International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Proposed Improvement of Contractor Selection for Maintenance of Reactor Effluent Air Cooler Using Value-Focused Thinking and Analytic Hierarchy Process at PT KPI RU V Balikpapan

Kurniawan Dahri[1], Manahan Parlindungan Saragih Siallagan[2]
[1,2] Master of Business Administration, School of Business and Management, Bandung Institute of Technology

ABSTRACT: PT KPI RU V Balikpapan performs turnaround to ensure equipment reliability for domestic oil and natural gas production. The Reactor Effluent Air Cooler (REAC) is an important refinery secondary process equipment. Experience in earlier maintenance showed that repeated work on the equipment's welding tube required further repair processes until it met welding compliance criteria. REAC repair rejections exceeded the 2% target at 43%. Welding on furnaces and tubes was repeated, consequently resulting in delays of work completion that may cost money. The study identified contractor selection criteria using Value-Focused Thinking (VFT). After consulting Subject Matter Experts and Management, five contractor selection criteria were identified: Safety and Health, Technical Ability, Management Capability, Reputation, and Financial. The contractor selection consider uses the Analytic Hierarchy Process (AHP) based on selection criteria. Contractor APL is the best alternative with a 57% score. AHP methods on goods and services procurement can improve contractor selection at the pre-qualification or tender evaluation phase.

KEYWORDS: AHP, Contractor Selection, Turnaround, VFT.

INTRODUCTION

The refinery industry plays a crucial role in meeting global energy demands by processing crude oil into valuable products such as gasoline, diesel, and jet fuel. As the demand for refined products continues to grow, refineries are faced with the challenge of executing complex and large-scale projects to expand, upgrade, or maintain their facilities. The success of these projects heavily depends on the selection of competent contractors who possess the necessary technical expertise, experience, and resources to execute the tasks effectively and efficiently.

The conventional methods of contractor selection in the refinery industry have often relied on past performance records, financial capabilities, and references from previous projects. While these criteria provide some insights into a contractor's capabilities, they may not involve all the essential aspects required for refinery projects, which often involve severe safety standards, sophisticated technology, and adherence to strict environmental regulations. As a result, there is a pressing need to propose an improved and tailored approach to contractor selection in the refinery industry. From the problem above, PT KPI Refinery Unit V in the case of Reactor Effluent Air Fin Cooler (REAC) repair due to turnaround, will develop a strategy of improvement of contractor selection to meet the project objectives: on time, on budget, on safety, and on quality.

BUSINESS ISSUE

REAC repair projects are more challenging in terms of delivery, service, quality, and safety aspects. Non-compliance with these aspects causes contractors to be given warning letters and even blacklisted. In accordance with PERTAMINA blacklist regulations, it even applies to PERTAMINA Group as a whole. But more than that, the impact on the company is greater, namely the fulfillment of fuel stocks, especially services in eastern Indonesia and compliance with safety matters. Negligence about safety can reduce the company's image, moreover if there is an incident and even fatalities. According to the refinery turnaround Post Implementation Report (PIR), there is an evaluation of the performance of contractors working on other equipment which can be explained as Table 1 The problem that occurs is the lack of QC supervision which causes rework. Apart from the contractor performance review mentioned, PIR also stated that limited tenders should be held based on recommended vendors based on both general and specific qualification to improve the contract management aspect. Similar to the cases, REAC as the critical equipment in Hydro Cracking Unit (HCU) has faced problem in QC, causing project delays for 7 days. The company suffers a potential loss of around 2.4 million

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

USD per day (gross) due to plant is not operate during equipment repair. Therefore, this research was conducted to propose the suitable contractor for the tender of REAC project repair at the future in accordance with the procurement goods and services guideline in PERTAMINA.

Table 1. Evaluation of Contractor Performance During Turnaround

Contractor	Equipment Scope	Problem	Evaluation
PT. KOIN	Heat exchanger, finfan cooler, coloumn, furnace	Lack of quality control (QC) supervision, inadequate tools, un-experienced manpower	Improvement in contractor selection. Evaluate the experience and tools readiness. QC aspects must be ensuring prior to contract award
PT. GTA	Heat exchanger, finfan cooler, coloumn, furnace, piping	Lack of QC supervision and follow up recommendation	
PT. PBAS	Heat exchanger, finfan cooler, coloumn	Lack of QC supervision, in-adequate tools, unexperienced manpower, lack of communication	

CONCEPTUAL FRAMEWORK

It is essential to provide a description of the conceptual framework for this study in the form that follows with the objective to drive the concept.

