



Decision Analysis to Find Best Solution of Operation and Maintenance Management System in Central Processing Plant (CPP) Gundih Using The SMART Method at PT. Pertamina EP

A. Zainal Abidin¹, Santi Novani²

¹PT. Pertamina EP, Field Cepu

²Bandung Institute of Technology

ABSTRACT: Central Processing Plant (CPP) Gundih is a gas field owned by PT. Pertamina EP Cepu Field area which is located in Blora Regency, Central Java. The gas produced by the CPP Gundih is channelled to the Tambak Lorok Gas and Steam Power Plant (PLTGU) with a capacity of 1,469MW in the Semarang City area, Central Java. Therefore, the CPP Gundih is a vital national object that supports national energy security, especially for the Central Java area. CPP Gundih first operated in 2013 with the operation and maintenance management system being fully handled by a third party with a contract term of one decade. In the coming year, the contract system will approach the end of the collaboration so that PT. Pertamina EP needs more efficient management schemes and strategies and more agile business processes.

In the past decade, there have been several evaluations that have become a concern for companies in implementing contract systems with third parties. These obstacles mean that several aspects are not managed well and result in problems that reduce the level of customer satisfaction, decrease profits, and increase operational and maintenance costs. So that PT. Pertamina EP is considering several options for better management of the CPP Gundih in the future, namely the option of detailing third party contracts in the future, the option of transferring management by PT. Pertamina EP partially, full management transfer option by PT. Pertamina EP without any third-party involvement.

From several proposed options, the author will use the Simple Multi Attribute Rating Technique (SMART) method to select the best option by considering aspects of Cost, Durability and Plant Availability, Manpower Competency Management, Remuneration, Communication Flow, and Integrated Work Procedure. The research results obtained from this method will become a reference for the PT management team. Pertamina EP for decision making related to the operation and maintenance implementation system at the Central Processing Plant (CPP) Gundih gas field.

KEYWORDS: Central Processing Plant (CPP) Gundih, SMART Method, Oil & Gas Industry, O&M Management System, Value Focused Thinking.

INTRODUCTION

Central Processing Plant (CPP) Gundih is a gas field which is one of the vital national objects owned by PT. Pertamina EP which is under the auspices of the Ministry of Energy and Mineral Resources. The gas produced from this field becomes raw material for feeding the Tambak Lorok PLTU to support electricity in the Central Java province area. So, the durability and availability of the CPP Gundih must be maintained optimally by suppressing the potential for unplanned shutdowns due to unplanned damage to gas purification equipment. So, taking this into account, the equipment management process and operation process must be carried out carefully in accordance with the design standards set by the licensor.

Since it first started operating in 2013, the operational management and maintenance process has been carried out by a third party with a service procurement scheme through a contract system with a value and time period determined by PT. Pertamina EP for 10 years. During the ongoing process of contact management by third parties, the dynamics occurring in the field are experienced, several aspects that will be evaluated in this research are as follows:

1. High operational costs
2. Low plant durability and availability
3. Poor Manpower Competency Management
4. Bad Remuneration



5. Long communication chain

6. Commitment to the realization of Work Procedure Standards that are not in accordance with the contract

Based on these six points, it is a challenge for companies in carrying out operation and maintenance activities at the CPP Gundih field. To explain in detail the six points, researchers will use a database for two years, namely 2021-2022.

LITERATURE REVIEW

Multiple Criteria Decision-Making Technique

Multiple Criteria Decision Making (MCDM) involves making informed choices when faced with a range of different, often contradictory, criteria. Multiple Criteria Decision Making (MCDM) problems are frequently encountered in several aspects of daily existence. The statement posits that the assessment of many options based on a certain set of decision criteria is an inherent aspect of governmental, industrial, or business operations (Sons, 1998). These criteria often contradict with one another.

