CHAPTER I

INTRODUCTION

1.1 Background of The Study

In today's complex industrial environments, effective project management plays a pivotal role in ensuring that operations – manufacturing, fabrications, component warehouse storage – run smoothly, on time, and within budget. Particularly in sectors like mining and heavy equipment, where projects often involve high costs, technical intricacies, and tight schedules, managing tasks efficiently can determine whether a company gains or loses competitive advantage. Traditional project management methods, such as linear planning or rigid tracking systems, often fall short when dealing with dynamic work conditions, interdependent teams, and changing priorities (Danijela Ciric Lalic et al., 2022). This condition, most of the time was caused by the complex waterfall decision making that are applied in the traditional methodologies. This is where agile methodologies, including Scrum framework, have gained prominence for their adaptability and iterative progress monitoring (Project Management Institute, 2021). Implementing the flat structured, the decision-making process is easier and faster to do. Moreover, scrum highlights how important conducting the iteration meeting is. It does not need to be a time-consuming one, but needs to be implemented in daily basis so the team can keep up with the update more responsively.

One real-world example where these challenges and opportunities converge is the Component Exchange (Comex) Department at PT XYZ, a major contractor in Indonesia's mining sector. The Comex Department is tasked with the overhaul and maintenance of heavy mining equipment through structured component replacement. Historically, this department relied on a Kanban-based tracking system that was only updated during weekly meetings. However, internal interviews with the Comex Scrum Master, project team members, and the Management Development (MD) Officer reveal that such a system offered limited visibility into daily progress and slowed communication. As a result, during the 2023/2024 fiscal year, several overhaul projects experienced delayed lead times and cost overruns—problems that highlighted the need for a more responsive and flexible project management approach. These conditions provide a strong rationale for transitioning to Scrum, an agile framework designed to tackle precisely such challenges.

Project management emphasizes that rigid, traditional processes can struggle in fast-changing environments. Scrum, as an agile framework, offers short iterations and daily feedback that contrast with the longer update cycles of Kanban. Scrum is known to be a flexible, iterative process that enables teams to adapt continuously as requirements change. In practice, Scrum's fixed-length sprints and daily standup meetings ensure regular inspection and adaptation, which addresses exactly the kinds of communication and delay issues observed in Comex's Kanban process. For example, agile methodologies like Scrum are specifically credited with accommodating changes and reducing risks of cost overruns through iterative

development, continuous testing, and frequent stakeholder feedback. By adopting such iterative practices, Comex teams can detect problems earlier and adjust plans quickly, thereby minimizing schedule slips and excess costs.

Beyond flexibility, Scrum also promotes greater team collaboration and cost efficiency. The Scrum approach tends to increase team cohesiveness by making teams self-organizing and improving collaboration levels. Self-organization empowers team members in Comex to assign tasks and share knowledge without awaiting hierarchical directives, countering the siloed communication previously noted in Kanban. Moreover, Scrum is associated with cost containment – by incorporating regular feedback loops, teams can avoid spending effort on low-value work, thus saving time and resources, and keeping costs more contained. In other words, problems are identified and resolved before they necessitate expensive rework later on. Finally, Scrum's emphasis on delivering working increments each sprint means that customers (or internal stakeholders) see faster results and higher quality, since bugs are fixed continuously and functionality is validated frequently. This faster, high-quality delivery improves overall customer satisfaction and project success rates. In sum, the literature confirms that Scrum provides improved flexibility, collaboration, and cost-efficiency – benefits that directly address the inefficiencies and overruns observed in Comex's project data.

Comex projects involve a wide range of complexities in their planning and execution. To systematically analyze these challenges, this study uses the Technology–Organization–Environment (TOE) framework, which has been applied in project complexity research in various industries. The TOE framework

categorizes project complexity into three dimensions – Technical, Organizational, and Environmental complexity. Each dimension encompasses specific factors that can complicate project delivery (Bosch-Rekveldt et al., 2011). In Comex, these dimensions manifest as follows:

Technical Complexity in Comex overhauls involves many different tasks (e.g. disassembly, part refurbishment, reassembly) and strict quality requirements for each component. The team's experience with the specialized maintenance technology varies, and many tasks depend on the completion of earlier steps. Thus, multiple task dependencies and high technical risk (such as equipment failures or new technology integration) increase complexity. In short, the variety of tasks, strict quality criteria, varying technological skill levels, and interdependent processes all contribute to technical complexity.

As for the Organizational Complexity, the typical Comex overhaul team is relatively large and cross-functional. Collaboration across subteams (mechanical, electrical, logistics) is essential but challenging. Compatibility of tools and systems (such as maintenance software and parts databases) affects workflow integration. Additionally, limitations in resource and skill availability (e.g. scheduling the necessary technicians and machines) add complexity. Organizational risk factors (such as schedule coordination, shift changes, or management interventions) can disrupt progress. In summary, the size and structure of the Comex team, collaboration demands, tooling compatibility, and resource constraints contribute to organizational complexity.

Regarding the Environmental Complexity, first to notify is that the Comex department operates under external pressures. There is competition within the mining services market for timely equipment availability. The stability of the project environment can be low – for instance, sudden changes in mine production schedules or regulatory requirements can arise. Finally, environmental risk factors (like economic or market volatility) can lead to abrupt scope changes. For example, Luis Mayo-Alvarez et al. (2024) note that highly volatile, uncertain, complex, and ambiguous (VUCA) environments majorly complicate project management. In the Comex context, market and operational volatility (a VUCA characteristic) underlines the need for agile methods.

