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Doctoral Dissertation

**Structural relationship between public service motivation,
psychological safety and R&D team learning process:
an empirical study of National R&D organization in Thailand**

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Abstract

Public service motivation (PSM) and collaboration are widely acknowledged as fundamental catalysts for effective public service. However, research examining the interplay between individual (PSM) and team-level (psychological safety [PS]) factors within R&D project teams remains limited. This study fills this void by presenting a theoretical model that examines the combined influence of PSM and PS on the project team learning process (PTLP) in national R&D organizations. Additionally, the study explores moderating effects of project management type (fully agile vs. partially agile), team member role (head vs. member), and team familiarity (less than 10 years vs. more than 10 years) on these relationships.

Employing a multimethod approach, the study utilizes Partial Least Squares – Structural Equation Modeling (PLS-SEM) to evaluate quantitative data and semi-structured interviews for collecting qualitative data for result refinement and deeper understanding. The results indicate a strong and positive correlation between PSM, PS, and PTLP, with PS playing a critical role as a mediator. Particularly noteworthy was the stronger link between PSM and PTLP observed in fully agile project management compared to partially agile environments. Furthermore, team member characteristics and lower team familiarity emerged as potential factors influencing the path coefficients of the model.

These findings suggest that fostering psychological safety within R&D project teams is critical to enhancing PTLP. Additionally, adopting fully agile project management practices can further strengthen the positive influence of PSM on learning outcomes. Both project teams and organizations should emphasize the promotion of PS and consider the identified moderating effects to foster a sustainable learning environment for R&D teams, thereby enhancing public service delivery in national R&D institutions.

Keywords: Public service motivation; Psychological safety; Project-based team learning; Research team; national R&D organization; Project management

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Chapter 1

Introduction

1.1 Study background

The contemporary business landscape necessitates effective teamwork management for organizations to secure a competitive edge. Collaborative environments facilitate the exchange of diverse knowledge and ideas, fostering innovation and adaptability. Team Learning Processes (TLPs) emerge as a critical mechanism within this framework, enabling the continuous learning and development of teams. Edmondson (1999), team learning is an ongoing process of internal and external reflection and action. It includes questioning, receiving feedback, experimenting, reflecting on outcomes, and openly discussing errors or unexpected results. Reports by international consulting further emphasize the significance of cultivating effective learning environments for organizational success and sustainability. Leadership styles, corporate culture, and dedicated resources are identified as key drivers of TLP. However, transitioning from mere teamwork to team learning hinges on complex social dynamics at both individual (member) and team (members, leader, and wider environment) levels. Edmondson (1999) defines team learning as a continuous process of internal and external reflection and action. This involves questioning, seeking feedback, experimenting, reflecting on results, and openly discussing errors or unexpected outcomes. Communication lies at the heart of this definition, enabling knowledge sharing and individual learning from fellow team members. Thus, TLP reflects the iterative learning process sustained through active communication and interaction within teams.

Communication and interpersonal interaction are central to effective team learning. However, fostering positive interpersonal exchange requires specific mechanisms. Recent research identifies psychological safety (PS) as a crucial

environmental factor in this process. Defined by Edmondson (1999) as a climate where individuals feel comfortable, open, and secure in expressing themselves, PS provides the foundation for strong team communication. Interestingly, studies emphasize the detrimental impact of anxiety on learning behavior. When encountering nervousness, individuals tend to exaggerate the possibility of failure beyond reality. For instance, Zeng, Zhao, and Zhao (2020) stated that fear of sharing dissenting opinions can hinder individual role empowerment and create team discomfort. This fear often manifests as silence or passive-aggressive behavior, leading to avoidance of potential negative feedback. These behaviors become significant roadblocks to collective learning and effective teamwork, akin to a silent cancer hindering organizational growth.

Establishing a psychologically safe environment for teams fosters open communication across diverse backgrounds. This necessitates eliminating fear-induced silence, a challenge addressed by several scholars who advocate for psychological safety (PS). PS refers to a state where individuals feel at ease expressing themselves without apprehension of facing adverse consequences. By creating a secure environment, teams can lower self-protective behaviors and encourage open interaction. However, despite its benefits, excessive PS can lead to unintended negative consequences like unethical behavior. Examples include corruption, reduced dedication, and self-serving task selection. These "dark side" outcomes highlight the need for moderation in fostering PS. Additionally, PS implementation can clash with traditional Asian cultures that emphasize seniority and hierarchical structures. This conflict can be particularly acute in large, highly regulated organizations, such as government agencies. While psychological safety (PS) encourages effective teamwork, it may not sufficiently direct individual work output. Excessive PS can even demotivate employees due to a tendency to avoid challenging tasks, potentially arising from a relaxed approach to interpersonal differences within the team.

Hence, individual motivation emerges as a pivotal factor. In the public sector, especially in developing nations such as Thailand and Southeast Asia, this motivation influences domestic political issues and plays a significant role in national development. Public servants face complex public expectations, making their behavior understanding essential for effective policy formulation. An ideal form of individual motivation is public service motivation (PSM). PSM describes individuals' drive to benefit society without personal gain, differentiating it from other motivations. This intrinsic motivation is expected from public servants and has expanded beyond its original government context to encompass the private and volunteer sectors. PSM is generally expected to exist and influence behavior in real-world settings.

National R&D organizations operate as project-based entities, where project management (PM) styles can impact team member motivation. Heterogeneity in project teams (academic backgrounds, expertise, seniority, personal connections) can hinder role empowerment. Team members might hesitate to express ideas due to discomfort with diverse feedback or fear of making mistakes. These factors pose obstacles to achieving PSM.

Research exploring the complex interaction between individual and team factors in the public sector is still relatively unexplored. Notably, the connection between public service motivation (PSM) and project team learning processes (PTLP) within R&D project work mediated by psychological safety (PS) has received scant attention. Although numerous studies across healthcare, education, and private sector product development demonstrate a positive connection between PS and TLP association, the nuanced dynamics in public R&D organizations, characterized by their complex goals, remain largely uninvestigated.

1.2 Problem statement and research gaps

Both public service motivation (PSM) and robust teamwork are expected qualities of public servants. There is a scarcity of research investigating the interaction between individual and team dynamics in the public sector. Specifically, the relationship between PSM, PS, and project team learning process (PTLP) within R&D project teams of a national R&D organizations remains under-investigated. Previous research largely focuses solely at the individual or team level, neglecting the crucial connection between public servant motivation and team learning effectiveness. Furthermore, the combined effect of PSM, PS, and PTLP in the context of public sector R&D projects with their unique challenges and goals has not been adequately addressed.

This research gap presents a significant opportunity to:

1. Develop a comprehensive theoretical model examining the link between individual motivation (by PSM) and team collaboration (by PTLP) through the mediating effect of team environment (by PS).
2. Investigate the moderating effects of factors like project management styles (fully agile vs. partially agile), team member roles (head vs. member), and team familiarity (less than 10 years vs. more than 10 years) on these relationships.

By filling this void, the study aims to offer valuable insights for improving public servant behavior and supporting strategic employee development plans, ultimately improving the effectiveness of R&D projects within a national R&D organization.

1.3 Objective of the Research

This dissertation aims to propose the theoretical model for examining the connection of the combination between individual motivation and team collaboration with PSM (Public Service Motivation), Psychological Safety (PS) and TLP (Team Learning Process), the mediator and the moderator effect

examination to enhance for increasing of the research project team learning process in the national research and development organization. The goal might be attained by completing the six objectives indicated under two criteria set of PSM as follows.

- 1) To investigate how PSM relates to PTLP through the mediation of PS within the R&D project teams of a national R&D organization.
- 2) To examine the three groups of moderating effects of structural relationships between public service motivation, and R&D project team learning process, psychological safety as a mediator, of the research and development project team in the national R&D organization. The three moderator groups are (2.1) project management types, (2.2) role in the team, and (2.3) team familiarity.

1.4 Research Significance

This study makes a significant contribution to the academic field by introducing a comprehensive theoretical model that connects public service motivation (PSM) with project team learning processes in national research and development organizations. It identifies the key factors that influence team learning beyond individual motivations and demonstrates how these factors impact team dynamics within R&D project teams. The proposed model proves to be a strong predictor of team learning, especially in national research settings.

- **Theoretical Contributions:** This research offers a multidimensional view of project team learning by integrating Public Service Motivation (PSM), Psychological Safety (PS), and team learning processes (TLP). PSM, a core element of public service theory, focuses on personal motivation, while PS fosters a supportive environment for interpersonal relationships and team learning. By exploring the interplay between PSM and PS, the study deepens our understanding of the dynamics that drive effective team

learning, offering new insights into the success factors behind R&D project teams.

- **Practical Implications:** The findings provide actionable guidance for improving team learning and performance. By tailoring collaborative strategies to the unique traits of individual team members, leaders can create a more positive and productive learning environment. This can enhance team cohesion, boost performance, and prevent toxic work cultures.

In summary, this study advances the understanding of team-based learning in national research teams by developing and validating a comprehensive model. The insights generated from this research are invaluable for both theoretical development and practical application, offering a clear roadmap for human resource strategies that promote effective team learning and collaboration.

1.5 Key Research questions

This dissertation investigates the factors influencing the effectiveness of the R&D PTLP within a national research organization. The research explores the interaction between individual motivation and team collaboration, considering the mediating and moderating effects of specific factors.

Major Research Question (MRQ):

How do public service motivation (PSM), psychological safety (PS), and their interaction influence the R&D project team learning process (PTLP) within national research institutes?

Subsidiary Research Questions (SRQs):

These questions delve deeper into the relationships explored in the MRQ:

SRQ 1: How do public service motivation (PSM), psychological safety (PS), and their interaction influence the research project team learning process (PTLP) within a national R&D organization?

SRQ 2: How do project management style, team member role, and team familiarity moderate the relationships identified in SRQ 1?

SRQ 2.1: How does the Fully agile PM (F-APM) moderate the relationship between PSM, PS, and PTLP?

SRQ 2.2: How does the Partially agile PM (P-APM) moderate the relationship between PSM, PS, and PTLP?

SRQ 2.3: How does the Project head (Head) moderate the relationship between PSM, PS, and PTLP?

SRQ 2.4: How does the Project member (Member) moderate the relationship between PSM, PS, and PTLP?

SRQ 2.5: How does the Less team familiarity (L-TF) moderate the relationship between PSM, PS, and PTLP?

SRQ 2.3: How does the More team familiarity (M-TF) moderate the relationship between PSM, PS, and PTLP?

1.6 Dissertation structure

This dissertation proposes a theoretical model probing the combined effects of individual motivation (Public Service Motivation - PSM) and team collaboration (Project Team Learning Process - PTLP) mediated by Psychological Safety (PS). Additionally, the model explores the moderating effects of various factors. The dissertation is structured interested in six chapters.

Chapter 1: Introduction

This chapter establishes the foundation by introducing the background of the research, which examines public motivation among public employees working within project teams. It identifies the motivation challenges in team management as highlighted in the problem statement. The research objectives and questions

are outlined to delineate the study's scope and direction. The dissertation structure provides a detailed overview of each chapter.

Chapter 2: Literature Review

In this chapter, a thorough examination of pertinent theoretical and empirical literature concerning Public Service Motivation (PSM), Psychological Safety (PS), Project Team Learning Process (PTLP), and their potential interrelationships is presented. The aim is to offer a comprehensive understanding of the existing knowledge and research gaps in these areas, laying the groundwork for the study's framework and hypotheses.

Chapter 3: Research Methodology

In this chapter, the research design for the study is detailed, encompassing the methods used for data collection, characteristics of the sample population, and the techniques employed for data analysis. This chapter serves to provide a clear outline of how the study was conducted, ensuring transparency and rigor in the research process.

Chapter 4: Result

This chapter presents the findings related to the research questions. The first subsidiary study investigates the structural model that explores the relationships among PSM, PS, and PTLP, with a particular focus on how PS mediates these relationships. The second subsidiary study examines the moderating effects within this model, exploring how specific factors influence the relationships between PSM, PS, and PTLP.

Chapter 5: Discussion and Managerial insight

This concluding chapter summarizes and interprets the key findings of the research, discussing theoretical implications, exploring practical applications, providing managerial insights, and a pivotal role in demonstrating the scholarly contribution and impact of the research.

Chapter 6: Conclusion and Limitations

This chapter presents a critical analysis of our findings, exploring their implications for both theory and practice. We examine the study's constraints and potential sources of bias. The chapter concludes by proposing avenues for further investigation and suggesting practical enhancements informed by our results.

Chapter 2

Literature Reviews

The interdependence of PSM (Public Service Motivation), PS (Psychological Safety), and PTLP (Project Team Learning Process) in scientific collaboration teams (of state-level research institutions) is scarcely discussed in the annectant scholars. Thus, this research will propose an enhanced comprehension model of the correlation between PSM, PS, and PTLP in the context of the project management styles, team member role, and team familiarity. The subjects' level of freedom differs depending on these moderators. Therefore, PTLP is selected to assess the degree of freedom in this matter to obtain the output. We will mention the six vital keywords, such as Public Service Motivation (PSM), (R&D) Project Team Learning Process (PTLP), Psychological Safety (PS), Project Management styles (PM), Team member role (Role), and Team Familiarity (TF). The description of each keyword is conducted to the influence of each keyword which illustrated in the existing work.

2.1 Public service motivation (PSM)

The notion that public service motivation (PSM) surpasses self-interest in driving civil employees remains prevalent (Houston, 2000; Perry and Wise, 1990). Despite various definitions (Perry and Wise, 1990; Brewer and Selden, 1998; Vandenabeele, 2007), a common thread of service to a broader community, rather than individual gain, unites them. The concept, however, poses open questions regarding its origins and development through socialization (Wright, 2008). Understanding PSM becomes critical for public administration, as it digs into the personal's desire to handle society via national service. (Perry and Hondeghem, 2008). This core concept links to desired outcomes in public

organizations, with researchers agreeing that PSM-driven individuals aim to serve the abstract notion of the public interest for collective societal benefit.

In their seminal work, Perry (1996) consistent four key extensions of public service motivation (PSM): a desire to shape policy, a commitment to the public good, a sense of empathy for others, and a sacrifice. Kim (2009) streamlined this model, reducing items from 24 to 12, while aligning with Vandenberg's (2008) five-dimensional framework: attraction to politics, public interest, compassion, self-sacrifice, and a novel addition – democratic governance. Notably, PSM research continues to evolve with instruments adapting to organizational contexts (public vs. private). Vandenberg (2020) developed a concise and practical PSM measure, revising earlier scales by Kim (2013) and Van der Wal (2008). These revisions focused solely on PSM dimensions, shifting away from cues reflecting private sector values based on individual work contexts. This emphasis reinforces the distinct nature of PSM within the public service domain.

Several topics have come about from PSM research such as job satisfaction, the interplay of career paths, performance outcomes, work commitment, work attitudes and behavior, perceived superior trust, entrepreneurial passion, social entrepreneurship intension, public sector attraction, perceived fit with the public sector, organizational learning, change-oriented organizational citizenship behavior, and leadership. (Liu and Perry, 2014; Wright and Pandey, 2008; Schott and Ritz, 2018; Lin et al, 2024; Palma et al., 2021; Chandra et al., 2021; Carpenter et al., 2012; Li and Wang, 2022; Chih and Wikael, 2015.). Staffs with high public service motivation (PSM) tend to be more committed to their organizations and the public good, leading to lower turnover. Many studies showed the potential negative aspects of too much PSM, e.g., stress, burnout, job dissatisfaction as well as involuntary or long-term absenteeism, negatively affecting physical well-being, and use of social media platforms out of work hours (Liu and Perry 2014; Van et al. 2015; Wang and Li. 2023).

