



## Proposed Project Management Maturity: A Study Case of Incinerator Project Delivery in Indonesia

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**ABSTRACT:** An Indonesian waste treatment plant manufacturer company experienced several issues related to delivery project of the product Incinerator. The issues occurred mainly resulted in the project delay and cost overruns, which potentially impacted negatively to the project success. A company performance of running project can be measured in the form of Project Management Maturity analysis, it is can be interpreted as an organization's capability to manage projects successfully utilizing a standardized practice that has been improved and enhanced through time. The objectives of this research are to identify the root causes of the business issue, assessing the project management maturity of the company, formulate the proposed solutions, and developing the implementation plan.

The assessment of the maturity level is done based on the PMBOK project management knowledge area that relevant to the business issue, namely Project Risk Management, Project Schedule Management, Project Resource Management, and Project Communications Management. The data analysis of this research involves gap analysis and root cause analysis. An analysis that related to the gaps between the existing condition and the next maturity level is conducted to identify the areas of improvement the company need to address. Furthermore, the root cause analysis is conducted to determine the root causes of the business issues.

The result of the data analysis is then utilized to formulate the proposed solution for improvement and the implementation plan. The proposed solutions in this research are to develop a proper risk management practices and documentation, implement scope management, development of project scheduling, and improvement of project team management regarding the development of resource management and communications management.

**KEYWORDS:** Project Management, Project Management Maturity, Project Risk Management, Project Schedule Management, Project Resource Management, Project Communications Management

### 1. INTRODUCTION

#### 1.1 Background

In 2021, as the highest contributor to the Gross Domestic Product (GDP) in Indonesia, the manufacturing sector contributed 19.25% or 228.3 billion USD to the GDP [1]. However, despite of the high growth and contribution to GDP, the industry still experiencing a decline in 2020 due to the COVID-19 pandemic [2]. Nevertheless, despite the prevailing global economic challenges, political uncertainties, and the ongoing COVID-19 pandemic, the manufacturing sector in Indonesia has demonstrated remarkable growth, recording a substantial increase of 3.39% in 2021.

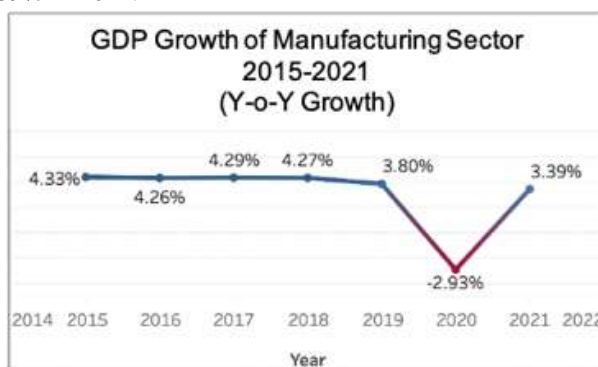


Figure 1. Growth of Manufacturing Sector in Indonesia



This positive growth is further reinforced by the significant rise in investment realizations within the industry, reflecting a high level of confidence in Indonesia as an attractive destination for business activities. Such developments not only contribute to the post-pandemic economic recovery but also serve as a catalyst for strengthening the overall economy of the country. [3]. A manufacturing company in Indonesia with a focus on producing fabricated metal products, machinery, and equipment, especially in waste treatment plant fabrication, is also contributed to the industry's growth. In conducting its manufacturing operations, the company primarily operates on a project basis, fulfilling orders and requests from its customers. A project, as defined in the Project Management Body of Knowledge (PMBOK), is a temporary endeavor undertaken to deliver a unique product or service [4]. The activities related to planning, organizing, and controlling all processes and activities within a project is defined as Project Management. Its primary objective is to ensure the successful completion of the project, despite challenges and risks, in the most effective manner possible [5].

During its course of conducting business, the company encountered several challenges and difficulties that had a significant impact on their project management and overall operations. These challenges led to two critical issues: project delays and cost overruns. The occurrence of project delays was a major concern for the company. Delays in project completion not only hindered the company's ability to deliver products or services to their clients on time but also had cascading effects on subsequent tasks and activities. This disruption in the project schedule had the potential to cause a chain reaction of delays throughout the project, resulting in a domino effect on other aspects of the company's operations. Furthermore, the cost overruns exacerbated the situation. When projects went over budget, it put a strain on the company's financial resources, leading to financial instability.

An organization's capability to manage projects successfully utilizing a standardized practice that has been improved and enhanced over time is referred to as Project Management Maturity. As an organization's level of project management maturity increases, it becomes better equipped to identify areas of improvement that can enhance project performance. This might involve identifying and addressing project risks more effectively, improving the accuracy of project estimates, optimizing resource allocation, or increasing stakeholder engagement. By pinpointing these areas of improvement, organizations can focus their efforts on implementing targeted improvements that are likely to have the greatest impact on project outcomes. This can lead to increased efficiency, improved quality, and better overall project performance, helping organizations to achieve their strategic objectives more effectively [6].

The objectives of this research are to identify the root causes of the business issue occurred, assess the company's project management maturity levels based on the related PMBOK's project knowledge areas, formulate the proposed solutions according to the issues, and developing the implementation plan.

## 1.2 Problem Identification

As a manufacturing company, its main products are waste treatment plants, which include an electrocoagulation machine and an incinerator. These products are responsible for generating a significant portion of the company's annual revenue, contributing approximately 80% of the total revenue. As a result, the company is heavily dependent on the delivery of these products to generate revenue and maintain growth. Any disruptions to the production or delivery of these products could have a significant impact on the company's financial performance. Therefore, it is crucial for the company to ensure that these products are delivered on time and in good working condition to meet the demands of their customers and maintain their market position. Incinerator is a waste treatment plant in a form of furnace for burning solid industrial waste. The steps in the incinerator manufacturing project consist of engineering design and preparation, materials, components and equipments procurement, fabrication, shipping, and installation and commissioning.

In the delivery process of incinerator, the company encountered several problems that negatively affected the project performance namely cost overruns and delay in the project completion. Several issues have affected the project. Firstly, the drafter team's practice of forwarding design specifications without proper revisions resulted in discrepancies and an improper engineering design during fabrication. This caused the procurement team to repeatedly repurchase materials and delayed the project progress.

Additionally, delays in down-payment settlements by customers created cash flow constraints and further contributed to procurement and fabrication delays. The purchasing inaccuracies also led to excessive material purchases, resulting in depreciation costs and increased financial burden for the company. Another issue was the mismanagement of the electrical team's assignment, where they were not given tasks during the initial phases despite being contracted for the entire project duration. This inefficiency directly impacted variable costs, particularly the salaries of idle employees who were paid without contributing to the project. These

inefficiencies have financial implications for the company, including additional expenses from paying salaries to idle workers, challenges in the installation process due to permit issues, increased costs for extended stays at the installation site, and a lack of compensation from the customer. These factors negatively affected the project's budget, caused delays, and put a burden on the company's finances, moreover, potentially disrupting the company's growth and reputation in the future.

## 2. THEORITICAL FOUNDATION

### 2.1 Project Management

Project management is defined as the implementation of knowledge, tools, skills, and techniques to project activities in order to meet project requirements. It is fulfilled through the appropriate application and integration of the project management processes identified for the project [7]. According to [5], project management is the activity that involves planning, organizing and controlling all process and activity in a project, it is undertaken so that the project is finished as successfully as possible in spite of all difficulties and risks. From the definitions above it can be concluded that the utilization of resources such as knowledge, tools, skills, and techniques within the processes in a project would decide the project success and failure, the outcome and also how it benefits the stakeholders. The success of a project is usually related to how well the project achieved three primary objectives, namely it is accomplished within the approved budget, specified duration, and is accomplished with a good performance, which requires the project to satisfies its requirements and specifications to deliver the specified benefits [5].