Given these TOE-defined complexities, the Scrum framework is a natural fit for Comex project management. Scrum's structure directly addresses the challenges identified. Technically, Scrum's iterative sprints break the project into manageable increments, reducing complexity through constant feedback. The daily standup meeting ensures that interdependent tasks and technical risks are discussed promptly. Organizationally, Scrum's emphasis on self-organizing teams fosters collaboration among the diverse Comex team members. Team members share responsibility for planning and problem-solving, which mitigates coordination challenges and tool compatibility issues by surfacing them early. Environmentally, Scrum enables rapid response to change – in a VUCA-like setting – Comex can re-prioritize backlog items each sprint to adapt to market shifts or strategic directives. As Drury-Grogan (2014) observes, the use of scrum iteration can integrate the best of both approaches to cope with volatility. While Comex is moving toward Scrum

(rather than Kanban), the point is the same – Scrum's fast cycles and visible backlog make the workflow transparent and resilient to external pressures.

Another important enabler is the existing Sicomex digital tracking system used by the department. Sicomex provides real-time data on overhaul status (e.g. parts availability, task completion). When integrated with Scrum, Sicomex can be used to update the sprint backlog continuously, allowing the Scrum Master and team to see progress instantly. This digital tool effectively supports Scrum's empirical process control – by maintaining transparency and enabling rapid inspection of work. In other words, daily Scrum meetings can be backed by up-to-date information from Sicomex, ensuring decisions are made on current data.

However, using Sicomex also introduces its own complexities. From the technical side, Sicomex's compatibility with other systems (e.g. inventory databases, scheduling tools) may be limited, which could hinder seamless information flow. Organizationally, staff must be trained and willing to use the new system features; resistance or skill gaps could slow adoption. These challenges themselves fall under the TOE framework (technical and organizational complexity) and must be managed. Recognizing such challenges in advance allows the project to include mitigation strategies (e.g. training sessions, interface improvements).

Ultimately, adopting Scrum is expected to confer a competitive advantage to PT XYZ's Comex operations. In the framework of competitive strategies formulated by Michael E. Porter (1985), improvements in project delivery speed,

cost efficiency, and customer satisfaction are also key drivers of advantage. Under Porter's cost leadership model, organizations attain an edge by minimizing operational costs and improving efficiency. By shortening lead times and reducing cost overruns through Scrum's iterative process (e.g. avoiding late-stage rework), Comex aligns with a cost-reduction strategy. It will eventually lead to how the project management methodology chosen will have such huge effect to the values that the company gains (Kaufmann & Kock, 2022). For example, the cost-containment benefits of Scrum (avoiding wasteful effort) directly contribute to lower overhead per overhaul. Meanwhile, Porter's differentiation strategy is achieved by offering superior value or quality. In Comex terms, higher quality maintenance and faster delivery of overhauled equipment translate to better "product" performance for the mines, which can increase customer (mine site) satisfaction and loyalty. Meeting or beating turnaround expectations can become a distinctive competence for the department (Areias & Eiriz, 2013). In effect, Scrum implementation is intended to reduce turnaround time and improve reliability, giving PT XYZ a stronger market position in meeting clients' time-sensitive equipment needs.

In summary, shifting Comex's project management from a rigid weekly-update model to Scrum's agile methodology addresses the TOE-driven complexities identified in this study. The literature and practical findings both support Scrum's strengths in handling such complexity – providing real-time communication, enabling rapid adaptation, and focusing on customer-valued outcomes (Marnada et al., 2021). By leveraging these strengths and carefully

measuring them against Scrum's guiding principles, the department aims not only to improve its internal project performance but also to create a sustainable competitive advantage. Faster, more reliable project delivery and better cost control will enhance customer satisfaction and align Comex's operations with strategic business goals.

1.2 Research Problem

The Component Exchange Department at PT XYZ plays a crucial role in ensuring the operational continuity of mining equipment by managing the overhaul and replacement of critical components. However, the department has faced persistent challenges in meeting its target project lead time of five days. Based on interviews with the project team, project leader, and project owner, it is evident that these delays are rooted in multifaceted project complexities—technical, organizational, and environmental—that disrupt workflow efficiency, hinder cross-functional coordination, and delay decision-making.

Technically, the complexity arises from the high number of components involved, stringent quality requirements, real-time data tracking demands, and process interdependencies that affect downstream tasks. Organizationally, the project involves large, multi-shift teams with varied skillsets, inconsistent communication between departments, low traceability of errors, and resistance to digital project tools. Environmentally, the department operates under external pressures such as urgent production demands, unstable spare part availability,

inconsistent procurement regulations, and the strategic expectation to continuously improve project performance with high transparency.

Despite adopting traditional project management practices, these methods have not adequately addressed the department's dynamic and interrelated challenges. The Waterfall approach, which is linear and rigid, lacks the responsiveness required to adapt to frequent changes and uncertainties. In this context, an Agile framework—specifically Scrum—offers a promising alternative to improve coordination, reduce lead times, and enhance adaptability. However, empirical research on Scrum implementation in industrial, non-software contexts—particularly within component exchange projects in mining services—is still limited.

This research problem highlights the need to evaluate the effectiveness of Scrum in managing project complexity and enhancing performance. It also reflects a gap in the literature regarding the application of Agile methodologies in operational and engineering environments outside of software development.

Therefore, the core research problem addressed in this study is:

1. How does Component Exchange Department of PT XYZ implement the Scrum framework in handling its projects in order to gain competitive advantage?
2. How does the Scrum Framework execution can help PT XYZ handle its technical, organizational, and environmental aspects of its project?