MCDM pertains to the organization and resolution of decision and planning problems that encompass many criteria. The objective is to assist decision makers who are confronted with such issues. MCDM involves the creation of a comprehensive preference hierarchy for a group of options, which are evaluated based on numerous criteria. It also entails the selection of the most favorable actions from a range of choices, each of which is evaluated against several, and frequently distinct, criteria (Sons, 1998). Multiple Criteria Decision Making (MCDM) analysis relies exclusively on the factors of multiples and alternatives (Sons, 1998).

General operations of any MCDM methods

There are three procedures involved in the utilization of any decision-making technique that includes numerical analysis of options (Sons, 1998):

1. Identify the pertinent criteria and options.
2. Assigning statistical metrics to determine the significance of the criteria and the effects of the alternatives on these criteria.
3. Evaluation and prioritization of each available option.

SMART (Single Multi-Attribute Rating Technique)

SMART is a multi-attribute decision-making strategy. The multi-attribute decision-making technique facilitates decision-makers in selecting among multiple choices. The decision maker must select an alternative that aligns with the specified objectives. Every alternative is comprised of a collection of attributes, with each attribute having a corresponding value. This value is computed by taking the average using a specific scale. Each characteristic possesses a weight that quantifies the significance of a certain scale, and each attribute also possesses a weight that signifies its relative importance compared to other qualities. The weighting and ranking process is utilized to evaluate each alternative and determine the optimal choice.

Some of the basic terms that will be used in SMART method are (Goodwin Paul & Wright George, 2004):

- a. Objectives: indication of the preferred direction of movement.
- b. Attributes: is used to measure performance in relation to an objective
- c. Share the emotional stresses and exhilaration of turning vision into reality

The main stages in SMART method are (Goodwin Paul & Wright George, 2004):

- Stage 1: Identify the decision maker (or decision makers).
- Stage 2: Identify the alternative course of action
- Stage 3: Identify the attributes which are relevant to the decision problem by using a value tree.
- Stage 4: Measure the performance of the alternatives on that attribute. Then rank each alternative with other criteria.
- Stage 5: Determine the weight for each attribute.
- Stage 6: For each alternative, take a weighted average of the values assigned to that alternative.
- Stage 7: Make a provisional decision
- Stage 8: Perform sensitivity analysis to see how robust the decision is to changes in the figure supplied by the decision maker.

Why Choose SMART Method?

In this research, author will use the SMART method as explained in the previous discussion, several points that encourage the author to use the SMART method are:

1. Unity: Unity is a basic and straightforward value function that follows a linear pattern.



- 2. Applicability: This feature is adequate for the majority of linear instances.
- 3. Interdependence: The choice model is not influenced by the alternatives.
- 4. Operations: All the attributes at the lowest level are taken into consideration.
- 5. Relevance: The ratings of alternatives have little correlation, meaning that altering the number of alternatives would not inherently affect the decision scores of the initial selections.

Conceptual Framework

A conceptual framework is a theoretical structure utilized by researchers to formulate ideas or establish logical connections among many aspects deemed significant for the occurrence of problems. The conceptual framework will analyze the interconnectedness between variables that are deemed essential to enhance the understanding of the dynamics of the subject or objects under investigation.

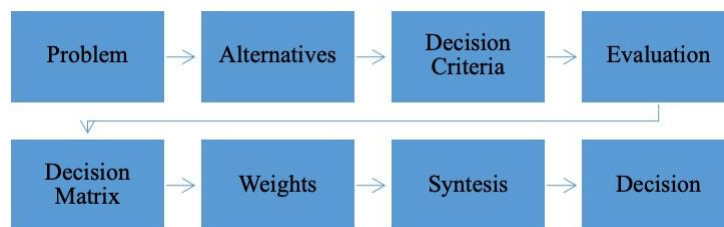


Figure 1. Conceptual Framework of Research

RESEARCH METHODOLOGY

Research Design

The entire method of conducting research that establishes a clear and logical course of action for responding to open-ended research questions through the collection, interpretation, analysis, and presentation of data is referred to as research design. According to Kothari (2004), a research design is a road map, blueprint strategy, and plan for carrying out an investigation that is appropriately planned in order to find solutions to the previously developed research questions. The subsequent text presents the theoretical structure of this investigation:

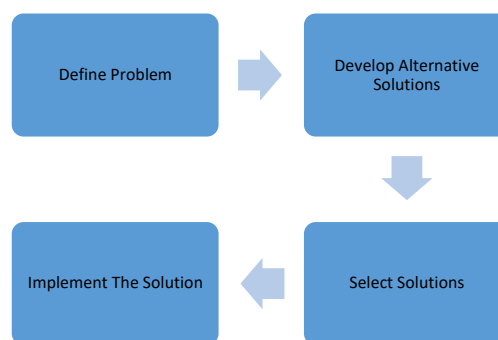


Figure 2. Research Design

Define the problem

In this step, the researcher will determine the issues/problems/events/facts that are considered priority to be discussed: determining the problems that occur based on the results of the PT gas distribution annual report meeting. Pertamina EP to consumers. In this meeting several problems were defined as the researchers explained in chapter 1 of the business issues section. The problem described is the result of an evaluation of the performance of third parties in managing the Central Processing Plant (CPP) Gundih over the last decade. In this project, the problem encountered was around high operational and maintenance costs and several benefit issues which were the top problem issues in Central Processing Plant (CPP) Gundih. The objective in this step is to make a decision analysis of which problems we must solve.

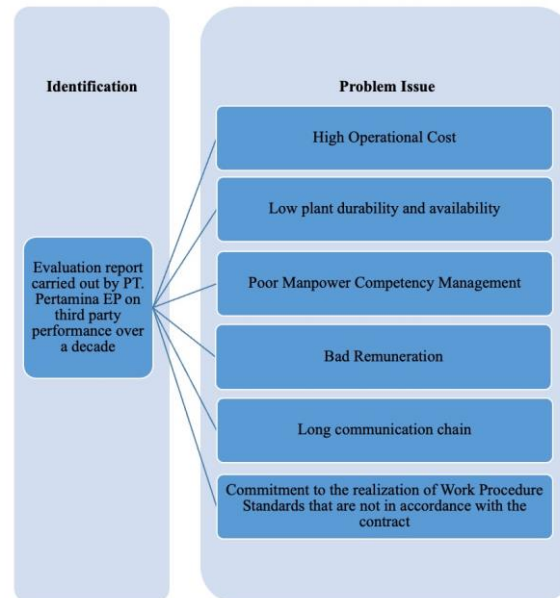


Figure 3. Framework of Problem Identification

Develop alternative solutions

In order to generate ideas for potential solutions to the stated difficulties, a Focus Group Discussion (FGD) was organized, assembling a heterogeneous group of experts from within PT. This Focus Group Discussion (FGD) was held around December 2023 separately according to the informants' ability to spare their time because the interviews were conducted between work and office operations. Pertamina EP Field Cepu. This essential meeting comprised delegates from key departments such as Reliability, Availability, and Maintenance (RAM), Production and Operations, Planning Budgeting and Evaluation, and the Manager of Cepu Field. By engaging in open and collaborative discussion, the FGD produced three distinct alternative ideas, each possessing its own individual strengths and potential consequences. The diverse range of options available allows for a comprehensive assessment and decision-making process, guaranteeing that the selected solution adequately tackles the current difficulties and advances the CPP Gundih :

- a) Detailing the scope of work on the Operation and Maintenance Contract currently running in the upcoming new Contract.
- b) Carrying out partial transfer of management, where part of the work is managed by a second party and part is carried out by the company
- c) Carrying out full transfer of management by the company (PT. Pertamina EP)

Select a solution

Decision making to select the best solution will be conducted by utilizing SMART (Simple Multi-Attribute Rating Technique). Based on the result of brainstorming session. There are several criteria that has been developed in this decision-making process:

1. Criteria: Cost
Sub-Criteria:
 - a. Cost
2. Criteria: Benefit
Sub-Criteria:
 - a. Durability and plant availability
 - b. Manpower Competency Management
 - c. Remuneration
 - d. communication flow

e. Integrated Work Procedure Standards

Implement the solution

Using a carefully selected alternative solution, researcher will create a detailed set of suggestions and a strong plan for implementing improvements to the Operation and Maintenance Management System (OMMS) at the Central Processing Plant (CPP) Gundih. This roadmap will not be a casual consideration, but a well-designed plan, analyzing every aspect of the chosen solution and thoroughly evaluating its effectiveness and practicality. By doing a comprehensive analysis, a detailed and practical strategy will be developed, specifying the required actions, allocation of resources, and timetables for implementing the solution and achieving measurable outcomes. This part will be regularly updated and adjusted to changing circumstances, ensuring a smooth and successful transfer from theory to practice. In the end, the success of this project depends on a realistic assessment of the chosen solution and a carefully designed plan for putting it into action. This will help turn possibilities into actual achievements, and drive the Central Processing Plant (CPP) Gundih towards achieving high levels of operational performance.

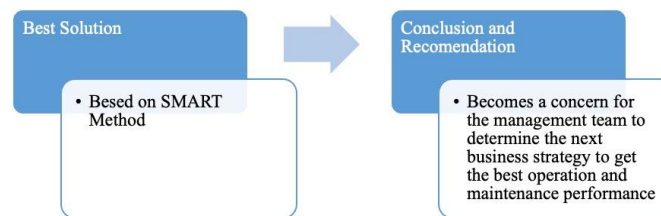


Figure 4. Implementation of Alternative Solution

In this study, the researcher adopted this research design by making several adjustments based on the needs of this study. The following is the research design that was tried to be applied:

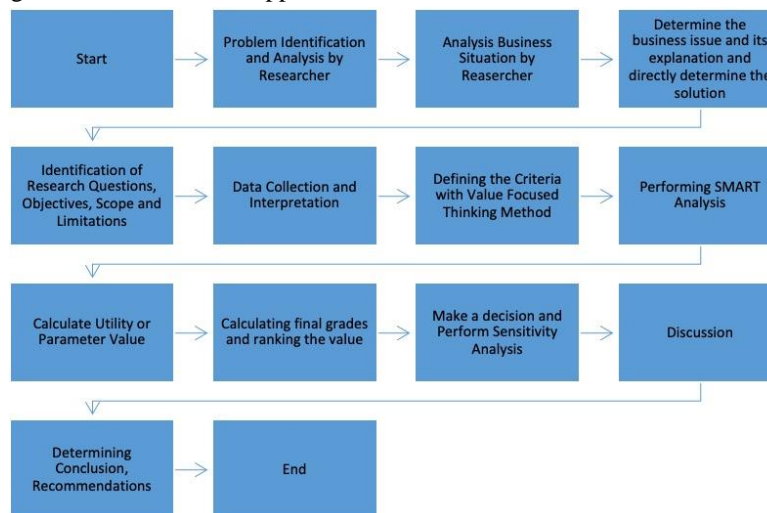


Figure 5. Research Design Based on The Needs of This Study

Data Collection Method

The researcher will use SMART methods for the decision-making process. The simplicity in gathering and analyzing the data result is the advantage of SMART method to make it widely used in decision making. The analysis is also transparent, giving us a better understanding of the problem and the calculation process for the decision-maker.

The alternatives in this project to solve the problem will be generated by using the Value Focused Thinking (VFT) method. Focus group discussion was conducted to narrow down the alternatives to solve the problem with a brainstorming session, what is the best way to decide the operation and maintenance management system in the Central Processing Plant (CPP) Gundih. The group of

discussion consists of 4 departments in PT. Pertamina EP Field Cepu. Which are the Production and Operation Gundih Department; Reliability and Maintenance Department (RAM) Gundih; Planning, Budgeting, and Evaluation Department; and Field Manager.