Project Management Institute (PMI) identifies the series of knowledge that generally recognized as excellent project management practices through its book Project Management Body of Knowledge (PMBOK). The term generally recognized means that the practices and knowledge provided are relevant to most projects most of the time, and there is consensus about their relevance and applicability. Meanwhile, the term excellent practice is related to to the application of knowledge, skills, tools, and methods to project management procedures can increase the likelihood of success throughout multiple projects in providing the anticipated business values and outcomes, according to good practice [7].

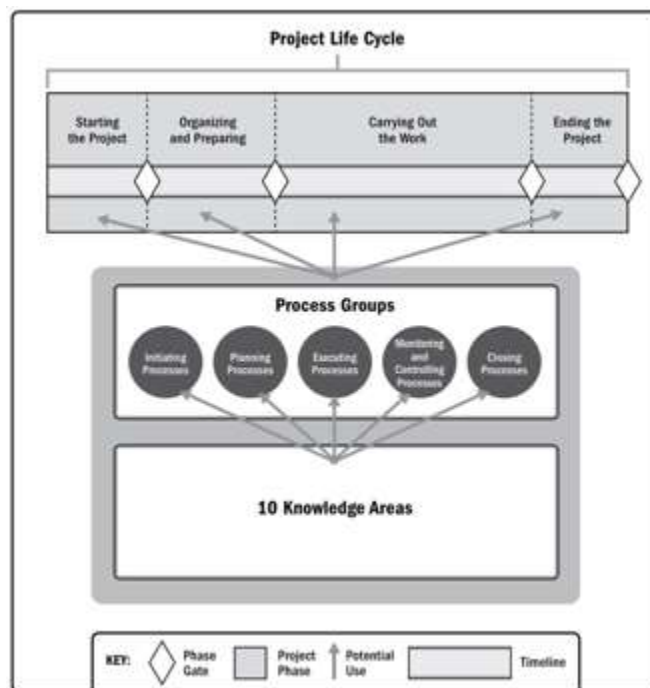


Figure 2. Components of a Project

Figure 2 above is an overview of the components that compose a project proposed in PMBOK. It states that A project in its life cycle, consists of several big project steps namely project start, organization and preparation, project work, and the ending, The



process within the steps is defined into five process groups, namely initiating process group, planning process group, executing process group, monitoring and controlling process group, and closing process group. In managing the work of process groups, there are areas or fields of specializations that generally utilized, which are defined into 10 project knowledge areas [7].

## 2.2 Project Life Cycle

Managing a project involves overseeing a series of activities to achieve project objectives. The project life cycle encompasses all activities from project initiation to conclusion and consists of multiple phases. This framework guides project management, ensuring timely delivery within budget and meeting quality standards. Each phase includes interrelated activities leading to deliverables crucial for project success. These deliverables serve as inputs for subsequent phases. The project life cycle is influenced by organizational factors, industry plans, and technological tools, impacting objectives, timelines, and resource allocation. Regardless of project specifics, the life cycle provides a fundamental structure for effective project management, ensuring timely, budgeted, and quality delivery. Regardless of the varying of a project's size and levels of complexity, a typical project can be composed by the activity of Starting the Project, Organizing and Preparing, Carrying Out the Work, and Ending the Project [7].

## 2.3 Project Management Process Groups

A Project Management Process Group refers to a collection of project management processes that are grouped together with the purpose of achieving particular project objectives. These groups are not tied to any specific project phase. The five Project Management Process Groups proposed by PMBOK are the following:

- A. **Initiating Process Group.** Encompasses activities aimed at initiating a new project or phase by obtaining the required authorization to proceed. Its objective is to align the project's purpose with stakeholders' expectations. This involves communicating the project's scope and objectives to stakeholders and discussing their involvement in achieving their expectations.
- B. **Planning Process Group.** Comprises activities to determine the project's scope, set objectives, and create a comprehensive plan for achieving those objectives. These processes involve developing project management plans and other relevant project documents. The iterative process of progressive elaboration allows for adjustments to the project plan as new information becomes available. The main objective of this Process Group is to establish a clear roadmap for successfully completing the project or phase.
- C. **Executing Process Group.** The work outlined in the project management plan to meet the project's requirements. This group involves managing resources and stakeholders, as well as performing project activities in accordance with the management plan. It ensures that the work essentials to achieve project objectives is completed as intended. The Executing Process Group requires a significant portion of the project's budget, resources, and time.
- D. **Monitoring and Controlling Process Group.** Consists of the processes necessary for monitoring, evaluating, and adjusting the project's progress and performance to detect areas where changes to the plan may be necessary. Monitoring is the process of collecting project performance data, creating performance metrics, and sharing performance information with stakeholders. Controlling involves comparing actual performance to planned performance, analyzing variances, identifying trends to improve processes, assessing alternative options, and recommending appropriate corrective action as required. The primary benefit of this process group is that it ensures that the project's performance is regularly measured and analyzed to identify and correct any deviations from the project management plan at regular intervals, significant events, or when there are exceptions.
- E. **Closing Process Group.** Composed of the processes used to formally finish or conclude a project, phase, or contract. This process group ensures that all the defined processes from other process groups are completed, and that the project or phase is officially completed. The main advantage of this process group is that it guarantees that phases, projects, and contracts are properly closed out.

## 2.4 Project Management Knowledge Areas

The Project Management Knowledge Areas represent different domains or areas of expertise that are typically utilized in project management. Each Knowledge Area comprises a collection of processes that pertain to a specific aspect of project management. These Knowledge Areas provide a comprehensive framework for managing projects effectively and are applicable to the majority



of projects across various industries. There are ten knowledge area stated in PMBOK, namely Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, and Project Stakeholder Management [7]. Each knowledge area consists of several components, that can belong to different process groups. The components of the project management knowledge areas and the mapping with project management process groups are illustrated in Table 1 below.

**Table 1.** Project Management Process Group and Knowledge Area Mapping

Knowledge Areas	Project Management Process Group				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
<b>Project Integration Management</b>	- Develop Project Charter	- Develop Project Management Plan	- Direct and Manage Project Work - Manage Project Knowledge	- Monitor and Control Project Work - Perform Integrated Change Control	- Close Project or Phase
<b>Project Scope Management</b>		- Plan Scope Management - Collect Requirements - Define Scope - Create WBS		- Validate Scope - Control Scope	
<b>Project Schedule Management</b>		- Plan Schedule Management - Define Activities - Sequence Activities - Estimate Activity Durations - Develop Schedule		- Control Schedule	
<b>Project Cost Management</b>		- Plan Cost Management - Estimate Costs - Determine Budget		- Control Costs	
<b>Project Quality Management</b>		- Plan Quality Management	- Manage Quality	- Control Quality	
<b>Project Resource Management</b>		- Plan Resource Management - Estimate Activity Resources	- Acquire Resources - Develop Team - Manage Team	- Control Resources	
<b>Project Communications Management</b>		- Plan Communications Management	- Manage Communications	- Monitor Communications	