PSM are examined in the various fields in public and nonprofit sector. (Taylor et al. 2013; Word and Carpenter. 2013) PSM is conducted the survey in many countries such as Germany, Australia, South Korea, China, Thailand, Netherlands, etc. (Kim 2009; Perry and Hondeghem, A. 2008; Liu and Perry 2014; Potipiroon and Ford 2017; Potipiroon and Wongpreedee 2020; Palma et al. 2021; Wang and Li, 2023; Loscher et al., 2023; Lin et al, 2024). There are a few papers that research similar to this article. For instance, Broekema, et al, (2019) sheds light on the interplay of PSM and public leaders' postcrisis learning orientation, thereby advancing our understanding of these factors. Our findings, drawing on data from Dutch mayors (2015), suggest a positive connection between PSM and a comprehensive approach to organizational learning following a crisis. This highlights a potential research gap at the team or project level, where future investigations could explore how PSM influences learning dynamics within smaller units. Moreover, Potipiroon and Wongpreedee (2020), studied exploring the influence of public service motivation on PS within municipal workforce circles which study under the context of critical workplace environment and inclination to disclose misconduct internally. That shows the research gap in the other sectors in Thailand can be explored.

2.2 Psychological safety (PS)

The ethos of psychological safety has evolved over time, with key contributions from various scholars. In 1965, Schein and Bennis first introduced it as the feeling of security individuals experience during change management (Schein and Bennis, 1965). Later, Kahn (1990) focused on individual security perceptions, defining it as the absence of fear regarding negative consequences for expressing beliefs or behaviors (Kahn, 1990). This individual perspective emphasizes the role of trusting and supportive relationships in fostering psychological safety, as highlighted by Newman et al, (2017). However, perhaps

the most widely cited definition comes from Edmondson (1999), who shifted the focus to group dynamics. Psychological safety, as she conceptualizes it, refers to a collective mindset within a team or group that encourages risk-taking among members, free from the threat of criticism or negative consequences. (Edmondson, 1999). This conceptualization emphasizes the shared nature of psychological safety and underscores its crucial role in fostering group risk-taking and creativity within team environments.

Edmondson (1999) devised and authenticated a septenary assessment instrument for gauging collective psychological security (PS). This evaluative framework encompasses team members' individual sense of safety in group contexts, reflecting their attitudes towards risk-taking and candid communication. Notably, Google's Re:Work project, investigating factors associated with improved team performance, utilized Edmondson's measurement tool to evaluate their teams' PS. (Google Re:Work, 2023). This highlights the practical relevance of measuring PS in enhancing team effectiveness. Additionally, the Fearless Organization website offers individuals the opportunity to self-evaluate their PS using the same scale (Fearless Organization, n.d.).

Building upon Edmondson's (1999) foundational work linking psychological safety (PS) to learning and performance, researchers have delved deeper into its multidimensional impact. Studies have explored PS's relationship with various outcomes, including speaking behavior, innovation, attitudes among workers, interactions, sharing of knowledge, creativity, work engagement, and organizational commitment. They demonstrated superior service performance, expressed reduced inclination to change careers or regret their professional choices, and/or indicated contentment with their vocational path. (Guchait et al, 2019; Liu et al., 2014; Wang et al, 2019a; Newman et al., 2017; Chang and Busser, 2020; Huo, M.L., 2021; Li et al, 2022; Rabiul et al, 2022c; Rabiul et al., 2023). Informed by a multi-theoretical perspective encompassing social learning, information processing, social identification, and social exchange theories

research suggests that PS fosters knowledge sharing by encouraging trust and open communication within teams (e.g., speaking up without fear of judgment) (Newman et al., 2017). This in turn facilitates individual and team-level learning behaviors, ultimately influencing employee performance indirectly (Baer and Frese, 2003). McElroy et al. (2024) identified three key themes related to how psychological safety can be fostered within the hierarchical structure of the operating room to improve debriefing effectiveness: (1) "commitment to learning," (2) "it is a safe space," and (3) "natural leader." These themes suggest that debriefings can foster a culture of learning and quality improvement among frontline workers. Furthermore, the findings support the notion that effective debriefings promote individual and team learning, ultimately acting as a springboard for significant organizational change. Notably, the study also emphasizes the significance of mitigating hierarchical influences and power structures to facilitate such positive organizational transformation. Furthermore, PS extends its influence beyond individuals and teams, impacting organizational performance. Baer and Frese (2003) demonstrated a strong good correlation between employees' collective perception of PS and organizational metrics like return on assets and goal achievement. PS also enhances employee attitudes, fostering organizational commitment, work engagement, and positive teamwork perceptions. Developing a competency framework for effective surgical educators propose a fostering PS as the first competency from five competencies and sixteen behaviors, Sharma et al (2024). PS have strong relation with agile technique in team learning process, psychological safety can be increased through peer and tutor support, the use of smiley emojis, and initiatives to reduce disruptive behavior (Marder, 2021). Consistent with the study of Barros et al. (2024), their research revealed that psychological safety serves as a crucial, albeit indirect, contributor to the success of agile software development initiatives. The direct success factor is team capabilities and customer involvement. This fosters

an environment where employees are more receptive to new technologies, continuous learning, and adapting to challenges.

While psychological safety (PS) boasts numerous benefits for teams, research suggests a potential "too-much-of-a-good-thing" effect (Pierce and Aguinis, 2013). In excessively high-PS environments, team dynamics can shift, leading to negative consequences. Pierce and Aguinis (2013) found that overly high PS may increase the likelihood of unethical behavior, as team members prioritize personal interests over group goals and engage in collusion. While limited research currently exists on the full spectrum of PS's potential downsides, Newman et al., (2017) cautiously acknowledge the possibility of such negative outcomes. Further investigation into the potential "dark side" of PS could offer valuable insights for practitioners in balancing its advantages with potential risks.

2.3 Project team learning process (PTLP)

The growing complexity of tasks and information demands placed on teams necessitates a more profound insight into the impact of collective learning practices on team performance. Regardless of the specific context, fostering these behaviors remains essential for optimizing team performance. Product and technology development increasingly embraces team-based structures, leveraging the potential of teams to boost individual commitment and performance. (Ramesh and Tiwana, 1999) Observational learning provides a valuable supplement to firsthand experiences. It allows individuals to learn from the successes and failures of others, accumulating a broader base of knowledge in a shorter timeframe. Notably, vicariously learning from failures can be particularly beneficial. The emotional impact of failure stories can be stronger, leading to a deeper understanding of the lessons learned. Additionally, knowledge gained from overcoming challenges is often considered more valuable than knowledge gained from successes. (Bledow et al, 2017; Sitkin, 1992). The rapidly evolving

nature of organizations, with growing turbulence, dynamism, and complexity, necessitates a shift beyond individual learning to address these evolving demands. (Tannenbaum et al, 2012).

Researchers continue to explore the complexities of team learning through diverse conceptualizations. For instance, Edmondson et al. (2007) consider it an "overarching framework," a streamlined depiction of an intricate organizational dynamic. In their view, team learning is a process where teams take action, gather and reflect on feedback, and make adjustments to improve. Sessa and London (2008) offer a more dynamic perspective. They see team learning as an evolving process where the learning itself, the factors fostering it, along with team dynamics, evolve in tandem with the group's development. Effective team learning is crucial for the rapid and successful development of a novel offerings and solutions. (Edmondson and Nembhard, 2009; Lynn et al., 1999). Through a continuous process of reflection, action, and information processing, team learning equips teams to detect and respond to environmental changes, fostering continuous improvement in performance. (Edmondson 1999). Characterized by a cyclical process of reflection and adaptation, team learning is fostered by psychological safety (Knapp, 2010). Through this process, shared group experiences are transformed into new knowledge. Four instruments assess team learning processes: Learning Behaviors in Work Teams (Van et al, 2006), Experiential Learning in Teams (Edmondson, 1999), Team Learning and Metacognition (Kayes et al, 2005), and Team Learning Beliefs and Behaviors. (Garavan, 2008).

An expanding collection of studies investigates the influence of diverse elements, such as infrastructure capabilities, user involvement, reporting quality, project risk, leadership styles, and problem-solving competency in information technology (IT) project performance (Xu at el 2010; Doll and Deng, 2001; Thompson et al, 2007; Wallace et al, 2004; Thite, 2000; Aladwani, 2002; Yang and Chen, 2011). In technology R&D teams, trust fosters communication and

awareness of individual expertise (Huang, 2009). This clarity enables efficient knowledge encoding and retrieval, ultimately facilitating knowledge sharing within the team. Kirkman et al. (2004) found no direct link between team leader-member racial similarity and team effectiveness, research on how racial diversity impacts team dynamics remains crucial. Communication allows for resource pooling in planning, which improves team performance. Furthermore, communication quality will have a bigger impact than frequency, and certain communication kinds (face-to-face, familiar teams) may exhibit stronger performance correlations (Marlow et al, 2018).

Several scholars found PS is a key element for grooming the team learning process under various contexts. For instance, Team psychological safety acts as a mediator in the relationship between group supervisor mentorship and environmental backing on one hand, and group knowledge development behavior on the other. This connection between leadership practices, PS, and educational growth process aligns with Human Resource Development (HRD) and Adult Education theory and practice. Knapp, R. (2010). Previous research has demonstrated that unique experience (Reagans et al, 2005), team psychological safety (Edmondson, 1999), and group cohesiveness (Wong, 2004) have a major impact on a team's learning behavior (Kostopoulos et al, 2011). PS and learning of group are important processes for understanding the enhancement of changing-oriented leaders help healthcare teams perform better. Change-oriented leadership fosters a positive and strong association between PS, unit learning, and ultimately, group performance. This focus on innovation, improvement, and adaptability to outside shifts enable group participants to embrace continuous learning, leading to a high-performing team. (Lin C et al.,2022). In nurse education, team learning, and psychological safety are fundamental to developing professional nursing competencies. Many multinational corporations (MNCs) current require English to be used as a universal company language to aid cooperation among employees who speak different native languages. (Neeley, 2017). However, creating a

psychologically security language environment is crucial for non-native speakers to feel comfortable using English and minimize stress (Nurmi & Koroma, 2020). In agile software development, agile practitioners view technical excellence as a mindset that prioritizes ongoing focus on sustainable code, learning, and teamwork. Our research underscores the significance of maintaining a mindset that continuously emphasizes sustainable code for achieving technical excellence within agile teams. Additionally, it highlights the crucial roles played by mindsets focused on continuous learning and teamwork (Alami et al., 2022).

2.4 Project management (PM)

Over the years, organizations have increasingly adopted a project-based structure to achieve their business goals more cost-effectively (Blomquist and Müller, 2006). Research proposes integrating elements of both traditional and agile approaches as a solution, involving the application of agile methods to varying extents (Abrahamson et al., 2009). This review will explore the literature on traditional and agile project management approaches to delineate their differences. Academic research into project management focuses on structuring work processes. Project management serves as both a subject of study and application, encompassing various practices and methodologies for organizing work (Paletz, 2012).

Project Management type (PM) refers to the way in which teamwork is managed. Agile PM (APM) is commonly used in software development projects, and waterfall PM (WPM) is an easy type to use and understand and is commonly used to manage a project in the government sector. WPM represents the conventional approach characterized by simplicity, predictability, and linearity, with clearly defined boundaries that facilitate easier planning (Spundak, 2014). However, its "one size fits all" nature poses challenges in complex project management scenarios, where diverse situations demand tailored solutions

(Fernandez, 2008). Due to its resistance to change, this method can prove challenging to implement effectively in dynamic and complex environments.

APM is different from WPM. In recent years, the APM approach has gained prominence due to increasingly dynamic project environments that demand flexibility and adaptability, traits prominently featured in agile project management methods. Agile methods rely heavily on extensive interaction within project teams and active collaboration with customers and key stakeholders (Conforto et al., 2014). This approach ensures that customers and stakeholders are deeply engaged throughout the project, enabling them to propose changes as needed. However, due to unpredictability and rapid changes, defining the final project solution upfront can be challenging (Fernandez and Fernandez, 2008). Projects with innovative objectives require team autonomy and effective agile communication practices to empower agile teams (Malik et al., 2021).

Several studies have been conducted on project management in the past. Because large firms frequently divide their activities into minor to mega project levels. The classic project style, often known as WPM, is commonly referenced, whereas the current popular approach is APM. The preceding paragraph explained the distinctions between WPM and APM. Thus, this part will address PM usage in prior work passes via various perspectives. For instance, in industry sector, Agile methods are mainly used in product development, project management and process development, whereas the usage in assembly planning and factory planning is less common (Burggräf et al, 2020). In ‘Team science and building a team’, noted that modern progress in translational medicine requires highly integrated teams working together to achieve scientific goals. Understanding team formation, evolution, project management, and psychological safety can maximize innovation and scientific success (Varun, 2023). Innovation resilience behavior, in high technology project teams, is positively related to project success. Moreover, innovation resilience behavior becomes more critical as adversity increases (Fey and Kock, 2022). In large

software projects, agile methodologies were aimed to reduce project failure risk by focusing on human-related factors like team capability and customer involvement that PS is an essential situation to involve the achievement (Barros et al., 2024). The organizational culture significantly influences the successful implementation of agile management methods, as emphasized by multiple authors. At the individual level, project team members must possess adequate competence to identify and address potential risks and changes within the project. Their ability to impact project outcomes, align with organizational goals, and deliver value to customers is crucial. This competence can positively influence the team's learning process, which is vital for future work (Conforto et al., 2014).

Moreover, many studies have modified APM formats to be more diverse and suitable for different contexts or situations. In accord with Abdallah et al. (2021), APM is found to be effective in the design phase of construction projects. Failures in such projects often stem from cost overruns, schedule delays, or uncontrolled project scope growth. Implementing a hybrid project management model that integrates lean, agile, and traditional approaches can enhance project success by lowering costs, accelerating schedules, optimizing outcomes, reducing waste, and enhancing stakeholder satisfaction. The organization must demonstrate flexibility and adaptability in adopting agile methods, or alternatively, investing in a suitable hybrid approach if preferred. Embracing change and fostering collaboration within a dynamic team, equipped with the requisite skills and knowledge among project stakeholders, including customers, can significantly enhance success rates (Sithambaram et al., 2021). Integrating APM with the stage-gate framework in technology-focused contexts projects has proven beneficial for improving project and product development performance, presenting a viable solution for managing innovation projects within high-tech companies (Conforto et al., 2016).

However, some paper refers PM to apply in the public sector such as Muhammad Zada of the Iqra National University (2023) study explores the impact of public leadership on project management effectiveness, particularly in

the public sector. The results indicated that public leadership positively influences clarity of objectives and enhances PM effectiveness. The research also demonstrated that top management support plays a significant role in mediating the correlation among public leadership and project management effectiveness. In summary, effective leadership is essential for the success of public endeavors in securing project achievements, particularly within the public sector, which faces numerous stakeholders, resource constraints, and intricate regulatory demands.

