to an exact, efficient, and optimal initial plan (Špundak, 2014). Later studies have criticized this methodology since it emphasizes too much on satisfying the famous triple constraints, but the role of customer satisfaction has been ignored (Vahidi & Greenwood).

2.4.1 Traditional methodology success factors

There are certain advantages to adopting this methodology, even if it is more appropriate for smaller projects, costly, and less flexible to changes within the project lifecycle: (Mahajan, 2022) (Lucidchart, 2018).

- Lay emphasis on thorough and understandable documentation.
- Establishes the end goal early.
- Follows a precise and well-defined list of actions.
- Frequent client involvement

These benefits identified from different literature reviews are categorized into the following two factors for this research purpose:

2.4.1.1 Requirement Clarity

Requirement clarity in traditional methodology focuses on detailed documentation practices and clear requirement definitions to ensure that project requirements are well-understood and documented before the start of development.

Traditional methodologies, often rely heavily on comprehensive documentation to capture project requirements which would reduce the team's workload and increase the maintainability of the project (McGovern, 2010). Requirements documents usually comprise detailed documentation of functional and non-functional requirements, user stories, use cases, system specifications, flowcharts, data models, sequence diagrams, and acceptance criteria. The team maintains continuous and parallel documentation throughout the project's lifecycle, and they can be used as a reference by the project team, stakeholders, and even the clients (Rong, et al., 2019).

Requirement definitions play a critical role in initiating and planning the project in a traditional approach. Each functional and non-functional requirement is well-defined, with little potential for ambiguity or misinterpretation (Kramer, 2018). Stakeholders work together to verify that the requirements accurately reflect their expectations, with any disagreements or concerns resolved before development begins. Once the requirements are documented, they are properly communicated to the project team, ensuring that everyone understands the project's scope, objectives, and deliverables. And, based on them, the project manager creates a project plan in the early stages of the project outlining the activities, tasks, milestones, resources, and dates for delivery

(Gupta, Mata-Toledo, & Monger, 2011). This structured approach helps in risk mitigation, effective resource management, and project delivery within scope, schedule, and budget restrictions.

2.4.1.2 Efficient Communication

Efficient communication in traditional methodology covers regular client involvement and the maintenance of formal meeting minutes (record maintenance) to ensure that project communication is effective and transparent.

Clients are engaged in the project at various stages in traditional methodology. They attend regular meetings and presentations with the project team to discuss project status, address problems, make decisions, and provide feedback and approvals on project deliverables. Frequent client involvement ensures that project progress is consistent with changes in client expectations and requirements, lowering the risk of misalignment and misunderstandings (Bakalova & Daneva, 2011).

Record maintenance covers how the project team maintains formal minutes of meetings after client discussions and ensures clients' requirements don’t conflict with existing records. Formal meetings with clients are frequently held to discuss project requirements, progress updates, decisions, and other relevant topics. During these discussions, a project manager or meeting secretary responsible for taking minutes would record key discussion points, action items, final decisions, and any follow-up tasks or responsibilities assigned. This would save the team time and effort from analyzing client records or calling them to clarify concerns (Whittaker, Laban, & Tucker, 2005).

2.5 Hybrid project management

The two most important and commonly applied project management approaches have been discussed thus far. The HPM technique basically involves combining two or more distinct PM methodologies to produce a new approach. In today's complex project environments, the hybrid model aims to find a balance between adaptability and structure, and it could address some of the challenges with the agile technique.

Since applying this methodology to small-scale projects would result in the use of project resources waste, it is advised to utilize it for medium – large scale IT projects (Copola, 2020).

Since choosing only one approach will not best suit the project to achieve project success, it appears that the ideal methodology would require mixing components from agile, the most successful methodology with traditional methodology (Špundak, 2014). Owing to these reasons, the study aims to examine suitable hybrid approaches to implement as PM approaches in the IT industry.

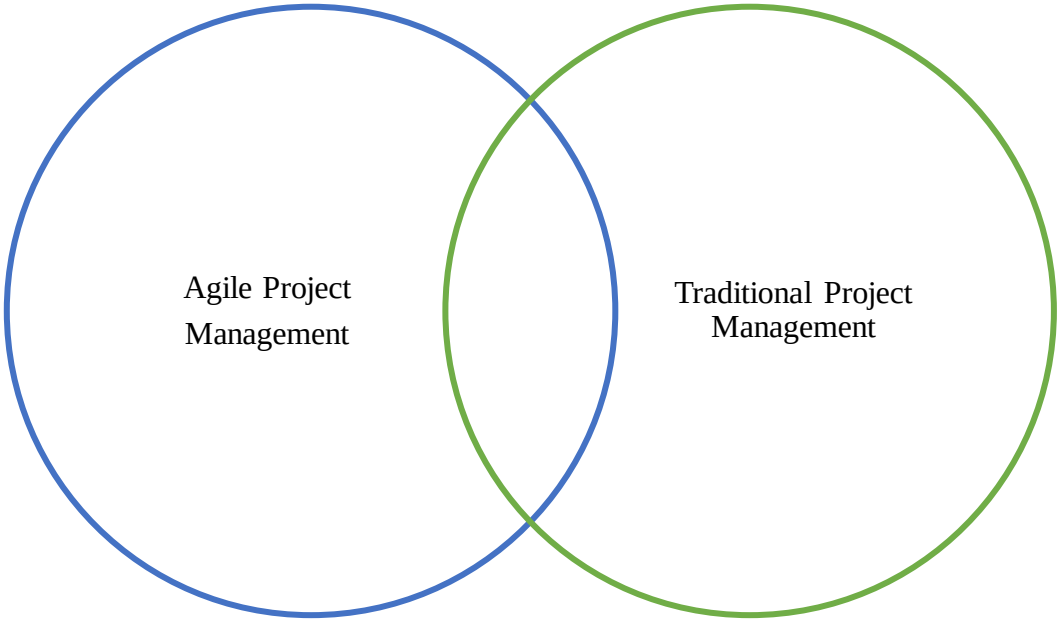


Figure 2.5: Hybrid PM Combination

2.6 Project duration impact on project effectiveness

Project duration is the amount of time it takes to complete a project from beginning to end (PMI, 2008). It is an essential component of project planning and scheduling since it directly affects budgeting, resource allocation, and overall project success (Motil, 2015). Several factors in agile and traditional methodologies like requirement delivery, prioritization, development techniques, documentation practices, and requirement definition are influenced by project duration.

Project duration has a direct impact on how requirements are prioritized and delivered in agile. A shorter project duration means there's less time to complete all the client requirements. As a result, the team must prioritize requirements according to their priority and impact on project objectives. Essential requirements are delivered first, then less significant ones. This delivery strategy ensures that the project meets its deadlines while also providing the most important features (Tsun Chow, Dac-Buu Cao, 2007) (Aizaz, Khan, Khan, Inayat-Ur-Rehman, & Akhunzada, 2021).

Agile SD techniques encourage iterative development and early testing in order to deliver functional software incrementally. Short project durations are compatible with agile concepts since they allow for rapid iterations and quick feedback. Agile teams work in short timeframes known as sprints or iterations, which can last from one to four weeks. These cycles enable steady progress and any issues or adjustments are addressed quickly, helping in meeting the project duration timelines (Tsun Chow, Dac-Buu Cao, 2007) (Jamal, 2022).

The influence of project duration on requirement clarity in a traditional methodology consisting, of client collaboration and effective documentation is significant. Client collaboration is critical to project success throughout the development process. Regular meetings, demos, and feedback sessions are critical for keeping the project on track and within the planned duration. Comprehensive documentation acts as a point of reference for the client and the project team. Project teams may eliminate uncertainty, reduce risks, and expedite procedures with accurate and current documentation. This increases productivity and lowers the possibility of rework or delays, which helps the project finish on schedule (Rong, et al., 2019). Previous studies have found that project duration can moderate the relationship between management constraints and project effectiveness (Fung H. P., 2015).

2.7 Conceptual framework of the research

The conceptual framework serves as a guide for the research based on the findings from the thorough literature review and existing theories (Ravitch & Riggan, 2016). So, the dependent, moderator, and five independent variables were derived based on existing literature.

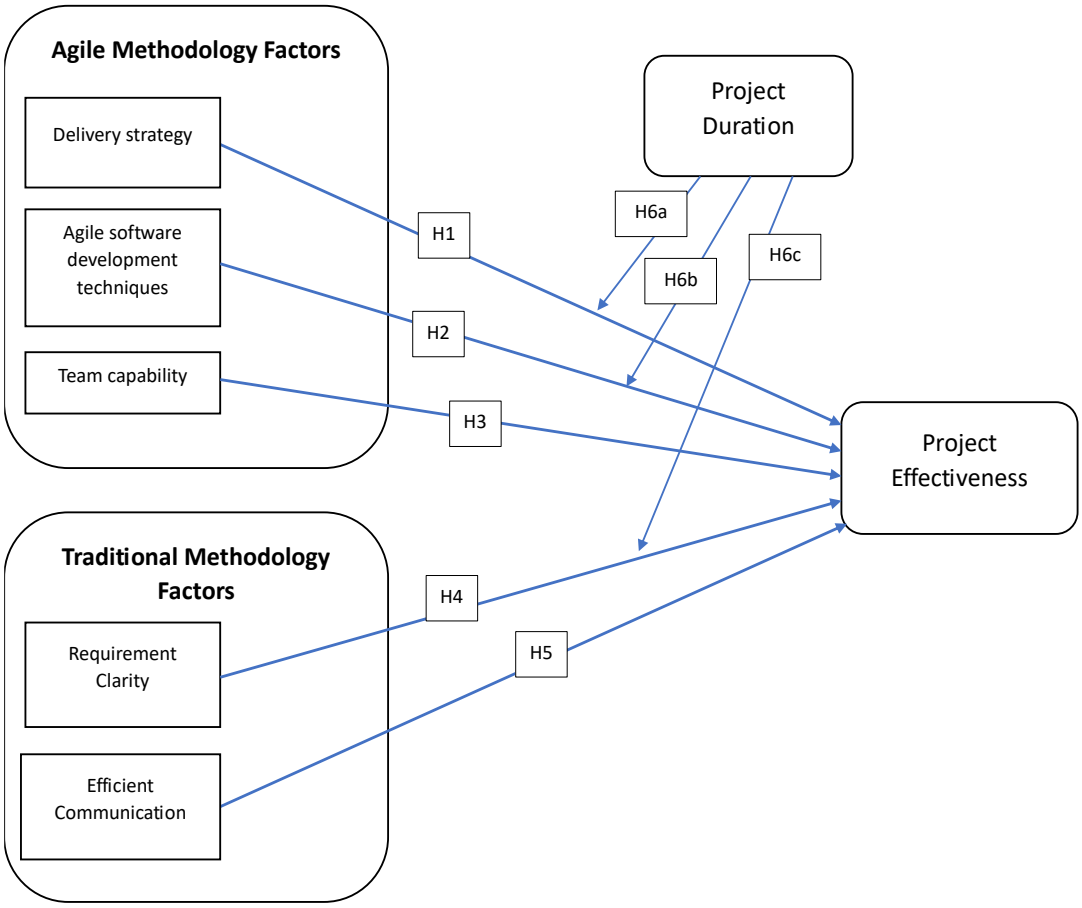


Figure 2.6: Conceptual framework of the research

Starting with the five independent variables, that depict the success factors of agile and traditional PM methodology coming together to achieve an effective project: delivery strategy, software development technique, team capability under agile studied in section 2.3.1, and requirement clarity and efficient communication under traditional methodology studied in section 2.4.1.

The dependent variable is the project effectiveness of the proposed (agile + traditional) hybrid approach, which is the primary interest of the study that all the five variables outlined above depend on. Project effectiveness indicates the degree to which a project

achieves its objectives and delivers the intended outcomes within the constraints of time, budget, and resources along with team and client satisfaction studied in section 2.2.1.

Lastly, the moderator variable: project duration studied in section 2.6, alters the association between the independent variables and project effectiveness, the dependent variable.

2.8 Definition of variables

2.8.1 Independent variables

After conducting a comprehensive literature review in sections 2.3.1 and 2.4.1, the following independent variables were derived depicting the success factors of agile and traditional PM methodology accordingly, coming together in a hybrid manner to achieve an effective project.

Table 2.1: Definition of independent variables

Constructs	Definition	Source
Delivery strategy	Degree to how regularly a requirement is prioritized and delivered	(Tsun Chow, Dac-Buu Cao, 2007) (Elvan Kula, 2022)
Agile software development techniques	Degree to which the team follows agile software engineering techniques of coding, testing, and maintenance standards	(Tsun Chow, Dac-Buu Cao, 2007) (Azarkerdar, 2018)
Team capability	Degree to which the team and managers feel empowered to make decisions	(Tsun Chow, Dac-Buu Cao, 2007) (Mendes, Viana, Vishnubhotla, & Lundberg, 2018)
Requirement Clarity	Degree to what extent documentation and requirement definition is conducted	(McGovern, 2010) (Kramer, 2018)

Efficient Communication	Degree to what extent client involvement and record maintenance occur	(Bakalova & Daneva, 2011) (Whittaker, Laban, & Tucker, 2005)

2.8.2 Dependent variable

This research study intends to measure the effect of the independent variable on the dependent variable, established as "Project effectiveness" of the proposed hybrid approach.

Table 2.2: Definition of dependent variable

Construct	Definition	Source
Project Effectiveness	Degree to how effective the project established via the proposed hybrid approach would be.	(Neelu & Kavitha, 2020) (Lindström & Näsman, 2016)

2.8.3 Moderator variable

After conducting a comprehensive literature review in section 2.6, the moderator variable was derived as “Project Duration”. This implies that project duration moderates the effect of the predefined independent variables on the project effectiveness of the proposed hybrid approach.

Table 2.3: Definition of moderator variable

Construct	Definition	Source
Project Duration	Degree to how project duration moderates the effect of delivery strategy, Agile SD techniques and requirement clarity on a successful PM implementation	(Fung H. P., 2015) (Aizaz, Khan, Khan, Inayat-Ur-Rehman, & Akhunzada, 2021)

2.9 Hypothesis development

Essential information for developing the hypothesis has been explained in the comprehensive literature review and conceptual framework. Hypothesis were derived to overcome the gaps in agile, by rather than re-inventing the wheel with a new PM approach, trying to make use of success factors of existing traditional PM approach that are currently established, to be successful and integrate them with Agile.

In this study, hypotheses were tested to determine whether a statement about the relationship of variables can be accepted or rejected. The independent variable will influence the dependent variable in a positive or negative manner, and the moderate variable is directional, explaining the weakness or strength between the variables (Saunders, Lewis, & Thornhill, 2009).

As a result, this study pursues to evaluate the success factors of agile methodology, such as delivery strategy, software development technique, and team capability, as well as the success factors of traditional methodology, such as requirement clarity and efficient communication, which were defined as independent variables, the dependent variable, project effectiveness, and the moderator variable, project duration. Based on these explanations, the following hypotheses were generated.

H1: Delivery strategy of Agile positively influences the project effectiveness of a HPM approach

The literature review shows that the Agile methodology's delivery strategy revolves around consistent delivery of software solutions, and prioritizing. On-time delivery in short iterations is a crucial factor in enhancing project effectiveness since it mitigates risks (Elvan Kula, 2022). Requirement prioritization is also integral to Agile delivery, aiming to fulfill customer needs within project constraints since it accelerates time-to-market (F. Hujainah, 2018).