As the first step for these methods, the researcher discusses with a small group to define the value tree. This small group consists of 4 people. Informant 1 is a worker from the planning, budgeting, and evaluation department. The main task is to plan the overall budget needs at PT. Pertamina EP Field Cepu, apart from that, the task of informant is:

- Informant 1 is to evaluate the company's operational expenses and expenditure that have been allocated so that the realization is in accordance with what has been determined.
- Informant 2 is a worker from the Gundih Production and Operation department, where he holds the position of assistant manager. His main task is as junior management who has full control over the gas production operational process from upstream to downstream. He also has full authorization for the management of workers under the department.
- Informant 3 is a worker under the Gundih Reliability, Availability and Maintenance (RAM) department where he holds the position of assistant manager. The main task of informant 2 is to ensure that all maintenance work in the Gundih field is according to plan and ensure the reliability of every facility in the central processing plant is in good condition and suppress maintenance breakdowns which result in decreased plant availability levels.
- Informant 4 is the Cepu Field Manager. He is the under-field manager of Field Cepu. He has the highest authority in Cepu. His main task is to ensure that all field operations run well, establish good relationships with stakeholders and the community and prioritize safety aspects in every company activity.

As the solutions to the problems require insight and experience from multiple cross-functional department members and management team are highly needed. Based on several discussions conducted, it is obtained that the fundamental objective is to find the best solution of operation and maintenance management system in central processing plant (CPP) Gundih area. The value driver from framing discussion is listed, structured, and linked to show mean-end objectives relationship is obtained the process thinking to generate alternatives are as follows:

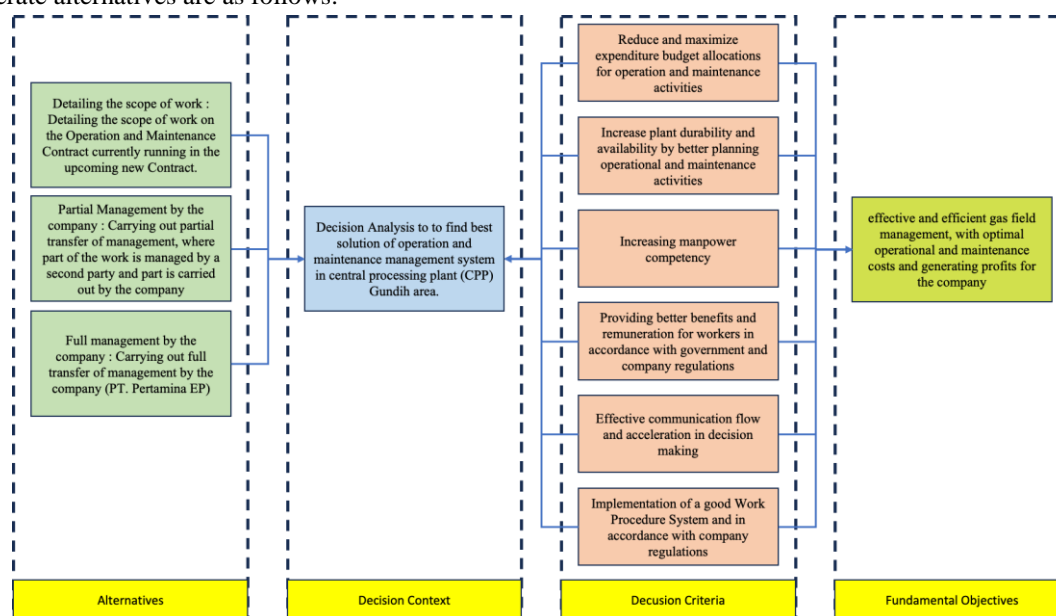


Figure 6. Value Focus Thinking process (Criteria and Alternatives)

RESULTS AND DISCUSSION

SMART Result

- Stage 1: Identify the decision maker (or decision makers).

