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Determining The Contract Service Strategy at Coal Terminal Maintenance to Address Contractor's Inability to Maintain Availability of Fixed Plants in Supporting Shipments Activities at PTKPC a Case Study PTKPC, East Kutai, East Kalimantan, Indonesia

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ABSTRACT: PTKPC, a coal producer, was facing challenges due to a permit transition in December 2021 from Coal Mining Contract of Work (PKP2B) to Special Mining Business License (IUPK). This change increases operational costs with added royalty rates, value-added tax, and profit-sharing obligations. To address this issue, the company decided to streamline contractors in each department in all business units, consolidating various tasks under one umbrella contract. The goal is to provide a big volume of work, potentially lowering rates and reducing PTKPC's operational costs. However, relying on a single contractor for crucial operations, as seen in the Coal Terminal Maintenance Department (CTMD), introduces risks. The sole contract winner, PTPB, struggles to meet obligations since the contract's initiation on December 1, 2021. The average contract fulfillment since commencement date is 86% of 100% desired target, disrupting fixed plant Coal Terminal maintenance activities. Physical availability is 93%, below the 94% target, increasing CTMD's maintenance costs by $0.059 per ton. This research seeks to identify the root causes of PTPB's inability to fulfill contractual duties and explore alternative solutions. and then from all the existing alternatives, what is the best alternative in responding to this condition. Utilizing primary and secondary data from PTPB's monthly proforma invoices, contract scope, and CTMD's monthly reports, the research employs methodologies like problem tree analysis and stakeholder analysis to unravel business complexities and identify root cause of the problems. Qualitative data collection methods, including focused group discussions (FGD) and semi-structured interviews, will be used to determine alternatives. These alternatives will be assessed using the Value-Focused Thinking (VFT) methodology. The Analytic Hierarchy Process (AHP) methodology, assisted by the AHP Super Decision application, will determine the best alternative: the "Implementation of Warnings and Penalties to PTPB". Implementing this alternative demonstrates PTKPC's commitment to stakeholders, ensuring contractor accountability without disrupting fixed plant maintenance. Penalty funds will support CTMD's financial viability, funding additional resources for tasks beyond PTPB's capacity. This strategy may be applied to other contracts within PTKPC.

KEYWORDS: AHP, Contractor, Problem tree, Super Decisions, VFT.

INTRODUCTION

Currently, Indonesia is among the top 5 largest coal-producing countries in the world. Based on the latest data from the Ministry of Energy and Mineral Resources, Indonesia's coal reserves amount to approximately 38.84 billion tons, with the majority located in Kalimantan, accounting for about 62.1% of the total potential reserves. This makes it the largest source of coal resources in Indonesia, with a total of 88.31 billion tons in resources and 25.84 billion tons in reserves. Sumatra follows with 55.08 billion tons in resources and 12.96 billion tons in reserves. With an average coal production of around 600 million tons per year, it is estimated that these coal reserves can last for approximately 65 years, assuming no new reserves are discovered. Therefore, the government continues to encourage efforts to utilize these resources to bring prosperity to all Indonesian society.

Coal mining remains a crucial part of Indonesia's energy supply, offering affordable energy solutions. From the Figure 1.1, from 2015 to 2017, Indonesia's coal production exceeded 450 million tons and continued to increase until 2022, reaching 685 million tons. Sales include both domestic and export markets. For the current year, 2023, production has already reached 517 million tons, with the majority still being exported at 240 million tons and absorbed in domestic at 176 million tons.

PTKPC held a coal contract of work (known as Perjanjian Karya Pengusahaan Pertambangan Batubara or PKP2B), initially executed on April 8, 1982. In December 2021, this contract transitioned to an Izin Usaha Pertambangan Khusus (IUPK). Under the previous

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PKP2B contract, PTKPC was granted a concession area spanning 84,938 hectares. However, with the new IUPK contract, the area has been reduced to 61,543 hectares. The mining operations encompass both the Sangatta project and the Bengalon project, each equipped with its coal-shipping infrastructure. Coal transportation from the Sangatta project to the port is facilitated through conveyor belts, while road transport is utilized for the Bengalon project. In Figure 1.2, it is explained that since operating in 1992 with a total of 7.3 million metric tons of coal mined, PTKPC's production has consistently increased. In the eighth year of operation in 1999, there was a 96% increase in production, reaching 14.3 million tons. PTKPC only needed the next 6 years to double that production, reaching 28.3 million tons in 2005.

After that point, PTKPC continued to increase production yearly until 2011 when it reached 41.1 million tons. PTKPC did not stop there; in 2014, production exceeded 50 million tons, and in 2019, it achieved a historical milestone with the highest production at 60.8 million tons. This achievement follows the maximum capacity of the coal transportation system, which is the overland conveyor. The production projection for 2023 is 55 million tons. This significant production growth has positioned PTKPC as one of the largest mining companies in Indonesia.

Figure 1. 1 Realization of Coal Production & Sales of Indonesian
(**Source:** Kementerian Energi dan Sumber Daya Mineral)

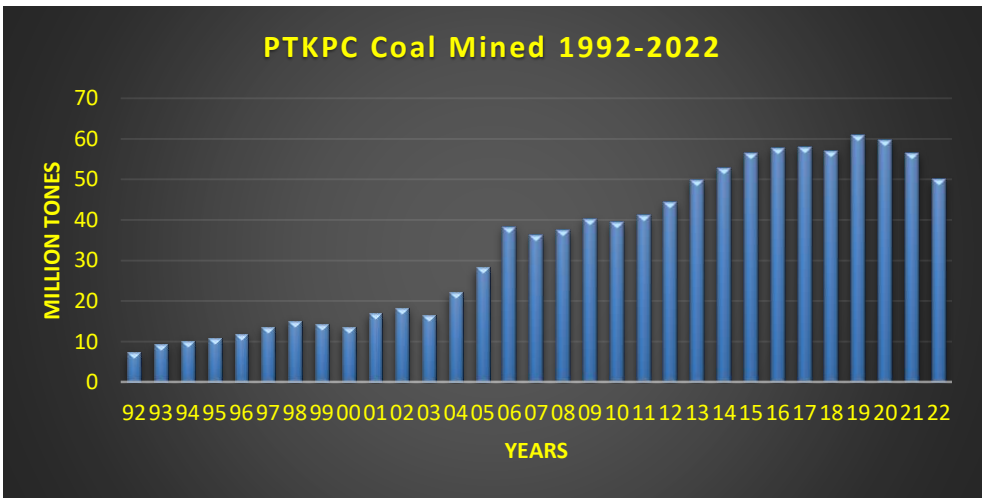

Figure 1. 2 Coal and OB Mined 1992-2023 Plan
(Source: Internal data)

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BUSINESS ISSUE

In the global context, every coal mining company operates as a price taker in the market. PTKPC is highly dependent on market prices. Generally, coal prices are influenced by four indexes: the average of the Indonesia Coal Index (ICI), the Newcastle Export Index (NEX), the Global Coal Newcastle Index (GCNC), and Platt's 5900. The global shift towards renewable energy sources poses challenges for coal mining companies, including declining coal demand and potential financial risks associated with stranded assets. Companies like PTKPC may need to adapt their business models. In conclusion, the existence of PTKPC is highly contingent on global conditions, such as demand and selling prices. One recent example is the conflict between Russia and Ukraine in 2022, which led to high prices but reduced demand. On the other hand, in the local context, at the end of 2021, PTKPC faced a change in its permit, transitioning from the Coal Mining Business Work Agreement (Perjanjian Karya Pengusahaan Pertambangan Batubara or PKP2B) to the Special Mining Business License (Izin Usaha Pertambangan Khusus or IUPK).