The delivery strategy of Agile can certainly influence project effectiveness by promoting iterative and incremental delivery, enabling adaptive planning and prioritization. So, the above hypothesis was generated.

H2: Agile software development techniques positively influences the project effectiveness of a HPM approach

The literature review shows that Agile SD techniques can influence the project effectiveness with efficient coding, maintainability of the project, and a robust testing strategy (Tsun Chow, Dac-Buu Cao, 2007). Maintaining well-defined coding standards enhances code quality and readability, reducing errors and improving software quality (Eisty & Carver, 2022). Testing is a crucial aspect of Agile methodology, guaranteeing that the final product meets user quality standards and user expectations (Azarkerdar, 2018).

The software development techniques of Agile mentioned above can influence project effectiveness. So, the above hypothesis was generated.

H3: Team capability of Agile has a positively influences the project effectiveness of a HPM approach

The literature review shows that the team capability of Agile plays a role in achieving project success. Team motivation, managerial adaptiveness, and trainings are crucial in Agile to make collective decisions and for continuous improvement (Tsun Chow, Dac-Buu Cao, 2007).

The team capability of Agile, characterized by motivation, management, and trainings provided can influence the project effectiveness. So, the above hypothesis was generated.

H4: Requirement Clarity of TPM positively influences the project effectiveness of a HPM approach

The literature review shows that requirement clarity in traditional methodology emphasizes detailed documentation and a clear definition of project requirements. Comprehensive documentation reduces the team's workload and enhances project maintainability (McGovern, 2010). Requirement definitions play a critical role in initiating and planning projects in traditional approaches which helps in risk mitigation and effective resource management (Gupta, Mata-Toledo, & Monger, 2011).

The requirement clarity in traditional methodology, characterized by detailed documentation and requirements definition can influence the project effectiveness. So, the above hypothesis was generated.

H5: Effective Communication of TPM positively influences the project effectiveness of a HPM approach

The literature review shows effective communication in traditional methodology entails regular client involvement and the maintenance of formal meeting minutes to ensure transparency and effectiveness. Frequent client involvement and recording key discussion points, decisions, and follow-up tasks during formal meetings ensures alignment with changing expectations, reducing the risk of misalignment and timesaving (Bakalova & Daneva, 2011).

The effective communication in traditional methodology, characterized by client involvement and record maintenance can influence the project effectiveness. So, the above hypothesis was generated.

H6a: Project duration moderates the effect of agile delivery strategy on project effectiveness of a HPM approach

The literature review shows project duration has a direct impact on how requirements are prioritized and delivered in agile. Shorter durations mean less time to fulfill all client requirements, motivating teams to prioritize based on severity and impact. The delivery strategy is moderated by project duration for project effectiveness, so the above hypothesis was generated.

H6b: Project duration moderates the effect of agile SD techniques on project effectiveness of a HPM approach

The literature review shows Agile SD techniques promote iterative development and early testing to deliver functional software incrementally within a duration. Agile iterations support steady progress and quick resolution for issues, ensuring adherence to project duration timelines. The agile SD techniques are moderated by project duration for project effectiveness, so the above hypothesis was generated.

H6c: Project duration moderates the effect of TPM requirement clarity on project effectiveness of a HPM approach

The literature review shows requirement clarity in traditional methodology is impacted by project duration through continuous client involvement and comprehensive documentation increasing project productivity, minimizing the chances of rework, and ultimately facilitating the project's timely completion. The requirement clarity is moderated by project duration for project effectiveness, so the above hypothesis was generated.

2.10 Chapter summary

Starting with the literature review which evaluates prior researchers and theories relevant to project management was covered. The conceptual framework of the study was then established alongside the identifying the independent, dependent and mediator variables based on the comprehensive literature study. Finally, the hypotheses were developed in the latter portion of the chapter.

CHAPTER 3 - RESEARCH METHODOLOGY

3.1 Introduction

To support the research questions and objectives drawn in section 1.3, this chapter will go into great length regarding the research methodology of the quantitative grounded theory study that focuses on examining the enhancement of the software development process using hybrid PM practices. Initially, the operationalization of variables is derived along with the research designs and sampling techniques considered. Finally, concludes the chapter with data collection methods used in the research.

3.2 Operationalization of variables

An operationalization of variables was conducted in order to process how the questions for the questionnaire are modelled out of the existing literature and theories, this is a process where the researcher turn abstract theories into measurable components (Heath, 2023). The item measures were adopted from previous studies represented by sources column mentioned alongside the measure in the following table. In accordance with the existing literature, these measures were reworded to align with the context of this study.

Table 3.1: Operationalization of variables

Constructs	Dimension	Item Measures	Sources
Delivery strategy	**Requirement delivery duration** Degree to how regularly a requirement is delivered	• My team regularly delivers product requirements in short timeframes for the client. • My team responds to client-driven requirements changes well.	(Moniruzzaman & Hossain, 2013) (Beck K. , 2001)

	Prioritization Degree to how the team, managers and focuses on their high priority work and deliver them	• My team prioritize and delivers features according to the project plan. • Team is aware on how requirements should be prioritized during sprint/ project planning. • Team demonstrates adaptability in handling new requirements and bugs, addressing them according to their priority and severity	(borhan, zulzalil, hassan, & ali, 2022)
Agile software engineering techniques	**Coding Designs** Degree to which the team follows well-defined coding standards	• My team practices well-defined coding standards • My team frequently conduct code reviews/ peer code reviews. • My team uses a software for continuous inspection of code quality to perform automatic reviews	(Eisty & Carver, 2022) (Ahmad, 2020)
	Maintainability Degree to how agile projects are maintained	• My team follows iterative and incremental methodology when developing requirements. • My team conducts daily scrums and progress	(Agrawal, 2019). (Hoda, Noble, & Marshall, 2012) (Biely, 2024)

		meetings before the end of the sprint.	
	Testing Strategy Degree to how correct testing strategies are conducted	• QA team involves in early testing to prevent defect inject into later stages. • QA team practices automating test scenarios to rerun test easily	(Qasymphony, 2018) (Azarkerdar, 2018)
Team capability	**Team Motivation** Degree to how team members feel empowered to make decisions within the Agile framework	• My team members have a level of autonomy to make decisions within the Agile framework. • I believe my team members are able to maintain a great Work/life balance. • My Team members maintain great teamwork when working together develop features and resolve issues	(Melo, Santana, & Kon, 2012) (Trzeciak & Banasik, 2022)
	Team Management Degree of Managers adaptiveness to change and acting as a facilitator	• My managers are adaptable and flexible to change in the context of implementing Agile practices. • My managers acts as a facilitator, effectively manages the team	(Yang, Huff, & Strode, 2009). (Vinekar, Slinkman, & Nerur, 2006)

		collaboration without stifling their creativity	
	Trainings Degree of which appropriate agile trainings are provided	• My company takes necessary actions to organize training sessions to make the employees aware of the agile practices. • My company takes measure to ensure that their employees stay updated on best practices in Agile methodologies post-training. • To what extent have you been able to apply the concepts learned in the Agile training in your everyday work	(Klünder, Trommer, & Prenner, 2022) (Nassazi, 2013) (Koutsikouri, Madsen, & Lindström, 2020)
Requirement Clarity	**Documentation Practices** Degree to what extent continuous documentation is conducted	• My team prepares detailed documentation on functional and non-functional requirements and are easily accessible. • Continuous and parallel documentation would reduce the team's workload and increase maintainability of the project.	(McGovern, 2010) (Rong, et al., 2019)

	Requirements Definition Degree of which project requirements are defined	• Project requirements are communicated clearly to the team so there's less re-work due to changes in requirements. • Project manager develops a project plan during the early stages	(Kramer, 2018) (Gupta, Mata-Toledo, & Monger, 2011)
Efficient Commun-ication	**Client Involvement** Degree to what extent client involvement exists	• My team receive immediate updates from the client when new requirements or changes are needed. • My team has frequent and sufficient discussions with the client to address any requirement concerns.	(Bakalova & Daneva, 2011)
	Record maintenance Degree to what extent record maintenance is conducted	• My team maintains a formal minutes of meeting after discussions with clients. • Communicated clients' requirements doesn't conflict with existing workflows.	(Whittaker, Laban, & Tucker, 2005) (Omair, 2008)
Project Duration	**Project Timeline** Degree to how project duration moderates the effect of delivery	• My team employs requirement prioritization and delivery to meet project duration timelines.	(Jamal, 2022) (Aizaz, Khan, Khan, Inayat-

	strategy, Agile SD techniques and requirement clarity on a successful PM implementation	• My team employs agile development and testing practices to meet project duration timelines. • Client collaboration and effective documentation plays a great role in meeting the planned duration of Agile projects. • My team addressed potential scope creep while maintaining project timelines.	Ur-Rehman, & Akhunzada, 2021)
Project Effectiveness	**Team Satisfaction** Degree to what extent team satisfaction can be achieved with the proposed hybrid approach	• The Hybrid approach would satisfy the team to be aware of the project status due to effective communications with the clients. • The Hybrid approach would satisfy the team's decision making due to maintenance of detailed documentation. • The Hybrid approach would satisfy the team in resolving concerns since frequent and proper communications could be held with the clients.	(Lindström & Näsman, 2016) (Peterson, 2007)

		• The Hybrid approach would satisfy the team since it would save time and effort by keeping meeting minutes instead of reviewing client recordings.	
	Project Quality Degree to what extent project quality can be achieved with the proposed hybrid approach	• The Hybrid approach would effectively address risks and opportunities in early thorough planning and accurate prioritizations, ensuring a smooth execution. • The Hybrid approach would ensure project targets are in line with both the client's and team's timelines, with the help of regular delivery and parallel documentation. • The Hybrid approach would aim to meet budget targets and enhance productivity, by practicing proper planning, efficient communicating and well-defined development techniques.	(Cobb, 2011) (Neelu & Kavitha, 2020) (Baccarini, 1999)

		• The Hybrid approach would ensure effective utilization of all available resources, through prior resource planning and being flexible to adapt to new requirements accordingly.	
	Client Satisfaction Degree to what extent client satisfaction can be achieved with the proposed hybrid approach	• The Hybrid approach would satisfy the client in terms of decision making with the help of detailed documentation. • The Hybrid approach would satisfy the client in terms of decision making with the help of effective communications with the development team.	(Baccarini, 1999)

3.3 Research philosophy

This research adopts a positivism philosophy with an ontological perspective to examine how to enhance the SD process using hybrid project management practices in the IT sector. Positivism is based on the belief that knowledge is derived from empirical observation and scientific methods (Park, Konge, & Jr, 2020). Positivism is chosen for this study since it emphasizes the use of empirical outcomes and scientific methods to uncover the research objectives of examining best practices and identifying existing issues in Agile, identifying suitable traditional PM practices, and recommendations for hybrid project management in SD.

Ontology perspective shapes the understanding of the nature of the real world and forms the basis for the research questions and hypotheses (Park, Konge, & Jr, 2020). In the

context of this research, SD and the project management process have defined characteristics and outcomes that can be objectively observed, measured with the created hypotheses, and finally analyzed.

3.4 Research approach

This research has applied a deductive approach to investigate the research topic. The deductive approach begins with deducing a testable hypothesis based on existing literature, indicating how those hypotheses will be measured, and then testing them (Soiferman, 2010). This quantitative research has followed a descriptive research design involved in observing and scientifically unfolding individual variable behavior in relation to the variable the researcher hopes to achieve (Sharma, 2019).

Finally, the research outcomes will be examined to either confirm or modify the hypothesis through empirical research methods, to determine the project effectiveness of hybrid approach in improving the SD process.

3.5 Research strategy

This research has utilized a quantitative research strategy to collect and analyze numerical data. This research collected data via questionnaires that was administered to SD professionals, project managers, and other IT stakeholders who have associated themselves with Agile methodology. The strategy will assist in developing quantitative evidence on the effectiveness of hybrid project management in improving the SD process in the IT industry.

3.6 Research population

As mentioned before the IT industry in Sri Lanka is a massive industry that has around 500+ registered firms as of 2023 (Sri Lanka export development board, 2023) with a workforce of over 150,000 employees (SLASSCOM, 2023). The target population for this study are professionals in medium to large scale organizations who are directly involved in Agile SD projects in the IT sector which is around 94.1% of the selected population according to previous studies (Hevapathige, 2021). These professionals include but are not limited to project managers, business analysts, software engineers, and quality engineers.

3.7 Sampling method

Given that gathering data from the entire target population of 141,150 individuals is rarely feasible for this study, so a sample should be defined by the author. The selected sample group of people ensures representative participation in this study. Deciding how to select the sample which represents the population for this research is done via a non-probability sampling method.

Non-probability sampling is widely employed in quantitative research, despite the desire for probability sampling to assure generalizability (Asiamah, Mensah, & Oteng-Abayie, 2022). While probability sampling seeks to select a representative sample from a population, non-probability sampling methods are frequently used due to their convenience, consume less time and cost to apply. It's also convenient when the target population is distributed, so the author can easily access participants who are readily available or accessible, making data collection more feasible (Lee & Landers, 2022).

Due to the unknown selection mechanism, using the non-probability method can result in erroneous conclusions and biased estimations. However, this approach can nevertheless help researchers generalize their findings provided they implement it wisely (Sarker & AL-Muaalemi, 2022).

3.7.1 Convenience sampling

A convenience sampling method includes the individuals with research topic related experience who happen to be most accessible to the researcher. Interestingly, this strategy is also widely utilized by quantitative researchers (Asiamah, Mensah, & Oteng-Abayie, 2022).

Furthermore, because the goal of this study is to overcome the limitations of agile, the sample included IT experts who only have some level of experience with agile, who are accessible to the researcher. To ensure that the selected sample is generalized and unbiased, the researcher chose individuals not solely easily accessible but also others with a diverse range of perspectives in different organizations via an employment focused social media platform. So, individuals such as project managers, business analysts, software engineers, DevOps engineers, and quality assurance engineers at both the senior level and engineering level working directly with the agile PM methodology were chosen to participate in the study.

3.7.2 Sampling size

The sample size was calculated using Cochran's equation (James E. Bartlett, Kotrlik, & Higgins, 2001), with a 95% confidence level and an 8% margin of error, and the previously determined population size of 141,150. Based on these figures, the required sample size is 150, so the study included 150 participants.

3.8 Data collection methods

Data collection for this research purpose was done via both primary and secondary methods (Hox & Boeije, 2005), the primary method is a form of direct data gathering done via an online structured questionnaire that was distributed to the chosen sample participants via a Google Form link. The secondary method was done mainly via reviewing and analyzing the existing raw and published research literature related to the study.

3.8.1 Time horizon

The time horizon defines the time frame relevant to the research. In this study, a cross-sectional time horizon is selected since it involves the collection of data at a specific period of time which is applicable to the research objectives (Melnikovas, 2018).

3.8.2 Data collection instrument

An online questionnaire was used to gather the necessary data for the research. The sources listed in the Operationalization table served as the foundation for the questionnaire items. An overview of the study and the target group were included at the beginning of the questionnaire. Followed by two primary sections of the questionnaire.