<b>Project Risk Management</b>		<ul style="list-style-type: none"> <li>- Plan Risk Management</li> <li>- Identify Risks</li> <li>- Perform Qualitative Risk Analysis</li> <li>- Perform Quantitative Risk Analysis</li> <li>- Plan Risk Responses</li> </ul>	- Implement Risk Responses	- Monitor Risks	
<b>Project Procurement Management</b>		- Plan Procurement Management	- Conduct Procurements	- Control Procurements	
<b>Project Stakeholder Management</b>	- Identify Stakeholders	- Plan Stakeholder Engagement	- Manage Stakeholder Engagement	- Monitor Stakeholder Engagement	

**2.5 Project Management Maturity Model**

Project Management Maturity refers to an organization's ability to manage projects effectively using standardized practices. As maturity increases, organizations can identify areas for improvement, such as risk identification, project estimate accuracy, resource allocation optimization, and stakeholder engagement. This enables targeted improvements to impact project outcomes, leading to increased efficiency, quality, and overall performance, ultimately achieving strategic objectives [6]. By assessing an organization's maturity level, it becomes easier to identify areas of weakness and focus on improving them, which can help to overcome the challenges and improve infrastructure effectively [8]. The method used in this research regarding to the maturity assessment of the project management is Project Management Maturity Model (PMMM) by PM Solutions Research [8]. This model assesses a company's level of project management maturity based on the implementation of practices and methodologies within the ten knowledge areas defined in the Project Management Body of Knowledge (PMBOK) and the maturity level characteristics proposed by PM Solutions Research. The following is the maturity levels:

- **Level 1: The Initial Process.** All businesses and projects start at level 1, either the practices are not qualified for level 2 or there was no formal maturity assessment in place. Level 1 organizations generally involve reaction-driven and ad-hoc decision-making process and project management practices, and there are no standardized method or process present. Awareness of project management is also present but not officially a standard.
- **Level 2: Structured Process and Standards.** The management on the level 2 organizations usually recognize the importance, supports, and encourages the use of project management practices. Basic project management processes and methodologies are being piloted, developed and utilized but only a standard for larger projects, while the smaller ones remain on the ad-hoc and informal processes. The cost, schedule, and technical performance of a project are all be tracked and measured using some fundamental metrics, though data collection and correlation can be done manually. The documentation of information of a project is frequently a combination of detailed and summary-level informations.
- **Level 3: Organizational Standards and Institutionalized Process.** The business is implementing project management processes, institutionalized as the standard of the company, and repeatable to use for all of the projects, applying a more formalized documentation. The process of project management is generally automated, utilizing software and tools related to the processes.
- **Level 4: Managed Process.** The focus of the organization at level 4 is to manage and enhance the processes and methodologies aiming for their continuous improvements. A consistent qualitative and quantitative benchmarking of



project management is also present, the benchmarking is usually from other company both in the same and different industry. The project processes, challenges, and changes are evaluated based on metrics related to the estimation and calculation of cost, baseline, and earned value of the project.

- **Level 5: Optimized Process.** The improvement and optimization of the project management processes is utilizing the lesson learned from the previous projects, focusing at improving project performance, identify weaknesses, anticipate issues, and enhance the project management processes. Knowledges and lessons learned from a project are consistently distributed to other project and team members.

### 3. CONCEPTUAL FRAMEWORK

This research involves the assessment project management maturity of components of the Project Management Knowledge Areas. The assessed knowledge areas are the ones that related to the company’s business issue, namely Project Risk Management, Project Schedule Management, Project Resource Management, and Project Communications Management. Furthermore, an analysis is conducted to address gaps of improvement areas the company need to overcome in order to advance to the next maturity levels. The conceptual framework of this research is illustrated in Figure.3.

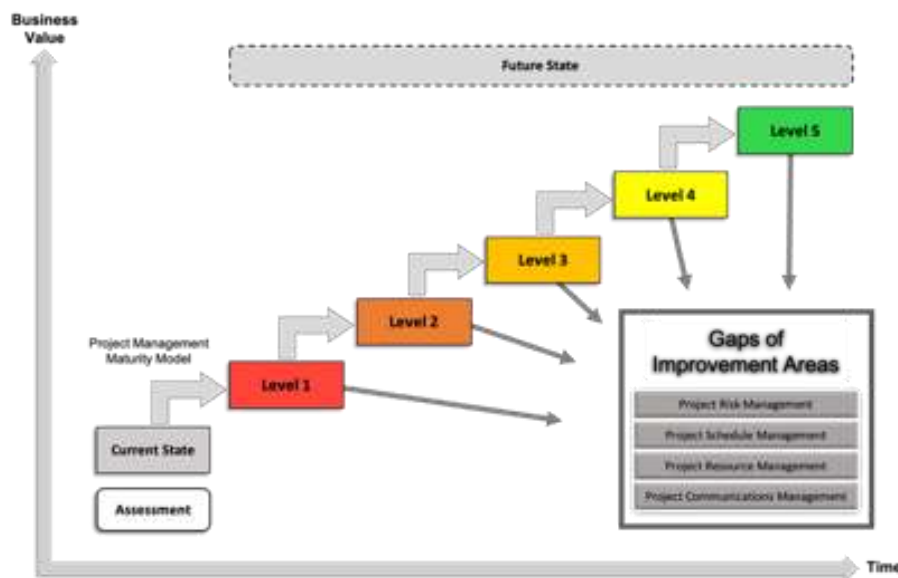


Figure 3. Conceptual Framework

### 4. RESEARCH METHODOLOGY

The proposed methodology for this research aims to determine the maturity level of the company in managing its projects, as well as identifying the root of the problems faced. This research’s design is qualitative research. In qualitative research, narrative data collecting is utilized to investigate a certain issue or phenomenon. Qualitative measures, which incorporate any measure where the data are not recorded in numerical form, are the cornerstone of qualitative research. They start with the presumption that reality is subjective rather than objective and are exploratory and inductive in nature [9]. This research utilizes a semi-structured interview to comprehend both the business issue and the existing condition of Project Management practices. The semi-structured interview involves issuing questions related to the practices, behaviors, and knowledge that the company utilize in its practice of managing projects. The data gathered are then utilized as an input for the data analysis which consists of gap analysis of the project management maturity model and root cause analysis of the business issues, in order to formulate the business solutions and also to draw conclusions and make recommendations.



Figure 4. Research Design

## 5. RESULT AND DISCUSSION

### 5.1 Gap Analysis of Project Management Maturity Level

#### 5.1.1 Project Risk Management

The gap analysis of Project Risk Management covers Plan Risk Management, Identify Risks, Perform Risk Analysis, Plan Risk Responses, Implement Risk Responses, and Monitor Risks, it is depicted in Table 2 and are based on the result of the maturity assessment illustrated in Figure 5.