Additionally, since PTKPC operates in open pits, weather conditions are also of paramount importance when conducting both fixed plant maintenance and operations. Maintenance planning is expected to be more flexible to align with the operational and shipment needs During the rainy season, mining activities may be limited, providing an opportunity to carry out maintenance on fixed plants. Thus, the availability and readiness of manpower in CTMD must be well-maintained. Over the past two years, exceptionally high rainfall has led to PTKPC's sales falling below the target. Actual shipments were 94.4% in 2021 and 84.1% in 2022. This situation compelled CTMD to conduct opportunistic maintenance. Consequently, the availability and readiness of manpower in CTMD are the primary keys to achieving this maintenance flexibility.

Several gaps exist between the current situation and the expected results, starting with low contract compliance as shown in Figure 1.3, which influences the plant's physical availability at only 93%, below the target of 94% as shown in Figure 1.4, and an increase in maintenance costs since December 2021, as seen in Figure 1.5 and for the detail gaps could be seen in Table 1.1.

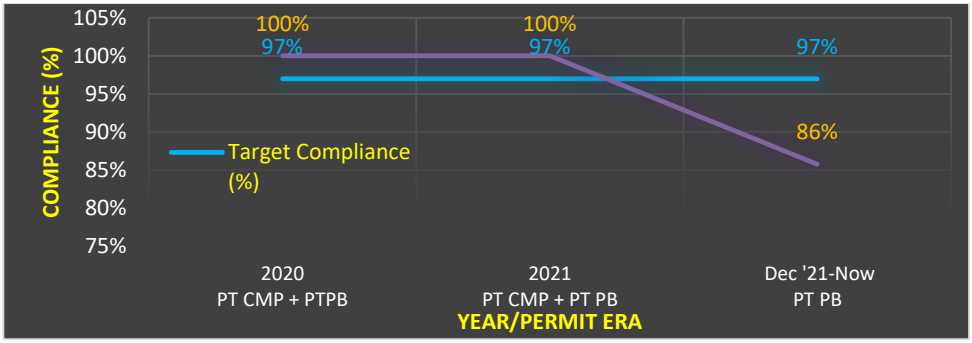

Figure 1. 3 The detailed gaps contract compliance Before Dec '21 vs After Dec '21
(Source: Internal data)

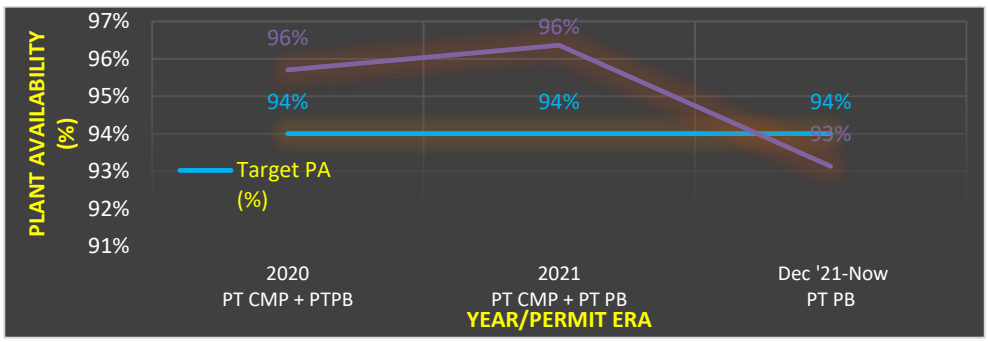

Figure 1. 4 The detailed gaps PA Before Dec '21 vs After Dec '21
(Source: Internal data)

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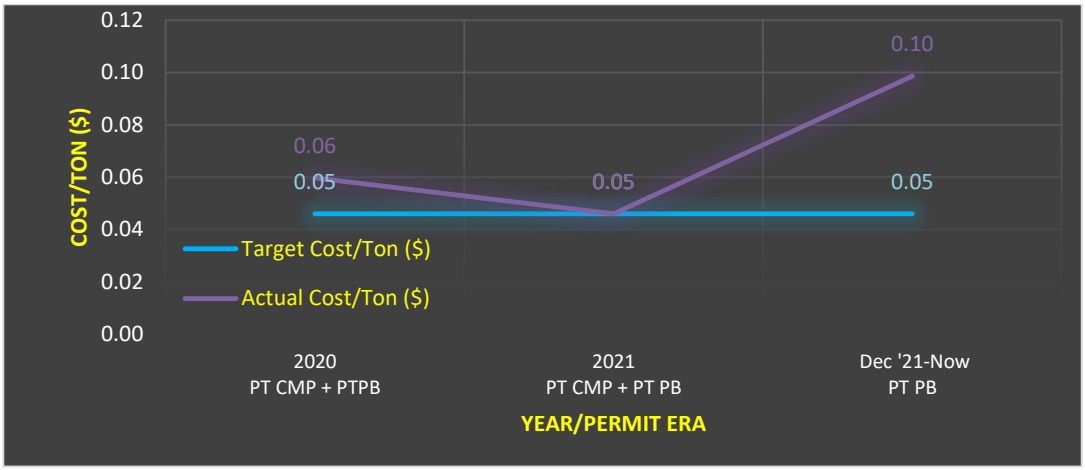

Figure 1. 5 The detailed gaps cost per ton Before Dec '21 vs After Dec '21
(Source: Internal data)

Table 1. 1 Gaps Before Dec '21 vs After Dec '21

Gaps Detail	Target	2020 PT CMP + PTPB	2021 PT CMP + PTPB	Dec '21-Now PTPB	Gap
Compliance	97%	100%	100%	86%	-11%
PA	94%	96%	96%	93%	-1%
Cost/Ton ($)	0.046	0.0597	0.046	0.105	0.059

(**Source:** Internal data)

CONCEPTUAL FRAMEWORK

In the paper's conclusion, the author aims to construct a framework that provides an overarching overview of the research methods employed for decision-making at PTKPC. This framework will be developed using various analytical tools and decision-making methodologies identified in the literature review. The conceptual framework the author intends to present is a fusion of multiple methodological approaches and conceptual frameworks, including:

- Gap Analysis: Gap analysis is a strategic problem-solving framework that identifies the difference between an organization's current state and its desired future state. It involves the following steps which are Understand the current state, Define the future state (goals and objectives), Analyse the gap between them, Identify the causes of the gap, and Create action plans to bridge the gap.
- Problem Tree / Tree Diagram (Silverman, 1994): The process of determining and analysing the causes of a problem involves creating a Problem Tree, which helps structure the understanding of the issue.
- Stakeholder analysis: The process of identifying and evaluating relevant parties involved in a project or organization. It involves understanding their interests, strengths, and relationships, which helps in relationship management and decision-making.
- Focus Group Discussion (Morgan, 1988): To explore all possible alternative solutions from the involved stakeholders, which will then be considered for potential recommendations and further tested in the subsequent steps to determine the best option.
- Analytical Hierarchy Process (Thomas L. Saaty, 1970): This approach aims to facilitate the resolution of intricate decision-making issues by methodically structuring and contrasting diverse preferences.