First, demographic characteristics including the respondent's employment role and years of experience, which can be utilized to gather their demographic information. Secondly, 28 questions measuring how well agile and traditional approaches used the success elements listed in the conceptual framework followed by 04 questions concerning the moderator variable, project duration and lastly, 10 questions concerning the dependent variable, project effectiveness of an HPM approach. Responses from the selected sample were gathered using a five-point Likert scale, enabling them to express their level of agreement, from strongly disagree to strongly agree. This scale lowers

respondents' levels of frustration while simultaneously increasing response rate and quality because of its simplicity (Tanujaya, Prahmana, & Mumu, 2023). Table 3.2 represents the corresponding numerical value for each Likert scale's response type.

Table 3.2: Five-point Likert Scale Interpretation.

Likert scale description	Value
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

3.8.3 Ethical guidelines

In order to ensure the ethical conduct of this study, the researcher followed all necessary procedures. The specifics of how their data would have been gathered, stored, and processed were given to the respondents at the beginning of the questionnaire. Participation in the questionnaire was entirely voluntary, and respondents were free to discontinue at any time. Furthermore, the questionnaire is only distributed for academic purposes so the data will be kept in the utmost of confidence. By applying the previously mentioned measures, the researcher was able to maintain the questionnaire's confidentiality. Respondents' consent was obtained, no personal identifiers were collected, and the research's purpose was made clear to all parties involved, preventing any potential ethical dilemmas (Swain & Spire, 2020).

3.9 Chapter summary

Starting with the operationalization of independent, dependent, and moderate variables, the researcher explains the research methodology comprising of research philosophy, approach, strategy, population, and sample method. The study adopts a quantitative research methodology following a deductive approach. Convenience sampling was used to determine the representativeness and credibility of the collected data. Finally, data collection methods were specified stating that both primary and secondary data sources were used.

CHAPTER 4 – DATA ANALYSIS

4.1 Introduction

The findings of the research and data analysis are covered in this chapter. The questionnaire used in this study was carefully reviewed to ensure that the information gathered was presented in an understandable manner, including tables, percentages, and graphs created with Statistical Package for Social Sciences (SPSS) software. Prior to conducting correlation and regression analyses, data screening, demographic data analysis, reliability and validity, and diagnostic tests are performed.

4.2 Participant analysis

With the aim of attempting to incorporate traditional with Agile methodology, to over the agile gaps the online questionnaire was distributed among 170 individuals in the IT sector in Sri Lanka who were supposedly engaged in agile based projects. 165 responses were received, the required sample size of 150 responds was achieved but 15 individuals have responded indicating that they do not have experience with Agile methodology, so they were not considered for the data analysis since it's based on an individual's work experience with Agile.

4.3 Initial data screening

Prior to analysis, a data screening process was carried out to check for individual response outliers and missing data from the valid responses. Missing data is defined as the values which is not stored/ missed in a variable which would lead to a significant harmful effect on the research conclusion (Graham, 2009). This research evaluation showed that there were no responses that were provided with insufficient/ missing details as displayed in figure 4.1.

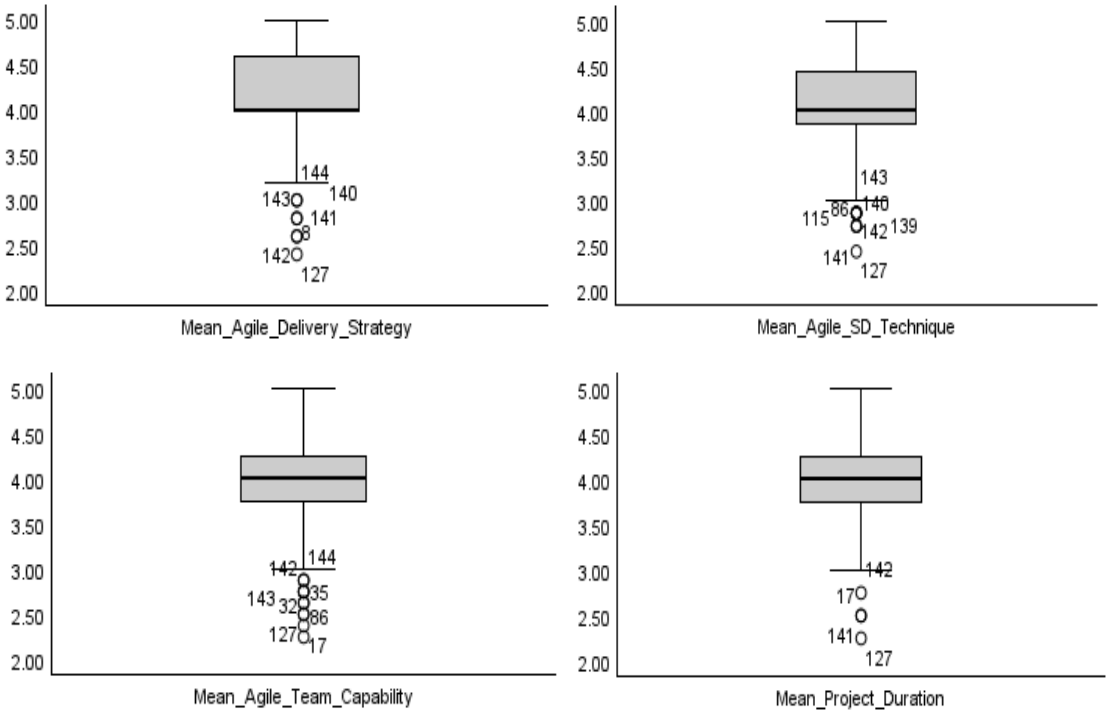
Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Mean_Agile_Delivery_Strategy	150	100.0%	0	0.0%	150	100.0%
Mean_Agile_SD_Technique	150	100.0%	0	0.0%	150	100.0%
Mean_Agile_Team_Capability	150	100.0%	0	0.0%	150	100.0%
Mean_Project_Duration	150	100.0%	0	0.0%	150	100.0%
Mean_Trad_Requirement_Clarity	150	100.0%	0	0.0%	150	100.0%
Mean_Trad_Efficient_Communication	150	100.0%	0	0.0%	150	100.0%
Mean_Hybrid_Approach	150	100.0%	0	0.0%	150	100.0%

Figure 4.1: Valid and missing cases of the data set

Furthermore, a Boxplot analysis was also conducted to identify outlier data values in the collected sample. An outlier is an observation that deviates unusually far away from its other values in a dataset. They too would lead to a significant harmful effect on the research conclusion (Cousineau & Chartier, 2010). Outliers are classified into two types namely mild outliers and extreme outliers. Mild outliers are data points that deviate moderately from the rest of the data that is indicated by a circle 'O' in the diagram. Extreme outliers are data points that are unusually far from the rest of the data, which is indicated by an asterisk '*' in the diagram (Unwin, 2010).

The following figures shows that no outliers for the requirement clarity variable, no extreme outliers, only mild outliers exists for other independent, moderate, and dependent variables, but are considered as insignificant and won't incur a harmful effect for the data analysis. So, the researcher proceeded with the data analysis with all 150 responses for this study.



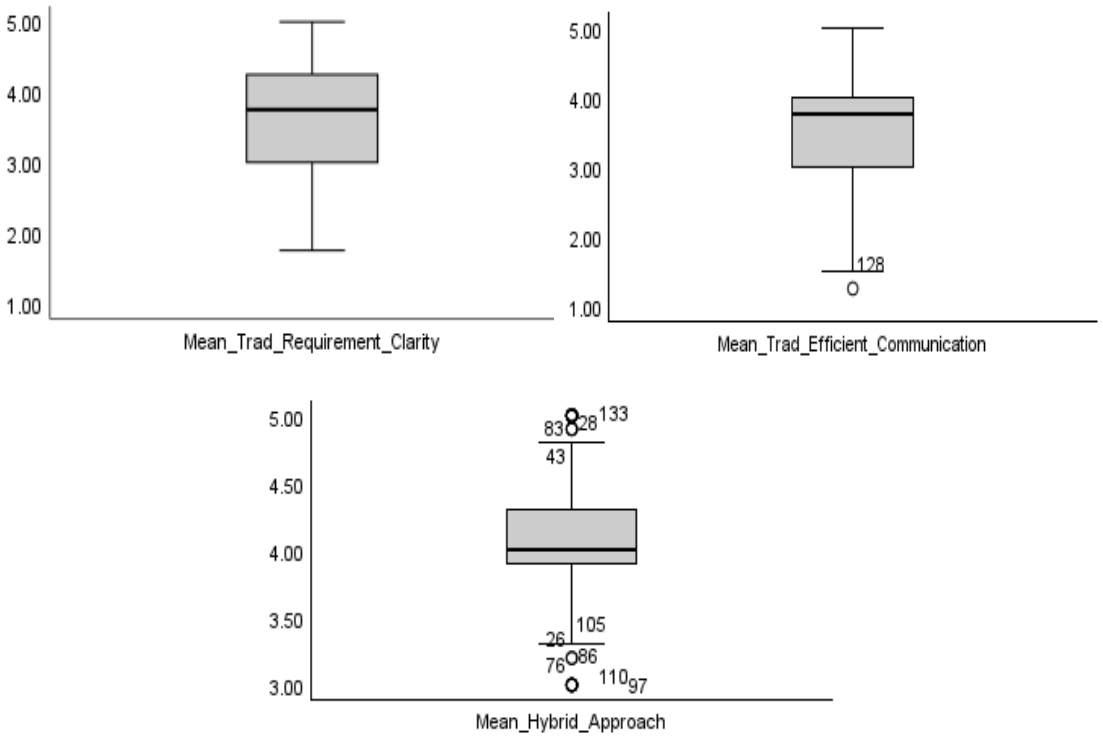


Figure 4.2: Outliers of independent, moderator and dependent variables

4.4 Demographic data analysis

Demographic data analysis provides understanding of the characteristics of the research sample (Klimczuk, 2021). This section analyses the research population's organization type, age, gender, and designation distributions as well as their agile experience.

4.4.1 Organization analysis

The organization analysis of the respondents is illustrated by the below figure 4.3. The researcher considered the most common organization types in Sri Lanka for the respondents to choose from.

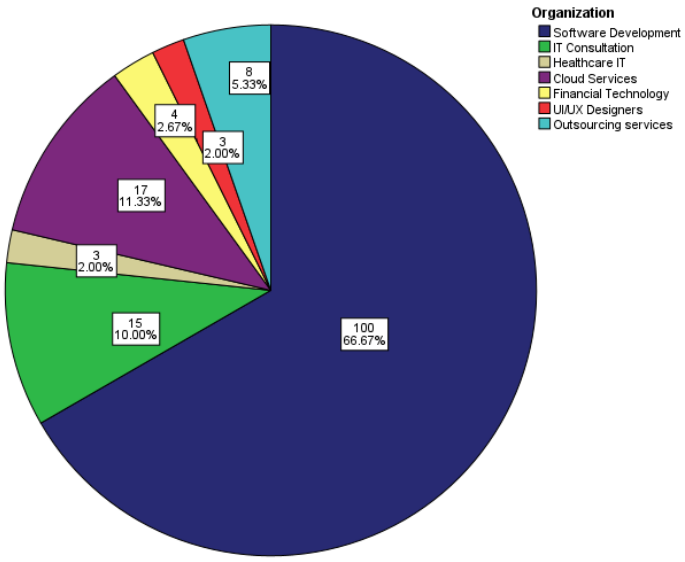


Figure 4.3: Organization analysis

According to the analysis, more than 66% of the respondents were working under a SD organization, followed by 11.3% from cloud services organizations and 10% from IT consultation with experience in agile. Other organization types such as outsourcing, finance, UI/UX, and healthcare services are relatively minor representatives of the sample.

4.4.2 Gender and age analysis

The gender analysis of the respondents is illustrated by the figure 4.4, and the age analysis is illustrated by the figure 4.5.

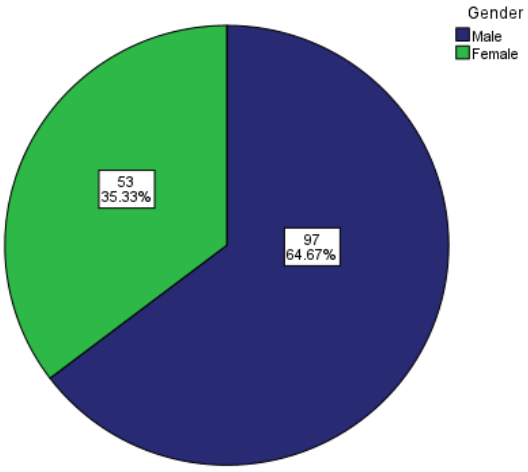


Figure 4.4: Gender analysis

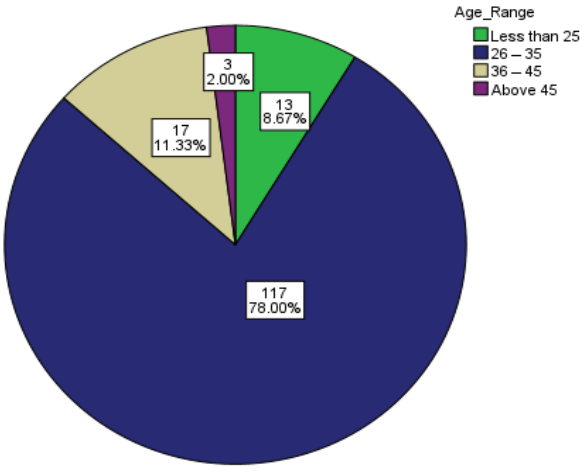


Figure 4.5: Age analysis

According to the analysis, figure 4.4 represents that 64.67% of the respondents were males, indicating that the male workforce with agile experience is higher. However,

35.33% were females, which is a relatively small percentage of the workforce. As displayed in the above figure 4.5, 78% of the respondents were aged from 26 – 35 followed by 11.3% in the 36 – 45 range and 8.67% less than 25 years and a lower percentage of 2% where the age range was above 45. The age analysis shows that the largest age group in this sample of employees is between 26 and 35 years.

4.4.3 Designation analysis

The designation analysis of the respondents is illustrated by below figure 4.6. The researcher considered the ten most common job roles in the IT industry in Sri Lanka for the respondents to choose from.