The current findings imply a potential need for tailoring project management (PM) type to specific project characteristics or contexts. Additional study is warranted to explore this notion in greater depth. It is plausible that various contextual factors within the research setting, beyond the chosen PM type, might have influenced the observed outcomes. Future studies could benefit from directly investigating the interaction between PM type and relevant contextual variables for a more nuanced understanding of their combined effect on project outcomes.

2.5 Role in the project (Role)

In project management, a work role refers to a specific function or position held within a team or organization, which encompasses both structural and social dimensions (Wrzesniewski et al., 2003). These roles are critical in defining responsibilities, authority, and interactions among team members. Key roles in projects, especially in sectors such as software development, include project managers, programmers, analysts, architects, testers, and developers. For instance, project managers oversee resource allocation, coordinate tasks, manage timelines, and ensure that project milestones are achieved (Alexy et al., 2013). Other team members, such as programmers, focus on more technical aspects like task initiation, execution, and issue resolution. While the responsibilities of different roles may sometimes overlap, having clearly defined roles is essential to

ensure project success and efficiency (Fauzi & Andreswari, 2022). Roles in project management are typically classified into two major categories: project heads (or leaders) and team members. The project head, with greater authority and decision-making power, guides the overall direction of the project, whereas team members perform specific tasks under the direction of the leader, contributing to the achievement of project goals (Fauzi & Andreswari, 2022). Studying the role structure within a project is crucial, as it helps in optimizing team dynamics, ensuring accountability, and aligning individual roles with project objectives. Understanding how each role impacts overall performance and project success provides critical insights into managing team efficacy, reducing conflicts, and improving communication within project management frameworks.

Research on roles in projects has increasingly focused on how these roles influence various factors such as public service motivation (PSM), psychological safety, and team learning, all of which are essential for project success. Public service motivation, a concept traditionally studied in the context of government and public sector employees, has been linked to how individuals engage with their roles in project management (Fareed & Su, 2021; Wang et al., 2022). However, the relationship between role in projects and public service motivation remains underexplored. The limited research that does exist has primarily examined outcomes like project success, employee retention, and innovative behavior (Rafique et al., 2021; Alreshoodi, 2019). Additionally, the nature of a person's role in the project can directly affect their psychological safety. In virtual teams, for example, project managers' personal and work characteristics have a significant impact on their sense of security and openness, indicating that leadership roles, in particular, can shape psychological safety (Dzandu et al., 2023). Furthermore, in agile software teams, roles that foster open communication and initiative-taking, such as project leaders, have been shown to enhance psychological safety, which is crucial for admitting mistakes and driving quality improvements (Alami et al., 2024). Conversely, in environments with

authoritarian leadership, the role of the leader may hinder psychological safety, thus affecting the project's success (Haseeb & Shah, 2023). Moreover, the role within a project significantly influences team learning, which is a critical determinant of project success across different industries. Leadership styles such as servant leadership have been shown to promote team learning and adaptability, which are vital for project success (Han & Zhang, 2024). Similarly, the active involvement of team members through mechanisms like team voice has been found to positively affect project learning and reflexivity, leading to better project outcomes (Wang et al., 2023). In educational and IT projects, the structured roles of team members and leaders facilitate a learning environment where individuals can develop critical skills and competencies, ultimately improving project performance (Mir & Rezania, 2023; Susanti & Oktarina, 2023). These studies underscore the importance of understanding how different roles within projects impact factors such as motivation, safety, and learning to enhance project management practices.

Despite the growing body of research on the role of individuals in projects, several gaps remain, particularly concerning the integration of human factors, such as public service motivation and psychological safety, in project management studies. One significant gap is the limited exploration of how different project roles, such as leaders and team members, influence public service motivation. Although motivation has been widely studied in various sectors, its specific connection to role differentiation in project settings, particularly in private and public projects, is still lacking. The available research tends to focus more on project success, innovation, and employee retention rather than on how roles foster or hinder public service motivation (Fareed & Su, 2021; Rafique et al., 2021). Another critical gap lies in understanding the nuances of psychological safety as it relates to specific project roles. While some studies suggest that project managers can either foster or diminish psychological safety based on their leadership style, there is limited empirical evidence on how this

dynamic plays out across different project environments, such as in virtual or cross-functional teams (Dzandu et al., 2023; Haseeb & Shah, 2023). More research is needed to explore how various roles, beyond just leadership, contribute to creating psychologically safe environments where team members can freely express ideas, admit mistakes, and innovate. Furthermore, there is a lack of comprehensive studies that examine the direct link between team learning behavior and specific project roles, particularly in industries like construction and IT.

Although team learning has been shown to mediate project performance, the role of individual team members and leaders in facilitating this learning process is underexplored (Wang et al., 2023; Mir & Rezania, 2023). This gap suggests a need for more research that delves into how roles can be structured to optimize learning and knowledge-sharing in projects. Addressing these gaps would provide a more holistic understanding of how project roles impact key outcomes like motivation, safety, and learning, ultimately contributing to better project management practices and success across various industries. The differences between the roles of project head and team members can significantly impact the project's structural model and its outcomes. Understanding these distinctions is essential for improving team dynamics and project performance.

2.6 Team familiarity (TF)

Team familiarity in project management refers to how well team members know each other through previous collaboration, including their skills, work habits, and communication styles. This familiarity is essential for boosting team performance, coordination, and innovation (Avgerinos et al., 2020).

Key classifications of team familiarity include 1) Geographic Team Familiarity: Co-located team familiarity generally has a more substantial positive impact on performance compared to remote collaboration (Staats, 2012). 2)

Hierarchical Team Familiarity: This involves the relationship between managers and front-line team members, often enhancing coordination within the team (Staats, 2012). 3) Role Experience, or the number of years individuals have spent in specific roles, is significant for team performance. It underscores the need for context-specific measures of experience (Huckman et al., 2009).

Existing research on team familiarity underscores its significant role in various sectors. Team familiarity develops through repeated interactions, trust-building, and interpersonal communication, which in turn improve coordination and efficiency in team settings (Costa et al., 2024). For example, in high-pressure environments like intensive care units (ICUs) and surgical teams, familiarity among team members leads to improved quality of care, reducing procedural times and minimizing errors (Zhang et al., 2023; Awtry et al., 2023). Similarly, studies of sports teams, such as those in the English Premier League, have shown that familiarity improves team cohesion, which helps mitigate disruptions caused by player substitutions or changes in team composition (Pasarakonda et al., 2023). In academic research, familiarity among team members lowers communication costs and promotes effective collaboration, as demonstrated by algorithms like MOTO, which identifies cohesive teams based on familiarity ("Familiarity-Based Collaborative Team Recognition in Academic Social Networks", 2022). These examples underscore the wide-ranging relevance of team familiarity across sectors and highlight its ability to enhance performance through trust and coordination.

Team familiarity also influences PSM by creating a cohesive work environment where team members are motivated to achieve collective goals. Familiar teams in sectors like healthcare and public services can better align with public service objectives and leverage performance management tools to improve outcomes (Munar et al., 2018). Transformational leadership further enhances the motivation of familiar teams by aligning team objectives with public service goals, thus fostering a high-performing and motivated team culture (Fareed & Su,

2021). In industries like construction, team motivation has been found to mediate the relationship between project management practices and performance outcomes, illustrating how familiarity contributes to enhanced project results. In addition, familiarity plays a vital role in promoting psychological safety, which is crucial for effective team performance, creativity, and conflict management (Rødsjø et al., 2024). Familiar teams build trust and reduce interpersonal barriers, allowing members to take risks and share ideas without fear of negative consequences (Huerta et al., 2024). This dynamic is particularly relevant in high-pressure environments, such as virtual project teams, where psychological safety and familiarity contribute to more effective teamwork (Rødsjø et al., 2024). However, familiarity can also present challenges in diverse teams, where the lack of initial familiarity may lead to conflicts that reduce cohesiveness. Effective leadership and inclusivity are thus critical to managing diversity while maintaining psychological safety (Wei & Ohland, 2022). Familiarity can also buffer the negative effects of toxic leadership, such as abusive supervision, by fostering a supportive environment where team members feel safe to share knowledge despite external pressures ("Knowledge Sharing in Project Teams: Psychological Barriers," 2022). Finally, team familiarity significantly boosts team learning, which is essential for project success. Familiar teams often display stronger learning behaviors due to their established communication patterns, trust, and conflict resolution mechanisms. In educational settings, team-based learning environments benefit from role-specific participation, which is enhanced by familiarity, promoting skill development and creativity (Susanti & Oktarina, 2023). Similarly, in project-based firms, familiarity enhances team members' ability to share knowledge and learn from experiences, directly contributing to project efficiency and success (Chies & Mazieri, 2023). Leadership styles such as servant leadership are particularly effective in familiar teams, encouraging learning, adaptation, and performance improvements (Han & Zhang, 2024).

Furthermore, familiar teams are more likely to engage in "team voice," where all members actively contribute ideas and feedback, further enriching the team's learning environment and fostering reflexivity (Wang et al., 2023). Thus, team familiarity not only fosters communication and trust but also enhances learning, creativity, and overall performance in project teams, making it a critical factor in successful project management across sectors.

Despite the growing body of research on team familiarity, several gaps remain unaddressed. A key gap is the insufficient understanding of the time required for teams to develop familiarity and the specific moments in a project when this familiarity becomes most beneficial. Although familiarity is known to enhance team cognition and performance, little attention has been given to the temporal aspects—such as how quickly familiarity evolves and when it begins to impact team dynamics (Muskat et al., 2022). Moreover, there is limited exploration of the potential downsides of team familiarity, particularly its effects on innovation. Familiarity, while advantageous for efficiency and coordination, may lead to stagnation in dynamic or innovative environments, where creativity and adaptability are critical. Over-familiarity could result in routine behaviors that stifle innovation, indicating a need for a more nuanced understanding of how team familiarity affects innovation across different contexts (Muskat et al., 2022).

Additionally, while familiarity has been used to recognize cohesive teams in academic social networks, the focus has largely been on identifying familiar teams rather than on understanding how familiarity evolves in such environments. This leaves a gap in comprehending how team familiarity develops and operates, especially in cross-institutional or diverse collaborations, which often perform better but struggle with communication barriers (Yu et al., 2022). In project-based organizations, familiarity is shown to mitigate the tradeoff between cost efficiency and quality, yet the phenomenon of multi-teaming, where individuals participate in multiple teams simultaneously, introduces complexity. The full impact of multi-teaming on project outcomes, particularly in relation to team

familiarity, is not fully understood, and further research is needed to explore how these factors interact (Choi et al., 2021). Addressing these gaps would provide a more comprehensive understanding of team familiarity, its development over time, and its various implications for project success in different settings. Addressing these gaps would enhance our theoretical and practical understanding of team familiarity, its development over time, and its varying effects across different project environments.

Overall, team familiarity, which encompasses various aspects of team experience, plays a crucial role in team dynamics and performance. The duration team members have worked together enhances familiarity, creating a supportive environment for learning from mistakes, sharing information, and open discussion. This, in turn, positively affects team learning and performance.

This knowledge gap warrants further research. The research request is “how do public service motivation (PSM), psychological safety (PS), and their interaction influence the R&D project team learning process (PTLP) through the lens of Project Management type (PM), Team member role (Role), and Team familiarity (TF) in R&D national organization”.

Chapter 3

Research Methodology

3.1 Research design

This research employs a multi-method to comprehensively analyze the connections among public service motivation (PSM), psychological safety (PS), and the R&D project team learning process (PTLP). This approach leverages the strengths of both quantitative and qualitative methods for a deeper understanding of the phenomenon.

Phase 1: Literature Review and Hypothesis Development

A systematic literature review will be conducted, focusing on key constructs such as PSM, PS, PTLP, and their interrelationships. Project management types (PM), role in the project (Role), and team familiarity (TF) will be explored as potential moderators influencing these relationships. This review will guide the development of research hypotheses.

Phase 2: Quantitative Data Collection and Analysis

A structured questionnaire will be formed to measure the main constructs and moderators. Sample size will be determined using a-priori power analysis through a dedicated Structural Equation Modeling (SEM) calculator like G*Power or a similar tool. Data gathering will occur via an online survey distributed to R&D project team members over a specified timeframe.

Partial Least Squares – Structural Equation Modeling (PLS-SEM) will be employed to study the quantitative data. This technique is particularly well-suited for this study due to its focus on exploratory research and complex models with potential for non-normality in the data. Partial Least Squares Structural Equation Modeling (PLS-SEM) will be employed to evaluate the proposed relationships, potential mediating effects, and moderating influences.

Phase 3: Collection and Analysis of qualitative data

To complement the quantitative findings and gain a deeper understanding of the practical implications, an optional phase involving qualitative data collection may be undertaken. This could involve in-depth interviews or facilitated brainstorming sessions with case study representatives. A semi-structured interview guide will be developed to explore topics such as participant feedback on the study's results and recommendations for practice. The qualitative data will be analyzed thematically to identify key insights and validate the quantitative findings.

Phase 4: Synthesis and Recommendations

The overall research findings will be synthesized across both quantitative and qualitative phases. Based on the analysis, a revised theoretical model will be proposed, incorporating the findings on the relationships between PSM, PS, PTLP, and the potential moderators. The research will culminate in practical recommendations for R&D organizations and project management practices, informed by the integrated quantitative and qualitative insights.

This multi-method approach ensures a rigorous and comprehensive investigation of the research questions, resulting in a more profound comprehension of the factors that impact R&D team learning in the framework of PSM and PS.

3.2 Research framework

This study introduces a new paradigm that investigates the relationship between essential elements that affect project results in research technology teams within R&D institutes in Thailand, addressing a previously reported gap in research. This study addresses a gap in research by introducing a novel paradigm examining the intricate relationships between Public Service Motivation (PSM), Psychological Safety (PS), Project Team Learning Process (PTLP), and the three moderators in Thai innovation teams. Figure 1 illustrates the framework's proposition of a connection between Public Service Motivation (PSM),

Psychological Safety (PS), and the Project Team Learning Process (PTLP) with the following seven hypotheses.

Hypothesis 1 (H1): *PSM positively affects PS*

Hypothesis 2 (H2): *PSM positively affects PTLP*

Hypothesis 3 (H3): *PS positively affects PTLP*

Hypothesis 4 (H4): *PS is the mediator of the relationship between PSM and PTLP*

Hypothesis 5 (H5): *Fully agile project management (F-APM) will have a positive impact on PSTL model.*

Hypothesis 6 (H6): *Partially agile project management (P-APM) will have a positive impact on PSTL model.*

Hypothesis 7 (H7): *Project head (Head) will have a positive impact on PSTL model.*

Hypothesis 8 (H8): *Project member (Member) will have a positive impact on PSTL model.*

Hypothesis 9 (H9): *Less team familiar (L-TF) will have a positive impact on PSTL model. (L-TF = TF < 10)*

Hypothesis 10 (H10): *More team familiar (M-TF) will have a positive impact on PSTL model. (M-TF = TF > 10)*

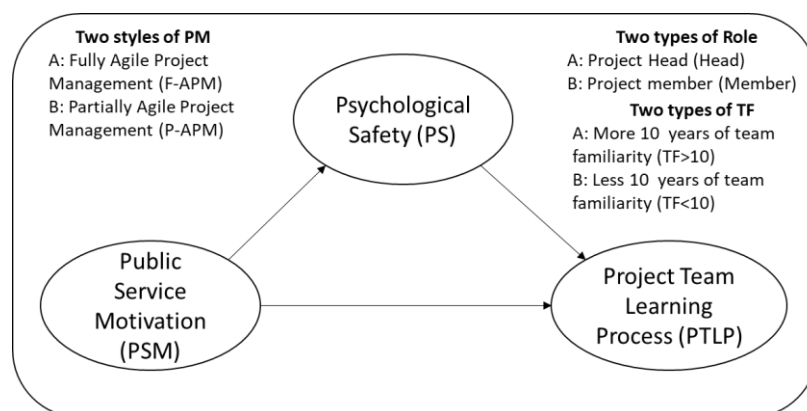


Figure 1. Research framework of the PSTL model.