The details of the conceptual framework can be seen in Figure 1.6.

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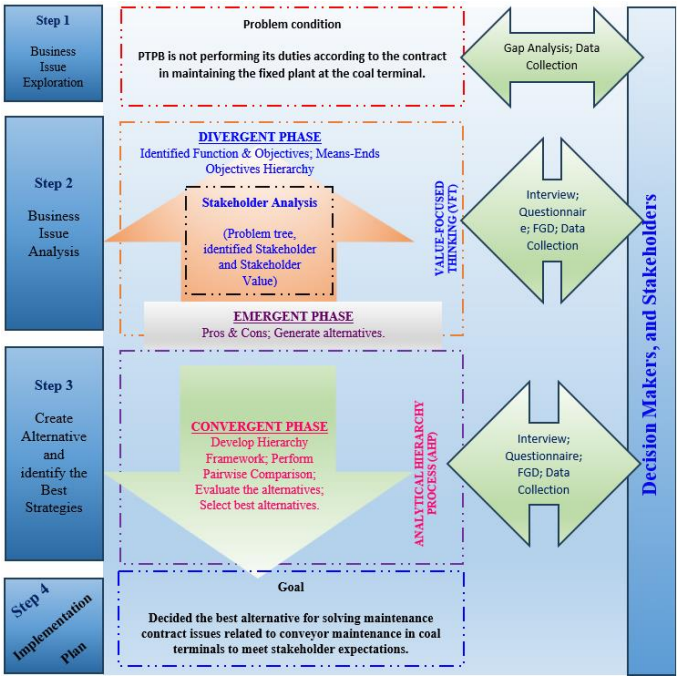

Figure 1.6 Conceptual Framework
(Source: Author)

DATA COLLECTION

Data collection methods are vital for precise and reliable information in research. The study collected data from December 2021 to June 2023 through the CTMD monthly report and pro forma invoices. Diverse data collection techniques include a literature review, interviews, and focus group discussions. The literature review involves gathering information from various sources, while semi-structured interviews are conducted in seven stages to explore the contractor's internal condition. Focus group discussions aim to devise business solutions for challenges in the CTMD. The data is categorized into primary and secondary data, with primary data including contract performance evaluations and monthly reports. Secondary data is gathered from book reviews, journals, statutory documents, literature studies, and interviews.

DATA ANALYSIS

- Qualitative data in this study is obtained through interviews, observations, and document analysis. Content analysis methods are applied to process information from each respondent, generating valid and relevant data for the study's purpose. Observations identify behaviours, events, or processes within the conservation research object. Interviews and Focus Group Discussions (FGD) with key respondents and decision-makers aim to elucidate causes and effects of the existing issue and identify the root cause using the Problem Tree/Tree Diagram for the first research question. The study explores solutions, preventive methods for future challenges, examines alternatives' pros and cons.
- The quantitative method in this study involves the statistical analysis of numerical data, emphasizing generalizations and mathematical modelling. Data sources include Contractor Performance Evaluation, Monthly Invoice, interviews, and focus group discussions. Following the AHP hierarchy structure from qualitative analysis, potential alternatives were listed. The data processing involves creating a pairwise comparison matrix based on numerical ratings from interview and FGD results. A consistency check is performed, evaluating the consistency of judgments made by decision-makers. Alternative solution assessment is conducted through pairwise comparisons, ranking alternatives based on criteria from interviews and FGDs. Priority ranking is then developed using AHP, and Super Decisions AHP software aids in analyzing and evaluating data. The outcomes assist decision-makers in identifying the optimal solution for the current issue and formulating preventive action plans for future contracts.

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ANALYSIS

The transition from PKP2B to IUPK permits incurred additional fees and taxes for PTKPC, impacting the company's expenses significantly. The new IUPK permit introduced extra royalty fees, VAT, and Additional Tax on the Price Difference of Coal Reference Profit Sharing as shown in the Table 1.2 below. Changes in taxes related to land and buildings, including regional tax, were implemented. Previously, two companies handled conveyor maintenance at CT, PTPB, and PTCMP, but the process was streamlined, and PTPB was awarded the contract in December 2021. The labor force in CTMD comprises 26% PTKPC personnel, 8% labor supply, and 67% contract services, totalling 156 coal terminal resources can be seen in the Tabel 1.3.

Table 1.2 Comparison of PTKPC PKP2B – IUPK

Comparison of PKP2B - IUPK		
Regulatory items	PKP2B	IUPK
Royalty Fee	13.50%	28% Export & 14% Domestic
Land and Building Tax (PBBKB)	7.5% (Meeting with royalties)	7.5% Becomes cost
Value Added Tax (VAT)	0%	11%
Land (PBB) and Regional Taxes	lumpsum	Following the standard calculation.
Corporate Income Tax	45%	22%
Additional Tax on the Price Difference of Coal Reference	Not applicable	According to the corporate tax rate
Profit Sharing	Not applicable	10%

(**Source:** Internal data)

Table 1. 3 Coal Terminal Maintenance Resources

2023 Coal Terminal Maintenance Resources			
PTKPC Employees	Labour Supplies	Contract Services	Total
40	12	104	156
26%	8%	67%	100%

(**Source:** Internal data)

- Problem tree analysis

  PTPB faces multifaceted challenges in meeting its contractual obligations. Social and environmental factors, such as the requirement to employ local non-skilled labor, limit the company's ability to take severe measures against striking workers. The transition from PKP2B to IUPK introduces additional fees and taxes, causing uncertainties and streamlining operations. Contractual complexities include an extensive scope, low-cost tenders, and delayed payments, leading to financial strains and workforce disruptions. Technical challenges involve difficulty in meeting standards, material acquisition issues, and maintaining equipment support. Financially, long payment terms, broad activities, and upfront costs further burden PTPB. A problem tree analysis reveals the intricate nature of these challenges, categorized as "complicated" in the Cynefin Framework, emphasizing the need for nuanced leadership and collaborative problem-solving with stakeholders. The result could can be seen in the Figure 1.7.

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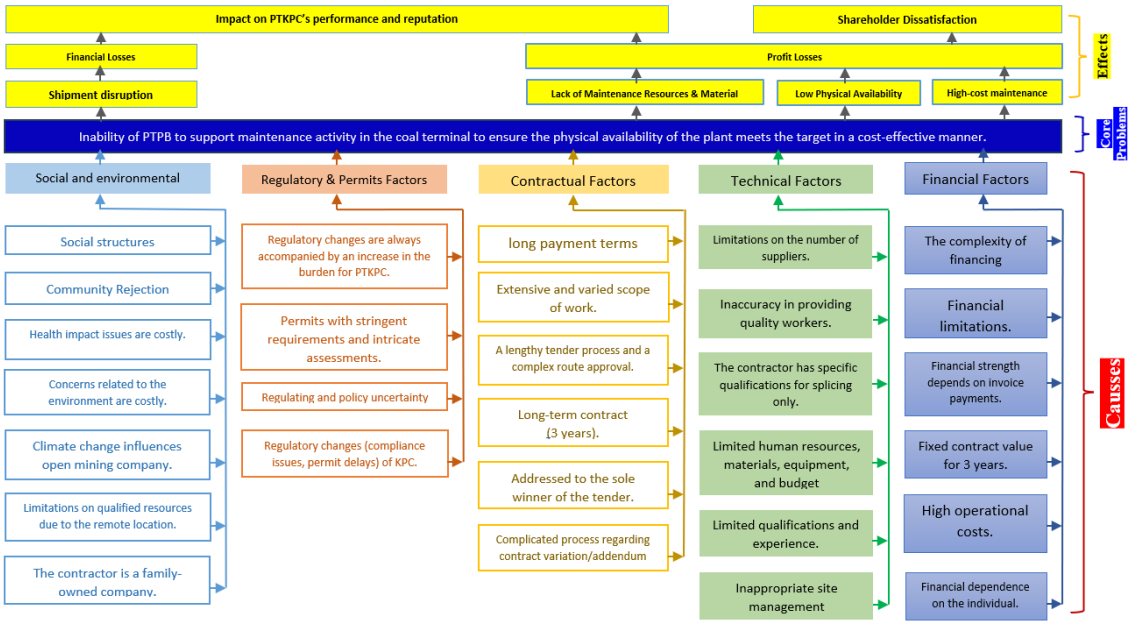