1.3 Objective of the Research

Referred to the problem background and research problem mentioned above, the objectives of this research are:

1. Analyzing the implementation of Scrum framework and how Component Exchange of PT XYZ can gain competitive advantage of it
2. Analyzing how PT XYZ manages to handle its Technical, Organizational, and Environmental project's aspects

1.4 The Implications of the Research

The research's advantage is the outcomes that is resulted from conducting the research. By conducting this research, the researcher hopes that it could generate insights for companies and other researchers or practitioners focusing on applying the Scrum framework as a part of Agile Project Management to optimize the project's outcomes. This research's advantages are:

1. Theoretical Implications

   Through this research, researcher can think analytically and critically on how the implementation of Scrum framework can give competitive advantages to the company who use this framework.
2. Managerial Implications

   With the presence of this research, hopefully PT XYZ can gain insights and knowledges in applying the Scrum framework in all of its projects
3. Social Implications

Hopefully this research can be a substantial reference for other researchers who have the same focus and concerns regarding the Scrum framework implementation as a part of Agile Project Management

1.5 Theoretical Framework

1.5.1 Competitive Advantage

Competitive advantage is something that urgently needed to gain by companies in order to win the competition they are currently diving in. It is really important to create a proper strategy to win the market. Competitive advantage is defined as all value-creating strategies a company can perform, for which its rivals cannot adopt at the same time (Innocent Otache, 2024). In order to obtain the optimal competitive advantages, optimizing several factors become necessary for firms. Those are involved in the idea of competitive advantage, that includes a number of crucial elements that are necessary for every organization to succeed, including quality, cost, delivery, dependability, responsiveness, innovation, and flexibility (Abdel-Aziz Ahmad Sharabati et al., 2022). The Resource Based views a company's resources or assets are examined in terms of competitive advantage by View of the Firm. A firm possesses a multitude of resources, including organizational, financial, human, physical, social, and technological ones. Both tangible and intangible resources are possible; tangible resources are concrete, physical, codified, or founded on explicit knowledge (tacit; whispered but recognized) (Mathur et al., 2007).

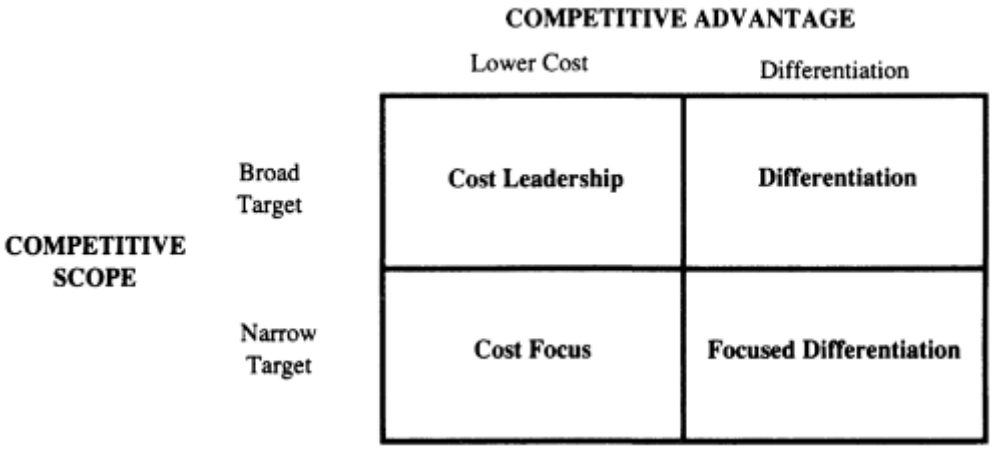

Figure 1. 1 Types of Competitive Advantage

Source: (Michael E. Porter, 1985)

Michael E. Porter (1985) mentioned that one way to define competitive advantage is a company's approach to sustaining above-average performance. A hierarchical relationship can be seen between supply chains, value chains, and competitive advantage. Fundamentally, types of Competitive advantage can be divided into two. The first one is based on differentiation. It is the capability to provide certain exceptional value to the consumers, in the case of product quality, special features, or other similar things. While another one is when company can perform lower cost and more efficiently than the competitors.

Furthermore, when companies can reach broad targets and producing for a lower cost, then it means that they can achieve the Cost Leadership, meaning that they are the cheapest and most efficient amongst the competitors. Different from the Cost Leadership one, Cost Focus section is stated when companies are just be able to target for a narrow market. They are preferring to focusing their expenses on smaller market. Meanwhile, the differentiation section is for the companies that

can reach such a broad market while at the same time, applying different methodologies, or resulting unique and innovative products, which are not owned by their rivals. Lastly, the focused differentiation section is for the companies that managed to be uniquely different from their competitors, but not targeting a large-scale market.

1.5.2 Scrum Framework

Scrum is a simple framework that assists individuals, groups, and institutions in creating value by finding flexible answers to challenging issues. To put it briefly, a Scrum Master must create an atmosphere where:

1. A Product Owner creates a Product Backlog and assigns tasks for complicated problems.
2. During a Sprint, the Scrum Team transforms a portion of the work into an Increment of value.
3. The stakeholders and the Scrum Team review the outcomes and make any adjustments for the upcoming Sprint.
4. Repetition

Scrum is based on lean thinking and empiricism. Empiricism maintains that experience and making judgments based on observations are the sources of knowledge (Schwaber & Sutherland, 2020). Lean thinking eliminates waste and concentrates on what matters most. Scrum uses an incremental, iterative methodology to maximize predictability and minimize risk. Scrum brings

together teams with all the knowledge and experience necessary to complete the task at hand, as well as the ability to share or pick up new skills as needed.

Software engineers find Scrum's organizational structure appealing due to the "structured freedom" and teamwork it fosters. Scrum uses incremental and iterative methods to optimize turnaround time and show responsiveness to rapidly changing market requirements, guaranteeing that consumers receive timely product releases (Mathrani et al., 2022).