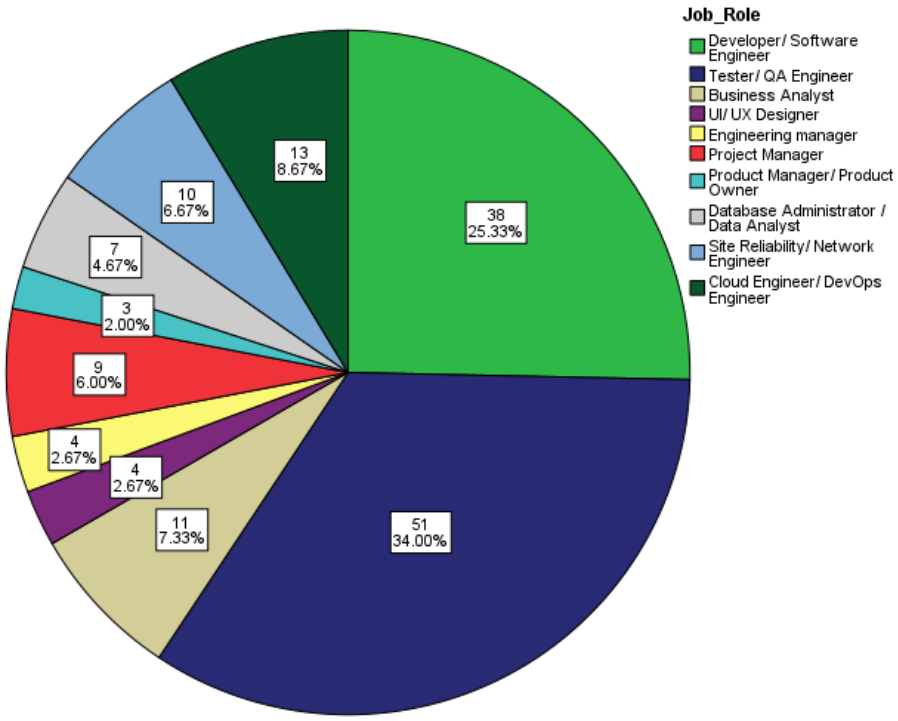


Figure 4.6: Designation analysis

In respects of the designation or job role analysis, figure 4.6 depicts that 34% of the respondents were QA engineers, closely followed by 25.33% of developers, and 8.67% of DevOps engineers, who are regularly impacted by the agile practices in the project. Total 8% of project and product managers and 7.33% of business analysts are amongst the respondents, who also contribute to the agile development process.

4.4.4 Agile experience analysis

The agile experience analysis of the respondents is illustrated by figure 4.7 which has been categorized into five groups for the respondents to choose from.

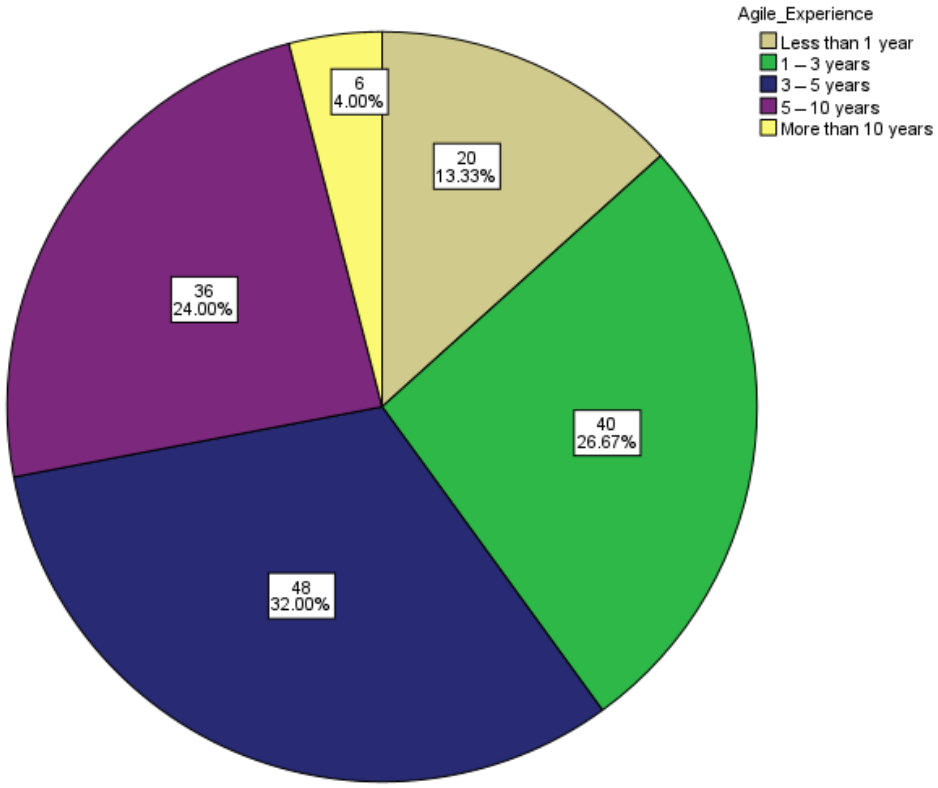


Figure 4.7: Agile experience analysis

In respects of the agile experience analysis, figure 4.7 depicts that 32% of the respondents have 3 – 5 years of experience, closely followed by 26.67% of 1 – 3 years. 24% of the respondents have 5 – 10 years of experience, while 13.33% have less than 1 year and 4% have more than 10 years of experience of working with Agile. The data analysis implies that employees with 1 to 5 years of experience comprise the majority of the agile process involvement.

4.5 Reliability and validity tests

Reliability and validity are means of illustrating and conveying the thoroughness of research procedures and the accuracy of research results. Research should refrain from using misleading variables to derive a valid research objective (Roberts & Priest, 2006).

The degree to which a measurement of an occurrence yields a consistent and steady result is known as reliability (Carmines & Zeller, 1985). Statistical techniques such as Cronbach's alpha coefficient can be used to measure the internal reliability of the variables (the individual questions) in the questionnaire (Cronbach, 1951).

Table 4.1: Reliability test of variables

Variables	Cronbach's Alpha Value	Reliability Level
Delivery strategy	0.812	Good
Agile SD techniques	0.793	Acceptable
Team capability	0.844	Good
Requirement Clarity	0.813	Good
Efficient Communication	0.893	Good
Project Duration	0.820	Good
Project Effectiveness	0.913	Excellent

Above table 4.1 demonstrates the Cronbach's alpha value of all the variables in the study, where all variables are accepted and reliable since the value is greater than 0.70 and closer to 1 (Arof, Ismail, & Saleh, 2018). The Agile SD variable's value is 0.793, but the reliability level is still at an acceptable level, all other independent variables and moderator variables are in the range of 0.80 – 0.89 with a good reliability level, and the dependent project effectiveness variable has a reliability level of excellent of more than 0.90. So, it indicates that the researcher can proceed with the data analysis, with the reliable data gathered from the questionnaire.

Validity defines how effectively the collected data covers the actual area of research (Punch, 1998). Even though all the research variables and their question item measures

were derived based on existing already proven literature, the researcher ensured to use Kaiser-Meyer-Olkin measure of sampling adequacy tests and Bartlett's test of sphericity tests to measure the validity of the variables (the individual questions) in the questionnaire.

Table 4.2: Validity test of variables

Variables	Kaiser-Meyer-Olkin Test Value	Bartlett's Test Value
Delivery strategy	0.792	0.000
Agile SD techniques	0.790	0.000
Team capability	0.829	0.000
Requirement Clarity	0.720	0.000
Efficient Communication	0.794	0.000
Project Duration	0.783	0.000
Project Effectiveness	0.884	0.000

Above table 4.2 demonstrates the validity test values of all the variables in the study, indicating that all variables are valid since the values of Kaiser-Meyer-Olkin test are greater than 0.5 and much closer to 1. And all Bartlett's test values are less than 0.05 indicating their validity (Field, 2009). The dependent, project effectiveness variable has a higher level of validity of 0.884 relative to the other valid variables. So, this test indicates that the researcher can proceed with the data analysis, with the validity of gathered data from the questionnaire.

4.6 Exploratory factor analysis

Apart from the above conducted Kaiser-Meyer-Olkin (KMO) and Bartlett's Test validity tests, the gathered data were also analyzed for validity using Exploratory Factor Analysis (FEA) as well.

4.6.1 Communality analysis

A communality is the degree to which one item corresponds with all other ones. The correlation strengthens as the communalities increase. Higher communality meant that the factor solution extracted a greater proportion of the variable's variation (Ather, 2009). For improved factor analysis measurement, communalities should be at least 0.4 (Silvai, Chinna, & Azam, 2019). The communalities in the below table 4.3 show that all extraction values range from 0.555 to 0.843, which is significantly higher than the allowed 0.4 this indicates the proportion of variance for each variable that’s explained by the factors. As a result, the current study's communalities are perfectly suitable for proceeding with the final factor analysis results.

Table 4.3: Communality analysis

	Initial	Extraction
Agile_Deli_Stra1	1.000	.555
Agile_Deli_Stra2	1.000	.671
Agile_Deli_Stra3	1.000	.717
Agile_Deli_Stra4	1.000	.719
Agile_Deli_Stra5	1.000	.667
Agile_SD_Tech1	1.000	.768
Agile_SD_Tech2	1.000	.758
Agile_SD_Tech3	1.000	.667
Agile_SD_Tech4	1.000	.592
Agile_SD_Tech5	1.000	.589
Agile_SD_Tech6	1.000	.748
Agile_SD_Tech7	1.000	.825
Agile_Team_Cap1	1.000	.638
Agile_Team_Cap2	1.000	.634
Agile_Team_Cap3	1.000	.662
Agile_Team_Cap4	1.000	.760

Agile_Team_Cap5	1.000	.770
Agile_Team_Cap6	1.000	.795
Agile_Team_Cap7	1.000	.843
Agile_Team_Cap8	1.000	.659
Mod_Pro_Dur1	1.000	.745
Mod_Pro_Dur2	1.000	.744
Mod_Pro_Dur3	1.000	.588
Mod_Pro_Dur4	1.000	.656
Trad_Req_Clar1	1.000	.785
Trad_Req_Clar2	1.000	.766
Trad_Req_Clar3	1.000	.755
Trad_Req_Clar4	1.000	.633
Trad_Effi_Com1	1.000	.819
Trad_Effi_Com2	1.000	.798
Trad_Effi_Com3	1.000	.713
Trad_Effi_Com4	1.000	.727
Hybrid_var1	1.000	.762
Hybrid_var2	1.000	.741
Hybrid_var3	1.000	.758
Hybrid_var4	1.000	.631
Hybrid_var5	1.000	.727
Hybrid_var6	1.000	.764
Hybrid_var7	1.000	.674
Hybrid_var8	1.000	.781
Hybrid_var9	1.000	.692
Hybrid_var10	1.000	.690

Extraction Method: Principal Component Analysis.

4.6.2 Component matrix

Table 4.4: Component matrix

	Component						
	1	2	3	4	5	6	7
Agile_Deli_Stra1	0.625						
Agile_Deli_Stra2	0.747						
Agile_Deli_Stra3	0.792						
Agile_Deli_Stra4	0.831						
Agile_Deli_Stra5	0.785						
Agile_SD_Tech1		0.849					
Agile_SD_Tech2		0.865					
Agile_SD_Tech3		0.702					
Agile_Team_Cap1			0.714				
Agile_Team_Cap2			0.746				
Agile_Team_Cap3			0.758				
Agile_Team_Cap4			0.693				
Agile_Team_Cap5			0.646				
Mod_Pro_Dur1				0.874			
Mod_Pro_Dur2				0.848			
Mod_Pro_Dur3				0.764			
Mod_Pro_Dur4				0.742			
Trad_Req_Clar1					0.899		
Trad_Req_Clar2					0.896		
Trad_Req_Clar3					0.812		
Trad_Req_Clar4					0.548		
Trad_Effi_Com1						0.916	
Trad_Effi_Com2						0.881	
Trad_Effi_Com3						0.860	
Trad_Effi_Com4						0.827	
Hybrid_var1							0.735
Hybrid_var2							0.667
Hybrid_var3							0.842
Hybrid_var4							0.714
Hybrid_var5							0.783

Hybrid_var6	0.822
Hybrid_var7	0.758
Hybrid_var8	0.736
Hybrid_var9	0.679
Hybrid_var10	0.753

Extraction Method: Principal Component Analysis.

The above table representing the components can be interpreted as the correlation of each item with the component. Higher values indicate a strong correlations (Principal Components Analysis | Spss Annotated Output, 2024). Each item has a loading corresponding to each of the 7 components. For instance, Agile_Deli_Stra1 is 0.625 correlated with the first component, and Agile_SD_Tech1 is 0.849 correlated with the second component.

4.6.3 Total variance explained

The Eigen value of a given factor represents the variation in all variables accounted for by that factor. The ratio of Eigen values represents the explanatory importance of the factors in relation to the variables (Silvai, Chinna, & Azam, 2019). These values from factor analysis represent the proportion of each variable's variance that can be explained by the remaining components. If a component has a low Eigen value, it contributes little to explaining variances in the variables and may be dismissed as redundant when compared to more relevant factors (Ather, 2009).

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.512	58.532	58.532	3.512	58.532	58.532	2.907	48.456	48.456
2	1.227	20.456	78.988	1.227	20.456	78.988	1.832	30.532	78.988
3	.426	7.098	86.086						
4	.346	5.761	91.847						
5	.287	4.776	96.623						
6	.203	3.377	100.000						

Extraction Method: Principal Component Analysis.

Figure 4.8: Total variance explained analysis

48.46% of the variance is explained by the first component whereas component 2 explains 30.53% of the variance. Total of 78.99% of the variance is accounted for by

the first two factors. As displayed in the above figure, the more factors you extract, the less variance explained by each successive factor. This variance can be graphically explained with a scree plot diagram.

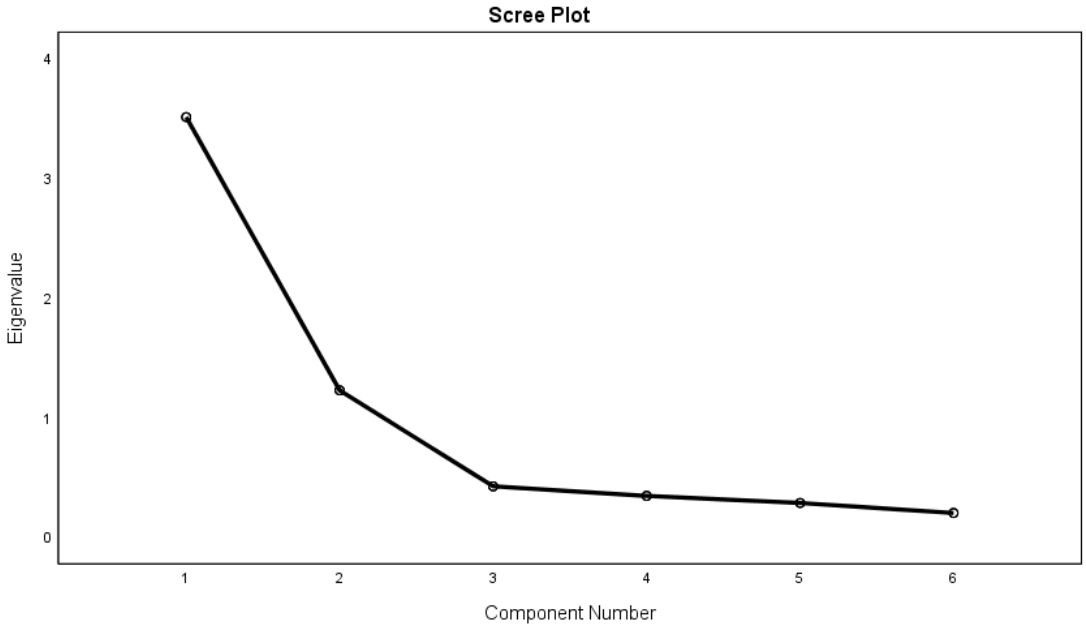


Figure 4.9: ScreePlot diagram

4.7 Regression diagnostics test

Regression diagnostics test is to see if the research model, as well as the assumptions we made about the data, are compatible with the collected data and whether no significant anomalies exist (Ferré, 2009). This test was done for all research variables, using normality, linearity, and heteroscedasticity testing.