Figure 1.7 Conceptual Framework
(Source: Author)

- Stakeholder Analysis

There are seven stakeholders crucial to PTPB's presence in PTKPC operations are identified, encompassing departments such as Coal Terminal Maintenance, Operation, Quality Control, Marketing, Contract, Finance, and PTPB itself. Through structured interviews and questionnaires, the researcher assesses each stakeholder's power and interest, utilizing stakeholder analysis and a power-interest matrix. The resulting matrix map categorizes stakeholders into Key Players, Keep Satisfied, and Minimum Effort quadrants as shown in the Figure1.8. Stakeholder for Key Players are CONT, CTM and PTPB its self while in Keep Satisfied categories is CTO Department. Stakeholder expectations are summarized for Key Players and Keep Satisfied categories, focusing on those with significant power and interest to anticipate potential implementation issues as shown in the Table 1.4.

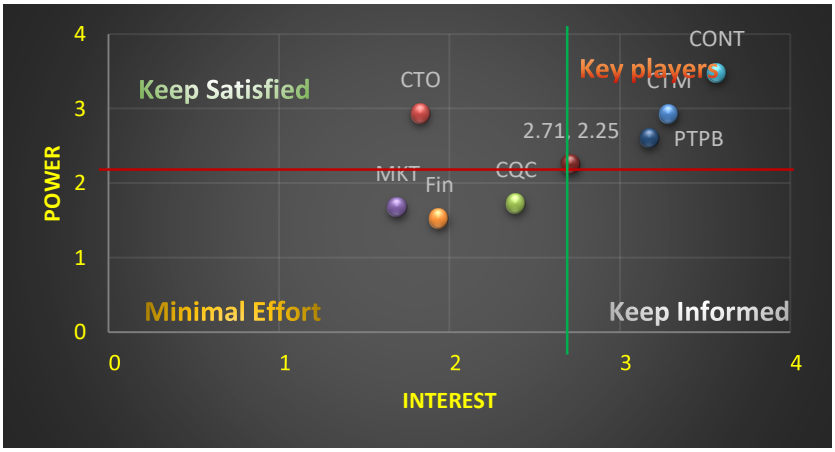

Figure 1.8 Power-Interest Matrix of the Contract PTPB Stakeholders
(Source: Author)

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Table 1.4 Four stakeholders wish for high power and interest.

No	Stakeholder	Expectations of the Contract PTPB
1	CONT	Not appointing only one contractor for a large scope of work is essential so that if obstacles arise, the impact will not be immediately significant. Additionally, having more than one contractor for a particular job fosters positive competition among the contractors in providing their services to PTKPC and also reviews the length of the contract duration for a sole appointment. However, these aspects require support and endorsement from top management or the Board of Directors.
2	CTMD	Not assigning a large scope of work to a single contractor, assessing the financial capabilities of the contractor before awarding a job, ensuring that the contractor's invoice payments are not delayed beyond 60 days, and having the contract department verify that contract rates comply with government's regulations.
3	PTPB	Ensure timely payment of invoices within the agreed 60-day period, provide overtime allowances to PTPB employees, and adjust contract values in accordance with legal standards and government's regulations.
4	CTOD	There are no issues with the physical availability of the plant; maintenance tasks are proceeding according to plan, and there are no prolonged shutdowns, reducing plant breakdowns and unscheduled maintenance due to unavailable resources

(**Source:** Author)

- Value-Focused Thinking (VFT)

  There are mean and fundamental goals that are motivated by values. The mean-end objectives hierarchy tool can assist in identifying the primary goals of this study based on the outcomes of interviews regarding the expectations of stakeholders within Contract PTPB Stakeholders, as indicated in Table 1.4 above. According to Figure 1.9, " Determining the fixed plant contract's maintenance strategy at the coal terminal to support shipping activities " is one of the top-level core objectives. At the second level, there are five mean objectives for optimising fixed plant maintenance according to stakeholder expectations. To make decisions using the AHP approach, the five mean objectives are: Optimization of the contract's value; Optimization of the **cost**-effectiveness contract; Optimization of the work **quality**; Optimization of the contract **duration**; and Optimization of **contract management** and control transposed into design criteria.

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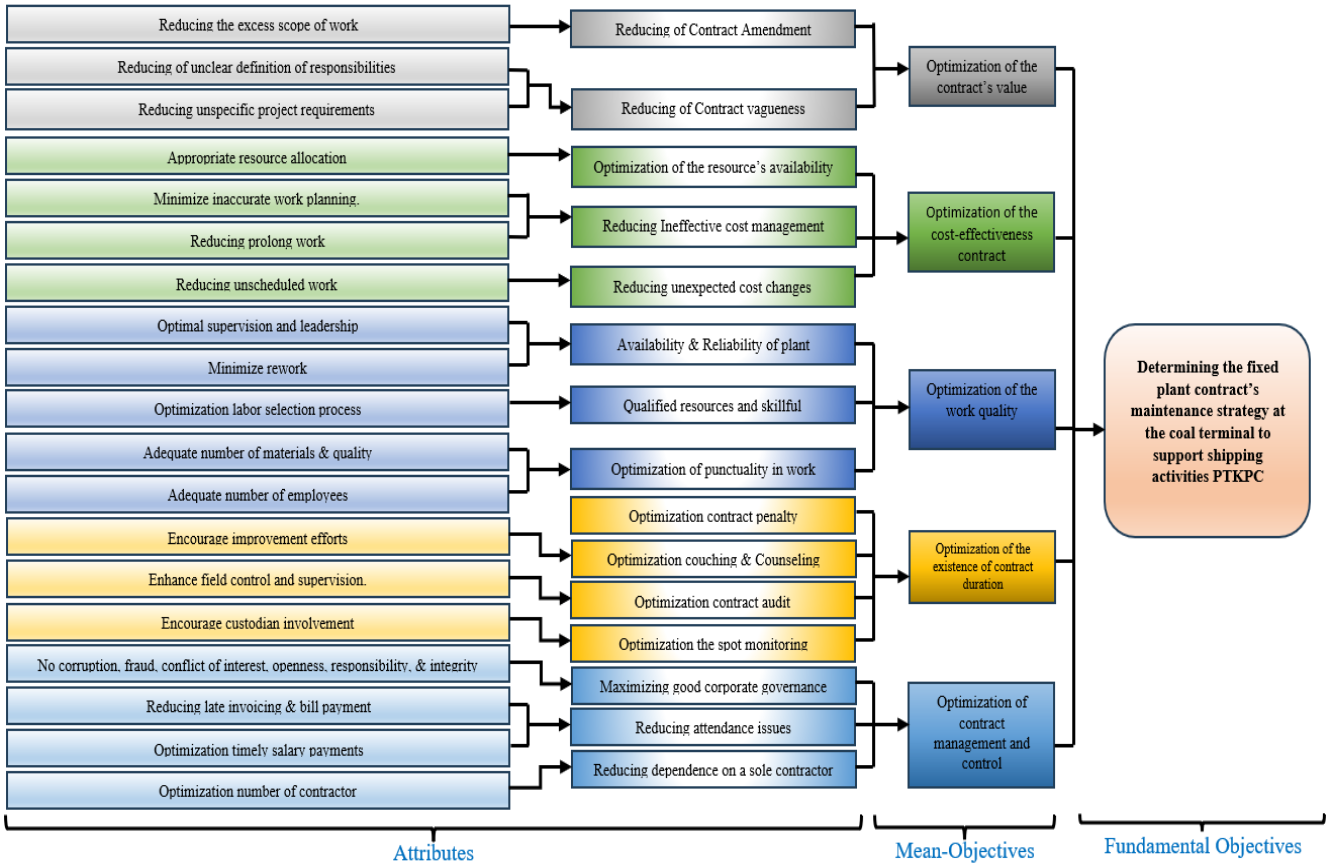