Figure 5. Project Risk Management Maturity Levels





Table 2. Gap Analysis of Project Risk Management

<i>Components</i>	<i>Maturity Level</i>	<i>Existing Condition</i>	<i>Next Maturity Level</i>	<i>Gaps Between Existing Condition and Next maturity Level</i>
<b>Plan Risk Management</b>	Level 2	Management team recognizes the importance of risk management plan. Planning risk management is not yet a routine, only done situationally. Basic documentation of risk management plan.	Level 3	Planning Risk Management is done routinely before each project. Develop template of a comprehensive risk management plan.
<b>Identify Risks</b>	Level 1	Risk identifications are reactive rather than proactive. The risks are only discussed only on an ad hoc basis, not yet a routine.	Level 2	Develop a proper documentation of risk identification. Risk identification become routine for larger, visible projects.
<b>Perform Risk Analysis</b>	Level 1	The risk analysis does not involve systemic analysis to assess the impacts, probabilities, and the priorities. Primarily based on past experiences and speculations.	Level 2	Enhance the depth and comprehensiveness of the risk analysis. Involve evaluation of impact, probability, and priority using quantitative measures (numerical values) and qualitative measures (low, medium, high).
<b>Plan Risk Responses</b>	Level 4	Risk responses are documented and integrated with other aspects of project management (e.g., cost, schedule, procurement)	Level 5	Establish a process of tracking project reserves involved in responding to risks. Lesson learned and evaluations are captured and used for continuous improvement
<b>Implement Risk Responses</b>	Level 2	Risk responses is well-implemented and documented. Not yet a standard and not yet fully integrated with other project management aspect (i.e., schedule planning and changes)	Level 3	Align risk response to change management of other project management aspects
<b>Monitor Risks</b>	Level 1	Risk reporting is done informally and not routine on weekly project meetings. No documentation regarding the risk progress.	Level 2	Develop a risk register that tracks the status of the risks. Establish a routine risk reporting in weekly meeting.

5.1.2 Project Schedule Management

The gap analysis of project schedule management includes Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Durations, Develop Schedule, and Control Schedule, it is depicted in Table 3 and are based on the result of the maturity assessment shown in Figure 6.



Figure 6. Project Schedule Management Maturity Levels

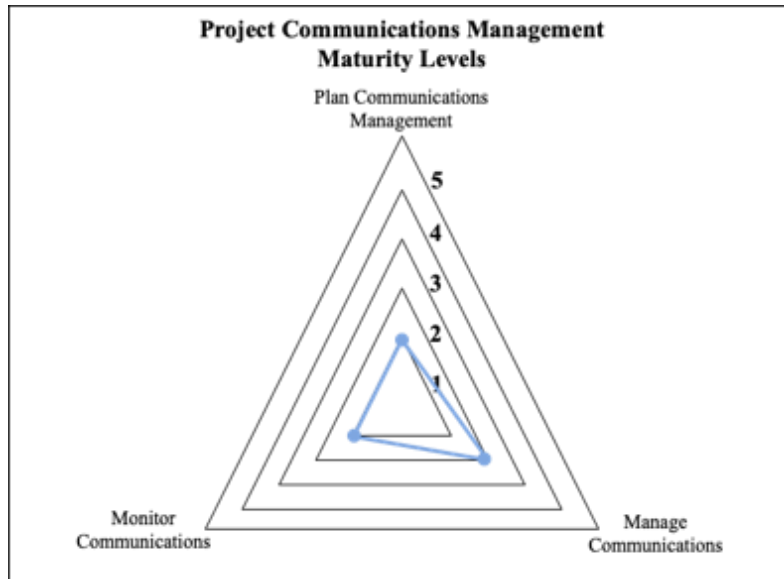
Table 3. Gap Analysis of Project Schedule Management

Components	Maturity Level	Existing Condition	Next Maturity Level	Gaps Between Existing Condition and Next maturity Level
Plan Schedule Management	Level 2	Developed a schedule template for all projects.	Level 3	Integrating scope management in planning project schedule.
Define Activities	Level 1	Activities still defined at a basic and general state.	Level 2	Activity definition is derived from the Scope Statement and aligned with WBS.
Sequence Activities	Level 1	Activity sequencing does not reflect the dependencies between tasks. Only based on past experiences.	Level 2	Developed a basic and documented process for sequencing activities. Utilize a visual representation to illustrate the activity dependencies such as network diagram.
Estimate Activity Durations	Level 2	Calculation of activity duration is relying heavily on expert knowledge and experiences, without a formal tools or technique.	Level 3	Implementing a specific tool and technique for estimating activity durations. Utilizes historical information and external dependent activities.
Develop Schedule	Level 1	A schedule of a specific project is used for making schedule of all other projects, rely on past project experiences.	Level 2	Develop a formalized process with a specific tools and technique for the baseline of developing schedule.
Control Schedule	Level 1	Schedule reporting done on informal and verbal basis in project weekly meetings	Level 2	Develop a more documented and formal approach to schedule control and reporting, involves specific reporting schedule template that outlines relevant information such as schedule baseline, planned status, and actual status.



**5.1.3 Project Communications Management**

The gap analysis of project communications management includes Plan Communications Management, Manage Communications, and Monitor Communications, it is depicted in Table 4 and are based on the result of the maturity assessment shown in Figure 7.



**Figure 7.** Project Communications Management Maturity Levels

**Table 4.** Gap Analysis of Project Communications Management

<i>Components</i>	<i>Maturity Level</i>	<i>Existing Condition</i>	<i>Next Maturity Level</i>	<i>Gaps Between Existing Condition and Next maturity Level</i>
<b>Plan Communications Management</b>	Level 1	Project team reports project status regularly during scheduled meetings	Level 2	Develop communications plan or Standard Operating Prochedure (SOP)
<b>Manage Communications</b>	Level 2	Established an organized approach in collecting project report via a check sheet in hard copy format	Level 3	Develop a formal information retrieval system that allows stakeholders to retrieve information from a specific repository, remotely and in real-time
<b>Monitor Communications</b>	Level 1	Project reports covering only basic project status, while performance and risks is handled on an ad hoc basis	Level 2	Develop a report that covers detailed information of time and costs, integration with cost and schedule management

**5.1.4 Project Resource Management**

The gap analysis of project resource management includes Plan Resource Management, Estimate Activity Duration, Acquire Resources, Develop Team, Manage Team, and Control Resources. It is depicted in Table 5 and are based on the result of the maturity assessment shown in Figure 8.

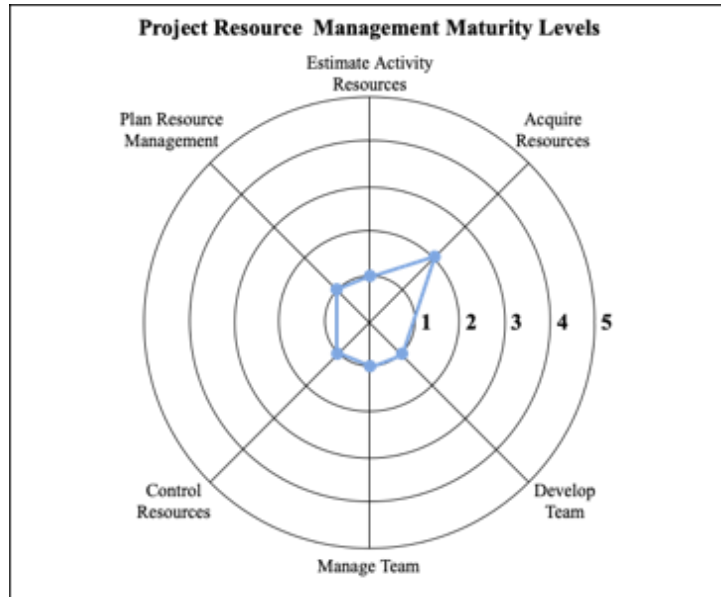


Figure 8. Project Resource Management Maturity Levels

Table 5. Gap Analysis of Project Resource Management

Components	Maturity Level	Existing Condition	Next Maturity Level	Gaps Between Existing Condition and Next maturity Level
Plan Resource Management	Level 1	Plannings are based on informal analysis relying on past experience and knowledge of the management team.	Level 2	Implement a structured approach covering formal analysis and documentation, considering not only quantity of resources, but also procurement time and constraints for physical resources. Also considering required skills, roles, and responsibilities for human resources.
Estimate Activity Resources	Level 1	Resource estimation relies on experience of previous and similar projects. No proper documentation	Level 2	Develop a structured practice that may include leveraging historical data of resources, developing template and method, also integrate with cost estimation, schedule development, and scope management
Acquire Resources	Level 1	Already identified the required skill sets for the project and considering resources availability, hence indicating that the company recognize the significance of aligning the necessary skills and availability of resources with project requirements. But the process is done informally, ad hoc and not organized	Level 2	Develop a staffing management plan that covers the desired parameter or requirement for the team (minimum experience, personal interests and characteristics, and capability to fit into the team working environment).