4.7.1 Normality test

To determine whether the research results are normally distributed, a normality test was performed. With a sample size of less than 300 (Kim, 2013), statistical techniques such as Shapiro-Wilk test can be used to measure the normality of data, it is based on the correlation between the data and the resultant normal scores (Peat & Barton, 2005). Multiple studies have confirmed that Shapiro-Wilk test is the best choice for normality testing of data among other alternative testing methods (Thode, 2002) (Hernandez, 2021). However, skewness and kurtosis tests have been covered in section 4.8 proving the normal distribution of the data set.

Table 4.5: Normality test of variables

Variables	Shapiro-Wilk Test	
	Statistic	Sig Value
Delivery strategy	0.927	0.000
Agile SD techniques	0.948	0.000
Team capability	0.947	0.000
Requirement Clarity	0.949	0.000
Efficient Communication	0.952	0.000
Project Duration	0.935	0.000
Project Effectiveness	0.926	0.000

The significant value for all variables is less than 0.05 indicating that the researcher has significant evidence to reject the null hypothesis that the variable follows a normal distribution. The research variables' normal distribution and approximate bell shape are represented by the following histograms in figure 4.10.

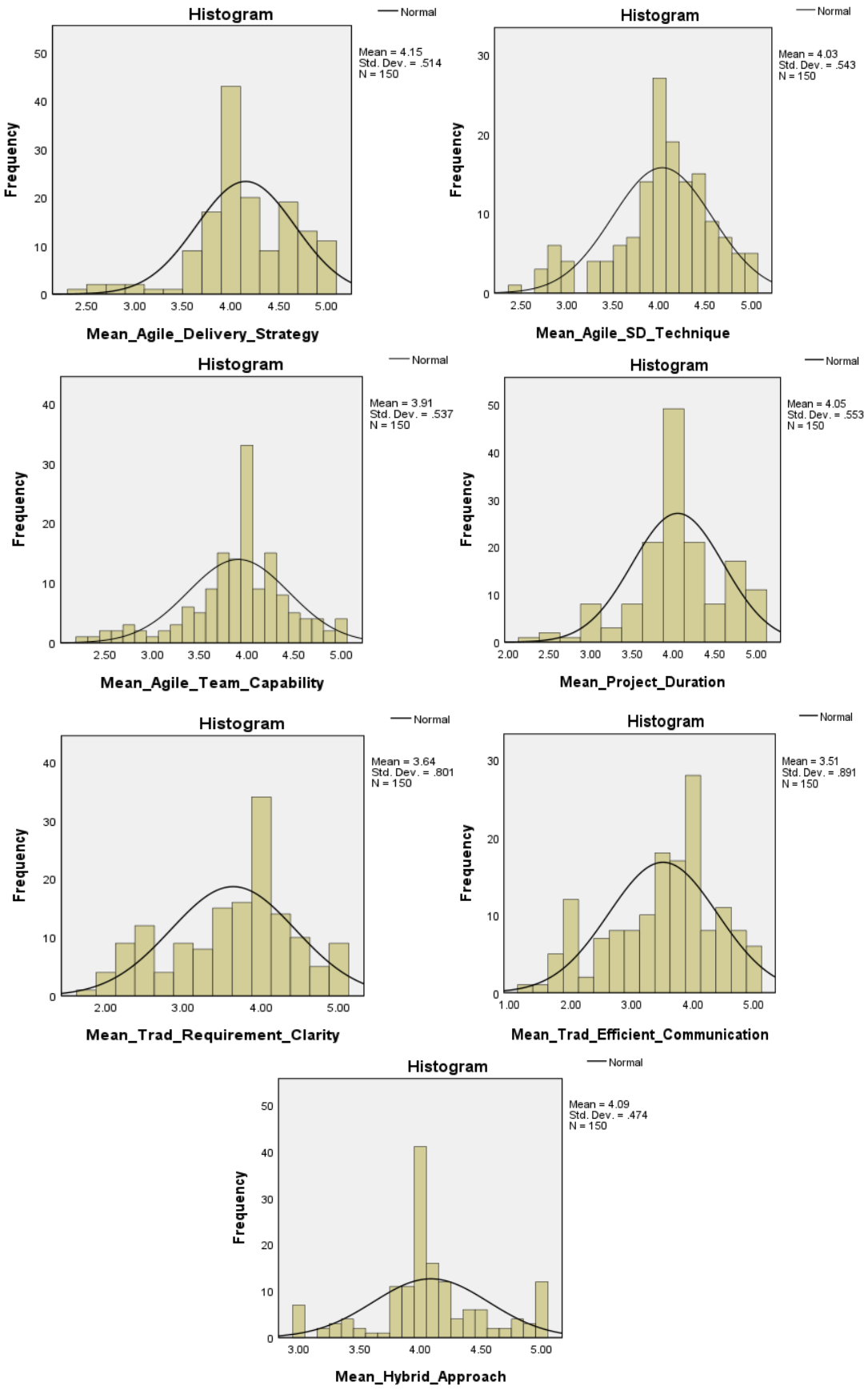


Figure 4.10: Histograms representing normal distribution of the data set.

4.7.2 Linearity test

In research, this technique is used to determine whether a relationship between variables is linear or not.

Table 4.6: Linearity test of variables

Variables	Linearity Sig Value with Project Effectiveness
Delivery strategy	0.000
Agile SD techniques	0.000
Team capability	0.000
Requirement Clarity	0.000
Efficient Communication	0.008
Project Duration	0.000

Table 4.6 represents that since the value is less than 0.05 there is significant linearity between Delivery strategy, Agile SD techniques, Team capability, Requirement Clarity, Efficient Communication, Project Duration, and the research dependent variable, Project Effectiveness. So, this test indicates that the independent and moderator variables have a linear relationship with project effectiveness.

4.7.3 Homoscedasticity test

Homoscedasticity ensures that residuals vary uniformly across the expected value range. This test denotes the assumption that the variance of the errors is constant at all stages of the independent variables.

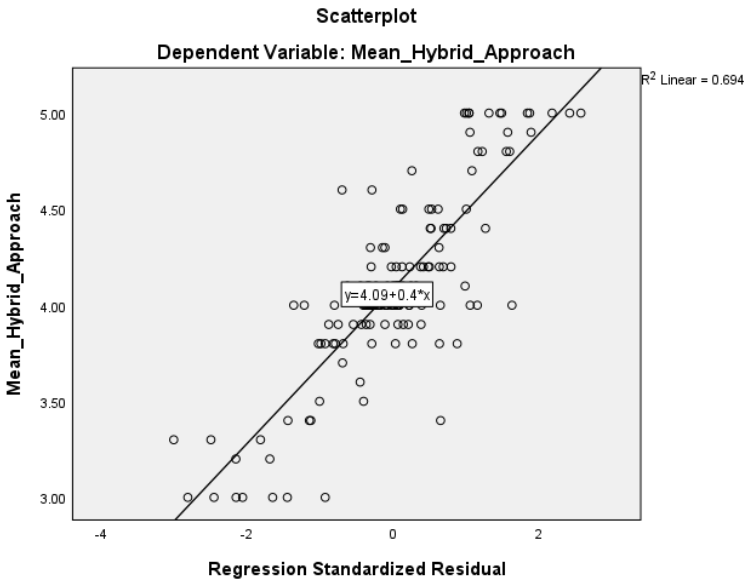


Figure 4.11: Homoscedasticity test of variables

Since the amount of error denoted by the distance from the line to the dots in figure 4.9, tends to increase and stays roughly consistent when you move further up the line, it denotes that the variables are homoscedasticity.

4.8 Descriptive statistics

Descriptive statistics are used to organize data by describing the relationships between variables in the research sample. Calculating descriptive statistics is a crucial first step when conducting research and should always be done before undertaking inferential statistical comparisons (Yellapu, 2018). The mean, standard deviation, skewness, and kurtosis are calculated to interpret this analysis and the normality of the data.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Mean_Agile_Delivery_Strategy	150	2.40	5.00	4.1547	.51352	-.641	.198	1.199	.394
Mean_Agile_SD_Technique	150	2.43	5.00	4.0305	.54281	-.688	.198	.405	.394
Mean_Agile_Team_Capability	150	2.25	5.00	3.9092	.53719	-.685	.198	1.009	.394
Mean_Project_Duration	150	2.25	5.00	4.0500	.55336	-.482	.198	.676	.394
Mean_Trad_Requirement_Clarity	150	1.75	5.00	3.6383	.80139	-.409	.198	-.589	.394
Mean_Trad_Efficient_Communication	150	1.25	5.00	3.5083	.89058	-.492	.198	-.494	.394
Mean_Hybrid_Approach	150	3.00	5.00	4.0867	.47426	-.029	.198	.364	.394
Valid N (listwise)	150								

Figure 4.12: Descriptive statistics of the variables

The table above depicts the distribution of data for the research variables, which were measured using five-point Likert scale. The mean of the seven variables is in the range of 3.63 – 4.15 depicting the central tendency of the data set. The standard deviation in

the range of 0.47 – 0.89 illustrates how much the data deviates from the mean of the variables illustrating the accuracy of the data set. In the given table, the skewness statistic value represents the leanness of the data. Kurtosis represents the peak/ height of the data. This analysis shows that the skewness values are within the range of -2 +2 and kurtosis values are within the range of -2 +2 and are closer to 0, they represent the data's normal distribution (Sheard, 2018). So, the researcher proceeded with the data analysis with all selected variables in this study.

4.9 Correlation analysis

The correlation analysis measures the association on the relationship between independent and dependent variables (Senthilnathan, 2019). In this study, Pearson correlation coefficient is used to calculate the strength of linear association between variables. Fundamentally, the coefficient of correlation R will range from -1 to +1, with measures categorized as Positive (+1), Zero (0), or Negative (-1) relationship. The strength of correlation coefficient is interpreted using rules of thumb, with a P-value <0.05 where the confidence level is 95% indicating statistical significance between the variables (Janse, et al., 2021). The following analyses were conducted.

4.9.1 Correlation between agile delivery strategy and project effectiveness of the HPM approach

Correlations

		Mean_Agile_Delivery_Strategy	Mean_Hybrid_Approach
Mean_Agile_Delivery_Strategy	Pearson Correlation	1	.298**
	Sig. (2-tailed)		<.001
	N	150	150
Mean_Hybrid_Approach	Pearson Correlation	.298**	1
	Sig. (2-tailed)	<.001	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.13: Correlation between agile delivery strategy and project effectiveness

The correlation between delivery strategy and project effectiveness is significant with a Significance (Sig.) value of 0.000 which is less than P-value of 0.05. The above graph also illustrates that there's a positive linear relationship between the two variables since it has a correlation value of +0.298. So, it can be stated that there's a significance and

positive relationship between agile delivery strategy and the project effectiveness of the HPM approach.

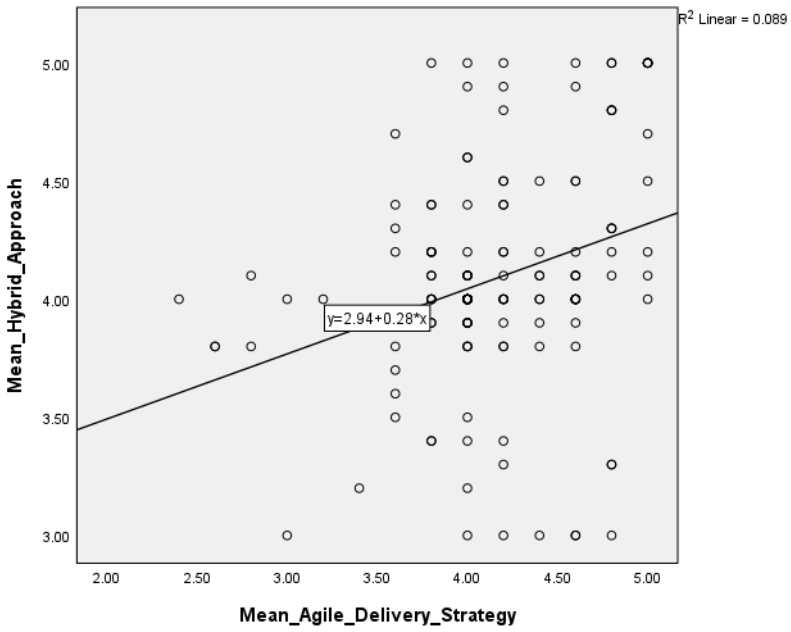


Figure 4.14: Linearity between agile delivery strategy and project effectiveness

The positive linear relationship of the two variables is also indicated by the above scatter/ dot diagram. The regression equation indicates that when the agile delivery strategy grows, the project effectiveness also increases by 28%.

4.9.2 Correlation between agile SD techniques and project effectiveness of the HPM approach

Correlations

		Mean_Agile_SD_Technique	Mean_Hybrid_Approach
Mean_Agile_SD_Technique	Pearson Correlation	1	.313**
	Sig. (2-tailed)		<.001
	N	150	150
Mean_Hybrid_Approach	Pearson Correlation	.313**	1
	Sig. (2-tailed)	<.001	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.15: Correlation between agile SD techniques and project effectiveness

The correlation between SD techniques and project effectiveness is significant with a Sig. value of 0.000 which is less than P-value of 0.05. The above graph also illustrates that there's a positive linear relationship between the two variables since it has a

correlation value of +0.313. So, it can be stated that there's a significance and positive relationship between agile SD techniques and the project effectiveness of the HPM approach.

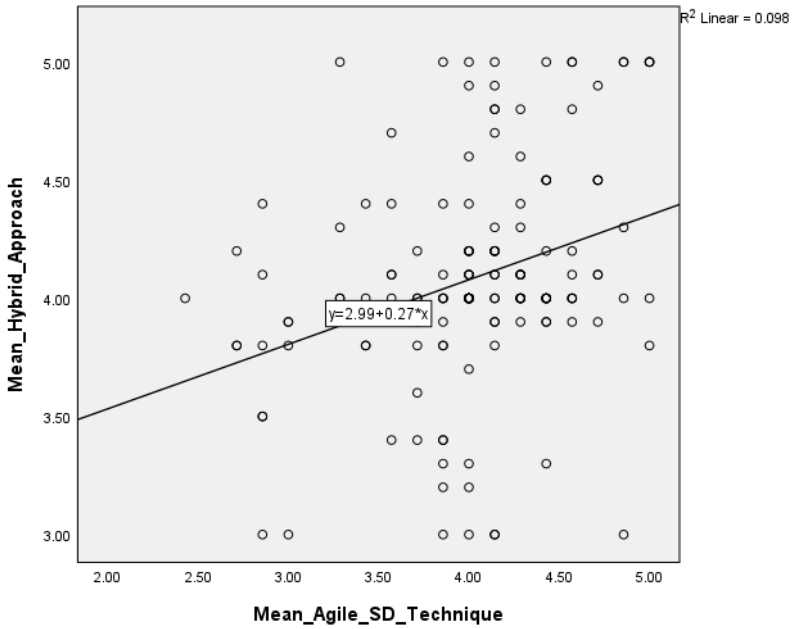


Figure 4.16: Linearity between agile SD techniques and project effectiveness

The positive linear relationship of the two variables is also indicated by the above scatter/ dot diagram. The regression equation indicates that when agile SD techniques grows, the project effectiveness also increases by 27%.