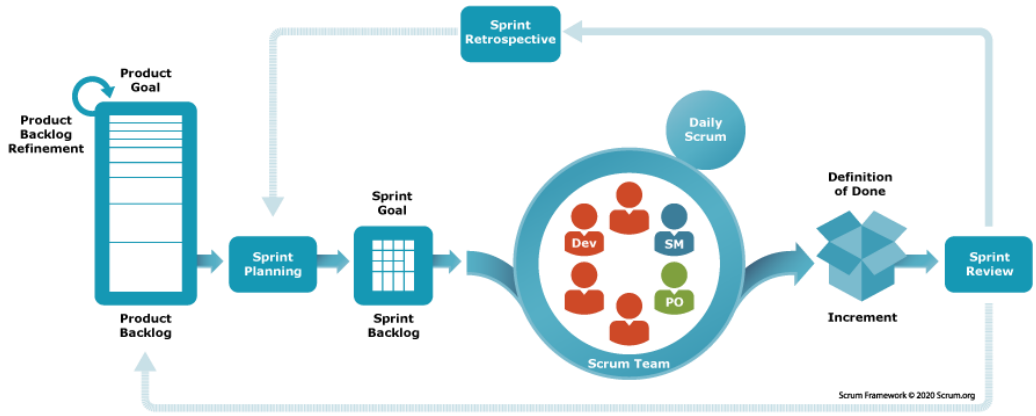

Figure 1. 2 Scrum Framework

Source: (Schwaber & Sutherland, 2020)

The Scrum framework is quite straightforward, consisting of a Scrum Team with a Product Owner, a Scrum Master, and developers, each with distinct responsibilities, see **Figure 1. 2**. The Scrum Team creates three objects and participates in five activities. The Scrum Guide, written and updated by Scrum co-creators K. Schwaber & J. Sutherland (n.d.), provides a concise and straightforward explanation of Scrum. The definition of Scrum, together with information on its

events, artifacts, and the guiding principles that unite them, are all included in the guide.

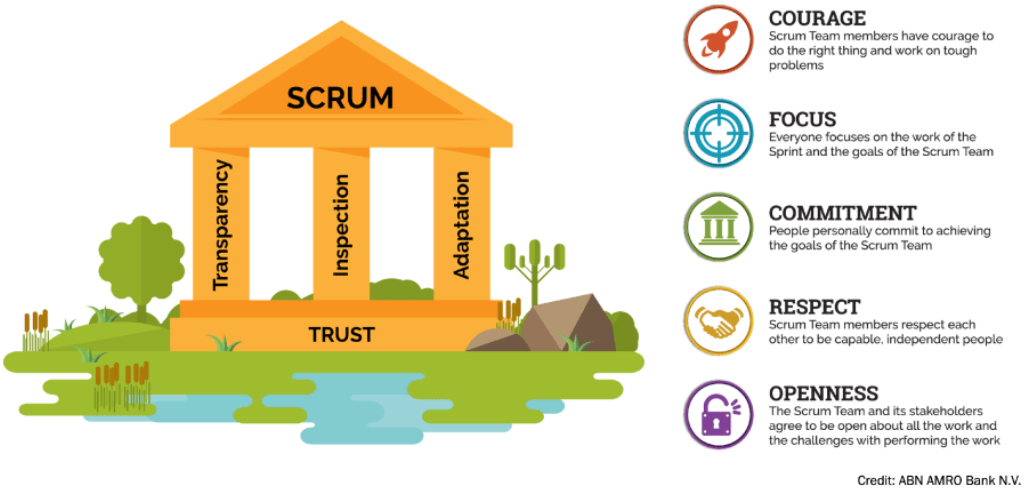

Figure 1. 3 Scrum Pillars

Source: (Schwaber & Sutherland, 2020)

Scrum is an empirical method where choices are made by trial and error, experience, and observation. The three pillars of Scrum are inspection, adaptation, and transparency – see **Figure 1. 3**. This lends credence to the idea of operating in cycles. Consider Empiricism as doing small-scale experiments, gaining knowledge from the results, and modifying your methods and actions as necessary.

To ensure that the transition to Scrum is successful, the Comex team will assess implementation effectiveness using well-established Scrum principles. In particular, the **six principles of Scrum** from the Scrum Body of Knowledge (SBOK) guide will serve as evaluation. These principles are: empirical process control, self-organization, collaboration, value-based prioritization, time-boxing, and iterative development. Collectively, they form the foundation of good Scrum

practice. For example, empirical process control – principle 1 – stresses transparency, inspection, and adaptation – which means the team will measure how well Sicomex and daily standups promote visibility and quick adjustments. Self-organization – principle 2 – implies that the team autonomously defines work plans; this will be evaluated by observing if team members are actively engaging in sprint planning and task assignment. Collaboration – principle 3 – will be assessed by the degree of cross-functional teamwork during sprints. Value-based prioritization – principle 4 – ensures the backlog is ordered by business value, which should translate to higher stakeholder satisfaction for Comex's services. Time-boxing – principle 5 – and iterative development – principle 6 – focus on delivering increments within fixed sprint cycles; project metrics like sprint velocity and on-time completion of sprint goals will be tracked. By aligning Scrum usage with these principles, the department can gauge whether the adoption meets its intended agile standards.

1.5.3 Technical, Organizational, and Environmental (TOE) Framework

Technical, Organizational, and Environmental (TOE) framework is basically a framework which developed by Bosch-Rekveldt et al. (2011). It is a framework that is used to define project complexity in large engineering projects, including the mining projects. This project complexity elements are consisted of 50 elements, which then be divided into main 3 aspects which later be called as TOE framework, just like what have been shown on **Table 1.** ***1***.