Figure 1.9 Hierarchy of Fundamental Objectives
(Source: Author)

- Generate Alternatives
  The VFT in Figure 1.10 was designed to assist the decision-maker in focusing on the fundamental and means activities before attempting to solve a decision problem. The values-driven approach is usually used to generate meaningful alternatives to achieve the values after problems are identified and the values (criteria) to be considered in the evaluation are decided. Based on the interview results and focus group discussions with key person (KP) stakeholders, questions were asked regarding the root cause of the contractor's inability and the relevant available scenarios to solve the problem. It was found that there are four alternatives could be implemented, namely:
  1. Direct contract termination
  2. Contract addendum
  3. Counselling & coaching
  4. Implementation of warning and penalties

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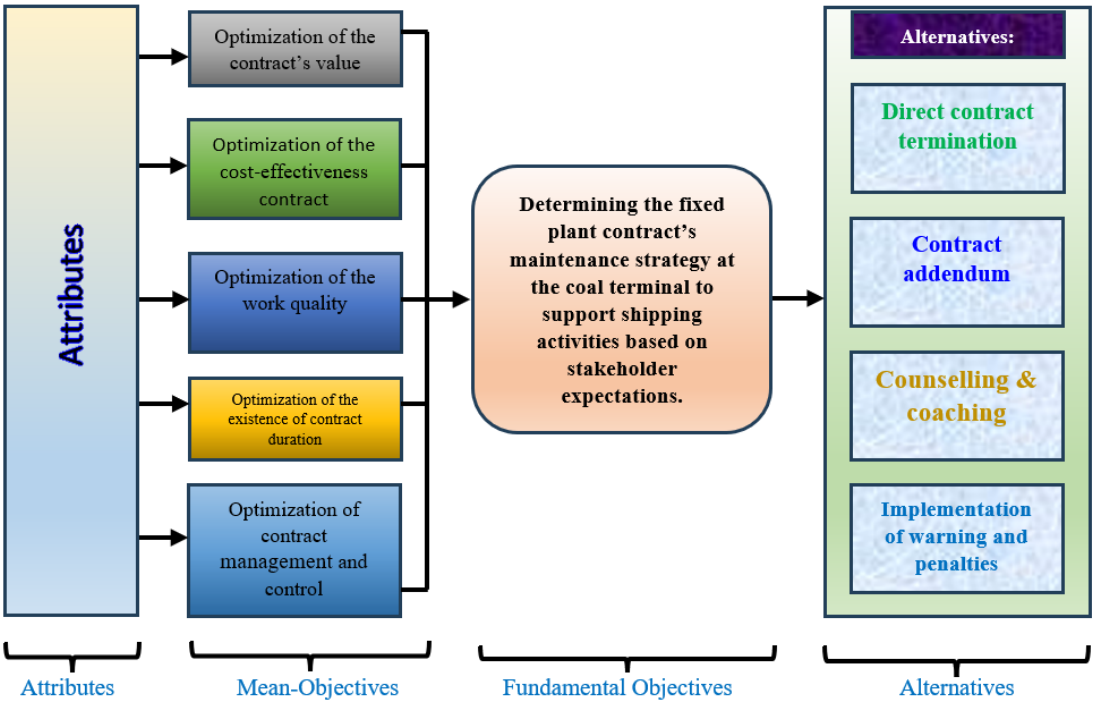

Figure 1.10 VFT process for developing alternative with a fundamental
(Source: Author)

- Conclusion of Business Analysis

  Based on the findings of the business problem exploration in the PTPB contract, it is evident that the extensive scope of work assigned during the transition period of the PTKPC contract from PKB2B to IUPK has led to PTPB's inability to fulfil its duties. This is primarily due to PTPB being tasked with new responsibilities outside its specialization. Additionally, the lengthy 3-year contract duration requires substantial capital to execute tasks, including hiring additional staff according to the expanded scope of work, investing in the procurement of equipment and splicing kit materials, and dealing with occasional delayed payments from PTKPC.

  The identified issues, analysed through the problem tree analysis method and gap analysis, indicate that the current situation has affected the availability of resources and maintenance materials, leading to unmet physical plant availability and increased maintenance costs. This, in turn, impacts PTKPC's sales, revenue, and reputation. To address the current situation, an analysis of several alternatives is needed to align with stakeholder expectations. The alternatives include:

  1. Direct contract termination
  2. Contract addendum
  3. Counselling & coaching
  4. Implementation of warning and penalties

  From the analysis results, several criteria for decision-making processes related to the four alternatives were identified. These criteria include:

  1. Cost
  2. Quality
  3. Time
  4. Contract Management

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BUSINESS SOLUTION

- Respondents Profile

  The Analytic Hierarchy Process (AHP) technique is employed to select the best alternative from those generated during the ideation phase. Pairwise comparisons are a crucial step in the AHP procedure. To establish pairwise comparisons, a survey is conducted to determine the relative significance of one element compared to another. Key person stakeholders can be interviewed during the prioritization process to provide assessments in decision-making. The AHP method is utilized to choose the best solution alternative by involving multiple key persons as decision-makers (see Table 1.5) at PTKPC (leaders with decision-making authority).

Table 1.5 List of Key persons of decision-making in determining contracts of PTPB.

No.	Key Person	Department	Job Description
1.	Manager Maintenance	CTMD	The highest-ranking leader and decision-maker in the Coal Terminal Maintenance department.
2.	Maintenance Planning Superintendent	CTMD	Determining the planning and scope of work for the CHMD Such a work plan would include activities related to material replacement, procurement processes, and cost control measures.
3.	Mechanical Superintendent	CTMD	responsible for executing the work, overseeing all resources within the CTMD and participating in the verification of contractor's invoices.
4.	Contract Superintendent	Contract Department	Conducting tender processes, verifying tender participants, analyzing submissions, and engaging in price negotiations while directly overseeing responsibilities related to the contract committee.
5.	Senior Contract specialist	Contract Department	Conducting tenders, verifying tender participants, analyzing submissions, negotiating prices, and periodically monitoring the contractor's performance together with custodian.