<b>Develop Team</b>	Level 1	Team member developments still on an ad hoc and reactive nature, no structured and consistent method.	Level 2	Develop a formal career development plan for team members. Providing structured and consistent trainings or workshops.
<b>Manage Team</b>	Level 1	Managing project team are still on informal, and ad hoc or reactive nature. No formal plan or SOP.	Level 2	Implementing structured team management approach, including develop plan or document that clearly defines roles and responsibilities, reporting and communication channels, and team performance expectations.
<b>Control Resources</b>	Level 1	Lack of regular and detailed tracking of resource usage and utilization.	Level 2	Develop plan and method for regular tracking of physical resource costs and usage, as well as monitoring human resource performance

**5.2 Root Cause Analysis**

Root cause analysis is a problem-solving technique that enables organizations to understand the underlying causes of problems and develop effective solutions. The primary goal of root cause analysis is to prevent the problem from recurring. By addressing the root causes, organizations can enhance their processes, prevent recurring issues, and drive continuous improvement. Root cause analysis utilizes various tools and techniques, such as fishbone diagrams (Ishikawa diagrams), fault tree analysis, 5 Whys, cause map, pareto analysis, process flowcharts, and statistical analysis. These tools help visualize the problem, identify potential causes, and facilitate structured analysis. As shown by Figure 9, this research utilizes cause map to analyze the root causes of the occurred issues. The root causes analysis itself are sequenced to each of the corresponding and related project management knowledge areas.



Figure 9. Cause Map



## 5.2.1 Root Causes of Project Risk Management

The problem root causes of the Project Risk Management aspects are an inadequate risk management practices, inadequate project control and monitoring, poor coordination, and inadequate product knowledge. Indicated by the inconsistent risk management, incomprehensive risk identification, and poor assessment.

## 5.2.2 Root Causes of Project Schedule Management

In the aspect of Project Schedule Management, the root cause of the problems faced by the company is inadequate schedule development. Effective schedule management helps identify and address risks that may impact project timelines, allowing proactive mitigation measures to be implemented to prevent delays and disruptions, which the company failed to capture. Proper schedule management minimizes unnecessary costs associated with delays, such as increased labor expenses and penalties, helping to keep the project within budget.

## 5.2.3 Root Causes of Project Communications Management

In this aspect, the problem root causes are poor coordination as well as inadequate project control and monitoring specifically in terms of communications. This may be the result of the company not developed a communication plan or Standard Operating Prochedure (SOP) and a proper communication method. A reliable communication practice and control would ensure that accurate information is shared, misunderstandings are minimized, and the project progresses smoothly towards its completion within the designated timeline.

## 5.2.4 Root Causes of Project Resources Management

An inadequate resource planning, as well as lack of experience and product knowledge are the root causes in the aspect of Project Communications Management. This is mainly resulted from the company's inadequate team management and development. The challenges caused by this issue are, human resource inefficiency due to idle workers, the failure of drafter team in designing product, as well as a technical issue of handling materials that caused material waste.

## 5.3 Proposed Business Solution

In this research, the formulated business solutions aim to solve the occurred business issues and improving the company's performance to be able to reach higher level of project management maturity.

### 5.3.1 Develop Risk Management Method

The first proposed solution for the company is to focus on the development of risk management practices. This is crucial because risk factors play a significant role in project execution, and addressing them effectively is essential for successful project outcomes. By establishing robust risk management practices, the company can identify, assess, and mitigate risks that may impact various aspects of the project. The solution also aims at the enhancement of the company's project management maturity in terms of the knowledge area of Project Risk Management and possibly other knowledge areas as several knowledge area improvements demand an integration with risk management aspect. The solution provided in this research is the development of a basic risk management template that covers the documentation of Risk Identification, Risk Assessment, and Risk Action Plan. By implenting this proposed solution, the company also expected to fulfill the standardization of ISO 31000 regarding risk management.

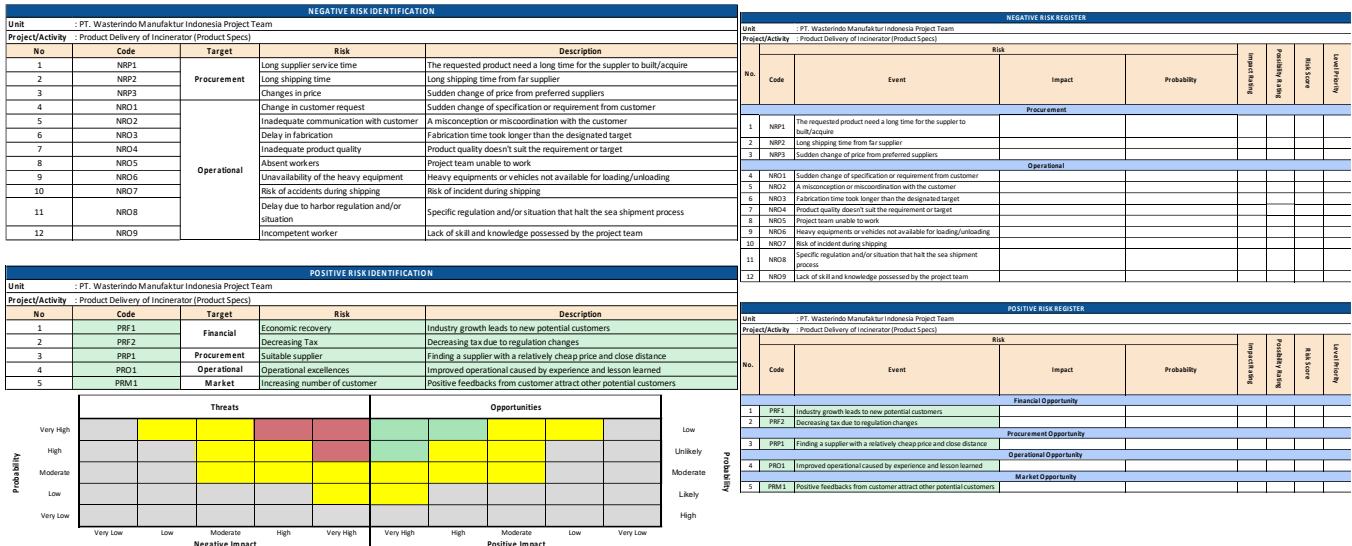


Figure 10. Proposed Template of Risk Identification, Risk Assessment, and Risk Matrix