Our framework proposes a complex interplay where PSM is hypothesized to positively influence both PS (H1) and PTLP (H2), with PS potentially mediating the relationship between PSM and PTLP (H4). This builds upon existing research demonstrating PSM's positive influence on learning orientation (Broekema et al., 2019) and psychological safety in local government settings (Potipiroon & Wongpreedee, 2020). We extend this research to the under-researched context of Thai national R&D institutes, suggesting similar effects at smaller team or project levels. H3 is further supported by Edmondson (1999) who found that psychological safety fosters team learning, performance and aligns with research by McElroy et al. (2024) suggesting its compatibility with agile methodologies.

Moreover, we posit three groups of moderating effect, the first is PM style (H5, H6), with the influence of PSM on PTLP potentially mediated by PS to a greater extent in Fully Agile PM (F-APM) compared to Partially Agile PM (P-APM). The existing research suggests the effectiveness of agile practices for fostering psychological safety and team learning (Varun, 2023; Barros et al., 2024), Notably, research by Sharma et al. (2024) highlights the potential benefits of F-APM for fostering psychological safety compared to more traditional approaches. Secondly, role in the project (H7, H8), which the difference in the role responsibilities between the project head and member can significantly impact the project and its outcomes. The responsibilities of each role clearly defined roles are crucial for project success (Fauzi & Andreswari, 2022). While team familiarity (H9, H10) is essential for boosting team performance, coordination, and innovation (Avgerinos et al., 2020). Huckman et al., 2009 applied the number of years of work experience to indicate team familiarity. Moreover, the high of team familiarity can enhanced the participation in team-based learning environments that promoting skill development and creativity (Susanti & Oktarina, 2023). Transformational leadership significantly bolsters the motivation of established teams by harmonizing team objectives with the

overarching aims of public service, thereby cultivating a culture that is both high-performing and driven (Fareed & Su, 2021).

Additionally, PS is examined under the mediator perspective. Project Management style was categorized into two distinct styles: Fully Agile and Partial Agile, reflecting the inherent characteristics of different project management approaches. Team familiarity within the project was categorized into two levels: low team familiarity and high team familiarity, reflecting varying degrees of team member knowledge and connection. PSM represents the intrinsic motivation of individuals to contribute to the betterment of society, which might enhance commitment and creative thinking within research and development teams. PS denotes the degree of trust and willingness to take risks within the team environment, which is essential for achieving the highest level of learning and cooperation. PTLP refers to the team's dynamics and techniques for acquiring and using collective knowledge. Project Management Styles include the methodologies project teams use to assign tasks, make decisions, and communicate throughout the project. The concept indicates that these variables engage in dynamic interactions, exerting mutual influence and eventually affecting the project. Especially the R&D project that was selected for the scope of the study.

3.3 Data Collection

Data for this study was collected via an online survey administered in 2021. The interview method is conducted with data from May to June 2022. Both methods were applied to research and development (R&D) staff at the National Electronic and Computer Technology Center (NECTEC). The survey instrument was approved by the NECTEC director for inclusion in internal manpower development initiatives. However, participants were informed that their participation was voluntary, their responses were confidential, and they could refuse questions or withdraw at any time.

3.4 The survey questionnaires

This study measured several key variables: Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Process (PTLP). PSM was evaluated using an adapted version of the seven items created by Vandenberghe (2014) and (2020) that based on Perry's (1996). Utilizing this concise 7-items aimed to enhance participant focus and questionnaire completion rates, potentially leading to improved data quality compared to employing longer items. For PS, we selected a combination of Edmondson's (1999) PS item and Aristotle's Google project indicator to conduct the PS questionnaire containing seven question items. For PTLP, we applied the six items of team learning behavior of Edmondson (1999) to conduct this survey. Variables were measured on a five-point scale: 1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, 4: Agree and 5: Strongly agree. The suffix "R" of certain PS constructs, signifies the reverse scored item when we analyzed the data. The reflective indicator variable was measured with the PS and PTLP parameters and was represented latent variables in the model.

List of items for measurement under each construct

Construct: Public service motivation (PSM)

Items of measurement

1. You are very motivated to contribute your work to society
2. Being able to contribute your work to society is very motivating
3. Defending the public interest is very important to you.
4. You voluntary and unselfishly contribute to your team or organization.
5. Serving the public interest is an important drive in your daily life
(at work or daily life).
6. To me, before anything, good researchers should think of society.
7. To me, helping people who are in trouble by research work is very important.

Construct: Project team leaning process (PTLP)

Items of measurement

1. Member tends to handle conflicts and differences of opinion privately or offline, rather than addressing them directly as a group. (R)
2. This team frequently obtains new information that leads us to make important changes in our plans or work processes.
3. Members of this team often raise concerns about team plans or decisions.
4. We try to discover assumptions or basic beliefs about issues under discussion.
5. Members put effort to project by goes out and gets all the information it possibly can from a lot of different sources.
6. We invite people from outside the team to present information or to have discussions with us.

Construct: Psychological safety (PS)

Items of measurement

1. If you make a mistake on this team, it is often held against you. (R)
2. Members of this team are able to bring up problems and tough issues.
3. People on this team sometimes reject others having different opinions. (R)
4. It is safe to take a risk in this team.
5. It is difficult to ask other members of this team for help. (R)
6. No one on this team would deliberately act in a way that undermines my efforts.
7. Working with members of this team, my unique skills and talents are valued and utilized.

3.5 The interview questions

This qualitative approach aims to deeply understand PSTL model which combine the Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Process (PTLP) through in-depth interviews, which will provide insights into how these factors affect participants' experiences.

By online-meeting, the step of semi structure question of this study

- Present the overall of this research
- Briefly discuss the key findings of the quantitative survey portion of the study as following:

Part 1: The main objective is to find the opinion and recommendation of the survey results in the PSTL model.

Dialogue of presentation:

“Overall, the results demonstrate a positive interplay with PSM, PS, and R&D PTLP, suggesting that higher levels of PSM are associated with increased personal satisfaction and greater perceived task leadership participation within R&D teams. Moreover, the analysis revealed a significant and good relationship between PSM and R&D PTLP, mediated by PS. This indicates that PS partially mediates the influence of PSM on PTLP. Therefore, PSM emerges as a crucial construct impacting both PS and PTLP within R&D project teams.”

- Ask the question to related with the study, such as
 - Do these findings resonate with your experiences in R&D teams? Why or why not?
 - Are there any findings that you disagree with? If so, can you explain your reasoning?

The sample of PSM question:

- Can you elaborate on what motivates you to work in R&D for a national organization?
- Do you feel a sense of responsibility to contribute to the advancement of technology in Thailand?

- What is the key reason that motivates you to work in the national R&D institute?

The sample of PS question:

- Can you describe an instance where you felt psychologically safe or unsafe within the team?
- If you need to discuss with the team member, how do you feel?
- Do you feel safe taking risks and experimenting with new approaches during R&D projects?

The sample of PTLP question:

- Can you give an example of a successful learning experience you had while working on an R&D project?
- Do you feel there are opportunities for team members to learn from each other's experiences and capability?

Part 2: The main objective is to finding the opinion and recommendation of the survey results of the six moderators as the Fully agile project management (F-APM), Partially agile project management (P-APM), Head of project team (Head), Member of project team (Member), More team familiarity (M-TF), and Less team familiarity (L-TF) in the PSTL model.

- Dialogue of presentation:

“For the effects of the three moderator groups, Project Management Types (PM), Role in the Project (Role), and Team Familiarity (TF), each moderator was further divided into subgroups:

The PM group was studied with two subgroups: (1) Fully Agile PM (F-APM) and (2) Partially Agile PM (P-APM).

The Role group was studied with two subgroups: (1) Project Head (Head) and (2) Project Member (Member).

The TF group was studied with two subgroups: (1) Less Team Familiarity (L-TF) and (2) More Team Familiarity (M-TF).

The comparison was made to see if there were any significant differences between the subgroups, and the result showed no significant differences among them. Upon examining the path coefficients, all were found to be positive. The path coefficient of F-APM was higher than that of P-APM in the relationships from PSM to PS and from PS to PTLP. However, in the direct effect relationship from PSM to PTLP, the influence was greater in the P-APM group.

As for the Role group, all path coefficients were positive. The path coefficient of Members was higher than that of Heads in the paths from PSM to PS and from PS to PTLP, but in the direct effect relationship from PSM to PTLP, the influence was greater in the Head group.

In the final group, TF, all path coefficients were also positive, with the path coefficients of Less TF being higher than those of More TF in the relationship of PSM-PS-PTLP.”

- Ask the question to related with the study, such as

The sample of moderator variable question:

- Have you encountered situations where [PM, Role, TF] played a positive or negative role in team learning or project outcomes? Can you provide an example?

The sample of insight and recommendation question:

- In your opinion, what are some key factors that contribute to successful R&D project team learning within this organization?
- Are there any additional aspects of project management, team dynamics, or organizational culture that you believe influence the relationship between PSM, PS, PTLP, and project outcomes?
- Is there anything else you would like to share about your experiences working in R&D teams?

- Summary and analysis under three key points as

- The relationship between PSM, PS and PTLP model
- The three moderators: PM, Role, TF
- The insight and recommendation

3.6 Analysis Tools

The suitability of the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique for this study is grounded in several key considerations. First, PLS-SEM exhibits robustness to non-normal data distributions, making it particularly advantageous when data deviate from normality, as is a potential concern in this research. Second, PLS-SEM is well-suited for small sample sizes, mitigating potential limitations arising from restricted data availability. Finally, PLS-SEM excels in exploratory research contexts aimed at developing new theoretical insights. Its ability to handle complex models with minimal distributional assumptions makes it ideal for elucidating intricate relationships and fostering greater understanding within this study. These combined strengths render PLS-SEM a compelling choice for analyzing the data in this investigation.

This study employed Partial Least Squares-Structural Equation Modeling (PLS-SEM) to analyze the dataset. The analysis followed a three-step approach.

- 1) The PLS algorithm was utilized to estimate the model's constructs and assess their measurement properties.
- 2) A bootstrapping procedure was conducted to evaluate the statistical significance of both the structural model paths and any potential mediating effects.

3.7 Case Analysis: National R&D organization in Thailand

The National Electronics and Computer Technology Center (NECTEC) in Thailand is the chosen case study for this research. NECTEC, under the Ministry of Higher Education, Science, Research and Innovation (MHESI), plays a vital role in Thailand's technological advancement. Its core responsibilities include

conducting R&D in electronics and computer technologies while fostering connections between research and industry through established programs. NECTEC aspires to be the foundation for Thailand's development in advanced technologies, focusing on areas like strategic big data and quantum computing. Their mission is to build a strong technological base for the nation.

NECTEC offers a compelling case study due to its unique characteristics. Their R&D projects operate under various project management styles, allowing team leaders flexibility in choosing the most suitable approach. Furthermore, NECTEC boasts a highly educated workforce, with over 70% of their 582 staff members working in R&D and holding degrees above bachelor's level. This diverse and skilled team, with expertise in technical and interpersonal areas, presents opportunities and challenges for collaboration within R&D projects. The specific context of NECTEC, with its focus on R&D, diverse project management styles, and the diverse academic backgrounds and expertise of team members, can sometimes pose challenges to their collaborative efforts, providing an ideal setting to explore the research questions.

Chapter 4

Results of the structure relationship between PTLP, PSM, PS as a mediator (PSTL model) and the moderator effects

This study aims to create a new theoretical model that explains how public service motivation (PSM) and the R&D project team learning process (PTLP) in Thai national IT research institutes, mediated by psychological safety (PS). A multi-method approach was employed to achieve this objective. Two sub-studies were conducted to explore and gain a deeper understanding of the connection between PSM and PTLP, with PS acting as both a mediator and a moderator. Both sub-studies involved data collection from 160 participants through a survey instrument and in-depth interviews with 10 participants from a case study. This dual approach facilitated a comprehensive investigation of the impact of PSM, PTLP, and PS within the context of Thai national R&D institutes.

The sample demographics accurately reflected the study population in terms of their project management styles (PM), Role in the project (Role), and Team familiarity (TF) as show in the Table 1. However, further details about the participants' characteristics are not presented due to privacy policy considerations and to protect the anonymity of voluntary participants. Prior to employing the partial least squares - structural equation model to test the hypotheses, we initially outlined the demographic characteristics of the participants as presented in Table 1.

Table 1 The Descriptive analysis of the research participants

Demographic	Total (%)	Min.	Max.	Mean	Std. Deviation.
Total of survey respondents	160 (100%)				

Project management style (PM)	160 (100%)	1	2	1.51	0.502
- Fully Agile PM (F-APM)	81 (50.63%)				
- Partially Agile PM (P-APM)	79 (49.38%)				
Role in the project (Role)	160 (100%)	1	2	1.31	0.465
- Head	55 (31.25%)				
- Member	110 (68.75%)				
Team familiarity (TF)	160 (160%)	1	2	1.62	0.487
- Less 10 years of TF (L-TF)	61 (38.13%)				
- More 10 years of TF (M-TF)	99 (61.87%)				
Total of in-dept interviews	10				

Note: This study focused on understanding stakeholder perspectives by transcending demographic factors such as age and gender. While these demographics might influence stakeholder engagement in other contexts, they were not considered central to the cultural environment of this case study.

Table 2. The details of 10 reviewees separated by position and group of the moderators

No.	Position	Role in the project (Role)		Project management style (PM)		Team familiarity (TF)	
		Head	Member	Fully agile	Partially agile	less than 10 years	more than 10 years
1	Deputy Executive Director	✓			✓		✓
2	Principal Researcher	✓			✓		✓
3	Senior Researcher	✓		✓			✓
4	Senior Research Assistant		✓		✓	✓	

5	Researcher		✓		✓		✓
6	Research Assistant		✓		✓	✓	
7	Research Assistant		✓		✓	✓	
8	Senior Researcher	✓		✓			✓
9	Deputy Executive Director	✓			✓		✓
10	Senior Researcher	✓			✓		✓

4.1 Sub study 1: The structural relationship between PTLP, PSM, and PS as a mediator

This study addresses a critical gap in the existing research on R&D teams within Thai R&D organizations. It proposes a novel paradigm that investigates the intricate relationships between key factors that influence project outcomes. Specifically, the study focuses on Public Service Motivation (PSM), Psychological Safety (PS), Project Team Learning Process (PTLP), and Project Management styles (PM).