Table 1. 1 Technical, Organizational, and Environmental (TOE) Aspects of Project Complexities

Source: (Bosch-Rekveldt et al., 2011)

Technical Aspects (T)	Organizational Aspects (O)	Environmental Aspects (E)
Goals	Size	Risks
Scope	Resources	Stakeholders
Risks	Risk	Location
Tasks	Project Team	Market Conditions
Experience	Trust	

The broad TOE framework with its three levels (categories, subcategories, and elements) provides the chance to debate with the many parties and stakeholders engaged in a project on different levels of aggregation which factors, in their own opinions, make the particular project complicated. The framework can also be extended for usage in other sectors thanks to the existing configuration. Below are the details about each subcategory, defined in Table 1. 2:

Table 1. 2 Definitions of the Sub-categories in TOE Framework

Sub-category	Definition
Goals (Technical Aspect)	All goals need to be specified and clear enough to be understood by the project team
Scope (Technical Aspect)	The quality requirements regarding the project deliverables that later will define the project scope

Risks (Technical Aspect)	The technical risks (number, probability, and/or impact) of them towards the project
Tasks (Technical Aspect)	A variety of tasks that specifically divide each job description of the whole project members
Experience (Technical Aspect)	Whether the involved parties or members have already experienced with new technology or any related things or not
Size (Organizational Aspect)	The site number of site locations that are involved in the project (including the contractor sites)
Risk (Organizational Aspect)	The number of risks that might be arisen in terms of organizational/management issues
Project Team (Organizational Aspect)	How the background diversities that are in the project team and how they are communicating if coming from different nationalities
Trust (Organizational Aspect)	How the entire project team can trust one another
Risks (Environmental Aspect)	The number of risks and probabilities regarding the environmental concerns
Stakeholders (Environmental Aspect)	Whether the political situation can impact the project and how internal management support is given for the project
Location (Environmental Aspect)	How remote is the location and whether the weather or extreme conditions can affect the project progress or not
Market Condition (Environmental Aspect)	The level of competition and stability of the market

Source: (Bosch-Rekveldt et al., 2011)

At this point, nevertheless, the framework's main goals are to improve knowledge of project complexity and obtain a footprint of the project's complexity. This framework makes it possible to identify the regions of complexity in a given project, regardless of the absolute ratings assigned to the various aspects.

Understanding these areas of complexity, consideration may be given to the management of these

1.6 Previous Researches

Table 1. 3 Previous Researches

No	Research Title/Authors	Variables	Result	Difference
1	Adapting the scrum framework for agile project management in science: case study of a distributed research initiative (Hidalgo, 2019)	- Scrum framework - Collaborative interdisciplinary projects - Management and coordination of tasks	Agile methodologies and ideas must be integrated with a "learn by doing" mentality and a high degree of flexibility for interdisciplinary cooperation.	The difference is located on the research cites and there is not any Management and coordination of tasks as the dependent variable.
2	Use of Scrum in the rehabilitation of a commercial building in Peru (Ormeño Zender & García de Soto, 2021)	- Scrum framework - Construction sector project	The study's findings demonstrate Scrum's enormous adaptability in the construction industry. The main findings are a shorter construction period that added value for the owner, flexibility in incorporating changes (caused by the client or by the intricate context in which the project is developed), risk	The difference is on the research cites and there is not construction sector project as the dependent variable.

			management in situations with high levels of uncertainty, and overall satisfaction for all parties involved.	
3	Scrum and Agility Beyond IT: Evidences in the Brazilian Mining Industry (Soueid & Cora Martins, 2021)	- Scrum Implementation Practices - Operational Efficiency - Innovation Output	After implementing Scrum, the mining firm saw better team collaboration and communication, closer customer involvement, more effective task prioritization, and even generation of new product ideas. The use of Sprint retrospectives as a continuous improvement practice further boosted efficiency. In conclusion, applying Agile Manifesto values and Scrum tools in this non-IT context led to notable gains in operational efficiency and innovation for the mining company.	The difference is on the research site and there is not innovation output as dependent variable.
4	The Role of Agile Project Management Methodologies in Increasing Project Success	- Agile/Scrum Project Management practices - Project Success Rates	A survey of 104 mine project managers revealed that adopting Agile methods enables	The difference is on the research site and there are not project

	Rates of a Mine in South Africa (Alphios Malekana & Chakauya, 2024)	- Cross-functional Collaboration	strategy execution and improves the mine's ability to handle uncertainty, while fostering continuous innovation and team adaptability. Key Scrum-related practices were found to enhance team management, cross-functional teamwork, customer collaboration, and product testing in the mining projects. The mine's result showed greater efficiency and effectiveness (e.g. higher value delivery, better staff engagement, lower costs) with Agile/Scrum, indicating that these methodologies can be a competitive differentiator in the mining sector's volatile environment.	success rates and cross-functional collaboratio n the variables.
5	Effect of Agile Project Management on Performance of Mining Projects in Rwanda: A	- Agile Project Management Practices - Project Performance Metrics	Statistical analysis (regression and correlation) revealed that adaptive planning	The difference is on the research site and the

	Case of ITSCI Project (Gatabazi & Kwena, 2025)	- Organizational Flexibility	and stakeholder collaboration have a positive, significant effect on mining project performance. Conclusively, even in mining projects (often seen as rigid), Agile methods were linked to higher productivity and success rates, reinforcing the idea that Scrum's adaptability can be a source of competitive advantage in project execution.	dependent variables.
6	The nexus between success factors and adoption of Agile project management framework: A moderated perceived compatibility paradox from the Omani oil and gas industry (Al Jabri et al., 2024)	- TOE Framework factors - Adoption Success of Agile/Scrum	Focusing on the Omani oil & gas industry, this study uses the TOE framework to analyze factors influencing Scrum/Agile adoption. A survey of industry professionals (analyzed via PLS-SEM) showed the Technological, Organizational, and Environmental Readiness prominently affect willingness to adopt Agile project management.	The difference is on the industry sector and the positions of scrum as the dependent variable instead of independent one.