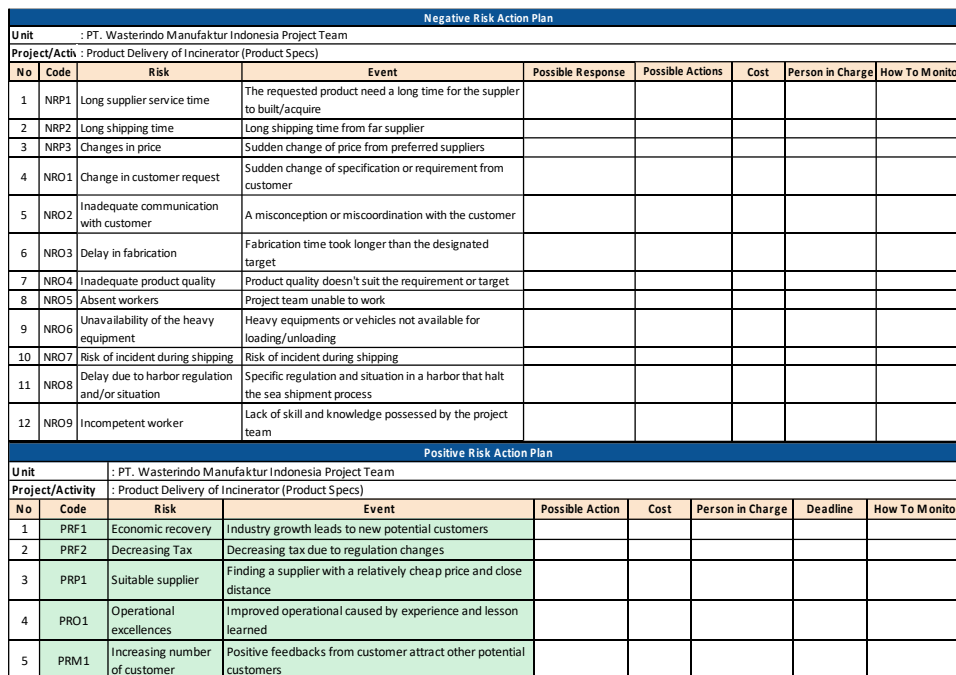


Figure 11. Proposed Risk Action Plan Template

5.3.2 Implement Scope Management

Hence, this research proposes an implementation of scope management to help the company to enhance its project management maturity and answer the business issues, in order to improve its project performance in general. In traditional predictive or waterfall projects, the scope baseline consists of the authorized version of the project scope statement, the work breakdown structure (WBS), and the associated WBS dictionary [7].

The initial step is generating a scope statement template. The project scope statement is a comprehensive document that outlines the project's scope, deliverables, assumptions, and constraints. It covers both the project scope and the product scope, ensuring a shared understanding among stakeholders. It helps with detailed planning, guides project execution, manages stakeholder expectations, and



prevents scope creep. The scope statement serves as a valuable tool for effective project management, promoting clarity, alignment, and evaluation of changes and additional work. It covers the description of product scope that elaborates the characteristics of the product or service, defined deliverables, the acceptance criteria of the project, and the exclusions. The proposed Scope Statement Template is shown in Figure 12.

Project Scope Statement	
Project Name	DELIVERY OF 1 UNIT INCINERATOR 100 KG/H
Project Sponsor	.....
Project Manager	.....
Date of Project Approval	.....
Last Revision Date	.....
Scope Description	- The objective of the project - Project requirements - Product specification
Deliverables	- Contains the product, result, or capability to perform a service that is required to complete a process, phase, or project - May also contains supplementary outcomes, including project management reports and documentation
Acceptance Criteria	Contains a series of conditions that must be fulfilled before the deliverables are accepted
Project Exclusions	Contains the elements or aspects that are not included in the project

Figure 12. Proposed Scope Statement Template

The next key step is the development of The Work Breakdown Structure (WBS). WBS is a hierarchical breakdown of the complete scope of work that needs to be performed by the project team in order to achieve the project objectives and deliver the required outcomes. It serves to organize and define the overall project scope, representing the work outlined in the currently approved project scope statement [10]. The following is the proposed WBS template in this research.



Figure 13. Proposed WBS Template





The WBS plays a crucial role as a communication tool within the project. It visually represents the project's scope, facilitating effective communication and understanding among stakeholders. To help the company in defining and clarifying the detail of the elements of the WBS while also ensuring that each element accurately represents its content, the company can develop and utilize a WBS dictionary. The WBS dictionary is a comprehensive resource that includes information about every element in the Work Breakdown Structure (WBS). It provides detailed descriptions of the work, deliverables, activities, and milestones associated with each element. When creating the WBS dictionary, it is common to discover any ambiguities or errors present in the WBS, leading to necessary revisions and improvements [10]. The proposed WBS dictionary template is shown in Table 6.

**Table 6.** Proposed WBS Dictionary Template

Level	WBS Code	Element Name	Responsible Organization	Description
1	<b>1 Product Delivery of Incinerator</b>			
2	<b>1.1 Initiation</b>			
3	1.1.1	Contract Settlement	Director, Project Manager	
3	1.1.2	Get Requirements	Director, Project Manager	
2	<b>1.2 Execution</b>			
3	1.2.1	Preparation	Project Manager	
4	1.2.1.1	Drawing	Drafter PIC	Mekanikal & Elektrikal
4	1.2.1.2	Control System Programming	IT PIC	
3	1.2.2	Procurement	Procurement PIC	
4	1.2.2.1	Material	Procurement PIC	Refraktori & Steel
4	1.2.2.2	Components	Procurement PIC	Feeding system & ash screw conveyor
4	1.2.2.3	Equipment	Procurement PIC	
3	1.2.3	Fabrication	Project Manager	
4	1.2.3.1	Ruang Bakar 1	PIC 2	
4	1.2.3.2	Ruang Bakar 2	PIC 3	
4	1.2.3.4	Exhaust Stack	PIC 1	
4	1.2.2.5	Cyclone	PIC 4	
4	1.2.2.6	Ventury Scrubber	PIC 2	
4	1.2.2.7	Water Scrubber	PIC 3	
4	1.2.2.8	Main Stack	PIC 2	
4	1.2.2.9	Fuel Supply System	PIC 3	
4	1.2.2.10	Electical & Control System	PIC 4	
3	1.2.4	Shipping & installation	Shipping PIC	
4	1.2.4.1	Shipping Phase 1	Shipping PIC	
4	1.2.4.2	Shipping Phase 2	Shipping PIC	
4	1.2.4.3	Installation	Project Manager	
3	1.2.5	Commissioning	Project Manager	



2	<b>1.3 Controlling</b>			
3	1.3.1	Preparation Control	Project Manager	
4	1.3.1.1	Drawing Control	Drafter PIC	
4	1.3.1.2	Programming Control	IT PIC	
3	1.3.2	Execution Control	Project Manager	
4	1.3.2.1	Procurement Control	Procurement PIC	
4	1.3.2.2	Fabrication Control	Project Manager	
4	1.3.2.3	Shipping Control	Shipping PIC	
4	1.3.2.4	Installation Control	Project Manager	
2	<b>1.4 Closing</b>			
3	1.4.1	Evaluation	Director, Project Manager	
2	<b>5. Project Management</b>			
3	1.5.1	Project Management Knowledge Areas	Director, Operations Manager, HR Manager, Financial Manager, Project Manager	

**5.3.3 Improve Schedule Management**

In the company’s case, the assessment result of project management maturity regarding project schedule management depicts the company’s struggles in solving the issue of project delay. This research proposes a development of project schedule management that aims to enhance the company capability of overcoming the issues and in the long run, the company is expected to continue to develop in order to establish a robust and reliable method schedule management. One of the key improvements is developing a reliable technique for the baseline of schedule planning of a project.