4.9.3 Correlation between agile team capability and project effectiveness of the HPM approach

Correlations

		Mean_Agile_Team_Capability	Mean_Hybrid_Approach
Mean_Agile_Team_Capability	Pearson Correlation	1	.418**
	Sig. (2-tailed)		<.001
	N	150	150
Mean_Hybrid_Approach	Pearson Correlation	.418**	1
	Sig. (2-tailed)	<.001	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.17: Correlation between agile team capability and project effectiveness

The correlation between team capability and project effectiveness is significant with a Sig. value of 0.000 which is less than P-value of 0.05. The above graph also illustrates

that there's a positive linear relationship between the two variables since it has a correlation value of +0.418. So, it can be stated that there's a significance and positive relationship between agile team capability and the project effectiveness of the HPM approach.

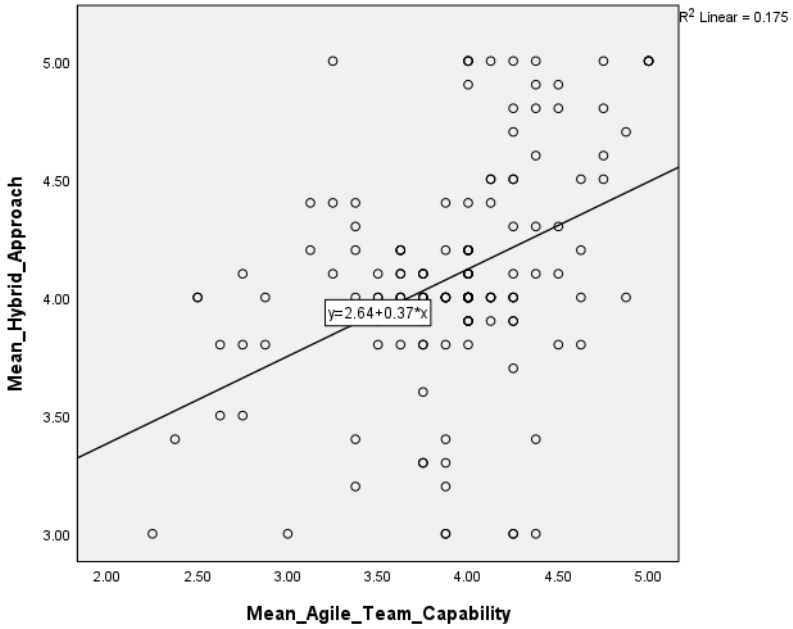


Figure 4.18: Linearity between agile team capability and project effectiveness

The positive linear relationship of the two variables is also indicated by the above scatter/ dot diagram. The regression equation indicates that when agile team capability grows, the project effectiveness also increases by 37%.

4.9.4 Correlation between TPM requirement clarity and project effectiveness of the HPM approach

Correlations

		Mean_Trad_Requirement_Clarity	Mean_Hybrid_Approach
Mean_Trad_Requirement_Clarity	Pearson Correlation	1	.196*
	Sig. (2-tailed)		.016
	N	150	150
Mean_Hybrid_Approach	Pearson Correlation	.196*	1
	Sig. (2-tailed)	.016	
	N	150	150

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 4.19: Correlation between TPM requirement clarity and project effectiveness

The correlation between requirement clarity and project effectiveness is significant with a Sig. value of 0.016 which is less than P-value of 0.05. The above graph also illustrates that there's a positive linear relationship between the two variables since it has a correlation value of +0.196. So, it can be stated that there's a significance and positive relationship between TPM requirement clarity and the project effectiveness of the HPM approach.

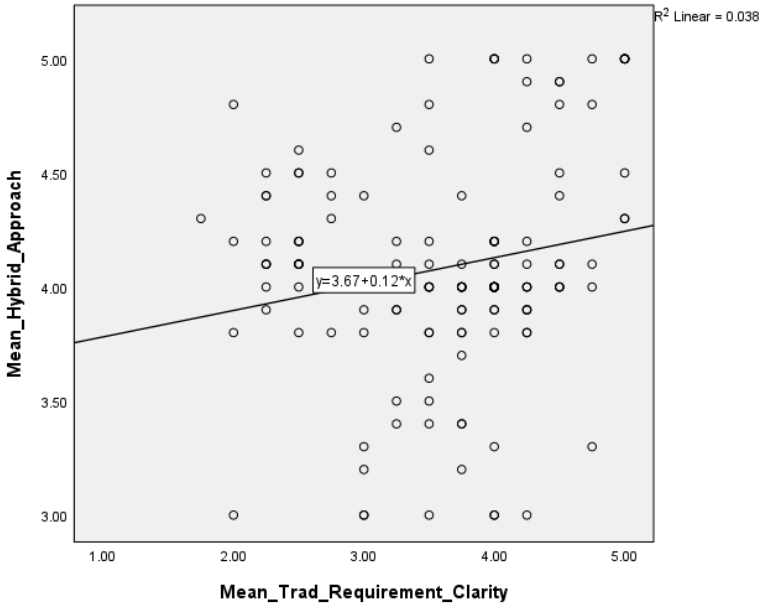


Figure 4.20: Linearity between TPM requirement clarity and project effectiveness

The positive linear relationship of the two variables is also indicated by the above scatter/ dot diagram. The regression equation indicates that when TPM requirement clarity grows, the project effectiveness also increases by 12%.

4.9.5 Correlation between TPM efficient communication and project effectiveness of the HPM approach

Correlations

		Mean_Trad_Efficient_Communication	Mean_Hybrid_Approach
Mean_Trad_Efficient_Communication	Pearson Correlation	1	.260**
	Sig. (2-tailed)		.001
	N	150	150
Mean_Hybrid_Approach	Pearson Correlation	.260**	1
	Sig. (2-tailed)	.001	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.21: Correlation between TPM efficient communication and project effectiveness

The correlation between efficient communication and project effectiveness is significant with a Sig. value of 0.001 which is less than P-value of 0.05. The above graph also illustrates that there's a positive linear relationship between the two variables since it has a correlation value of +0.260. So, it can be stated that there's a significance and positive relationship between TPM efficient communication and project effectiveness of the HPM approach.

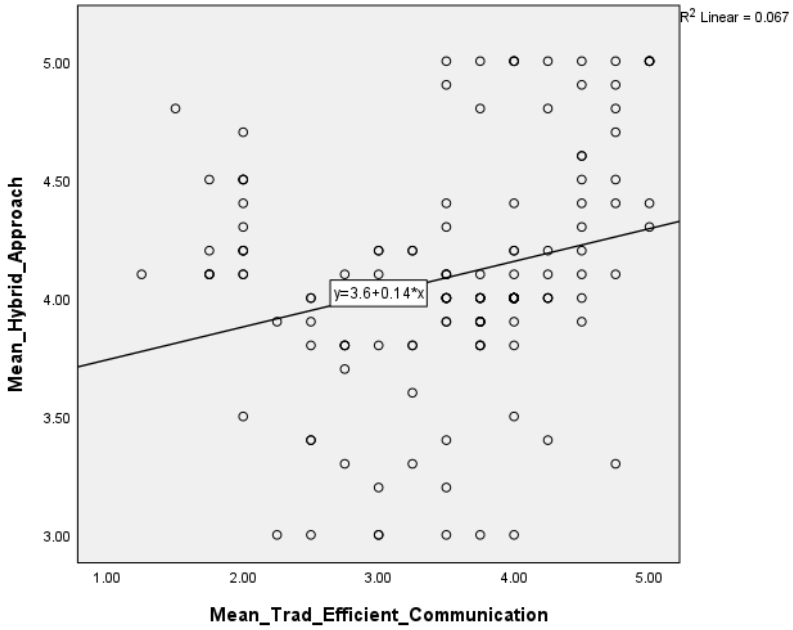


Figure 4.22: Linearity between TPM efficient communication and project effectiveness

The positive linear relationship of the two variables is also indicated by the above scatter or dot diagram. The regression equation indicates that when TPM efficient communication grows, the project effectiveness also increases by 14%.

4.10 Regression analysis

Regression analysis is a statistical tool for investigating the influence of independent variables with dependent variables. A bivariate correlation was conducted to verify how each independent variable correlates with the dependent variable in the study, based on that result a simple linear regression analysis was selected to determine how each individual independent variable relates to the dependent variable.

Therefore, the researcher ensured to derive R^2 value, Sig. and F values of the ANOVA table and Sig. and beta values of the coefficient table to conduct the regression analysis. R^2 value states the percentage of which the independent variable expresses the dependent variable. The closer R^2 value is for +1, there exists a perfect linear

relationship between the two variables. Additionally, the adjusted R^2 values should be generally less than R^2 indicating the model accuracy (Kumari & Yadav, 2018).

The coefficient table displays the significance with Sig. < 0.05 and unstandardized coefficient beta value representing the positive or negative relationship between the variables. The ANOVA table displays the F value which should be greater than 1 and the significance of the linear regression model with Sig. < 0.05, finally explaining the overall validity of the hypothesis of the selected variables (Kumari & Yadav, 2018).

4.10.1 Regression analysis for agile delivery strategy and project effectiveness of the HPM approach (H1)

Table 4.7: Regression analysis of H1

Model Summary		
Agile delivery strategy	R Square	Adjusted R Square
	0.089	0.083
ANOVA Table		
Agile delivery strategy	F value	Sig.
	14.470	0.000
Coefficient Table		
	Unstandardized Coefficients B	Sig.
(Constant)	2.942	0.000
Agile delivery strategy	0.276	0.000

Delivery strategy of Agile positively influences the project effectiveness of a HPM approach is the first research hypothesis (H_1) that is considered when evaluating the regression analysis results. According to the model summary in the above table, the R^2 value is 0.089, which implies that 8.9% of project effectiveness is explained by the agile delivery strategy variable. And the adjusted R^2 value of 0.083 is less than R^2 indicating the hypothesis accuracy.

The ANOVA results shows that the F value is 14.470, indicating that the value is greater than 1 which implies that the hypothesis is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

The coefficient table illustrates the Beta value for agile delivery strategy as 0.276 indicating a positive relationship with project effectiveness. The Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the research hypothesis (H_1) can be accepted. The regression equation for H_1 can be calculated as follows.

$$Project\ effectiveness\ = 2.942 + \ 0.276(Agile\ delivery\ strategy)$$

This analysis concludes that when the agile delivery strategy improves, the project effectiveness of the HPM approach also improves and the research hypothesis (H_1) can be accepted.

4.10.2 Regression analysis for agile SD techniques and project effectiveness of the HPM approach (H2)

Table 4.8: Regression analysis of H2

Model Summary		
	R Square	Adjusted R Square
Agile SD techniques	0.098	0.092
ANOVA Table		
	F value	Sig.
Agile SD techniques	16.026	0.000
Coefficient Table		
	Unstandardized Coefficients B	Sig.
(Constant)	2.986	0.000
Agile SD techniques	0.273	0.000

Agile SD techniques positively influences the project effectiveness of a HPM approach is the second research hypothesis (H_2) that is considered when evaluating the regression analysis results. According to the model summary in the above table, the R^2 value is 0.098, which implies that 9.8% of project effectiveness is explained by the agile SD techniques variable. And the adjusted R^2 value of 0.092 is less than R^2 indicating the hypothesis accuracy.

The ANOVA results shows that the F value is 16.026, indicating that the value is greater than 1 which implies that the hypothesis is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

The coefficient table illustrates the Beta value for agile SD techniques as 0.273 indicating a positive relationship with project effectiveness. The Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the research hypothesis (H_2) can be accepted. The regression equation for H_2 can be calculated as follows.

$$Project\ effectiveness\ = 2.986 + \ 0.273(Agile\ SD\ techniques)$$

This analysis concludes that when agile SD techniques improves, the project effectiveness of the HPM approach also improves and the research hypothesis (H_2) can be accepted.

4.10.3 Regression analysis for agile team capability and project effectiveness of the HPM approach (H3)

Table 4.9: Regression analysis of H3

Model Summary		
Agile team capability	R Square	Adjusted R Square
	0.175	0.169
ANOVA Table		
Agile team capability	F value	Sig.
	31.339	0.000
Coefficient Table		

	Unstandardized Coefficients B	Sig.
(Constant)	2.644	0.000
Agile team capability	0.369	0.000

Team capability of Agile positively influences the project effectiveness of a HPM approach is the third research hypothesis (H_3) that is considered when evaluating the regression analysis results. According to the model summary in the above table, the R2 value is 0.175, which implies that 17.5% of project effectiveness is explained by the agile team capability variable. And the adjusted R2 value of 0.169 is less than R2 indicating the hypothesis accuracy.

The ANOVA results shows that the F value is 31.339, indicating that the value is greater than 1 which implies that the hypothesis is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

The coefficient table illustrates the Beta value for agile team capability as 0.369 indicating a positive relationship with project effectiveness. The Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the research hypothesis (H_3) can be accepted. The regression equation for H_3 can be calculated as follows.

$$Project\ effectiveness = 2.644 + 0.369(Agile \text{ team capability})$$

This analysis concludes that when agile team capability improves, the project effectiveness of the HPM approach also improves and the research hypothesis (H_3) can be accepted.

4.10.4 Regression analysis for TPM requirement clarity and project effectiveness of the HPM approach (H4)

Table 4.10: Regression analysis of H4

Model Summary		
	R Square	Adjusted R Square
TPM requirement clarity	0.038	0.032
ANOVA Table		
	F value	Sig.
TPM requirement clarity	5.887	0.016
Coefficient Table		
	Unstandardized Coefficients B	Sig.
(Constant)	3.666	0.000
TPM requirement clarity	0.116	0.016

Requirement clarity of TPM positively influences the project effectiveness of a HPM approach is the fourth research hypothesis (H_4) that is considered when evaluating the regression analysis results. According to the model summary in the above table, the R2 value is 0.038, which implies that 3.8% of project effectiveness is explained by the requirement clarity variable. And the adjusted R2 value of 0.032 is less than R2 indicating the hypothesis accuracy.

The ANOVA results shows that the F value is 5.887, indicating that the value is greater than 1 which implies that the hypothesis is effective. Furthermore, the Sig. value is 0.016 which is less than 0.05 indicating the significance of the hypothesis.

The coefficient table illustrates the Beta value for requirement clarity as 0.116 indicating a positive relationship with project effectiveness. The Sig. value is 0.016 which is less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the research hypothesis (H_4) can be accepted. The regression equation for H_4 can be calculated as follows.

$$Project\ effectiveness\ = 3.666 + 0.116(Requirement\ clarity\ of\ TPM\ )$$

This analysis concludes that when the requirement clarity of TPM improves, the project effectiveness of the HPM approach also improves and the research hypothesis (H_4) can be accepted.

4.10.5 Regression analysis for TPM efficient communication and project effectiveness of the HPM approach (H5)

Table 4.11: Regression analysis of H5

Model Summary		
TPM efficient communication	R Square	Adjusted R Square
	0.067	0.061
ANOVA Table		
TPM efficient communication	F value	Sig.
	10.701	0.001
Coefficient Table		
	Unstandardized Coefficients B	Sig.
(Constant)	3.602	0.000
TPM efficient communication	0.138	0.001

Efficient communication of TPM positively influences the project effectiveness of a HPM approach is the fifth research hypothesis (H_5) that is considered when evaluating the regression analysis results. According to the model summary in the above table, the R2 value is 0.067, which implies that 6.7% of project effectiveness is explained by the efficient communication variable. And the adjusted R2 value of 0.061 is less than R2 indicating the hypothesis accuracy.