Central Processing Plant (CPP) Gundih is a gas field belonging to the working area of PT. Pertamina EP and managed under the Cepu Field. CPP Gundih has been operating since 2013 and since its inception, operations and maintenance have been handled by



a third party with a contract period of 10 years. After almost a decade of operation by a third party, many evaluations have become a concern for the company, especially in terms of costs and work procedures that need a lot of improvement. Based on these improvement needs, the company needs a lot of input to decide on the continuation of the Gundih CPP management system after the contract period with the third party has expired. In this case, the decision holders are representatives of the company, namely the Cepu Field Manager and the Zone 11 General Manager.

2. Stage 2: Identify the alternative course of action

Three alternative management structures for CPP Gundih were proposed to address shortcomings in the current third-party O&M contract. Option A focuses on revamping the existing contract with a tighter scope of work and enhanced oversight. Option B proposes a partial transfer of management, leveraging a third party for specific tasks while internalizing key operations. Option C advocates for a full transfer of management to PT. Pertamina EP, aiming for streamlined leadership, optimized resource allocation, and potential production increases. Each option offers distinct advantages and challenges, requiring careful evaluation to determine the optimal solution for CPP Gundih's future success.

3. Stage 3: Identify the attributes which are relevant to the decision problem by using a value tree.

To determine the optimal management solution for CPP Gundih, a multi-criteria decision-making framework was established, prioritizing both cost-effectiveness and a range of operational benefits. Cost remains a pivotal factor, where lower expenditure is preferred while maintaining or exceeding service quality. Beyond cost, several crucial benefits are considered:

- Durability and plant availability: Ensuring high plant resilience translates to reliable gas delivery for consumers and increased company profits.
- Manpower competency management: Competent personnel minimize human error and enhance operational efficiency.
- Remuneration: Fair and comprehensive employee compensation fosters workforce stability and motivation.
- Communication flow: Streamlined communication empowers faster decision-making and better solution identification.
- Integrated work procedure standards: Adherence to agreed-upon procedures ensures smooth operations and optimal outcomes.

This multi-faceted approach ensures a holistic evaluation of potential solutions, ultimately guiding the selection of the best fit for CPP Gundih's long-term success and sustainable growth.

4. Stage 4: Measure the performance of the alternatives on that attribute. Then rank each alternative with other criteria.

Cost

Table 1. Comparison of Cost

Alternatives Solution		Cost (IDR/Year)
Detailing the scope of work on the Operation and Maintenance Contract currently running in the upcoming new Contract.	Alternative 1	Rp. 74.500.000.000,00
Carrying out partial transfer of management, where part of the work is managed by a second party and part is carried out by the company	Alternative 2	Rp. 69.500.000.000,00
Carrying out full transfer of management by the company (PT. Pertamina EP)	Alternative 3	Rp. 39.500.000.000,00

Durability And Plant Availability

When assessing the durability and plant availability of different management options for CPP Gundih, a focus group discussion identified full transfer of control by PT. Pertamina EP as the most reliable solution. This was attributed to the company's direct control over equipment maintenance planning, supervision, and monitoring. Absence of third-party involvement eliminated lengthy approval processes and communication chains, allowing for swifter issue resolution and ultimately enhancing plant reliability in gas distribution. In essence, full control empowers faster response to equipment issues, minimizing downtime and maximizing gas delivery consistency.



Manpower Competency Management

In evaluating manpower competency management, the group discussion favored the full transfer of management option over the partial transfer approach. This preference stemmed from the perceived superior control and flexibility offered by direct company oversight. With full control, the company could comprehensively address all competency criteria, including mandatory and auxiliary items, without relying on or negotiating with a third party. Supervisors could directly assess and manage third-party personnel, facilitating desired placements and fostering smoother integration within the company structure. While the partial transfer option still provided some advantages compared to the existing third-party contract, it ultimately fell short in terms of employee management autonomy and agility.

Remuneration

Remuneration emerged as a critical factor in evaluating the different management options for CPP Gundih. Participants in the discussion group sessions deemed fair and adequate employee compensation crucial for both employee motivation and operational stability. Full transfer of management by the company received the highest rating due to its potential for ensuring employees receive the full allocated income, avoiding deductions associated with third-party involvement. The research highlights the importance of prioritizing remuneration, as inadequate compensation can lead to demotivation, disruptions, and ultimately hinder the success of any chosen management alternative.