1.7 Research Model

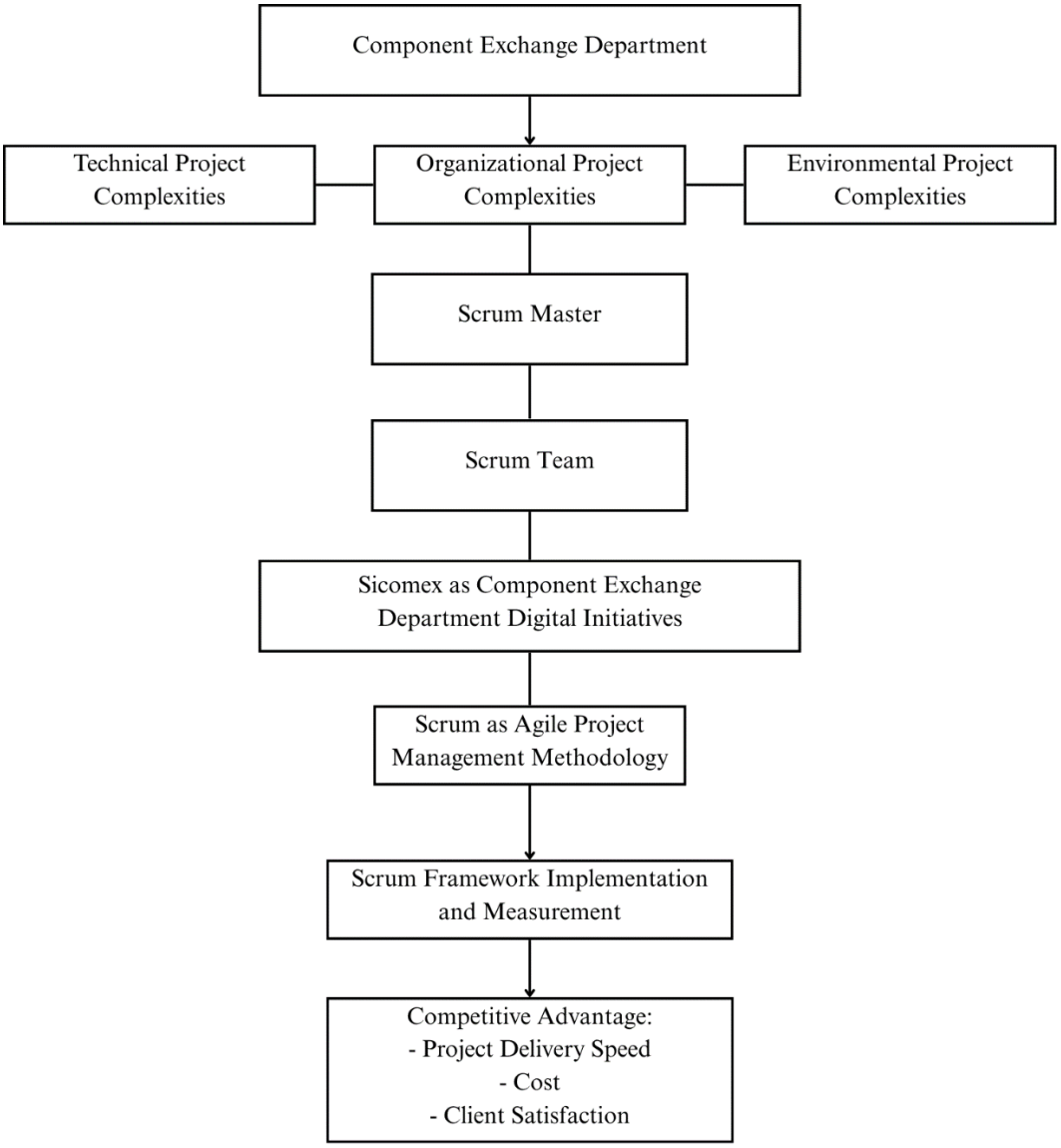

Figure 1. 4 Research Model

As one of the most critical departments existed in PT XYZ Balikpapan, there are several Technical, Organizational, and Environmental project complexities faced by the Component Exchange (Comex) department in ensuring that its daily business process – which is the overhauling activity – goes well. To be able to deal with all three aspects of complexity, it takes a scrum master, and the members of

the entire scrum team, to be able to overcome them. The procurement of technology such as Sicomex is also urgently needed, as a means of digital acceleration in helping the smooth updating of overhauling progress – which is the main function line of the Comex Department. The use of scrum as agile project management is required to ensure that the scrum team can handle unexpected changes that can occur quickly and precisely. Later, how Comex implements scrum will then be measured – both from the process and the output produced. The outputs obtained can help PT XYZ Balikpapan to remain competitive with its competitors – measured through project delivery speed, cost, and client satisfaction.

1.8 Conceptual Definition

1.8.1 Competitive Advantage

Michael E. Porter (1985) mentioned that competitive advantage is fundamentally divided into two, lower cost and differentiation, which then be defined into 4 sections (Cost Leadership, Cost Focus, Differentiation, and Focused Differentiation). One way to define competitive advantage is a company's approach to sustaining above-average performance.