The ANOVA results shows that the F value is 10.701, indicating that the value is greater than 1 which implies that the hypothesis is effective. Furthermore, the Sig. value is 0.016 which is less than 0.05 indicating the significance of the hypothesis.

The coefficient table illustrates the Beta value for efficient communication as 0.138 indicating a positive relationship with project effectiveness. The Sig. value is 0.001 which is less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the research hypothesis (H_5) can be accepted. The regression equation for H_5 can be calculated as follows.

$$Project\ effectiveness\ = 3.602 + \ 0.138(Efficient\ communication\ of\ TPM\ )$$

This analysis concludes that when efficient communication of TPM improves, the project effectiveness of the HPM approach also improves and the research hypothesis (H_5) can be accepted.

4.10.6 Multiple regression analysis

Table 4.12: Multiple regression analysis

Model Summary		
	R Square	Adjusted R Square
Model 1	0.272	0.246
ANOVA Table		
	F value	Sig.
Model 1	10.743	0.000
Coefficient Table		
	Unstandardized Coefficients B	Sig.
(Constant)	2.238	0.000
Agile delivery strategy	0.157	0.006
Agile SD techniques	0.144	0.007
Agile team capability	0.132	0.009
TPM requirement clarity	0.084	0.032

TPM efficient communication	0.115	0.012

According to the model summary in the above table, the R^2 value is 0.272, which implies that 27.2% of project effectiveness is explained by all the agile and traditional variables. And the adjusted R^2 value of 0.246 is less than R^2 indicating the accuracy of all five hypotheses.

The ANOVA results shows that the F value is 10.743, indicating that the value is greater than 1 which implies that all the hypotheses are effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of all the hypotheses.

The coefficient table illustrates a positive beta value for all the variables, indicating a positive relationship with project effectiveness. The Sig. values are less than 0.05 indicating the significance of the hypothesis yet again, ensuring that the independent varaible research hypotheses (H_1 – H_5) can be accepted. This analysis concludes that when the agile delivery strategy, Agile SD techniques, Agile team capability, TPM requirement clarity, and TPM efficient communication improves, the project effectiveness of the HPM approach also improves.

This study also includes a multicollinearity test, which is used when performing multiple linear regression analysis on variables that are significantly correlated not only with the dependent variable but also with each other. The below computed table depicts that all the variable values of VIF are greater than 1 and less than 5, indicating that the variables are moderately correlated to each other.

Table 4.13: Multicollinearity test

		Collinearity Statistics	
Model		Tolerance	VIF
1	Agile delivery strategy	.519	1.926
	Agile SD techniques	.450	2.220
	Agile team capability	.430	2.324
	TPM requirement clarity	.360	2.779
	TPM efficient communication	.393	2.542

4.11 Moderator analysis

A moderator variable is a third variable that influences the relationship between two variables. In other words, the strength of the association between two variables varies as the moderator construct's levels change. (Fairchild & McQuillin, 2010) This section analyses the project duration moderating effect of an agile delivery strategy, SD techniques, and TPM requirement clarity on the project effectiveness of a HPM approach.

Regression analysis was used to test the moderation effects of the variables. The researcher ensured to derive the R^2 and R^2 change value, Sig., F and beta values to measure the significance of the moderator effect. R^2 change value indicates the improvement in R^2 when the moderator is added and Sig. < 0.05 would indicate the significance of the moderator effect explaining the overall validity of the hypothesis. (Cui & Wu, 2016)

Each impacting individual independent variable was tested with the project duration moderator along with the inclusion of generated interaction (independent variable*moderator variable) to measure the significance of the moderator effect of the three hypotheses. The following analyses were done as two models, model 1 indicates the effect on variables before the moderator interaction, and model 2 indicates after the moderator interaction.

4.11.1 Regression analysis for project duration moderating effect of agile delivery strategy on project effectiveness (H6a)

Table 4.14: Regression analysis of H6a

Model Summary

	R Square	R Square Change
Model 1	0.267	0.267
Model 2	0.308	0.041

ANOVA Table

		F value	Sig.
Model 1		26.772	0.000
Model 2		21.708	0.000

Coefficient Table

		Coeff. B	Sig.
Model 1	Agile Delivery Strategy	-0.087	0.331
	Project Duration	0.494	0.000
Model 2	Agile Delivery Strategy	-0.961	0.002
	Project Duration	-0.451	0.173
	Interaction (AgileDeliveryStrategy*ProjectDuration)	0.231	0.004

In the above table, the R^2 change value is 0.041 indicating that there is an improvement of 4.1% in R^2 when the moderator is added, resulting in an increase from 26.7% to 30.8% of project effectiveness. The ANOVA results shows that the F value is 21.708, indicating that the value is greater than 1 which implies that the project duration moderating effect of agile delivery strategy is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

Finally, the coefficient table illustrates the Beta value for Interaction as 0.231 indicating a positive relationship with project effectiveness. The Sig. value is 0.004 which is less than 0.05 indicating the significance of the hypothesis, ensuring that the research hypothesis (H_{6a}) can be accepted.

This analysis concludes that project duration in fact does moderate the effect of agile delivery strategy on project effectiveness of a HPM approach and the research hypothesis (H_{6a}) can be accepted.

4.11.2 Regression analysis for project duration moderating effect of agile SD technique on project effectiveness (H6b)

Table 4.15: Regression analysis of H6b

Model Summary			
		R Square	R Square Change
Model 1		0.262	0.262
Model 2		0.286	0.023
ANOVA Table			
		F value	Sig.
Model 1		26.128	0.000
Model 2		19.460	0.000
Coefficient Table			
		Coeff.	Sig.
Model 1	Agile SD technique	-0.002	0.978
	Project Duration	0.440	0.000
Model 2	Agile SD technique	-0.719	0.035
	Project Duration	-0.287	0.402
	Interaction (AgileSDTechnique*ProjectDuration)	0.184	0.030

In the above table, the R^2 change value is 0.023 indicating that there is an improvement of 2.3% in R^2 when the moderator is added, resulting in an increase from 26.2% to 28.6% of project effectiveness. The ANOVA results shows that the F value is 19.460, indicating that the value is greater than 1 which implies that the project duration moderating effect of SD technique is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

Finally, the coefficient table illustrates the Beta value for Interaction as 0.184 indicating a positive relationship with project effectiveness. The Sig. value is 0.030 which is less than 0.05 indicating the significance of the hypothesis, ensuring that the research hypothesis (H_{6b}) can be accepted.

This analysis concludes that project duration in fact does moderate the effect of the agile SD technique on the project effectiveness of a HPM approach and the research hypothesis (H_{6b}) can be accepted.

4.11.3 Regression analysis for project duration moderating effect of TPM requirement clarity on project effectiveness (H6c)

Table 4.16: Regression analysis of H6c

Model Summary			
		R Square	R Square Change
Model 1		0.262	0.262
Model 2		0.277	0.015
ANOVA Table			
		F value	Sig.
Model 1		26.138	0.000
Model 2		18.643	0.000
Coefficient Table			
		Coeff.	Sig.
Model 1	TPM requirement clarity	0.005	0.904
	Project Duration	0.436	0.000
Model 2	TPM requirement clarity	-0.525	0.094
	Project Duration	0.018	0.942

Interaction (TPMRequirementClarity*ProjectDuration)	0.123	0.088

In the above table, the R^2 change value is 0.015 indicating that there is an improvement of 1.5% in R^2 when the moderator is added, resulting in a minor increase from 26.2% to 27.7% of project effectiveness. The ANOVA results shows that the F value is 18.643, indicating that the value is greater than 1 which implies that the project duration moderating effect of requirement clarity is effective. Furthermore, the Sig. value is 0.000 which is less than 0.05 indicating the significance of the hypothesis.

Finally, the coefficient table illustrates the Beta value for Interaction as 0.123 indicating a minor relationship with project effectiveness but the Sig. value is 0.088 which is higher than 0.05 indicating the insignificance of the hypothesis, so the research hypothesis (H_{6c}) cannot be accepted.

This analysis concludes that project duration does not moderate the effect of TPM requirement clarity on the project effectiveness of a HPM approach and the research hypothesis (H_{6c}) should be rejected.

4.12 Analysis conclusion

Based on the Pearson Correlation analysis, the coefficient value and R-value for the relationship between all the research independent variables (agile delivery strategy, SD technique, team capability and TPM requirement clarity, efficient communication) and project effectiveness are always positive with a Sig. value less than 0.05. Indicating that there's a significance and positive relationship between all the independent research variables and project effectiveness.

As reported by the regression analysis for all the independent variables, the ANOVA results shows that the F value is always positive which implies that their influence on project success is effective. Furthermore, the Sig. value for the variables is less than 0.05 indicating the significance of their influence and accepting the $H_1 – H_5$ hypothesis.

The moderator analysis for project duration in the PM process indicated that there is a moderate effect of agile delivery strategy and SD techniques on the project effectiveness of a HPM approach with a Sig. value less than 0.05, resulting in accepting the H_{6a} and H_{6b} hypothesis. However, project duration did not moderate (insignificant) the effect of TPM requirement clarity on project effectiveness since it had a Sig. value of 0.088,

resulting in rejecting the H_{6c} hypothesis. The summary of each hypothesis is denoted in Table 4.16.

Consequently, it can be said that the optimum hybrid methodology would involve combining delivery strategy, SD technique, team capability from agile and requirement clarity, and efficient communication from traditional methodology to achieve better project success based on time, cost, quality, team, and client satisfaction.

Table 4.17: Hypothesis conclusion

	Hypothesis	**Status**
H_1	Delivery strategy of Agile positively influences the project effectiveness of a HPM approach	Accepted
H_2	Agile software development techniques positively influences the project effectiveness of a HPM approach	Accepted
H_3	Team capability of Agile has a positively influences the project effectiveness of a HPM approach	Accepted
H_4	Requirement Clarity of TPM positively influences the project effectiveness of a HPM approach	Accepted
H_5	Effective Communication of TPM positively influences the project effectiveness of a HPM approach	Accepted
H_{6a}	Project duration moderates the effect of agile delivery strategy on project effectiveness of a HPM approach	Accepted
H_{6b}	Project duration moderates the effect of agile SD techniques on project effectiveness of a HPM approach	Accepted
H_{6c}	Project duration moderates the effect of TPM requirement clarity on project effectiveness of a HPM approach	Rejected

4.13 Chapter summary

Starting with the participant analysis, data screening, reliability, validity, and diagnostic tests were conducted. After the tests have been completed a correlation and regression analysis was conducted to measure the association and influence on the relationship between variables accordingly. The regression analysis ensured that all H_1, H_2, H_3, H_4, and H_5 research hypotheses can be accepted. Finally, the moderator analysis was performed to measure the strength of the association between the two variables. This analysis confirmed that $H6_a$ and $H6_b$ moderating hypotheses can be accepted but $H6_c$ will be rejected since the moderating effect is not significant.

CHAPTER 5 – DISCUSSION OF FINDINGS

5.1 Introduction

The research findings derived from the previous chapter are discussed critically alongside the research objectives in this chapter. These findings were also linked with the existing literature review done in the study.

5.2 Critical discussion of research findings to accomplish the research objectives

The following are the four research objectives that will be critically discussed with the findings of the study.

5.2.1 Identify the existing issues in managing IT projects using an agile-based methodology (RO1)

This section addresses the first research question along with the first research objective (RO1) using the existing literature.

RQ1	In what ways does agile practices differ from theory in medium – large-scale IT companies?

Existing studies have confirmed that medium-large scale companies using agile processes have only an average success rate of 54% (Khalil, 2017). Existing studies regarding agile PM have merely reported the success and failure factors and their impact on projects in Sri Lanka, no evaluation has been conducted to address the common issues in agile projects. Pursuing this statement, the researcher ensured to identify said issues in handling agile projects.

Some of the common issues associated with agile methodology in medium to large-scale IT companies include poor resource planning, underuse of collaboration and communication, ongoing requirement changes, unclear definition of done, and insufficient documentation (Sharma, Sarkar, Gupta, 2012). These issues were classified into three major categorized in the research to observe whether they are Sri Lankan medium to large scale companies are facing the same issues.

The agile methodology, based on customer involvement, can get off track if the client representative is unclear about features requirements. Inadequate team communication

and scheduling with end users can lead to misalignment of effort and resources, resulting in lower code quality and missed defects (Sharma, Sarkar, Gupta, 2012).

Agile favors working software over relevant documentation, so project schedules make it difficult to maintain comprehensive and inclusive design and implementation documentation due to constant user requirements changes (Boehm, Port, 2001). Lack of documentation hinders maintenance activities, accurate requirement changes, new developers' understanding of product development processes, and knowledge transfers in project or resource changes (Sharma, Sarkar, Gupta, 2012).

The project's incremental developed proportion is no use if clients constantly change requirements, wasting time, effort, and resources of the agile team. The team would bear the financial impact and face significant rework for the project's development and testing (Sharma, Sarkar, Gupta, 2012).

5.2.2 Examine the best practices to consider in managing IT projects in an agile-based methodology (RO2)

This section addresses the first research question along with the second research objective (RO2) using the existing literature. The first research question covers both the issues and best practices in agile based projects to perceive how the practice actually varies from theory in medium – large-scale IT companies.

RQ1	In what ways does agile practices differ from theory in medium – large-scale IT companies?

Agile methodology acquired great traction in IT projects due to its nature of adaptability and delivering software in small increments. The agile methodology best practices were derived using Chow and Chao's critical factors for project success (Tsun Chow, Dac-Buu Cao, 2007). The following three critical success factors were considered in this research to observe whether they are still in practice in Sri Lankan medium to large scale companies.

Delivery strategy of the Agile methodology emphasizes consistent software solution delivery, emphasizing customer satisfaction, adaptability, and continuous improvement, with on-time delivery being a key factor in project effectiveness (Elvan Kula, 2022). Agile delivery strategy promotes iterative and incremental delivery,

enabling adaptive planning and prioritization. It enhances project effectiveness by mitigating risks and accelerating time-to-market (Elvan Kula, 2022).

Agile software development techniques enable iterative, flexible, and collaborative development, ensuring efficient coding, project maintainability, and robust testing strategies for high-quality software increments while responding to constant requirement changes and customer feedback (Tsun Chow, Dac-Buu Cao, 2007). This factor helps to improve code quality, reduce errors, and meet user expectations, thereby enhancing overall project success (Azarkerdar, 2018).

Team capability in Agile methodology refers to the combined abilities, competencies, and effectiveness of team members in delivering value to clients, influencing agile SD performance and project success (Mendes, Viana, Vishnubhotla, & Lundberg, 2018). The team capability of Agile, characterized by motivation, management, and trainings provided influences the project effectiveness (Tsun Chow, Dac-Buu Cao, 2007).

5.2.3 Identify the suitable TPM practices that could be incorporated with the agile methodology (RO3)

This section addresses the second research question along with the third research objective (RO3) using the existing literature.

RQ2	What limitations of the existing agile methodology are overcome by incorporating TPM as a hybrid project management approach?

This study aims to utilize existing, effective TPM approaches to incorporate them with Agile to overcome the gaps and issues in it. Pursuing this aim, the researcher ensured to classify the following two best practices in TPM to overcome the research gaps.