(**Source:** Author)

- Modelling of Analytic Hierarchy Process
  1. Construct structure a hierarchy

     The analysis aims to identify the optimal solution for addressing PTPB's challenges in conveyor maintenance at the coal terminal. The goal is to eliminate resource shortages, ensure plant availability, and maintain cost-effectiveness. Failure to address this issue may disrupt shipping activities and impact stakeholder expectations. Four alternatives are proposed based on the analysis, with criteria synthesized from stakeholder values in the contract. The decision-making process utilizes the Analytic Hierarchy Process (AHP) and AHP Super Decision software, depicted in the Hierarchy Structure of the AHP Model in Figure 1.11.

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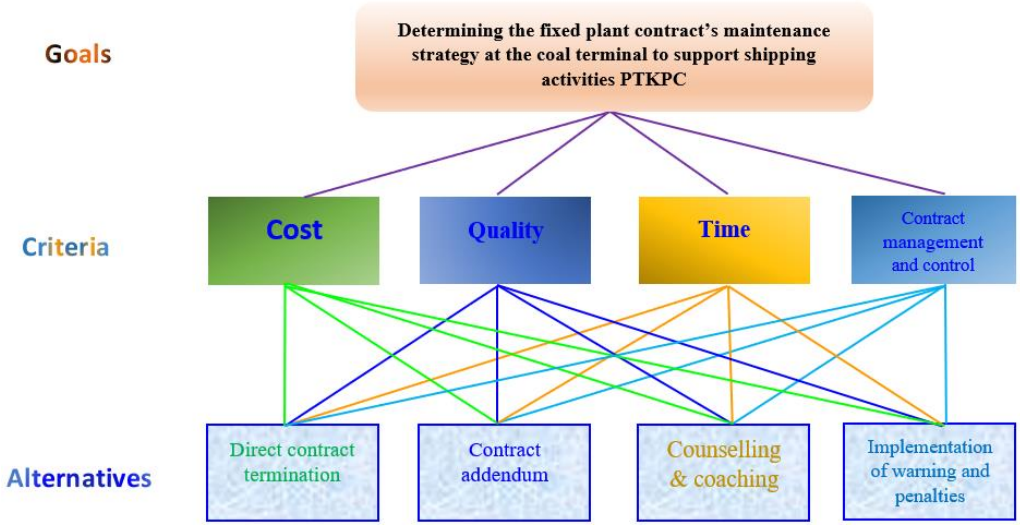

Figure 1.11 The structure a Hierarchy of AHP Model
(Source: Author)

2. Pairwise Comparison of AHP-Model

The identified criteria and sub-criteria have been subjected to pairwise comparisons, and the outcomes have been transformed into a questionnaire for respondents. Key individuals are required to provide their scores for each comparison table. An illustrative example of how a key person expresses judgment intensities through a paired numerical rating. Subsequently, interviews will be conducted with five key individuals using the questionnaires to obtain pairwise comparisons of the criteria and potential solutions.

Interviews with five key decision-makers involved in the PTPB contract in CTMD yielded point values for paired comparisons of criteria and alternative solutions. The obtained results, will be utilized for further calculations in this paper. The geometric mean, will be employed based on the collective pairwise comparisons from all key persons. Calculated results are presented in Table 1.6 for Pairwise Criteria Comparison and Table 1.7 for Pairwise Alternative Comparison.

Table 1.6 Pairwise Comparison of Criteria

No.	Criteria	Respondent					Geometric Mean
		KP1	KP2	KP3	KP4	KP5	
1	Cost-Quality	0.33	1.00	0.33	3.00	4.00	1.06
2	Cost-Time	0.50	2.00	0.33	4.00	3.00	1.32
3	Cost-Contract management	2.00	2.00	2.00	1.00	1.00	1.52
4	Quality-Time	0.50	2.00	2.00	1.00	1.00	1.15
5	Quality-Contract management	2.00	2.00	3.00	0.33	0.33	1.06
6	Time-Contract management	3.00	1.00	4.00	0.33	0.33	1.06

(**Source:** Author)

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Table 1.7 Pairwise Comparison of Alternative

Criteria	Alternative	Respondent					Geometric Mean
		KP1	KP2	KP3	KP4	KP5	
Cost	Direct contract termination-Contract addendum	1.00	0.50	1.00	1.00	1.00	0.87
	Direct contract termination-Counselling & coaching	0.50	0.33	0.50	0.50	0.50	0.46
	Direct contract termination-Implementation of warning and penalties	0.33	0.25	0.50	0.50	0.50	0.40
	Contract addendum-Counselling & coaching	0.50	0.33	1.00	0.50	0.50	0.53
	Contract addendum-Implementation of warning and penalties	0.33	0.25	0.50	0.50	0.33	0.37
	Counselling & coaching-Implementation of warning and penalties	0.50	0.50	0.25	1.00	0.25	0.44
Quality	Direct contract termination-Contract addendum	1.00	1.00	1.00	1.00	1.00	1.00
	Direct contract termination-Counselling & coaching	1.00	0.50	0.50	0.50	0.50	0.57
	Direct contract termination-Implementation of warning and penalties	0.50	0.33	0.33	0.33	0.33	0.36
	Contract addendum-Counselling & coaching	1.00	0.50	1.00	0.50	0.50	0.66
	Contract addendum-Implementation of warning and penalties	0.50	0.25	0.33	0.33	0.33	0.34
	Counselling & coaching-Implementation of warning and penalties	0.33	0.33	0.50	0.50	0.25	0.37
Time	Direct contract termination-Contract addendum	1.00	1.00	1.00	1.00	1.00	1.00
	Direct contract termination-Counselling & coaching	0.50	0.50	0.33	0.33	0.33	0.39
	Direct contract termination-Implementation of warning and penalties	0.33	0.33	0.25	0.25	0.33	0.30
	Contract addendum-Counselling & coaching	0.50	0.50	0.33	0.25	0.33	0.37
	Contract addendum-Implementation of warning and penalties	0.33	0.25	0.25	0.25	0.33	0.28
	Counselling & coaching-Implementation of warning and penalties	0.50	0.33	1.00	0.50	1.00	0.61
Contract management	Direct contract termination-Contract addendum	1.00	1.00	1.00	1.00	1.00	1.00
	Direct contract termination-Counselling & coaching	0.50	0.50	0.50	0.50	1.00	0.57
	Direct contract termination-Implementation of warning and penalties	0.33	0.50	0.33	0.50	0.50	0.43
	Contract addendum-Counselling & coaching	0.50	0.50	0.50	0.50	1.00	0.57
	Contract addendum-Implementation of warning and penalties	0.33	0.33	0.33	0.50	0.50	0.39
	Counselling & coaching-Implementation of warning and penalties	0.50	0.50	0.50	1.00	0.33	0.53

(**Source:** Author)

3. Synthesize the results to determine the best alternative solution.
   Synthesize the results to determine the best alternative solution. From the paired comparison results, both at the criteria and alternative levels in Tables 1.6 and 1.7 above, the next step is to synthesize the calculations with the assistance of Super Decision AHP software. Before using the software, it is necessary to prepare the paired comparison matrices at both the criteria and alternative levels, as shown in Tables 1.8 and 1.9 below, as input data for the Super Decision AHP software.