The technique proposed in this research is Critical Path Method (CPM), a network-based approach used to coordinate activities, create schedules, and monitor project progress. It involves constructing a network diagram that represents the sequence of activities and their interdependencies. CPM provides important information about operation parameters such as earliest start and finish (ES and FS) times, latest start and finish (LS and LF) times, maximum available time, and also scheduling flexibility (slack time). By using CPM, project managers can identify the critical path, optimize the project timeline, and make informed decisions. CPM is widely utilized in various industries for efficient project planning and control, ensuring projects are completed within designated timeframes [11]. The initial steps of CPM are defining activities, estimating activity durations, and defining each activity dependency. Furthermore, a project network diagram and the value of ES, LS, EF, LF and the float can be calculated, these components are the input of the critical path definition. The result of the critical path calculation is described on Table 7.

**Table 7.** Critical Path Calculation

CODE	ACTIVITY	PREDECESSOR	DURATION	ES	LS	EF	LF	FLOAT
A	PROJECT INITIATION	-	1	0	0	1	1	0
B	PEMBUATAN SHOP DRAWING	A	4	1	1	5	5	0
C	PEMROGRAMAN SISTEM KONTROL	A	4	1	8	5	12	7
D	PROCUREMENT: MATERIAL	B	4	5	7	9	11	2
E	PROCUREMENT: COMPONENTS	B	4	5	13	9	17	8
F	PROCUREMENT: EQUIPMENT	B	7	5	5	12	12	0



G	FABRICATION: RUANG BAKAR 1	D	6	9	11	15	17	2
H	FABRICATION: RUANG BAKAR 2	D	6	9	11	15	17	2
I	FABRICATION: EXHAUST STACK	D	4	9	13	13	17	4
J	FABRICATION: CYCLONE	D	4	9	13	13	17	4
K	FABRICATION: VENTURI SCRUBBER	I	3	13	14	16	17	1
L	FABRICATION: WATER SCRUBBER	J	3	13	14	16	17	1
M	FABRICATION: MAIN STACK	G	2	15	15	17	17	0
N	FABRICATION: FUEL SUPPLY SYSTEM	H	2	15	15	17	17	0
O	FABRICATION: ELECTRICAL & CONTROL SYSTEM	C,F	5	12	12	17	17	0
P	SHIPPING 1	E,G,H,I,J	1	15	17	16	18	2
Q	SHIPPING 2	K,L,M,N,O	1	17	17	18	18	0
R	INSTALLATION	P,Q	3	18	18	21	21	0
S	COMMISSIONING	R	2	21	21	23	23	0

Based on the critical path calculation, the critical path of Incinerator project is A – B – F – Q – R – S. This means that any delay occurred during those activities will delay the overall completion time of the project. Without any delay, total completion time for the project is 23 weeks. These informations can be utilized by the company as the baseline of schedule development. The diagram of the CPM can be applied into the network diagram, which is illustrated in Figure 11 below.

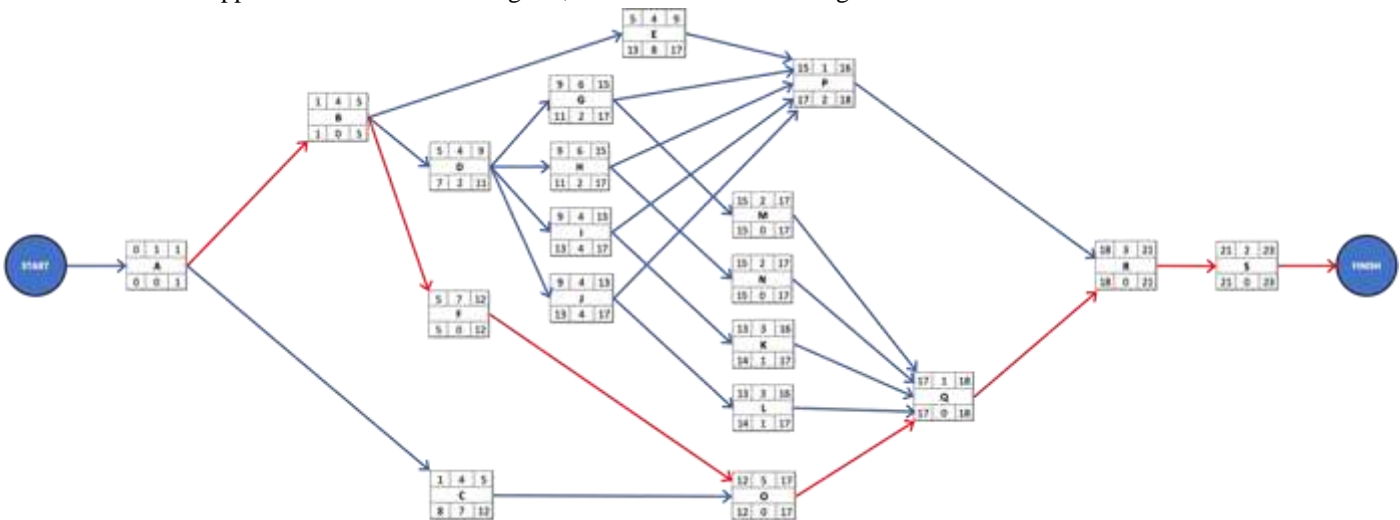


Figure 14. Critical Path of Incinerator Project

The result of critical path method can become a baseline for defining project schedule, the proposed schedule resulted by CPM with the integration with WBS is described in Figure 15 below.

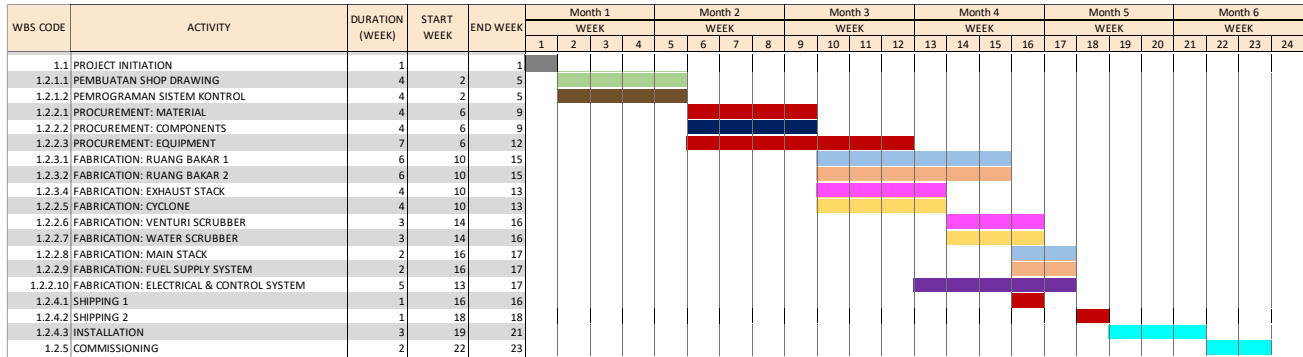


Figure 15. Proposed Schedule and Integration with WBS

As illustrated in Figure 15, the schedule generated through CPM calculations resulted a longer duration compared to the original schedule. The reason for this discrepancy is that the original schedule did not adhere to the CPM rule, which mandates the completion of a predecessor activity before the start of a subsequent activity. This situation can arise when the company acknowledges that a specific predecessor activity does not need to be fully completed for the next activity to commence. The schedule created using CPM can still serve as a reference and justification for the project's activities. It can be used as a baseline to establish timelines and provide a framework for the next project iteration.