The first stage of the analysis addresses measurement model assessment for Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Process (R&D PTLP), constructed under PLS-SEM framework. Two established indicators, Cronbach's alpha (CA) and Composite reliability (CR), were employed to evaluate internal consistency reliability. A requirement of 0.6 to 0.9 for CA and CR, (Bagozzi, 1988), are served as the indicator for satisfactory reliability.

Furthermore, two indices were utilized to assess construct validity: Outer loadings, and Average Variance Extracted (AVE). Outer loadings exceeding 0.4 indicate acceptable individual item reliability. Convergent validity is established when AVE surpasses 0.5, as per Bagozzi (1988) and Hair et al. (2013)., signifying distinctness between constructs shown in Table 3.

The constructs achieved satisfactory levels of reliability and validity. Composite reliability (CA) exceeded 0.75 and Cronbach's alpha (CR) exceeded 0.83 for all constructs (Public Service Motivation (PSM), Psychological Safety (PS), and R&D project team learning process (PTLP), exceeding recommended thresholds. Average Variance Extracted (AVE) values were above 0.50 for all constructs, demonstrating adequate convergent validity. Finally, all item loadings exceeded 0.4, confirming individual item reliability.

Table 3. the results of reliability and validity of PSM, PS and R&D PTLP construct

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.862	0.893	0.545	PSM 1 (0.825) PSM 2 (0.817) PSM 3 (0.704) PSM 4 (0.732) PSM 5 (0.702) PSM 6 (0.705) PSM 7 (0.669)
Psychological Safety (PS)	0.754	0.836	0.508	PS 2 (0.693) PS 4 (0.596) PS 5R* (0.775) PS 6 (0.657) PS 7 (0.820)
R&D Project Team Learning Process (PTLP)	0.755	0.835	0.504	PTLP 1R* (0.684) PTLP 2 (0.749) PTLP 3 (0.701) PTLP 4 (0.639) PTLP 5 (0.761)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix "R" of certain PS constructs signifies the reverse scored

Building upon the prior stage, this study examined the structural relationships between PSM, PS, and PTLP within research project teams in a national R&D institute. These are the results of validating our four hypotheses.

H1: *PSM positively affects PS*

H2: *PSM positively affects PTLP*

H3: *PS positively affects PTLP*

H4: *PS is mediator of the relationship between PSM and PTLP*

The results indicate path analysis revealed a positive and significant association between PSM and PS ($\beta = 0.405, p = 0.000$), with PS further exerting a significant positive influence on PTLP ($\beta = 0.480, p = 0.000$). Furthermore, a less pronounced yet statistically significant direct impact of PSM on PTLP was detected ($\beta = 0.210, p = 0.024$). These findings were confirmed through bootstrapping analysis, with all t-statistics exceeding the critical value of 1.96 and p-values reaching significance at the 0.05 level. Overall, the findings illustrate a positive correlation among PSM, PS, and R&D PTLP, indicating that higher levels of public service motivation correspond to enhanced personal satisfaction and increased perceived leadership involvement in tasks within R&D teams. Moreover, the effect size of this model is given by the value of F square. Cohen (1988) defined F square as less than 0.2 (no measurable effect), 0.02-0.15 (small effect size), 0.15-0.35 (medium effect size), and more than 0.35 (large effect size). The model demonstrates moderate to large effect sizes for the individual paths: PSM to PS ($f^2 = 0.196$), PS to PTLP ($f^2 = 0.299$), and the direct effect of PSM on PTLP ($f^2 = 0.057$). This implies that PS is crucial in elucidating both PTLP and the influence of PSM on PTLP. These show in Table 4 as below.

Table 4. The results of the structural model examination

Relationship	Path coefficients (β)	<i>t</i> -statistics	<i>p</i> -value	F-square (f^2)
PSM to PS	0.405	0.151	0.000 Significant	0.196 Medium effect size
PS to PTLP	0.480	7.639	0.000 Significant	0.299 Medium effect size
PSM to PTLP	0.210	2.262	0.024 Significant	0.057 Small effect size

Ultimately, the mediation analysis validated that PS partially mediates the relationship between PSM and R&D PTLP. The particular indirect effect of PSM on PTLP through PS was found to be significant and positive. ($\beta = 0.194$, $t = 4.717$, $p < 0.000$). This suggests that although PS partially mediates the relationship between PSM and PTLP, there is also a direct effect present, shown in Table 5.

Table 5. The results of the mediator examination of structural model

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.198	4.717	0.000 Significant	PS as a mediator

The analysis showed a meaningful and favorable connection between PSM and PTLP, with PS serving as a mediator. This indicates that PS partially mediates the influence of PSM on PTLP. Therefore, PSM emerges as a crucial construct impacting both PS and PTLP within R&D project teams.

This qualitative approach aims to gain a deeper understanding of the complex constructs under investigation: Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Process (PTLP). In-depth interviews will provide valuable insights into the lived experiences of

participants, including the impact of the aforementioned moderators on these constructs.

The results of interviewees

- 1) After the brief presentation of the survey result to interviewee, the questions are started.

Question 1 - Are there any findings that you disagree with? If so, can you explain your reasoning?

Summary answer –

- No one disagrees with this finding. The interviewees provided useful insights, as exemplified by the following statements in Table 6.

Table 6. Interviewees statement of question 1

Interviewee No.	Statement
1	<i>“I agree with this relationship. It’s like we take on tasks from the government, then try to create outcomes and collaborate with various organizations, making the research useful in real-world applications and expanding its impact. For me, I also get to try new things outside of the regular research, which is nice. It feels good to see the work actually being used, and in terms of results, there’s potential.”</i>
2	<i>“Um. I agree.”</i>
3	<i>“It’s possible. I believe that most people who come to work here do it for the country. If they want money, they should go work for a private company”</i>
4	<i>“It’s definitely possible. From what I’ve seen, people here are okay with the slower pace and the many processes of working in the</i>

	<i>government. If someone doesn't like that, they wouldn't be able to stay."</i>
5	<i>"In my team, learning isn't really tied to any specific method. To get the desired results, there are many approaches, and it's about finding which one works best for each person."</i>
6	<i>"I agree that, like in our team, people who share the same mindset tend to work in the same direction. It makes it easier to talk and discuss things with each other."</i>
7	<i>"Yeah, it's possible. People need to have similar goals to those in their team. Especially in a government job, if you're expecting the kind of rewards you'd get in the private sector, it's not going to happen."</i>
8	<i>"It's understandable. You need people with a similar mindset and way of thinking to work together peacefully."</i>
9	<i>"That's how it is. It makes sense, nothing unusual about it."</i>
10	<i>"The work environment here is comfortable, my supervisor encourages discussions, and I've learned a lot from this experience. Everyone knows their responsibilities, but there are instances of being taken advantage of"</i>

Question 2 - What is the key reason that motivates you to work in the national R&D institute?

Summary answer –

- Individual factors, such as the obligation to repay government scholarships after graduation, a passion for research, the opportunity to work in a learning environment, and the chance to receive scholarships to study abroad, influence participants' decisions to pursue R&D careers. Additionally, factors like family values that emphasize working in government agencies play a role.

However, it is worth noting that participants may cite multiple factors in their opinion. The interviewees provided useful insights, as exemplified by the following statements in Table 7.

Table 7. Interviewees statement of question 2

Interviewee No.	Statement
1	<i>"I was a government scholarship student, and after graduating, I came back to work here to fulfill my obligation. I enjoy doing research, so I wanted to work here. At the time, there weren't many other options, and I admired the research being done here."</i>
2	<i>"Career path or promotion is a key goal for people to figure out how they can grow in their jobs. Some people focus solely on academic research and aren't interested in other types of work at all."</i>
3	<i>"The work here seems fun. I get to do research, though at first, I had no idea what it really involved. But as I went along, I learned a lot."</i>
4	<i>"I enjoy research and would also like to find a scholarship to study abroad. My family has their own business, but I don't want to work in it."</i>
5	<i>"I enjoy research, it's not boring, and my parents also want me to work as a civil servant. In terms of government jobs, this is the best one."</i>
6	<i>"My family works in government, so when I got this job, I ended up staying for the long haul."</i>
7	<i>"The benefits here are a big reason why people who've worked here for a long time stick around. It's hard to switch jobs at this point."</i>

8	<i>"Most of the people who work here for a long time are scholarship recipients who have returned to fulfill their obligations. By the time they finish repaying their scholarships, they are already quite old and it's difficult for them to find employment elsewhere."</i>
9	<i>"If you're a scholarship student, you have to work here to pay it back. But this place gave me the opportunity to study, so I'm just giving back by working here. It's pretty normal."</i>
10	<i>"My parents are professors, and when I started working here, I liked it. Now I'm back to repay my scholarship, but I've already finished that. I still have some goals I want to achieve, which I can't talk about yet. I need to complete them while I'm still here because if I leave, I probably won't be able to make it happen."</i>

Question 3 - Is there anything else you would like to share about your experiences working in R&D teams?

Summary answer –

- More than a half of number of participants said some employee works at the public organization because it is a security work. Although they are not active in sometime, they still can work at here. The only condition as we have to keep a minimum level of work performance requirement to maintain our work status.
- Determination of criteria, such as performance evaluation criteria or Promotion Evaluation Criteria, is too complicated and lacks clarity causing the practice guidelines not to meet the desired main goals.
- Someone said it is easy to understand that the employee work to get the money or tangible benefit. I think employee, who has the intrinsic motivation as a PSM, is very small groups.

The interviewees provided useful insights, as exemplified by the following statements in Table 8.

Table 8. Interviewees statement of question 3

Interviewee No.	Statement
1	<i>"I am a researcher, born to be a researcher. If I grow up to be an executive, from another perspective, it would be a loss of research personnel. So, I spend some time doing research in my previous laboratory. Otherwise, our expertise would decrease. I moved to the management level, so I had to learn many new things. I also proposed a proposal on compensation consideration, but it was rejected. I think our executives did not overlook it. If there is a next opportunity, I will propose it again. If we think this matter is important, do not let it pass. If it is not today, then come and propose it again in the future."</i>
2	<i>"In group discussions, when sharing different opinions that aren't technical or directly related to useful work processes like procurement, those ideas are less likely to be accepted. Once the team has already agreed on something, it's tough to change the decision unless the new suggestion is significantly better and more practical. If the idea is just a 'blue sky' concept, it's hard to get people on board."</i>
3	<i>"The team's pretty good. Whenever I have a problem, I can always ask for advice. But sometimes the pressure feels a bit much, especially when you compare it to the pay. Still, it's not too bad."</i>
4	<i>"If you work here and want to get rich, find a new job. It's better to work for another agency. But the society here is good. You get freedom and can do the research you want. So, it's a good balance."</i>
5	<i>"I have a diverse team, and many of them are postdocs. Discussions are quite open to ensure we get the best results."</i>

6	<i>"I work with a skilled and responsible team, and the overall atmosphere is pretty great. In a research team, you need a variety of skills. One person might be great at this, another might be an expert in that, so we combine our strengths. For example, when writing a paper, some people have good content but struggle with English, so I step in to help. It's all about supporting each other."</i>
7	<i>"I work with a skilled and responsible team, and the overall atmosphere is pretty great. In a research team, you need a variety of skills. One person might be great at this, another might be an expert in that, so we combine our strengths. For example, when writing a paper, some people have good content but struggle with English, so I step in to help. It's all about supporting each other."</i>
8	<i>"Collaboration with both internal and external organizations is crucial for knowledge exchange and for continuously improving research output. After working for a long time, it's good to change things up—like sending people to work with private companies to refresh themselves and quickly update their knowledge."</i>
9	<i>My team? I always listen to them. But some still say I don't. The truth is what they're saying just isn't right. I try to explain the correct way, but they keep pushing for what's wrong, and that's not fair. It's a matter of following the rules for working together. But when it comes to the actual work, the team is pretty open to everyone's input. Sometimes it looks like we're arguing intensely, but it always stays at the meeting table."</i>
10	<i>"As a new team leader, I admit managing people is really hard. Writing code is so much easier. People are complicated. Sometimes talking doesn't even help, because they just stay quiet. If they don't speak up, I have no idea what's going on. But when it comes to the</i>

<i>work itself, I'm not worried. Managing people, though—that's the tricky part."</i>

4.2 Sub study 2: The moderator effect of the structural relationship between PTLP, PSM, and PS as a mediator

The structural relationship between Project Team Learning Process (PTLP), Project Service Motivation (PSM), and Psychological Safety (PS) is a critical factor in determining the performance outcomes of projects. In modern project management, understanding how these elements interact can provide insights into optimizing processes and enhancing success rates. The mediation effect of PS on the relationship between PSM and PTLP suggests that the way teams learn and adapt during projects directly impacts success, but this impact is also influenced by how project team learning success is measured and perceived.

In this study, we explore six key moderators that affect this relationship:

- 1) Fully agile project management (F-APM)** – This type of project environment is characterized by full adherence to agile principles, where iterative progress, flexible planning, and constant feedback loops are prioritized. We examine how this approach moderates the PTLP-PSM-PS relationship.
- 2) Partially agile project management (P-APM)** – Here, teams adopt a hybrid model that incorporates some agile methodologies alongside more traditional approaches. This moderation explores the effectiveness of mixed project management styles in influencing the PTLP-PSM-PS relationship.

- 3) **Project Head (Head)** – The role of the project leader or manager can significantly shape how learning processes and success metrics are implemented and evaluated. This moderator looks at the impact of leadership style and experience.
- 4) **Project Member (Member)** – Individual team members’ skills, experience, and engagement can play a moderating role in the success of the project. We analyze how the involvement of team members influences the PTLP-PSM-PS connection.
- 5) **Less team familiarity (L-TF)** – Teams with lower familiarity, either because they are newly formed or include members with diverse backgrounds, face unique challenges. In this study, the lower 10 years or participant in team is the definition. This moderator examines how lower familiarity within teams affects the structural relationships.
- 6) **More Team Familiarity (M-TF)** – Conversely, teams that have worked together before or have a higher degree of cohesion may experience different dynamics. In this study, the higher 10 years or participant in team is the definition. This moderator evaluates how established team relationships moderate the impact of PTLP on project success through PSM and PS.

By analyzing these six moderators of three groups, we aim to uncover how different project environments, leadership roles, and team dynamics influence the learning processes within a team and how these processes translate into project learning success. Understanding these moderating effects is crucial for organizations aiming to optimize their project outcomes through tailored approaches in management and team configurations.

The results of how each moderator influences the relationship between PTLP, PSM, and PS are shown below.

The initial phase of the analysis focused on assessing the measurement model for Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Processes (R&D PTLP). Using the Partial Least Squares Structural Equation Modeling (PLS-SEM) framework, we evaluated the internal consistency reliability of these constructs using Cronbach's alpha (CA) and composite reliability (CR). To be considered reliable, both CA and CR must fall between 0.6 and 0.9 (Bagozzi, 1988).

Additionally, we assessed construct validity using outer loadings and average variance extracted (AVE). Outer loadings greater than 0.4 indicate acceptable individual item reliability. Convergent validity is established when AVE exceeds 0.5 (Bagozzi, 1988; Hair et al., 2013).

Moderator 1: Fully agile project management (F-APM)

All constructs (Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Processes (PTLP)) exhibited satisfactory levels of reliability and validity. Composite reliability (CR) and Cronbach's alpha (CA) values exceeded the recommended thresholds of 0.71 and 0.82, respectively. Additionally, average variance extracted (AVE) values for all constructs were above 0.53, indicating adequate convergent validity. Finally, all item loadings were greater than 0.4, confirming the reliability of individual items, shown in Table 9 as below.