Table 1.8 Pairwise comparison matrix of criteria

Criteria	Cost	Quality	Time	Contract Management
Cost	**1.00**	**1.06**	**1.32**	**1.52**
Quality	**0.94**	**1.00**	**1.15**	**1.06**
Time	**0.76**	**0.87**	**1.00**	**1.06**
Contract Management	**0.66**	**0.94**	**0.94**	**1.00**

(**Source:** Author)

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Table 1.9 Pairwise comparison matrix of alternatives

Criteria	Alternative	Direct contract termination	Contract addendum	Counselling & coaching	Implementation of warning and penalties
Cost	Direct contract termination	1.00	0.87	0.46	0.40
	Contract addendum	1.15	1.00	0.53	0.37
	Counselling & coaching	2.17	1.89	1.00	0.44
		2.49	2.70	2.30	1.00
Criteria	Alternative	Direct contract termination	Contract addendum	Counselling & coaching	Implementation of warning and penalties
Quality	Direct contract termination	1.00	1.00	0.57	0.36
	Contract addendum	1.00	1.00	0.66	0.34
	Counselling & coaching	1.74	1.52	1.00	0.37
	Implementation of warning and penalties	2.77	2.93	2.70	1.00
Criteria	Alternative	Direct contract termination	Contract addendum	Counselling & coaching	Implementation of warning and penalties
Time	Direct contract termination	1.00	1.00	0.39	0.30
	Contract addendum	1.00	1.00	0.37	0.28
	Counselling & coaching	2.55	2.70	1.00	0.61
	Implementation of warning and penalties	3.37	3.57	1.64	1.00
Criteria	Alternative	Direct contract termination	Contract addendum	Counselling & coaching	Implementation of warning and penalties
Contract management	Direct contract termination	1.00	1.00	0.57	0.43
	Contract addendum	1.00	1.00	0.57	0.39
	Counselling & coaching	1.74	1.74	1.00	0.53
	Implementation of warning and penalties	2.35	2.55	1.89	1.00

(**Source:** Author)

4. Development of priority ranking

The calculation process of the gathered data is analysed with the assistance of Super Decision AHP software, resulting in prioritized rankings at both the criteria and alternative levels, as presented in Figures 1.12 and 1.13. Appendix C of this final project shows the steps involved in entering data into the AHP Super Decision.

Main Network: Determining the fixed plant contract's maintenance strategy at the coal terminal AHP.sdmod: ratings: Unweighted Super Matrix

Clusters	Nodes	Determining t...	1Cost	2Quality	3Time	4Contract ...
1Goal	Determining the fixed plant contract's maintenance strategy	0.000000	0.000000	0.000000	0.000000	0.000000
2Criteria	1Cost	0.299601	0.000000	0.000000	0.000000	0.000000
	2Quality	0.257004	0.000000	0.000000	0.000000	0.000000
	3Time	0.226279	0.000000	0.000000	0.000000	0.000000
	4Contract management and control	0.217116	0.000000	0.000000	0.000000	0.000000
3Alternatives	1Direct contract termination	0.000000	0.141458	0.148528	0.124638	0.161526
	2Contract addendum	0.000000	0.152787	0.151070	0.120871	0.157325
	3Counselling & coaching	0.000000	0.260020	0.220416	0.305939	0.259816
	4Implementation of warning and penalties	0.000000	0.445735	0.479986	0.448552	0.421333

Figure 1.12 Data capture from Super Decision AHP software related to priority ranking.
(Source: Super Decision AHP)

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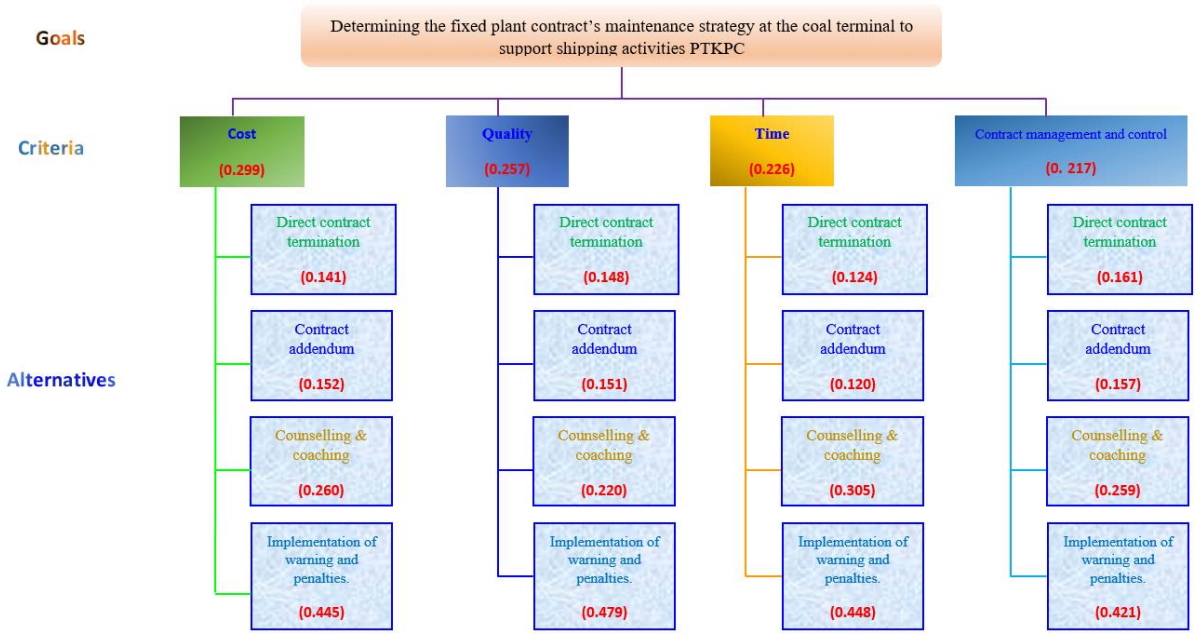

Figure 1.13 The weight of all criteria and alternatives
(Source: Super Decision AHP)

5. Consistency ratio.
   Ensuring the consistency of decision-makers' assessments in the AHP methodology is vital for the quality of the final decision. The calculation of the consistency ratio, measuring the agreement degree in pairwise assessments, has been conducted using Super Decision AHP software. The results, indicate consistency ratios below 0.1 at both criteria and alternative levels as shown in the Table 1.10. This signifies that the provided pairwise comparisons by respondents are consistent and deemed acceptable.