Communication Flow

Analyzing the communication flow sub-criteria reveals that the decision-making process emerged as the key differentiator. The full transfer of management (alternative 3) received the highest score due to its streamlined communication structure, eliminating external third-party layers and enabling faster troubleshooting and problem-solving. While options 1 and 2 involve lower company costs due to fixed budget constraints, employee compensation suffers under third-party involvement, impacting morale and potentially hindering smooth operations. Ultimately, the full transfer of management, despite no budgetary differences, provides the greatest potential for improved communication and decision-making agility, contributing to a more efficient and responsive CPP Gundih.

Integrated Work Procedure Standards

In the context of evaluating alternative management solutions for CPP Gundih, integrated work procedure standards emerged as a critical factor. The group discussions emphasized its importance in maintaining safety, operational efficiency, and quality standards. When assessed using direct rating, the "full transfer of management by the company" option received the highest score due to concerns surrounding the current third-party contract. The lack of clear regulations regarding work procedure management under the existing contract has led to several issues. Notably, third-party vendors view work procedures as valuable assets and maintain tight control over them, creating opacity and hindering company oversight. Additionally, requesting updates to procedures proves difficult due to this lack of transparency. Therefore, the group discussion concluded that a full transfer of management would allow the company to implement and maintain unified, integrated work procedures, ultimately ensuring optimal safety, operational effectiveness, and quality control at CPP Gundih.

5. Stage 5: Determine the weight for each attribute.

After measuring all of the alternative values. It can conclude in the table below:

Table 2. Alternative Performance in each Sub-Criteria

Alternative Solution	Cost	Benefit				
	Cost	Durability and Plant Availability	Manpower Competency Management	Remuneration	Communication Flow	Integrated Work Procedure Standards
Detailing the scope of work on the Operation and Maintenance Contract	41	50	25	25	0	0



Partial transfer of management	78	50	75	75	100	100
Full transfer of management by the company	100	100	100	100	100	100

The subsequent step is determining the sub-criteria's weight and calculating the aggregate of weighted value. The researcher asked the group discussion member to rank the best to least preferred level of sub-criteria and calculate the normalized weight. The result could see in the table below:

Table 3. Weight of sub-criteria

Criteria	Sub-Criteria	Original Weight	Normalized Weight
Cost	Cost	100	0.29
Benefit	Durability and Plant Availability	83	0.24
Benefit	Manpower Competency Management	67	0.19
Benefit	Remuneration	50	0.14
Benefit	Communication Flow	33	0.10
Benefit	Integrated Work Procedure Standards	17	0.05
Total		350	1.00

6. Stage 6: For each alternative, take a weighted average of the values assigned to that alternative. After obtaining the weight of sub-criteria, calculate the value from each alternative to get aggregate weighted value, like shown in the table below.

Table 4. Detailing the scope of work on the Operation and Maintenance Contract Aggregate of weighted value

Criteria	Sub-Criteria	Value	Normalized-Weight	Result
Cost	Cost	41	0.29	11.89
Benefit	Durability and Plant Availability	50	0.24	12.00
Benefit	Manpower Competency Management	25	0.19	4.75
Benefit	Remuneration	25	0.14	3.50
Benefit	Communication Flow	0	0.10	0.00
Benefit	Integrated Work Procedure Standards	0	0.05	0.00
Total				32.14

Table 5. Partial Transfer of Management Aggregate of weighted value

Criteria	Sub-Criteria	Value	Normalized-Weight	Result
Cost	Cost	78	0.29	22.62
Benefit	Durability and Plant Availability	50	0.24	12.00
Benefit	Manpower Competency Management	75	0.19	14.25
Benefit	Remuneration	75	0.14	10.50
Benefit	Communication Flow	100	0.10	10.00