1.9 Operationalization of the Concept

The operationalization of the concept aims to identify criteria that can be studied so that in the research process there are clear limitations in measurement. This study will measure the competitive advantage that can be achieved by PT XYZ, referring to the Theory of Competitive Advantage (Michael E. Porter, 1985). Later, the measurement of whether PT XYZ has achieved competitive advantages

or not will be assessed from 3 scopes – Project speed delivery, cost, and customer satisfaction.

The successful criteria also comprehend about how PT XYZ could manage to handle the 3 project complexities aspects – Technical, Organizational, and Environmental (TOE) – it faces. The operational definition and measurement of TOE framework in this research can be explained as mentioned on the Table 1.4 below

Table 1. 4 Explanation for the Sub-orders of TOE Framework

TOE	Sub-ordering	Explanation
T	Goals	Are the project goals clear amongst the project team?
T	Scope	Are there firm quality requirements related to project deliverables?
T	Tasks	Does the project have various tasks? (for instance, numerous types of tasks)?
T	Tasks	Are there any uncertainties in technical procedure to be implemented?
T	Experience	Does the project make use of new technology, e.g non-proven technology?
T	Risk	Do you consider the project being high risk (number, probability and/or impact of) in terms of technical risks?
O	Size	How many locations of sites are involved in the project?
O	Resources	Are the resources (employees and materials), and skills which become mandatory in the project available?
O	Project Team	How many different languages were used in the project for work- or work-related communication?
O	Trust	Do you trust the project team members (including partner if applicable)?
O	Risk	Do you consider the project being high risk (number, probability and/or impact of) in terms of organizational risks?
E	Stakeholders	Does the political condition impact the project?
E	Stakeholders	Is there any form of internal support (management support) for the project?

E	Location	Do you expect unstable and/or extreme weather conditions; could they potentially influence the project progress
E	Market Conditions	How is the tightness level of competition related to the market condition in the industry?
E	Risks	Do you consider the project being high risk (number, probability and/or impact of) in terms of risk from the environment?

Source: (Bosch-Rekveldt et al., 2011)

Aside from that, below is the itemized steps of the whole Scrum process, in order to identify whether PT XYZ has performed the overall Scrum process framework or not Schwaber & Sutherland (2020). These are the scrum events that should be applied by PT XYZ in order to help them managing their projects, which eventually attains them the competitive advantage. The steps then are divided into:

1. Sprint. Sprints are the main aspect of Scrum, where ideas are later then turned into value. They are fixed-length work stages of one month or fewer that allow for consistency and brief feedback iterations in order to analyze and change both how work is done and what is worked on. All the work essential to accomplish the Product Goal, including Sprint Planning, Daily Scrums, Sprint Review, and Sprint Retrospective, occur within Sprints.
2. Sprint Planning. Sprint Planning is when the Scrum Team decides what they want to accomplish throughout the Sprint. They make this explicit by producing a Sprint Backlog containing the Sprint Goal, the selected Product Backlog Items, and the Developers' plan for delivering the task.
3. Daily Scrum. It is a phase where the Scrum Team's Developers attend a 15-minute session. To reduce complexity, it is held at the same time and location on each working day of the Sprint. If the Product Owner or Scrum

Master is actively working on items from the Sprint Backlog, they are considered Developers.

4. Sprint Review. The objective of the Sprint Review is to examine the result of the Sprint and establish future adjustments. The Scrum Team presents the outcomes of their work to key stakeholders and progress toward the Product Goal is reviewed.
5. Sprint Retrospective. The Sprint Retrospective is intended to plan strategies for improving quality and effectiveness. The Scrum Team evaluates how the previous Sprint went in terms of persons, interactions, processes, tools, and Definition of Done. Inspected elements frequently vary depending on the field of work. Assumptions that led them wrong are recognized and their causes investigated. The Scrum Team reviews what went well throughout the Sprint, what difficulties arose, and how they were (or were not) resolved.

1.10 Research Methodology

1.10.1 Research Type

The type of research used in this research is qualitative research. Qualitative Research is studying the nature of phenomena—that is, their qualities, various expressions, the environment in which they arise, or the viewpoints from which they can be viewed—but not their scope, regularity, or position along an objectively established causal chain. The primary objective of the data collecting, which is typically done in narrative form, is to find insights that can lead to testable hypotheses (Ugwu & Val, 2023). The phenomena that will be observed in this

research is about the implementation of Scrum Framework as Agile Project Management methodology to gain competitive advantages in the point of view of handling Technical, Organizational, and Environmental project aspects, by having PT XYZ as the subject.

1.10.2 Research Sites

As what have been mentioned earlier, this research takes PT XYZ as the research sites. Researcher chooses PT XYZ because as a big mining industrial company, PT XYZ needs to continually update their project methodologies in order to keep serving their clients perfectly, while maintaining their presence in the market. As a matter of that, the implementation of Scrum Framework is an interesting concern to be analyzed for a company who has its business focus on mining and has to sustainably performs a good project outcome.