Table 9. The results of reliability and validity of PSM, PS and R&D PTLP constructs in F-APM group

Construct	Internal Consistency Reliability	Discriminant Validity	Indicator validity
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	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.874	0.901	0.567	PSM 1 (0.856) PSM 2 (0.858) PSM 3 (0.688) PSM 4 (0.745) PSM 5 (0.696) PSM 6 (0.707) PSM 7 (0.702)
Psychological Safety (PS)	0.739	0.836	0.561	PS 2 (0.707) PS 5R* (0.712) PS 6 (0.695) PS 7 (0.827)
R&D Project Team Learning Process (PTLP)	0.712	0.820	0.533	PTLP 1R* (0.775) PTLP 2 (0.749) PTLP 4 (0.638) PTLP 5 (0.710)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix "R" of certain PS constructs signifies the reverse scored

Our analysis found a positive relationship between Public Service Motivation (PSM) and Psychological Safety (PS). Additionally, PS positively influenced Project Team Learning Processes (PTLP). However, PSM did not directly affect PTLP. Bootstrapping analysis confirmed these results.

We found that PS plays a crucial role in connecting PSM and PTLP. This means that PS is essential for PSM to positively impact PTLP in R&D projects. The effect size analysis showed moderate to medium effects for the individual paths from PSM to PS and from PS to PTLP, especially in fully agile project

management groups. However, the direct relationship between PSM and PTLP was found to be weak. These findings are summarized in Table 10.

Table 10. The results of the structural model examination in F-APM group

Relationship	Path coefficients (β)	<i>t</i> -statistics	<i>p</i> -value	F-square (f^2)
PSM to PS	0.405	3.574	0.000 Significant	0.196 Medium effect size
PS to PTLP	0.593	8.878	0.000 Significant	0.590 Medium effect size
PSM to PTLP	0.217	1.932	0.053 Insignificant	0.079 Small effect size

Our analysis confirmed that Psychological Safety (PS) plays a crucial role in the relationship between Public Service Motivation (PSM) and Research and Development Project Team Learning Processes (R&D PTLP). PSM positively influences PTLP through PS, and this effect is significant ($\beta = 0.240$, $t = 3.564$, $p < 0.000$), as shown in Table 11.

Table 11. The results of the mediator examination of structural model in F-APM group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.240	3.564	0.000 Significant	PS as a mediator

Our analysis revealed a significant positive relationship between PSM and R&D PTLP, with PS acting as a key intermediary. This suggests that PS is a critical factor in facilitating the positive impact of PSM on R&D PTLP.

Moderator 2: Partially agile project management (P-APM)

The constructs demonstrated satisfactory levels of reliability and validity. Composite reliability (CR) and Cronbach's alpha (CA) for all constructs (Public Service Motivation (PSM), Psychological Safety (PS), and R&D project team learning process (PTLP) exceeded the recommended thresholds of 0.75 and 0.83, respectively. Additionally, average variance extracted (AVE) values were consistently above 0.51, indicating adequate convergent validity. Finally, all individual item loadings exceeded 0.4, confirming their reliability. The results are illustrated in Table 12.

Table 12. The results of reliability and validity of PSM, PS and R&D PTLP constructs in P-APM group

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.856	0.889	0.533	PSM 1 (0.825) PSM 2 (0.817) PSM 3 (0.704) PSM 4 (0.732) PSM 5 (0.702) PSM 6 (0.705) PSM 7 (0.669)
Psychological Safety (PS)	0.758	0.838	0.513	PS 2 (0.696) PS 4 (0.596) PS 5R* (0.775) PS 6 (0.657) PS 7 (0.820)

R&D Project Team Learning Process (PTLP)	0.786	0.855	0.545	PTLP 1R* (0.684) PTLP 2 (0.749) PTLP 3 (0.711) PTLP 4 (0.639) PTLP 5 (0.761)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix “R” of certain PS constructs signifies the reverse scored

The findings show that the path analysis revealed a significant positive relationship between PSM and PS ($\beta = 0.396$, $p = 0.000$), with PS also having a significant positive impact on PTLP ($\beta = 0.408$, $p = 0.090$). However, the direct effect of PSM on PTLP was not significant ($\beta = 0.223$, $p = 0.090$). Bootstrapping analysis confirmed these results, as the t -statistics exceeded the critical value of 1.96, and p -values were significant at the 0.05 level. The analysis highlighted that PS mediates the relationship between PSM and PTLP, indicating PS as a key factor influencing PSM’s effect on PTLP in R&D project teams. Additionally, the model’s effect sizes show moderate to medium effects for the paths: PSM to PS ($f^2 = 0.186$), PS to PTLP ($f^2 = 0.197$), and PSM to PTLP ($f^2 = 0.059$). This underscores PS’s significant role in explaining the model within the partially agile project management group. These details are presented in Table 13.

Table 13. The results of the structural model examination in P-APM group

Relationship	Path coefficients (β)	t -statistics	p -value	F-square (f^2)
PSM to PS	0.396	4.954	0.000 Significant	0.186 Medium effect size
PS to PTLP	0.408	3.809	0.000 Significant	0.197 Medium effect size
PSM to PTLP	0.223	1.693	0.090 Significant	0.059 Medium effect size

The mediation analysis ultimately confirmed that PS plays a mediating role in the relationship between PSM and R&D PTLP. The specific indirect effect of PSM on PTLP through PS was both significant and positive ($\beta = 0.161$, $t = 2.643$, $p < 0.008$). This suggests that PS fully mediates the connection between PSM and PTLP, as illustrated in Table 14.

Table 14. The results of the mediator examination of structural model in P-APM group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.161	2.643	0.008 Significant	PS as a mediator

The analysis demonstrated a significant positive relationship between Public Service Motivation (PSM) and the R&D Project Team Learning Process (PTLP), with Psychological Safety (PS) acting as a mediator. This suggests that PS fully mediates the effect of PSM on PTLP, highlighting PS as a key factor influencing both PSM and PTLP in R&D project teams.

Moderator 3: Project head (Head)

The constructs demonstrated satisfactory levels of reliability and validity. The composite reliability (CR) and Cronbach's alpha (CA) for all constructs, including Public Service Motivation (PSM), Psychological Safety (PS), and R&D project team learning process (PTLP), exceeded the recommended thresholds of 0.76 and 0.84, respectively. This indicates a high degree of internal consistency for these measures. Furthermore, the average variance extracted (AVE) values for all constructs were above 0.51, suggesting adequate convergent validity. In other words, the items within each construct are highly correlated and measure the same underlying concept. All item loadings were greater than 0.4, confirming the reliability of individual items. This means that each item is strongly related to its

respective construct and contributes to the overall measure. These findings are summarized in Table 15.

Table 15. The results of reliability and validity of PSM, PS and R&D PTLP constructs in Head group

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.878	0.901	0.570	PSM 1 (0.822) PSM 2 (0.774) PSM 3 (0.839) PSM 4 (0.848) PSM 5 (0.731) PSM 6 (0.688) PSM 7 (0.532)
Psychological Safety (PS)	0.763	0.843	0.522	PS 2 (0.781) PS 4 (0.597) PS 5R* (0.796) PS 6 (0.597) PS 7 (0.807)
R&D Project Team Learning Process (PTLP)	0.768	0.841	0.517	PTLP 1R* (0.684) PTLP 2 (0.718) PTLP 3 (0.817) PTLP 4 (0.570) PTLP 5 (0.781)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix "R" of certain PS constructs signifies the reverse scored

The results from the path analysis indicate a positive and significant relationship between Public Service Motivation (PSM) and Psychological Safety (PS) ($\beta = 0.355$, $p = 0.000$). Furthermore, PS significantly influences the R&D project team learning process (PTLP) positively ($\beta = 0.494$, $p = 0.000$). A notable direct effect of PSM on PTLP was also observed ($\beta = 0.357$, $p = 0.001$). These findings were validated through bootstrapping analysis, where all t -statistics surpassed the critical threshold of 1.96, and p -values indicated significance at the 0.05 level. Overall, the results illustrate a positive connection among PSM, PS, and R&D PTLP, suggesting that higher levels of public service motivation correlate with increased psychological safety and enhanced learning processes in R&D teams. Additionally, the model reveals moderate to small effect sizes for the individual paths: PSM to PS ($f^2 = 0.144$), and a large direct effect size from PS to PTLP ($f^2 = 0.425$). The path from PSM to PTLP shows a medium effect size ($f^2 = 0.222$), indicating that PS significantly contributes to explaining both PTLP and the influence of PSM on PTLP. These results are summarized in Table 16, as shown below.

Table 16. The results of the structural model examination in Head group

Relationship	Path coefficients (β)	t -statistics	p -value	F-square (f^2)
PSM to PS	0.355	3.499	0.000 Significant	0.144 Small effect size
PS to PTLP	0.494	4.989	0.000 Significant	0.425 Large effect size
PSM to PTLP	0.357	3.412	0.001 Significant	0.222 Medium effect size

The mediation analysis validated the mediating role of Psychological Safety (PS) in the relationship between Public Service Motivation (PSM) and R&D project team learning process (PTLP). The specific indirect effect of PSM on PTLP through PS was found to be significant and positive ($\beta = 0.175$, $t = 2.679$,

$p < 0.007$). This suggests that while PS partially mediates the relationship between PSM and PTLP, there is also a direct effect present, as illustrated in Table 17.

Table 17. The results of the mediator examination of structural model in Head group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.175	2.679	0.007 Significant	PS as a mediator

The analysis demonstrated a significant and positive connection between Public Service Motivation (PSM) and the R&D Project Team Learning Process (PTLP), with Psychological Safety (PS) acting as a mediator. This suggests that PS partially mediates the effect of PSM on PTLP. Consequently, PSM is identified as an essential factor influencing both PS and PTLP in R&D project teams.

Moderator 4: Project member (member)

The constructs demonstrated satisfactory reliability and validity. Composite reliability (CR) values were above 0.70, and Cronbach's alpha (CA) exceeded 0.81 for all constructs; Public Service Motivation (PSM), Psychological Safety (PS), and the R&D Project Team Learning Process (PTLP), surpassing the recommended thresholds. Average Variance Extracted (AVE) values were above 0.50 for all constructs, indicating strong convergent validity. Additionally, all item loadings were greater than 0.4, confirming individual item reliability. These results are presented in Table 18.

Table 18. The results of reliability and validity of PSM, PS and R&D PTLP constructs in Member group

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.856	0.889	0.535	PSM 1 (0.819) PSM 2 (0.820) PSM 3 (0.643) PSM 4 (0.694) PSM 5 (0.696) PSM 6 (0.715) PSM 7 (0.718)
Psychological Safety (PS)	0.750	0.834	0.504	PS 2 (0.643) PS 4 (0.603) PS 5R* (0.760) PS 6 (0.694) PS 7 (0.828)
R&D Project Team Learning Process (PTLP)	0.706	0.818	0.531	PTLP 1R* (0.708) PTLP 2 (0.771) PTLP 4 (0.652) PTLP 5 (0.775)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix "R" of certain PS constructs signifies the reverse scored

The results from the path analysis showed a significant positive relationship between PSM and PS ($\beta = 0.458$, $p = 0.000$), with PS also having a significant positive effect on PTLP ($\beta = 0.513$, $p = 0.000$). However, the direct effect of PSM on PTLP was not significant ($\beta = 0.146$, $p = 0.242$). These findings were validated

through bootstrapping analysis, where the *t*-statistics exceeded the critical value of 1.96 and *p*-values were significant at the 0.05 level. The analysis highlighted that PS mediates the relationship between PSM and PTLP, indicating that PS plays a crucial role in linking PSM to PTLP in R&D project teams. The model's effect sizes show moderate to medium impacts for the paths from PSM to PS ($f^2 = 0.265$) and from PS to PTLP ($f^2 = 0.321$), while the direct effect of PSM on PTLP is small ($f^2 = 0.026$). These details are presented in Table 19.

Table 19. The results of the structural model examination in Member group

Relationship	Path coefficients (β)	<i>t</i> -statistics	<i>p</i> -value	F-square (f^2)
PSM to PS	0.458	6.162	0.000 Significant	0.265 Medium effect size
PS to PTLP	0.513	5.513	0.000 Significant	0.321 Medium effect size
PSM to PTLP	0.146	1.170	0.242 Insignificant	0.026 Small effect size

The mediation analysis confirmed that PS fully mediates the relationship between PSM and R&D PTLP. The specific indirect effect of PSM on PTLP through PS was both significant and positive ($\beta = 0.235$, $t = 4.132$, $p < 0.000$). This demonstrates that PS completely mediates the PSM-PTLP relationship, as shown in Table 20.

Table 20. The results of the mediator examination of structural model in Member group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.235	4.132	0.000 Significant	PS as a mediator

The analysis showed a significant positive relationship between Public Service Motivation (PSM) and the R&D Project Team Learning Process (PTLP), with Psychological Safety (PS) acting as a mediator. This suggests that PS fully mediates the effect of PSM on PTLP, positioning PS as a key factor influencing both PSM and PTLP within R&D project teams.

Moderator 5: Less team familiarity (L-TF)

All constructs (Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Processes (PTLP)) demonstrated satisfactory levels of reliability and validity. Composite reliability (CR) and Cronbach's alpha (CA) values exceeded the recommended thresholds of 0.78 and 0.85, respectively. Additionally, average variance extracted (AVE) values for all constructs were above 0.50, indicating adequate convergent validity. Finally, all individual item loadings exceeded 0.4, confirming their reliability. These are ensuring distinctness between constructs as shown in Table 21.

Table 21. The results of reliability and validity of PSM, PS and R&D PTLP constructs in L-TF group

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.901	0.921	0.627	PSM 1 (0.797) PSM 2 (0.865) PSM 3 (0.846) PSM 4 (0.735) PSM 5 (0.767) PSM 6 (0.766) PSM 7 (0.759)

				PS 2 (0.709)
				PS 4 (0.646)
Psychological Safety (PS)	0.780	0.851	0.536	PS 5R* (0.780)
				PS 6 (0.644)
				PS 7 (0.859)
				PTLP 1R* (0.716)
R&D Project Team Learning				PTLP 2 (0.781)
Process (PTLP)	0.808	0.867	0.566	PTLP 3 (0.722)
				PTLP 4 (0.747)
				PTLP 5 (0.794)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix “R” of certain PS constructs signifies the reverse scored

Path analysis revealed a significant positive relationship between Public Service Motivation (PSM) and Psychological Safety (PS). Additionally, PS was found to have a significant positive influence on Research and Development Project Team Learning Processes (R&D PTLP). However, a direct relationship between PSM and R&D PTLP was not significant. Bootstrapping analysis confirmed these findings, with t-statistics exceeding the critical value of 1.96 and p-values below 0.05.

The results indicate that PS mediates the relationship between PSM and R&D PTLP, suggesting its crucial role in this context. The effect sizes of the individual paths were moderate to large, with PSM to PS having a moderate effect size ($f^2 = 0.242$) and PS to R&D PTLP having a large effect size ($f^2 = 0.372$). These findings, summarized in Table 22, suggest that PS is a significant predictor of R&D PTLP, especially in teams with less familiarity.