Benefit	Integrated Work Procedure Standards	100	0.05	5.00
Total				74.37

Table 6. Full transfer of management by the company Aggregate of weighted value

Criteria	Sub-Criteria	Value	Normalized-Weight	Result
Cost	Cost	100	0.29	29.00
Benefit	Durability and Plant Availability	100	0.24	24.00
Benefit	Manpower Competency Management	100	0.19	19.00
Benefit	Remuneration	100	0.14	14.00
Benefit	Communication Flow	100	0.10	10.00
Benefit	Integrated Work Procedure Standards	100	0.05	5.00
Total				101.00

From the aggregate of weighted value, it can conclude that full transfer of management by the company is the best alternative (101.00). The second position goes to partial transfer of management (74.37) and the last choice is the Detailing the scope of work on the Operation and Maintenance Contract (32.14).

7. Stage 7: Make a provisional decision

The next step is trading weight with cost, as shown in the table below.

Table 7. Weight vs. Cost

Alternative Solution	Weight	Cost (IDR)
Carrying out full transfer of management by the company (PT. Pertamina EP)	101.00	Rp. 39,500,000,000.00
Carrying out partial transfer of management, where part of the work is managed by a second party and part is carried out by the company	74.37	Rp. 69,500,000,000.00
Detailing the scope of work on the Operation and Maintenance Contract currently running in the upcoming new Contract.	32.14	Rp. 74,500,000,000.00

We can conclude from Figure 4.6. below that Carrying out full transfer of management by the company (PT. Pertamina EP) generates the highest weight and most affordable cost on that graph. It makes Carrying out full transfer of management by the company (PT. Pertamina EP) is the best alternative according to SMART method.



Figure 7. Weight vs. Cost



8. Stage 8: Perform sensitivity analysis to see how robust the decision is to changes in the figure supplied by the decision maker.

From SMART methods, sub-criteria play the most vital role in selecting the best alternative. The important Sub-Criteria from the most attractive to the less attractive start with Cost, Durability and Plant Availability, Manpower Competency Management, Remuneration, Communication Flow, and Integrated Work Procedure Standards. The difference is the weight value of each Sub-criteria, as shown in the table below.

Table 8. The Rank of SMART Criteria's Weight

Criteria	Sub-Criteria	Priority Ranking (Weighted)	Rank
Cost	Cost	0.29	1
Benefit	Durability and Plant Availability	0.24	2
Benefit	Manpower Competency Management	0.19	3
Benefit	Remuneration	0.14	4
Benefit	Communication Flow	0.10	5
Benefit	Integrated Work Procedure Standards	0.05	6

The alternative chosen from SMART methods is Innovation becomes the preferred alternative. Despite the fact that the most preferred alternative is the same, each method's weight accumulation rank position is different. The rank table show as follows:

Table 9. Weighted accumulation Rank

Alternative Solution	Weighted Accumulation Rank
Detailing the scope of work on the Operation and Maintenance Contract	3
Partial transfer of management	2
Full transfer of management by the company	1

In the SMART Method, Full transfer of management by the company reach the first position because it offers the lowest cost and most accessible compared to other alternatives. When setting the strategy to achieve the fundamental objective, the group discussion agreed that the chosen alternatives shouldn't burden the operational/ capital expenditure. The alternative chosen must also offer an effective and accessible way of monitoring maintenance and operation process in gas field – Central Processing Plant (CPP) Gundih. It could be proven in discussion and interview sessions to make pairwise comparisons; the rank of the cost and manpower competency management get in first and second position.

CONCLUSION

The research analyzed the current issues with the third-party O&M system at CPP Gundih, finding significant concerns: high costs, low plant availability, inadequate manpower management, unfair employee compensation, slow communication, and outdated work procedures. To address these problems, various alternatives were explored, with the full transfer of management by PT. Pertamina EP emerging as the preferred solution. This approach was deemed most effective in optimizing field processes, reducing costs, enhancing efficiency, and ensuring control over key aspects like manpower, communication, and procedures.

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