1.10.3 Key Informants

The research subject involved in this research is consisted the minimum of 3 pivotal elements that have correlation with handling projects, moreover in the project management in PT PT XYZ INDONESIA, which is:

1. The 1 Scrum Master of the project in PT XYZ's Balikpapan site
2. 1 Department head of PT XYZ's Balikpapan site
3. 1 Management Development (MD) officer in PT XYZ's Balikpapan site
4. 1 Project member in Component Exchange Department PT XYZ's Balikpapan site

5. 1 PT XYZ's Corporate Planning and Management Development (CPMD) division members

Table 1. 5 Key Informants and List of Questions to be Asked

Key Informant	Question
Scrum Master	During the Scrum implementation, do you get involved in all the scrum artifacts that was applied by the scrum team?
	How would the process of forming sprint be implemented in the project?
	In term of communication, how has scrum contributed to the communication skill improvement of the project team?
	From your perspective, does using Scrum help the team deliver work faster or more efficiently? Why or why not?
	What are the considerations or parameters that you chose to create the fixed plan to decide the threshold for Comex Department?
	How significant the changes are, before and after using the Sicomex software, to update the activities progress?
	According to your opinion, what has been the most challenging things in implementing scrum, as to keep consistently applying it as well?
	What are the main factors that make you feel convenient and suitable to use scrum as the project management methodology in the Sicomex project?
	Can you please specify the exact goal and what parameters have been used to determine whether the project is successful or not?
	How often do stakeholders outside your team (e.g., clients, regulators, third-party inspectors) request new deliverables or revisions?

	Does your Scrum structure (e.g., review meetings or backlog refinement) help handle these requests?
Department Head	Are there firm quality requirements related to project deliverables?
Management Development Officer	Can you tell me about the decision process behind implementing Scrum in our organization's projects? What were the main drivers that led the company to try an Agile framework like Scrum?
	In other PT XYZ projects, have you observed that Scrum's flexibility with scope (e.g., re-prioritizing features) has helped in meeting time or cost targets better than before?
	Does scrum encourage regular client/stakeholder engagement – has that led to delivering what the client wants more accurately?
	Can you give an example – perhaps a sprint where not everything was completed – and explain how the team addressed the unfinished work (e.g., moved it to the next sprint, swarmed to get it done, identified the cause in retro)? How does the Scrum Master or Project Manager support the team when delays occur?
	What have been the biggest challenges in implementing Scrum at PT XYZ?
Project Members	Is there any form of internal support (management support) for the project?
CPMD Division Member	Could you please elaborate technical project complexities that in most cases, become the bottlenecks throughout the remanufacturing process that is conducted by the Comex Department?
	Does Scrum necessitate changes in your organizational structure or culture? For instance, scrum may promote self-organizing teams and transparency, has it been noticed that teams taking more ownership or

	communicating more effectively across departments because of scrum?
	Is the condition where stakeholders involved often have different points of view? So that the complexity of this project is also higher?
	Have you observed any change in project delivery speed or timelines since Scrum was introduced? Do projects tend to finish faster, or certain phases complete more quickly?
	Does breaking work into sprints and focusing on incremental delivery help reduce procrastination or waiting times in projects?
Project Members	Is there any form of internal support (management support) for the project?
All Key Informants	Do you trust the project team members (including partner if applicable)?

1.10.4 Type of Data

a) Text

Text is all the data that will be gained through written sources like documents, books, scientific articles, company archives, personal documents, and also official documents.

1.10.5 Data Source

a) Primary data

Primary data are those that are based on first-hand knowledge that researchers have about relevant factors for the particular objectives of the study. Here in this study, the primary data that will be needed by the researcher is how the implementation of scrum framework as agile project

management methodology in PT XYZ can give it competitive advantage over its competitors in 2024.

Primary data is gained by conducting the interview and writing down the words and notes resulted from the interview. Researcher will need to carry out the interview directly with the project manager, management development officer, and project members of PT XYZ's mining project.

b) Secondary data

Secondary data is all the data that can be gained through written documents like books, scientific articles, archives, personal documents and also official documents.

1.10.6 Data Collection Technique

a) Observation

Observation is one kind of qualitative research approach that includes ethnography and field research in addition to participant observation. Several study locations are included in the observational research design (Jamshed, 2014). Observation can be classified into three types, namely participant observation, overt & covert observation and unstructured observation (Sugiyono, 2015).

In carrying out this research, researcher will involve in the project that is owned by PT XYZ for about 30 days, which includes observing the scrum process directly in the field. In practice, the participation performed is passive because the researcher comes to the research location but is not directly involved in the activities.

b) In-depth Interview

A qualitative interview is a kind of framework where standards and practices are not just documented but also attained, tested, and strengthened (A. Oakley, 1998). There are certain types of interviews, they are unstructured interview, semi-structured interview, and in-depth interview (J. Mason, 1994).

In order to gather the exact reality, researchers conducted in-depth interviews with research subjects. Therefore, in order to collect data that is accurate and supported by science, researchers must gather the data directly from the research subjects.

1.10.7 Data Analysis and Interpretation

In qualitative data analysis, the process must be carried out interactively and continually until it is finished in order for the data to be saturated (Sugiyono, 2015). In order to ensure that the research is conducted as effective as possible, researcher will be performing certain data analysis which are broken down into:

1. Data reduction. Data reduction is the process of selecting words to revitalize, abstract, and modify "rough" data derived from field notes. Reduction in data collecting involves summarizing study findings concisely and precisely and drawing key conclusions from field observations (Sugiyono, 2015). In order to reduce or enhance the data collected, data reduction is an essential step.

2. Data Display. Following data reduction or simplification in the preceding step, data display is completed. Ensuring study data from the field easy to read and comprehend is the goal of the data display (Sugiyono, 2015). In qualitative research, narrative language, flowcharts, charts, and brief descriptions are frequently utilized to communicate findings.
3. Conclusion Drawing. The previous conclusions are provisional and could be modified if compelling evidence is discovered while gathering data. Thorough verification of the data collection procedure and the data itself is necessary in order to account for the data when forming conclusions.
4. Program Evaluation and Review Technique (PERT). PERT is a transformation tool for project management by bringing a statistical, event-oriented network approach to planning and managing intricate, uncertain projects (Sulivan, 1978).