Table 22. The results of the structural model examination in L-TF group

Relationship	Path coefficients (β)	t-statistics	p-value	F-square (f^2)
PSM to PS	0.441	4.706	0.000	0.242

			Significant	Medium effect size
PS to PTLP	0.512	5.473	0.000 Significant	0.372 Large effect size
PSM to PTLP	0.244	1.653	0.098 Insignificant	0.084 Small effect size

The mediation analysis confirmed the fully mediating role of Psychological Safety (PS) in the relationship between Public Service Motivation (PSM) and Research and Development Project Team Learning Processes (R&D PTLP). The specific indirect effect of PSM on PTLP through PS was significant and positive ($\beta = 0.226$, $t = 3.593$, $p < 0.000$). This indicates that PS completely mediates the relationship between PSM and PTLP, as shown in Table 23.

Table 23. The results of the mediator examination of structural model in L-TF group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.226	3.593	0.000 Significant	PS as a mediator

Our analysis revealed a significant and positive relationship between Public Service Motivation (PSM) and Research and Development Project Team Learning Processes (R&D PTLP), mediated by Psychological Safety (PS). This indicates that PS plays a fully mediating role in the influence of PSM on PTLP. Consequently, PS emerges as a critical factor impacting both PSM and PTLP within R&D project teams.

Moderator 6: More team familiarity (M-TF)

All constructs (Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Processes (PTLP)) demonstrated satisfactory levels of reliability and validity. Composite reliability (CR) and Cronbach's alpha (CA) values exceeded the recommended thresholds

of 0.67 and 0.80, respectively. Additionally, average variance extracted (AVE) values for all constructs were above 0.50, indicating adequate convergent validity. Finally, all item loadings exceeded 0.4, confirming the reliability of individual items. These results shown in Table 24 as below.

Table 24. The results of reliability and validity of PSM, PS and R&D PTLP constructs in M-TF group

Construct	Internal Consistency Reliability		Discriminant Validity	Indicator validity
	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	Outer loading
Indicators	0.6-0.9	0.6-0.9	>0.5	>0.4
Public Service Motivation (PSM)	0.840	0.875	0.505	PSM 1 (0.850) PSM 2 (0.781) PSM 3 (0.613) PSM 4 (0.754) PSM 5 (0.668) PSM 6 (0.691) PSM 7 (0.591)
Psychological Safety (PS)	0.746	0.838	0.564	PS 2 (0.666) PS 5R* (0.766) PS 6 (0.719) PS 7 (0.765)
R&D Project Team Learning Process (PTLP)	0.673	0.802	0.504	PTLP 1R* (0.647) PTLP 2 (0.743) PTLP 3 (0.677) PTLP 5 (0.738)
Meaning	Acceptable	Acceptable	Acceptable	Acceptable

* The suffix "R" of certain PS constructs signifies the reverse scored

The results from the path analysis indicate a significant and positive relationship between Public Service Motivation (PSM) and Psychological Safety (PS). Additionally, PS was found to have a significant positive influence on Project Team Learning Processes (PTLP). However, a direct relationship between PSM and PTLP was not significant. Bootstrapping analysis confirmed these findings, with *t*-statistics exceeding the critical value of 1.96 and *p*-values below 0.05.

Our analysis revealed a significant and strong mediating effect of PS on the relationship between PSM and PTLP. This suggests that PS plays a crucial role in influencing the impact of PSM on PTLP within R&D project teams. Furthermore, the effect sizes of the individual paths, from PSM to PS ($f^2 = 0.147$) and from PS to PTLP ($f^2 = 0.305$), were moderate to medium, indicating that PS is a significant factor in explaining the relationship between these variables, especially in groups with more team familiarity. The direct relationship between PSM and PTLP, however, had a small effect size. These findings are summarized in Table 25.

Table 25. The results of the structural model examination in M-TF group

Relationship	Path coefficients (β)	<i>t</i> -statistics	<i>p</i> -value	F-square (f^2)
PSM to PS	0.358	3.849	0.000 Significant	0.147 Medium effect size
PS to PTLP	0.482	5.535	0.000 Significant	0.305 Medium effect size
PSM to PTLP	0.193	1.499	0.134 Insignificant	0.049 Small effect size

Finally, the mediation analysis confirmed the mediating role of PS in the relationship between PSM and R&D PTLP. The specific indirect effect of PSM on PTLP through PS was significant and positive ($\beta = 0.173$, $t = 2.862$, $p < 0.004$). This indicates that while PS fully mediates the PSM-PTLP relationship, shown in Table 26.

Table 26. The results of the mediator examination of structural model in M-TF group

Relationship	Specific Indirect effects	<i>t</i> -statistics	<i>p</i> -value	Meaning
PSM to PS to PTLP	0.173	2.862	0.000 Significant	PS as a mediator

We found a strong positive link between PSM and R&D PTLP, but this relationship is fully mediated by PS. This implies that PS is essential for PSM to positively impact R&D PTLP within project teams.

Following the quantitative data analysis, the research will employ in-depth interviews to further validate the findings. These interviews will involve a diverse sample of participants, carefully selected to represent the moderators identified in the study: Project Management (PM), Role in the project (Role), and Team familiarity (TF).

The results of interviewees

- 2) After the brief presentation of the survey result to the interviewee, the questions are started.

Question 4 - Have you encountered situations where [Project management, Project Role, Team familiarity] played a positive or negative role in team learning or project outcomes? Can you provide an example?

Summary answer 4 – All of them agree with the result. They think it is a matter of familiarity in working together, which is quite high, and management under government agencies is not flexible because of various regulations, especially in finance and formal documents, which have complicated and difficult procedures. While there are some differences between PM, Role, and TF, they do not make them clearly different.

– The role of the project head: someone in the more team familiar group thinks that the project head should be the person who has to deal with conflicts when project members have problems with each other. In contrast, someone in the less familiar group, they preferred to mediate issues between team members., as exemplified by the following statements in Table 27.

Table 27. Interviewees statement of question 4

Interviewee No.	Statement
1	<i>"Choosing the right tasks that align with the team's shared mindset and common goals is important."</i>
2	<i>"It has been like this for a long time. You can see the average age of the people here. The average age is 40 and up. It is considered an elderly organization. If the results show that there is no difference, it is not strange."</i>
3	<i>"My coworkers are great, but there's some pressure from the boss. Sometimes it gets a bit stressful."</i>
4	<p><i>"The team leader is pretty great. They often give advice and suggestions and let us try things our own way without stopping us or convincing us not to. They encourage us to experiment and try different things, which motivates us to do more."</i></p> <p><i>"As for coworkers, there should be mutual support, not just taking advantage. Especially when the workplace is flexible, everyone on the team shouldn't only focus on their own tasks but also look at the bigger picture and see how they can contribute to other areas."</i></p>

	<i>There shouldn't be any unfairness within the team. If conflicts arise, it affects the work, and learning almost never happens because everyone just sticks to their own thing without sharing or collaborating. That's not the way to go."</i>
5	<i>"It can be said that we have been together for a long time until we know each other's paths. The person who is the project leader also grew up from being a member of the project. The result is understandable."</i>
6	<i>"My project head is friendly to the team members. Her role is not very different from that of the members, but she has the power to make decisions and solve problems for the team members."</i>
7	<i>"When I have a problem in the team regarding another member's responsibility for the work, I will talk to solve the problem myself. I don't have the project head handle it. I think that the problem is about the people in the team. The members should handle it themselves."</i>
8	<i>"The role of the leader is like being the middleman, making sure things run smoothly for the team, solving problems, and negotiating with higher-ups. Whether the negotiations work out or not, the leader has to come back, explain things, reassure the team, and figure out solutions. They can't fully commit to anything because they don't have the final say. Honestly, being just a team member is way easier!"</i>
9	<i>"I'm not surprised that the differences in project management are not different because we are a government agency. Some steps must be done in order and cannot be skipped. Otherwise, we will be accused of corruption."</i>

10	<p><i>“The team members have known each other for a long time, so they’re really close. But the work they’re doing isn’t really relevant anymore. Moving them to a different department is tough because they don’t feel like they’ve done anything wrong. So, we end up trying to find work for them to do. For some, we even ask them to stay on until they retire. As for the younger ones, they’re more open to moving to a more suitable department. The leader had to solve this by getting them to learn new skills so they can continue working together.”</i></p>
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For the other recommendations of interviewees for the PSM-PTLP-PS relationship show as below,

- *“Sometimes, when someone asks for too much, it can make the other person uncomfortable, especially if they’re quiet or not good at saying no. This could lead to them being taken advantage of. So, if you’re on the same team, be mindful of this (No.1).”*
- *“Managing a research team in the public sector compared to the private sector is different in terms of ownership. The public sector has more diverse and complex goals. Personally, I think the evaluation and reward system needs to be adjusted to help people grow along with the organization over time (No.1).”*
- *“In Thailand, researcher as a professional isn’t very well-known, unlike being a doctor or teacher. If you work in government research, the pay is even lower than in the private sector. If you’re not truly passionate about it, I think once people finish their government service, they’d probably leave (No.4).”*

- *“The way to manage a team depends on the leadership style and the individuals involved. My style is one way, others might have a different approach. There’s no one-size-fits-all method (No.5).”*
- *“Motivating people is so difficult. You can send them to training, give advice, but if they’re not open to it, what’s the point? It’s better to wait until they come to the realization themselves. I’ve seen someone who took 10 years to change, but they’re much better now (No.7).”*
- *“Managing a team with members from different generations isn’t easy. Most of the issues come from the senior members, who might be more fearful or rely on past experiences that didn’t work out before, using them as excuses not to try now. If you manage the seniors well, the younger members will follow suit (No.8).”*
- *“One way to make people learn quickly (forcing them to learn) is by rotating positions. Researchers, in particular, should learn about management, not just focus on their specific area of expertise and ignore the bigger picture. You might be dedicated to your work, but you also need to see if it aligns with the organization’s goals. It’s not about only doing what you want; you have to consider others too (No.9).”*
- *“Too much flexibility in work can become a major obstacle to managing a team effectively. Not everyone is self-driven or responsible, so they might need guidance and instructions from the team leader to get things done (No.10).”*

Chapter 5

Discussion and Managerial insight

5.1 Discussion

In this research, we question the belief that PSM universally results in R&D project team learning. When considering this, we take into account the moderating effects of intrinsic motivation and the learning process of the R&D project team. Until far, there has been little focus on comprehending the possible limitations that might clarify the differences in the connection between PSM and team learning. The noteworthy interconnections observed in our research provide essential additions to the literature on PSM. Studies have consistently shown that people who possess a high level of Public Service Motivation (PSM) are more inclined to exhibit dedication and loyalty towards their public sector organizations. This commitment is primarily driven by the perceived alignment between the organizations' attributes and their own personal values and beliefs.

Our research findings reveal a more nuanced understanding of the relationship between Public Service Motivation (PSM) and the Project Team Learning Process (PTLP) compared to initial assumptions. Notably, the findings show that Psychological Safety (PS) acts as a crucial mediating variable, strengthening the association between PSM and PTLP. While the direct effect of PSM on PTLP is positive and statistically significant, the indirect effect mediated by PS is demonstrably stronger. These align with the concept that a psychologically safe climate can facilitate the fulfillment of employees' altruistic needs. Within this climate, employees feel empowered to voice their ideas and concerns, openly discuss problems, and contribute their best solutions (Edmondson, 1999; Baer and Frese, 2003). This sense of security is likely fostered by the characteristics of PS, which promote open communication and

knowledge sharing through trust building mechanisms (Liu et al., 2014; Newman et al., 2017). They likely create an environment that indirectly influences employee performance, potentially by fostering collaboration, innovation, and knowledge transfer (Baer and Frese, 2003).

This study contributes to the existing scholars on Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Process (PTLP). We expand the understanding of PSM's influence by demonstrating its role in facilitating PTLP, a relationship not previously explored in depth. Our findings extend prior research on PSM, which has primarily focused on its connection to factors like job satisfaction, occupational choice, performance (individual and organizational), commitment (organizational and job), work attitudes and behaviors, perceived supervisor trust, entrepreneurial and social entrepreneurial inclinations public sector attraction, perceived fit with the public sector, organizational learning, change-oriented organizational citizenship behavior, and leadership. (Liu and Perry, 2014; Wright and Pandey, 2008; Schott and Ritz, 2018; Lin et al, 2024; Palma et al., 2021; Chandra et al., 2021; Carpenter et al., 2012; Li and Wang, 2022; Chih and Wikael, 2015.). Additionally, we contribute to the PS literature by highlighting its mediating role in the PSM-PTLP relationship. Prior research on PS has largely concentrated on its impact on individual and team outcomes such as trust, knowledge sharing, and error reporting (Edmondson, 1999; Liu et al., 2014). Our findings resonate with the growing body of research that emphasizes the positive aspects of Public Service Motivation (PSM) (e.g., Broekema et al., 2019). These studies highlight the potential for PSM to foster positive learning orientations.

However, a gap exists in the literature regarding the influence of PSM on learning dynamics within smaller units, such as 1) project teams, 2) role team and 3) team familiarity. This study addresses this gap by examining the relationship between PSM and Project Team Learning Process (PTLP) within R&D teams. Shedding light on a critical gap, our study examined the intricate interplay

between PM styles, role in the project, and familiarity of team, PSM, PS, and PTLP within R&D teams.

Firstly, PM styles, both fully agile PM and partially agile PM appear to support PSM and PS. These findings suggest that both approaches cultivate environments conducive to nurturing public service motivation and fostering a sense of psychological safety within project teams. However, the field of PM styles in public administration remains underdeveloped. While prior research, such as Marian (2012), has explored the use of project management for organizational culture change within public institutions, a comparative analysis of different project management styles has been largely absent. Our research addresses this gap by examining the effects of fully agile and partially agile approaches on PSM, PS, and PTLP. Furthermore, the stronger positive effect of psychological safety (PS) on project team learning process (PTLP) observed in Fully agile project management (F-APM) suggests a potential explanation. The inherent flexibility and rapid iteration cycles characteristic of F-APM may foster particularly effective environments for team learning. This aligns with existing research that explores the synergy between PS and agile techniques in the context of team learning. Studies have shown that agile approaches, coupled with PS, can lead to increased knowledge sharing, continuous improvement, collective learning, enhanced team capabilities, and greater customer involvement (Marder, 2021; Alami et al, 2022; Barros et al., 2024.). Our finding of a weaker direct effect of Public Service Motivation (PSM) on the Project Team Learning Process (PTLP) in fully agile project management (F-APM) needs further investigation. This unexpected result raises intriguing questions about the potential moderating role of project management style. One description is that the direct influence of PSM on team learning might be more pronounced in partially agile project environments. Here, the more structured nature of partially agile approaches may provide a more explicit framework for channeling PSM into concrete learning activities.

Secondly, role in the project, we examine the effect of project head or leader and project member to the relationship of PSM, PTLs and PS. The results from the path analysis indicate a significant and positive relationship between Public Service Motivation (PSM) and Psychological Safety (PS) within the context of project heads. This suggests that project heads with higher levels of PSM are more likely to foster a psychologically safe environment within their teams. Furthermore, the positive influence of PS on the Research and Development (R&D) project team learning process (PTLP) underscores the importance of psychological safety in facilitating effective team learning. The direct effect of PSM on PTLP, while significant, is relatively smaller compared to the indirect effect mediated by PS. This indicates that the positive impact of PSM on PTLP is primarily channeled through PS, highlighting the crucial role of psychological safety in fostering team learning. The moderate to small effect sizes observed in the model suggest that while PSM and PS are significant factors influencing PTLP, other variables may also play a role. Further research could explore additional factors that contribute to the effectiveness of R&D project teams.