5.3.4 Improve Team Management

Improving team management is expected to enhance the company’s maturity in the aspect of Project Resource Management and Communications Management, and also solve several roots causes the company experienced in terms of the inadequate resource planning, poor coordination and controlling practices. The proposed solutions for these issues are the following:

- 1. Project Team Reassignment.** This research suggests the reassigning of the idle team to serve as a Person in Charge (PIC) for other team’s work. For instance, drafter team assigned to the latter stage of fabrication and electrical to the earlier stage. The current structure the company adapted for its project is not assigning a PIC who are responsible in managing, coordinating, and controlling teams in their respective project activity. So, in terms of project monitoring, the project manager relies heavily on a senior or trusted team member to conduct the reporting. Beside minimizing idle time, this reassignment is expected to enhance the project monitoring and coordination, as well as developing the reassigned PIC, especially in terms of project management practices. However, the reassignment may need to be accompanied by training or knowledge transfer related to the assigned work. The conducted training also aims at ensuring the project teams possess an adequate knowledge of the product, including the drafter team who previously made a mistake.
- 2. Utilization of Project Management Information System.** A Project Management Information System (PMIS) is a platform that enables project managers and teams to access and utilize various IT software tools for effective project management. These tools include scheduling software, work authorization systems, configuration management systems, information collection and distribution systems, and interfaces to online automated systems like corporate knowledge base repositories [7]. Information collection and distribution systems facilitate the collection of project progress updates, status reports, and other relevant information from team members, ensuring timely and organized distribution to stakeholders. Work authorization systems authorize and control work activities, ensuring compliance with established procedures and guidelines. These systems address issues of poor coordination and unauthorized actions faced by the company, aimed at reducing project delays and cost overruns. The proposed PMIS utilizes electronic project management tools in the form of project dashboards for the distribution of project information.

6. CONCLUSION

1. The root causes of the business issues experienced by the company are the poor coordination within the project teams, in this case between the drafter procurement, and fabrication team. Moreover, there is an issue of the inadequate project control and monitoring resulted the poor coordination to be overlooked. There are also an issue of inadequate product knowledge and lack of experience that causes the inaccurate product drawing. An inadequate schedule development is also



present. These issues along with inadequate risk management practices are the root causes for the project delay. Beside causing project delay, the lack of experience, inadequate risk management practices and product knowledge also resulted in cost overruns. The other root causes of this problem are the inadequate resource planning, specifically the human resources.

2. Based on the gap analysis, the project management of the manufacturer company resulted a relatively low level of maturity in many aspects of the project management knowledge areas. The summary of the assessment is as follows:

a. Project Risk Management

- Plan Risk Management: level 2
- Identify Risk: level 1
- Perform Risk Analysis: level 1
- Plan Risk Responses: level 4
- Implement Risk Responses: level 2
- Monitor Risks: level 1

b. Project Schedule Management

- Plan Schedule Management: level 2
- Define Activities: level 1
- Sequence Activities: level 1
- Estimate Activity Durations: level 2
- Develop Schedule: level 1
- Control Schedule: level 1

c. Project Communications Management

- Plan Communications Management: level 1
- Manage Communications: level 2
- Monitor Communications: level 1

d. Project Resource Management

- Plan Resource Management: level 1
- Estimate Activity Resources: level 1
- Acquire Resources: level 2
- Develop Team: level 1
- Manage Team: level 1
- Control Resources: level 1

3. The first proposed business solution is to implement scope management, scope management is essential aspect that can enhance the project management practices in general and become one of the requirements for the improvement of various project management maturity knowledge areas. In terms of project scope management this research is proposing the developing of project scope statement, Work Breakdown Structure (WBS) and the WBS dictionary, the identification and documentation of project scope in a structured manner is expected to provide a clearer informations regarding project objectives and exclusions to the company.

Next is to develop a proper risk management method, it is expected to improve the company capability to identify and assess risks, also provide a clearer overview of both negative risks (threats) and positive risks (opportunities), in a documented and structured manner. The proposed solution related to project risk management is the development of documents related to risk identification, risk assessment, and risk action plan. The next solution is the improvement of



project schedule development, it involves the development and utilization of Critical Path Method (CPM) to become the baseline for developing project schedule.

The third solution proposed by this research is implementing team reassignment to solve the issue of human resource efficiency due to idle workers. In this matter, the solution involves reassignment of the workers to become the PIC of project phases in their idle times.

The final proposed solutions are related to the implementation of Project Management Information System to enhance the communication practices in the projects, this research proposes the use of Trello to build project dashboard to provide a clearer and easier project monitoring and communications.

4. The implementation plan for the improvements consists of several key components, including project scope management, project risk management, project schedule management, project resource management, project communications management, and integration of these management areas. The plan aims to address the gaps in project management maturity and enhance business practices in a systematic and structured manner.

To execute the plan, specific tasks and actions have been identified, such as developing templates for scope statement, WBS, and WBS Dictionary, conducting risk identification and assessment, implementing the Critical Path Method (CPM) for project scheduling, reallocating team resources, conducting team training, developing a Standard Operating Procedure (SOP) for project reporting and communications, and integrating all the management areas.

The timeline for the implementation plan will be depicted using a Gantt chart, providing a visual representation of the tasks and their durations. It is important to acknowledge that the proposed improvements have the potential to elevate the company's maturity level to either level 2 or 3. However, assessing the full impact of these improvements may require evaluating multiple project iterations to accurately measure the company's progress.

## REFERENCES

1. Statista, "Breakdown of GDP Indonesia 2021, by sector," Statista, 2022. [Online]. Available: <https://www.statista.com/statistics/1019099/indonesia-gdp-contribution-by-industry/>. [Accessed February 2023].
2. Badan Pusat Statistik, "Laju Pertumbuhan PDB Industri Manufaktur," 2022. [Online]. Available: <https://www.bps.go.id/indicator/9/1216/1/laju-pertumbuhan-pdb-industri-manufaktur.html>. [Accessed February 2023].
3. Kementerian Perindustrian Republik Indonesia, "Industri Manufaktur Indonesia Semakin Ekspansif," 2022. [Online]. Available: <https://kemenperin.go.id/artikel/23125/Industri-Manufaktur-Indonesia-Semakin-Ekspansif>. [Accessed February 2023].
4. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide) - 7th ed. and The Standard for Project Management, Pennsylvania: Project Management Institute, Inc., 2021.
5. D. Lock, The Essentials of Project Management 4th ed., Farnham: Gower Publishing Ltd., 2017.
6. N. Brookes, M. Butler, P. Dey and R. Clark, "The Use of Maturity Models in Improving Project Management Performance: An Empirical Investigation," International Journal of Managing Projects in Business, vol. 7, no. 2, 2014.
7. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK Guide) - 6th ed., Pennsylvania: Project Management Institute, Inc., 2017.
8. J. K. Crawford, Project Management Maturity Model (4th ed.), CRC Press, 2021.
9. C. G. Thomas, Research Methodology and Scientific Writing (2nd ed.), Thrissur: Springer, 2021.
10. Project Management Institute, Practice Standard for Work Breakdown Structures - 3rd ed., Pennsylvania: Project Management Institute, Inc., 2019.
11. S. Zareei, "Project Scheduling for Constructing Biogas Plant using Critical Path Method," vol. 81, pp. 756-759, 2018.

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