Requirement clarity in TPM emphasizes on detailed documentation and clear requirement definitions to ensure that project requirements are well-understood and documented before development begins. Traditional methodologies often use comprehensive documentation to capture project requirements, reducing workload and increasing maintainability. The team maintains continuous and parallel documentation throughout the project's lifecycle for the reference of the project team, stakeholders, and clients. (Rong, et al., 2019) Requirement definitions play a critical role in initiating and planning projects in TPM which helps in risk mitigation and effective resource

management and enhancing project effectiveness (Gupta, Mata-Toledo, & Monger, 2011).

Efficient communication in traditional methodology involves regular client involvement and maintaining formal meeting minutes for effective and transparent project communication. Regular client involvement and thorough documentation during meetings ensure project alignment, reduce misalignment, and save time, ultimately enhancing project effectiveness (Bakalova & Daneva, 2011).

5.2.4 Provide proper recommendations on utilizing both traditional and agile based hybrid project management practices in software development to achieve project effectiveness (RO4)

This section addresses the third research question along with the fourth research objective (RO4) using the existing literature.

RQ3	What ways can a project modify their agile project management approach currently being used to achieve project effectiveness?

The project effectiveness of the hybrid approach was measured based on the theory of triple constraints and stakeholder theory. The three constraints of time, cost, and quality have been closely linked to measuring project success (Navarre & Schaan, 1990) was considered for this study along with the client and team satisfaction (Freeman, 1984). Both triple constraints and stakeholder theories aim to improve effectiveness within projects and are prominent in the field of project management.

Based on the Pearson Correlation analysis, the coefficient value and R-value for the relationship between all the research independent variables (agile delivery strategy, SD technique, team capability and TPM requirement clarity, efficient communication) and project effectiveness are always positive with a Sig. value less than 0.05. Indicating that there's a significance and positive relationship between all the independent research variables and project effectiveness.

As reported by the regression analysis for all the independent variables, the ANOVA results shows that the F value is always positive which implies that their influence on project success is effective. Furthermore, the Sig. value for the variables is less than 0.05 indicating the significance of their influence and accepting the $H_1 – H_5$ hypothesis.

Therefore, it can be said that agile delivery strategy, SD technique, team capability, TPM requirement clarity, and efficient communication has a significant positive impact on project effectiveness.

According to the moderator regression analysis to test the project duration's moderating effect of agile delivery strategy, SD technique, and TPM requirement clarity on project effectiveness. The coefficient table illustrated that agile delivery strategy and SD technique of Sig. value less than 0.05 indicated a significant positive relationship with project effectiveness. However, TPM requirement clarity had a Sig. value of 0.088 which is higher than 0.05 indicating the insignificance of the moderating effect of project duration. The analysis indicated that the project durations' impact is often moderated at a somewhat lower rate with the effectiveness of HPM approaches since hybrid model leverages the strengths of both methodologies. This approach allows for adaptability and iterative progress while still maintaining some level of structure and predictability. As a result, project duration could become less of a central focus, when the emphasis is more on delivering functional features regularly and adjusting plans while balancing scope, schedule, and resources effectively, rather than strictly adhering to a fixed timeline.

Evidently, according to the study, the optimum methodology would involve combining delivery strategy, SD technique, team capability from agile the most successful methodology and requirement clarity, efficient communication from traditional methodology to achieve better project success.

5.3 Chapter summary

This chapter concluded the research findings derived from the literature review and data analysis chapter alongside the research objectives. To sum up, the delivery strategy, SD techniques, team capability of agile and requirement clarity, effective communication of TPM in project management has an impact on project effectiveness.

CHAPTER 6 – CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The conclusions drawn from the study along with recommendations and limitations are explained in this final chapter of the research. This thesis work was motivated by the fact that agile methodology has certain drawback during software development process.

6.2 Research Conclusions

The contribution of this research work was to analyze agile challenges and study how they can be overcome by adopting other suitable TPM approaches to achieve project success. The research objectives were achieved and derived based on the research questionnaire responses and existing literature. The following descriptions summarize the research findings for each objective.

The initial objective was to identify the existing issues in handling IT projects in an agile-based methodology. The literature reviews upheld issues such as poor resource planning, underuse of collaboration and communication, ongoing requirement changes, unclear definition of done, and insufficient documentation were observed. (Sharma, Sarkar, Gupta, 2012)

The second research objective was to examine the best practices to consider in managing IT projects in an agile-based methodology. The literature review and responses received indicated that the three critical success factors, delivery strategy, software development technique, and team capability were in fact still considered and are in practice in the industry (Tsun Chow, Dac-Buu Cao, 2007).

After agile best practices were assessed in the study, the third objective was initiated to identify the suitable TPM practices that can be incorporated with the agile methodology. The comprehensive literature review and questionnaire determined that TPM has some suitable practices that could be incorporated with agile namely, requirement clarity focusing on detailed documentation practices and clear requirement definitions, and efficient communication covering regular client involvement and the maintenance of formal meeting minutes (Mahajan, 2022).

The final objective was to provide suitable recommendations on using both traditional and agile based, hybrid project management practices in software development. This

too was achieved by the data analysis and hypothesis testing in the research. The results stated that agile delivery strategy, SD technique, team capability and TPM requirement clarity, efficient communication has a significant positive impact on project effectiveness. The moderator analysis for project duration in the PM process indicated that there is a moderate effect of agile delivery strategy and SD techniques on the project effectiveness of a HPM approach. Project duration did not moderate (insignificant) the effect of TPM requirement clarity on project effectiveness.

Consequently, it means that the optimum hybrid methodology would involve combining delivery strategy, SD technique, team capability from agile and requirement clarity, efficient communication from traditional methodology to achieve better project success based on time, cost, quality, team, and client satisfaction.

6.3 Research Recommendations

This research recommends using the evaluated success factors of agile (delivery strategy, SD technique, team capability) and success factors of traditional methodology (requirement clarity, efficient communication) to achieve project effectiveness. Which would impact positively for all the players in the PM process. This research contributes with new insights in regards to project effectiveness, both theoretically and managerially.

6.3.1 Theoretical Implications

This study has several theoretical implications. Previous agile research has overlooked the need of addressing agile challenges and how to overcome them while achieving project effectiveness. Similarly, evaluating which TPM criteria can be integrated to ensure project success. Hence, this research helps to understand the agile project success as well as failures in agile PM.

Theoretical implications could extend to agile iron triangle theory, exploring how hybrid approaches manage IT projects better than singular methodologies based on the three constraints of time, cost, quality, team, and client satisfaction coming together to measure project success.

As reported by the analysis, for all the independent variables, the ANOVA results shows that the F value is always positive which implies that their influence on project success

is effective. Furthermore, the Sig. value for the variables is less than 0.05 indicating the significance of their influence and accepting the $H_1 – H_5$ hypothesis. The moderator analysis for project duration in the PM process indicated that there is a moderate effect of agile delivery strategy and SD techniques on the project effectiveness of a HPM approach with a Sig. value less than 0.05, resulting in accepting the H_{6a} and H_{6b} hypothesis.

The research findings denotes that the optimum PM methodology would involve combining delivery strategy, SD technique, team capability from agile and requirement clarity, efficient communication from traditional methodology to achieve better project success and overcome the issues faced in agile, which provides a basis for future studies within similar topics.

6.3.2 Managerial Implications

Incorporating the hybrid approach in an agile software development process means that from the start till the end of the process where agile practices are maintained, the project can integrate mentioned TPM practices as well to improve the project effectiveness. Continuous agile practices include on-time project delivery, requirement prioritization, incremental development, early stages of testing, and team capabilities, by following TPM practices like maintaining parallel documentation, clear requirement and resource definition from the very start of the project and by ensuring sufficient client involvement and recording key discussion points, decisions, and follow-up tasks during formal meetings.

It is necessary to clearly define the project duration since it is an essential component of project planning, scheduling, and achieving the project goals. By defining the project duration, the agile teams can deliver their software on time and follow an efficient SD process and ensure better stakeholder involvement and satisfaction throughout the project lifecycle. Organizations that use HPM can gain a competitive edge by completing projects more efficiently and effectively, resulting in faster time-to-market and higher project success rates. The HPM approach can improve risk management by enabling early detection and mitigation of risks via continuous monitoring and iterative modifications. Implementing HPM can help team members develop more adaptable skill sets as they learn to traverse both traditional and agile approaches.

All these factors would finally result in resolving the mentioned agile issues, leading to achieving overall project success based on time, cost, quality, and the team and client satisfaction could also be realized.

6.4 Research Limitations

One of the study's key limitations is the lack of quantitative literature in the subject of project management. Few academic publications were accessible in this sector at the time of this study, so there are very few reliable references to validate the PM techniques and processes that are really used in the industry. While adequate qualitative research materials existed for the Agile, there was insufficient research materials accessible for the traditional methodology and even materials related to hybrid methods.

Further, the respondent's experiences related to TPM practices was not taken into consideration before acquiring data from them regarding the TPM factors in the questionnaire. With this limitation, the accuracy of responses regarding the TPM section might be inadequate for the study.

Another limitation of the study is the limited sample size, the respondents were chosen from a small number of Sri Lankan organizations that were accessible to the researcher. Although the sample was chosen as of now, it may not be an exact representative of the population of the IT sector in the years to come because of the industry's continuous changing behavior.

6.5 Future Research

This research was a quantitative study with a small sample size accessible to the researcher from individuals in the IT industry. An extension of this research would be to do a qualitative and quantitative study concurrently. Furthermore, the sample size chosen could be significantly greater in the IT industry. Using a high-quality sample and allowing respondents to express their emotions and assess their performance will provide a more comprehensive study outcome.

Success factors of other PM methodologies like kanban, extreme programming (XP), lean, Six Sigma, and PRINCE2 methodologies, could also be taken into consideration to derive an optimal hybrid methodology. So, the research outcomes could have a wider range of accuracy across diverse approaches.

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APPENDIX 01 – QUESTIONNAIRE

Are you practicing Agile Methodology in software development process in your current team?

- Yes *<<Continue to next section>>*
- No *<<Continue to Submit form>>*

Demographic Information

Type of your IT Organization

- Software Development
- IT Consultation
- Healthcare IT
- Cloud Services
- Financial Technology
- UI/UX Designers
- Outsourcing services

What is your gender

- Male
- Female

Select the age range.

- Less than 25
- 26 – 35
- 36 – 45
- Above 45

What is the role that you're currently playing in your team

- Developer/ Software Engineer
- Tester/ QA Engineer
- Business Analyst
- UI/ UX Designer
- Engineering manager
- Project Manager
- Product Manager/ Product Owner
- Database Administrator / Data Analyst
- Site Reliability/ Network Engineer
- Cloud Engineer/ DevOps Engineer

How long have you been involved in Agile project

- Less than 1 year
- 1 – 3 years
- 3 – 5 years
- 5 – 10 years
- More than 10 years

#	Questions	Measurement				
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Delivery strategy This section reflects how effectively your current project uses Agile Methodology practices in terms of how a project is delivery. **Please indicate your agreement or disagreement with the following statements.**						
1	My team regularly delivers product requirements in short time-frames for the client					
2	My team responds to client-driven requirement changes well.					
3	My team prioritize and delivers features according to the project plan					
4	My team is aware on how requirements should be prioritized based on impact and urgency during sprint/ project planning					
5	Team demonstrates adaptability in handling new requirements and bugs, addressing them according to their priority and severity					
Agile software development techniques This section reflects how effectively your current project uses Agile Methodology practices in terms of how development techniques are applied. **Please indicate your agreement or disagreement with the following statements.**						
6	My team practices well-defined coding standards					
7	My team frequently conduct code reviews/ peer code reviews					

8	My team uses a software or other means for continuous inspection of code quality to perform automatic reviews					
9	My team follows iterative and incremental methodology when developing requirements					
10	My team conducts daily scrums and progress meetings before the end of the sprint.					
11	QA team involves in early testing to prevent defect inject into later stages.					
12	QA team practices automating test scenarios to rerun test easily					
Team capability This section reflects how effectively your current project uses Agile Methodology practices in terms of how your team perform to deliver outcomes. **Please indicate your agreement or disagreement with the following statements.**						
13	My team members have a level of ease to make decisions within the Agile project					
14	I believe my team members are able to maintain a great Work/life balance					
15	My Team members maintain great teamwork when working together develop features and resolve issues					
16	My managers are adaptable and flexible to change in the context of implementing Agile practices					
17	My managers acts as a facilitator, effectively manages the team collaboration without restricting their creativity					
18	My company takes necessary actions to organize training sessions to make the employees aware of the agile practices.					

19	My company takes measure to ensure that their employees stay updated on best practices in Agile methodologies post-training					
20	My team members have been able to apply the concepts learned in the Agile training in their everyday work at great extent					
Requirement Clarity This section determines the degree of traditional software development practices that are being used in your current project in terms of requirements transparency. **Please indicate your agreement or disagreement with the following statements.**						
25	My team prepares detailed documentation on functional and non-functional requirements and are easily accessible					
26	My team maintains continuous and parallel documentation which would help in to reduce the team's workload and increase maintainability of the project					
27	Project requirements are communicated clearly to the team so there's less re-work due to changes in requirements					
28	Project manager develops and follows a project plan from the early stages of the project					
Efficient Communication This section determines the degree of traditional software development practices that are being used in your current project in terms of maintaining efficient communication. **Please indicate your agreement or disagreement with the following statements.**						
29	My team receive immediate updates from the client when new requirements or changes are needed					

30	My team has frequent and sufficient discussions with the client to address any requirement concerns					
31	My team maintains a formal minutes of meeting after discussions with clients					
32	Our clients ensure that the new requirements doesn't conflict with existing documented workflows					
Project Duration This section explores your experience with the effect of a project duration in achieving a successful delivery **Please indicate your agreement or disagreement with the following statements.**						
21	My team employs requirement prioritization & delivery to meet project duration timelines					
22	My team employs agile development practices to meet project duration timelines					
23	Client collaboration and effective documentation plays a great role in meeting the planned projects duration					
24	My team addressed potential scope creep while maintaining project timelines					
Effectiveness of the proposed Hybrid PM approach The proposed Hybrid Project Management methodology is a combination of the success factors of agile and traditional methodology mentioned before, to overcome the differences in Agile. This section determines how effective the Hybrid PM approach would be to enhance the Software Development process. **Please indicate your agreement or disagreement with the following statements**.						
33	The Hybrid approach would satisfy the team to be aware of the project status due to effective communications with the clients.					

34	The Hybrid approach would satisfy the team’s decision making due to maintenance of detailed documentation.					
35	The Hybrid approach would satisfy the team in resolving concerns since frequent and proper communications could be held with the clients					
36	The Hybrid approach would satisfy the team since it would save time and effort by keeping meeting minutes instead of reviewing client recordings					
37	The Hybrid approach would effectively address risks and opportunities in early thorough planning and accurate prioritizations, ensuring a smooth execution.					
38	The Hybrid approach would ensure project targets are in line with both the client's and team's timelines, with the help of regular delivery and parallel documentation					
39	The Hybrid approach would aim to meet budget targets and enhance productivity, by practicing proper planning, efficient communicating and well-defined development techniques					
40	The Hybrid approach would ensure effective utilization of all available resources, through prior resource planning and being flexible to adapt to new requirements accordingly					
41	The Hybrid approach would satisfy the client in terms of decision making with the help of detailed documentation					
42	The Hybrid approach would satisfy the client in terms of decision making with the help of effective communications with the development team					