Finally, familiarity in the team is investigated in two groups such as Less and More team familiarity with the project team. The 10-year familiarity is the line to separate the group. The findings indicate a significant and positive relationship between Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Processes (R&D PTLP) in teams with less familiarity. This suggests that in newer teams, fostering psychological safety is crucial for leveraging the positive influence of PSM on team learning outcomes. While the overall pattern of relationships between PSM, PS, and PTLP remains consistent in teams with more familiarity. The direct relationship between PSM and PTLP is weaker in more familiar teams, indicating that across both familiarity conditions, psychological safety is a key mechanism through which PSM influences team learning. While PSM alone does not directly enhance team learning, it exerts its effect through the creation of a psychologically

safe environment where team members feel free to share knowledge, experiment, and engage in collaborative learning.

These factors might include elements such as the existing hierarchical structure, or the risk aversion of the project leader. Future research that delves deeper into such contextual elements is necessary to understand their potential influence fully.

5.2 Managerial insight and Implication

Based on our findings, we can offer some managerial insights for project team leaders, particularly when utilizing a PM styles approach within R&D teams.

1) Fostering a psychological safety climate in the project team. Where the direct effect of PSM on PTLP may be weaker, project leaders should actively cultivate a psychological safety (PS) climate. This can be achieved by encouraging open communication, promoting learning from mistakes, and fostering trust within the team. By nurturing a PS climate, project leaders can support and potentially amplify the intrinsic motivation (reflected by PSM) that drives team learning, even in the context of F-APM, newer and established team. Organizations should prioritize creating a psychologically safe environment within R&D project teams. This can involve implementing policies and practices that promote open communication, trust, and respect among team members.

2) Conversely, for project teams lacking a strong PS climate, partially agile project management (P-APM) might be a more strategic approach. The more structured nature of P-APM may provide a clearer pathway for team members with high PSM to translate their intrinsic motivation into concrete learning behaviors. Further research is needed to validate this proposition, but these insights offer a starting point for project leaders navigating the complex interplay between project management styles, PSM, and team learning.

3) Enhance Public Service Motivation, Organizations can enhance public service motivation among team members by providing opportunities for professional development, recognizing, and fostering a sense of purpose and meaning in the work.

4) Prioritize Team Learning, to maximize the positive impact of PSM on team learning, organizations should focus on creating a psychologically safe environment. Managers should prioritize interventions that cultivate psychological safety, such as open communication, tolerance for mistakes, and encouraging innovative thinking, as these practices not only improve team morale but also amplify the effects of motivation on team performance. This will facilitate the flow of information, encourage knowledge sharing, and promote a culture of continuous learning.

5) Consider Team Familiarity, the findings suggest that the impact of PSM and PS on PTLP may vary based on team familiarity. Organizations should tailor their strategies to address the specific needs of teams at different stages of development.

Moreover, the implication of this dissertation offers several keys for public sector organizations, and project management practices as below.

- 1) This research value offers a more nuanced view of Public Service Motivation (PSM) by moving beyond its association with job satisfaction or performance. It highlights that PSM does not always directly lead to R&D team learning, but rather emphasizes the importance of intrinsic motivation and the learning process itself. This expands our understanding of PSM by demonstrating its potential role in facilitating team learning, a previously under-investigated area.
- 2) This research underscores the critical role of psychological safety (PS) as a bridge between Public Service Motivation (PSM) and R&D team learning. By fostering an environment where team members feel safe to communicate openly, share knowledge, and learn from mistakes,

psychological safety strengthens the positive influence of PSM on team learning effectiveness.

- 3) Both fully agile and partially agile project management styles appear to create environments that encourage public service motivation and psychological safety within teams. This suggests that either approach can be beneficial. However, the research also highlights a gap in our understanding of different project management styles in public administration. Further investigation into how various styles impact factors like PSM, PS, and PTLP could be valuable for optimizing project success.
- 4) Fully agile project management (F-APM) seems to be a double-edged sword. While it promotes psychological safety, the direct link between public service motivation (PSM) and team learning appears weaker in this context. This suggests project management style might play a moderating role. The study proposes that the more structured nature of partially agile approaches might offer a clearer path for translating PSM into concrete learning activities within teams.
- 5) Leaders or managers should recognize by which motivation impacts learning and adjust their leadership styles accordingly. Team leaders can actively enhance team learning by leveraging their motivational influence while also fostering a psychologically safe environment where all team members feel empowered to learn and grow.
- 6) The team member rotation can provide the changing of team dynamics. Organizations can enhance project team learning and reduce the negative effects of team familiarity by implementing personnel rotation programs or fostering team diversity. By introducing new perspectives and experiences, personnel rotation can stimulate knowledge sharing and prevent stagnation. Additionally, diverse teams can bring a wider

range of skills, knowledge, and problem-solving approaches to the table, leading to more innovative and effective solutions.

Chapter 6

Conclusion and Limitations

6.1 Conclusion

This study examined the interplay between Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Process (PTLP) within R&D teams at Thailand's National Electronic and Computer Technology Center (NECTEC). Employing an online survey distributed in 2021, data was collected from 160 R&D professionals. Utilizing Partial Least Squares-Structural Equation Modeling (PLS-SEM), the study delves into the complex relationships between these variables, considering the influence of Project Management (PM) styles.

The path analysis revealed a compelling narrative. Higher levels of PSM were significantly associated with enhanced PS, suggesting that R&D professionals driven by public service motivation experience greater psychological safety within their teams. Meanwhile, PS fosters a thriving R&D PTLP, as evidenced by the significant positive relationship between PS and PTLP. Interestingly, a direct effect of PSM on PTLP was also observed, indicating that public service motivation can independently contribute to enhanced learning processes within R&D teams. The effect sizes of these relationships ranged from moderate to large, highlighting their practical significance. Further exploration confirmed the partial mediating role of PS in the PSM-PTLP relationship. While higher PSM indirectly influences PTLP through fostering PS, a direct effect also remains, suggesting that public service motivation can contribute to learning processes through other mechanisms beyond enhancing psychological safety

We found the six points of this key findings. Firstly, the analysis revealed a significant positive relationship between PSM and PS, indicating that R&D team members who are motivated by public service principles report a stronger sense of psychological safety in their teams. Secondly, a positive relationship was also found between PTLP and PS, suggesting that a psychologically safe environment fosters effective team learning processes. Thirdly, the study further identified a crucial link between PSM and PTLP, highlighting the importance of intrinsic motivation, such as PSM, as a novel driver of success in R&D project teams' learning. Fourthly, the impact of PM styles on these relationships was explored. The results demonstrate that both fully agile and partially agile PM can cultivate environments conducive to PSM, PS, and PTLP, though specific nuances may exist between the two styles. Fifthly, the study explored the impact of the project role on these relationships. Results indicated that both project heads and project members significantly influenced PSM, PS, and PTLP, albeit in distinct ways. Finally, the impact of team familiarity was examined within a team context. Findings suggest that team familiarity influenced PSM, PS, and PTLP, with PS serving as a mediating factor that promoted team learning.

6.1.1 Theoretical contributions

This study contributes to existing literature in several key areas, offering novel theoretical insights into the relationships between Public Service Motivation (PSM), Psychological Safety (PS), Project Team Learning Process (PTLP), Project Management (PM) styles, Role in the project and Project team familiarity within R&D project teams.

In conclusion, this study makes significant theoretical contributions by:

- 1) **Deliver a novel public service team learning model:** By integrating the concepts of Public Service Motivation (PSM), Psychological Safety (PS), and Project Team Learning Processes (PTLP) to explore how individual motivation influences interpersonal learning within public service teams in government agencies.

- 2) **Advancing Psychological Safety Research:** The study enhances the current understanding of the mediating role of psychological safety (PS) by confirming its crucial influence in the relationship between Public Service Motivation (PSM) and Project Team Learning Processes (PTLP). It extends existing theories on psychological safety by demonstrating its importance across teams with different levels of familiarity, showing that PS is essential not only for newer teams but also for more established ones. This adds depth to the field by emphasizing that the need for psychological safety is persistent and ongoing, regardless of team maturity, thus contributing to both organizational behavior and team learning literature.
- 3) **Extending Public Service Motivation (PSM) Theory:** The findings contribute to the PSM literature by illustrating its dual role in influencing team learning in R&D environments. While PSM is traditionally seen as a motivator for public service-oriented behavior, this study demonstrates that its impact is twofold: PSM directly fosters team learning and functions through PS as a mediator to enhance learning outcomes. This dual mechanism enriches the theoretical understanding of PSM and highlights its broader impact in complex, innovation-driven environments like R&D settings, paving the way for future research on PSM's influence on learning processes in different organizational contexts.
- 4) **Identifying Direct and Indirect Effects of PSM on Learning:** The discovery of a potential direct effect of PSM on PTLP, independent of PS, introduces a new theoretical avenue for understanding how intrinsic motivation associated with public service values drives team learning. This finding aligns with research on intrinsic motivation and learning orientation, suggesting that individuals motivated by public service values may actively engage in learning behaviors beyond the influence of psychological safety. This expands current theories of PSM, suggesting

that its impact on learning is both direct and mediated by psychological safety.

- 5) **Opening New Research Directions on PM Styles:** By encouraging further investigation into how project management (PM) styles influence the relationship between PSM, PS, and PTLP, this study opens up new lines of inquiry. Although the data on PM styles was not significant, this calls for future research to explore the subtle differences between various project management approaches (e.g., agile, waterfall, hybrid) and their impact on team motivation and learning outcomes. Such research could provide a more nuanced understanding of how different PM methodologies foster or hinder learning within R&D teams.

6.1.2 Practical contributions

Moreover, this study translates its theoretical insights into several practical contributions that can benefit the guide for role and team familiarity in R&D teams, organizations, and project management approaches by:

- 1) **Team Building Initiatives:** Organizations can use the findings to design team-building programs focused on fostering psychological safety (PS) and enhancing public service motivation (PSM) to improve the learning processes and effectiveness of R&D teams.
- 2) **Leadership Development:** Project leaders should be trained to create a psychologically safe environment that encourages open communication, risk-taking, and idea-sharing. Leaders can inspire PSM among team members to boost overall team learning and performance.
- 3) **Performance Evaluation:** The study provides a framework for assessing R&D team performance based on PSM, PS, and Project Team Learning Processes (PTLP). Organizations can use these factors to identify areas for improvement and design targeted interventions.

- 4) **Policy Development:** Organizations can develop policies that emphasize psychological safety and public service motivation to create a conducive environment for team collaboration and innovation. This can lead to better project outcomes and enhanced R&D team performance.
- 5) **Fostering Public Service Motivation (PSM):** By identifying and cultivating individuals with a strong sense of public service motivation, organizations can create teams that are more collaborative and motivated. This can be done through recruitment, onboarding, and training programs that emphasize the societal impact of the organization's mission.
- 6) **Enhancing Psychological Safety (PS):** Project leaders and team members should promote open communication, tolerance for errors, and respectful interactions to build trust and psychological safety within the team. This environment encourages innovation and learning from mistakes, thereby enhancing team performance.
- 7) **Optimizing Project Team Learning Process (PTLP):** Organizations can implement strategies such as collaborative learning activities, workshops, and mentoring programs to promote continuous learning and knowledge sharing within teams, thereby improving project outcomes.
- 8) **Tailoring Project Management (PM) Approaches:** Project leaders should choose PM methodologies (e.g., fully or partially agile) that align with team culture and dynamics to enhance team learning processes. The research suggests both agile approaches are conducive, but further exploration is needed.
- 9) **Personnel Rotation and Team Diversity:** To reduce the familiarity level and encourage fresh perspectives, organizations should implement personnel rotation programs and promote diversity in teams. This can enhance psychological safety and stimulate continuous learning and knowledge sharing.

10) **Measurement and Monitoring Tools:** Organizations should develop tools to regularly measure PSM, PS, and PTLP to track progress, identify gaps, and inform ongoing interventions. Regular assessment helps ensure that strategies are effective in enhancing team learning and collaboration.

By implementing these practical recommendations, R&D project teams, and organizations can leverage the study's findings to create environments that cultivate public service motivation, foster psychological safety, and optimize R&D project team learning processes, ultimately leading to enhanced innovation and project success.

6.2 Limitations and Future work

While this study sheds light on the interplay between Public Service Motivation (PSM), Psychological Safety (PS), and Research and Development Project Team Learning Process (PTLP) within a national R&D organization, acknowledging its limitations is crucial for advancing our understanding. These limitations include:

- 1) A single organization was focused on this study, potentially limiting the generalizability of the findings to other R&D contexts. Due to time and resource constraints, including budgetary limitations and a strict timeline, prevented us from expanding the research scope to encompass a more diverse range of R&D settings.
- 2) The sample size of 160 participants is relatively small. While resource limitations restricted our ability to recruit a larger sample, we conducted a pilot study to ensure the validity and reliability of the instruments used and made significant efforts to achieve a diverse sample within the organization.
- 3) The reliance on survey data limits our ability to delve deeper into the mechanisms underlying the relationships between PSM, PS, and PTLP.

Surveys inherently struggle to capture the nuances of team-level dynamics and communication patterns that can significantly influence learning behaviors within project teams.

- 4) This study was conducted within a specific cultural context, limiting its generalizability to other cultures. The findings may not be applicable to populations with different cultural norms, values, and beliefs. The other of cultural norms and values can significantly impact how individuals perceive and experience these variables.
- 5) This study provides a snapshot of the relationships at a single point in time. However, the dynamics of these variables may evolve over time and across different project phases.

By acknowledging these limitations, we can highlight areas for future research and emphasize the need for further exploration of these relationships in different contexts, with larger and more diverse samples, using a wider range of data collection methods that can capture the complexities of team dynamics. Future research can extend these findings in several compelling directions:

- 1) Future research could address the limitation of broadening the generalizability of the study by investigating these relationships across diverse organizational settings, encompassing different industries, cultures, and project types. By including a wider variety of contexts, researchers can explore how these factors might influence the observed relationships.
- 2) Future research should replicate this study with a larger and more geographically diverse participant pool to address the limitations of generalizability imposed by the sample size. This will enhance the generalizability of the findings and allow for more robust statistical analyses.
- 3) Future research should investigate the relationships between PSM, PS, and PTLP across multiple cultural contexts to examine the extent to which these constructs are universal or culturally specific. This would involve

comparing data from diverse populations and identifying any cultural nuances that influence these relationships.

- 4) Longitudinal studies that track changes in PSM, PS, and PTLP over time can offer valuable insights into their temporal interactions and how they respond to the evolving dynamics of project environments. Understanding these temporal aspects can inform project management practices and interventions designed to optimize team learning throughout the project lifecycle.

By building on this foundation and addressing the limitations identified, future research can unlock a deeper understanding of how public service motivation and project management styles influence team dynamics and the learning process. This knowledge will equip organizations to make informed decisions about fostering a psychological safety climate and a collaborative environment, ultimately enabling project teams toward successful learning.

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List of Contribution

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