Table 1.10 Summary result of consistency ratio calculation

Item	Consistency Ratio (CR) by Super Decision	Standard CR<0.1	Result
Pairwise comparison level 1	0.00291	CR<0,1	Acceptable
Pairwise comparison level 2:			
Cost	0.01708	CR<0,1	Acceptable
Quality	0.00988	CR<0,1	Acceptable
Time	0.00253	CR<0,1	Acceptable
Contract management	0.00468	CR<0,1	Acceptable

(**Source:** Super Decision AHP)

6. Modelling of Analytic Hierarchy Summary
   The study employs the Analytic Hierarchy Process (AHP) with Super Decision AHP software to determine the optimal alternative for addressing PTPB's challenges in conveyor maintenance at the Coal Terminal. The prioritization ranking criteria, derived from the weighted hierarchy tree in Figure 4.13, include:
   1. Cost = 29.96%
   2. Quality = 25.7%
   3. Time = 22.63%
   4. Contract Management = 21.71%

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Cost received the highest score in the prioritization ranking, reflecting the importance attributed to it in discussions and Focus Group Discussions (FGD) regarding the PTPB contract. This emphasis is driven by the substantial value and scope of the current contract, aiming to prevent disruptions in the maintenance of the fixed plant at the coal terminal. Quality also garnered a high score, considering the ongoing operational activities of PTKPC and the imperative to maintain high-quality plant availability. The last two criteria, time and contract management, obtained lower scores due to their challenging nature for modification, requiring Board of Directors' approval and involving a lengthy process. The synthesized results of pairwise comparisons, analysed using Super Decision AHP, contribute to these ranking:

1. Implementation of warning and penalties = 44.98%
2. Counselling & coaching = 26.02%
3. Contract addendum = 14.61%
4. Direct contract termination = 14.38%

The Implementation of warning and penalties emerged as the top choice for addressing PTPB's inability to fulfill its current contract obligations, securing the highest score. This approach is considered the most effective in preventing disruptions to the maintenance of the fixed plant at the coal terminal, as illustrated in Figure 1.14.

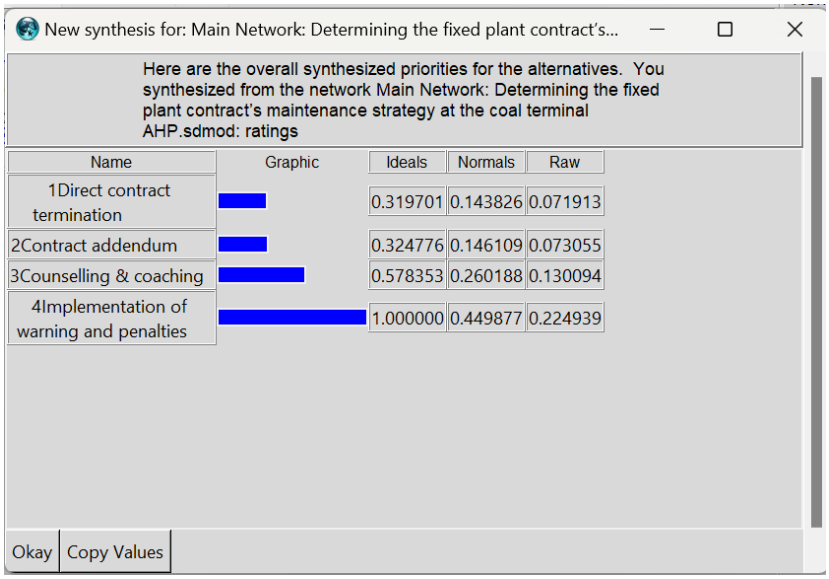

Figure 1.14 Data capture from Super Decision AHP software related alternatives synthesized priorities.
(Source: Super Decision AHP)

IMPLEMENTATION PLAN & JUSTIFICATION

In this final project, the researcher proposes alternatives to address issues related to PTPB's inability to fulfil the contract using the 5W + 1H method (What, When, Where, Who, Why, and How).

- What
  In response to PTPB's inability to perform conveyor maintenance duties, the proposed solution is the gradual implementation of warnings and penalties. This recommendation is grounded in thorough analytical approaches, including internal and external analysis, problem tree analysis, stakeholder analysis, Value-Focused Thinking (VFT), and Analytic Hierarchy Process (AHP). The strategy involves issuing warnings and subsequently imposing penalty payments for each instance of PTPB's failure to fulfill contractual obligations.
- Why
  Several considerations for why the Implementation of Warnings and Penalties can be applied in addressing this issue are as follows:

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1. Timing: Can be implemented directly and already undertaken.
2. Demonstrating the firmness of PTKPC: "To uphold the integrity and reputation of PTKPC in front of stakeholders, including all contractors.
3. The implementation approach: Easy implementation, can be directly deducted from the invoice.
4. Financial considerations: In covering PTPB's deficiencies, the costs incurred are not as large as the contract value.

- Who
  The implementation of warnings and penalties involves direct action by the custodian, specifically the cost control and administration section. The custodian verifies PTPB's submitted invoice and calculates deductions based on their failure to fulfill tasks. The contractor must then approve the penalty value. The finance department deducts the penalty from the invoice amount to be paid to PTPB. The penalty funds are redirected to the OPEX budget for the relevant department, addressing resource needs. Contractual details for penalties are outlined, and the custodian superintendent can recommend and execute invoice event deductions due to non-compliance.
- Where
  The implementation of warnings and penalties will be applied to PTPB that perform conveyor maintenance at the fixed plant coal terminal in accordance with the agreed-upon contract as stated on the document contract.
- When
  The proposed implementation of warnings and penalties involves monthly assessment during PTPB's submission of the job sheet and invoice. The penalty is calculated based on the variance between actual work and contractual requirements. While this approach was inconsistently applied previously due to custodian uncertainty, the research suggests consistent application from January 2024 until the contract concludes in December 2024. Despite prior serious warnings, PTPB has not demonstrated substantial performance improvement.
- How
  As explained above, the imposition of penalties can be applied every month when the PTPB submits its invoice. The determination of monthly contractor payment submissions is specified in the contract clauses.

CONCLUSION

This research provides a comprehensive understanding of the strategy selection for addressing PTPB's inability to perform conveyor maintenance at the fixed plant Coal Terminal in alignment with stakeholders' expectations. The root causes of the contractor's inability to meet the contract's compliance requirements have been identified through a problem tree analysis. These root causes include social and environmental factors involving local worker employment and climate challenges, regulatory and permits factors with increased burdens and uncertainties which can influence PTKPC sales and revenue, contractual factors stemming from streamlined contracts and extended approval processes, technical factors related to limited qualifications and capital for initial operations, and financial factors due to extensive scope, delayed payments, and cash flow limitations. These insights contribute to a thorough comprehension of the challenges faced by PTPB in fulfilling its contractual obligations.

The study explores relevant scenarios to address the existing non-compliance contract performance problem, employing Stakeholder Analysis and Value-Focused Thinking (VFT) methods. The synthesized results yield four alternatives: direct contract termination, contract addendum, counselling & coaching, and implementation of warning and penalties. Furthermore, using the Analytic Hierarchy Process (AHP) method, the research identifies the best alternative to tackle the current condition. Involving five decision-makers and considering criteria such as Cost, Quality, Time, and Contract Management, the AHP analysis, facilitated by Super Decision software, identifies the "Implementation of warning and penalties" as the optimal choice among the alternatives.

RECOMMENDATION

The recommendation for implementing the "Implementation of Warnings and Penalties" as the optimal alternative is grounded in its immediate readiness, affirming PTKPC's strength, and a straightforward approach for easy execution. The strategy not only addresses PTPB's shortcomings effectively but also showcases PTKPC's commitment to maintaining integrity and reputation among stakeholders. Financial considerations reveal that the costs associated with this approach are relatively modest in comparison to the overall contract value. Furthermore, the proposed concept of this research holds potential for application to other contracts.

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However, it emphasizes the importance of considering the unique characteristics of each contract and conducting a comprehensive review to ensure decisions align with the values of all stakeholders involved.

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