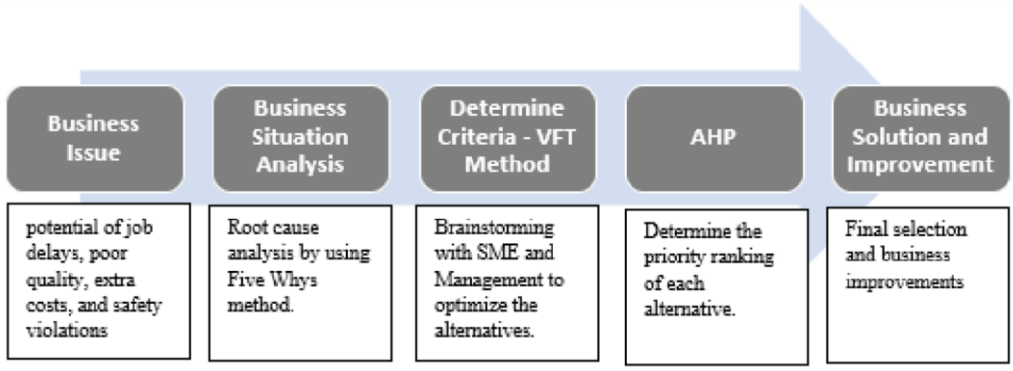

Figure 1. Conceptual Framework

The problem in evaluation of contractor selection for REAC systems repair to meet the objective: time, quality, and cost. If the contractor is not chosen properly, there is a chance of job delays, poor quality, extra costs, and safety violations. Technical evaluation should be carried out to contractors. The "Five Whys" is a way to find the root reasons of issues or problems by asking "why" repeatedly until it leads to the cause. When applied to choosing a contractor, it can help organizations or people understand the basic reasons why it's hard to choose the right one for a job. Important criterion for assessing alternative solutions, such as delivery, service, quality, safety, and other solutions shall be considered in selecting the best contractor for REAC repair project. In this study, brainstorming with Subject Matter Expert (SME) is used to find suitable options based on expertise and experience. Value Focused Thinking method beneficial in uncertain and complex situations with several conflicting goals or criteria. Factors to be considered in the pre-qualification and technical evaluation phase such as delivery, service, quality, and safety.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Several alternative solutions obtained from brainstorming phase are constructed to Analytical Hierarchy Process (AHP) method for selecting the best alternative for REAC repair project. This study will propose the best alternatives solutions to the management as decision maker. Several improvements also proposed in technical bidding of procurement phase.

RESEARCH METHODOLOGY

The research methodology for contractor selection uses a systematic process to find, assess, and select the best contractor for a specific project. An overview of a research approach for contractor selection can be found below:

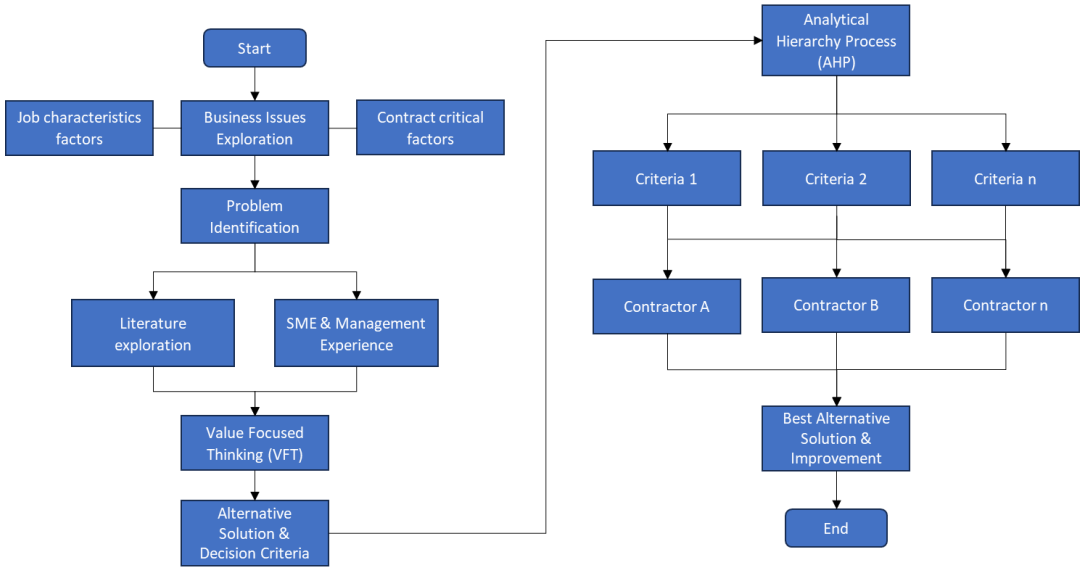

Figure 2. Research Framework

AHP PROCESS

1. Hierarchical structure
   The organization of the decision problem is hierarchical, with three levels: the goal, the criteria, and the options
2. Pairwise comparison
   The relative importance values show how much more important one element is than another, as judged by the person making the choice. Subject Matter Experts (SME) can be interviewed to be consideration by decision maker. Basic matrix scale of value as shown in Table 2

Table 2. Paired Comparison Scale

Interest Intensity	Information
1	Both elements are equally important
3	One element is slightly more important than the other.
5	One element is more important than the other.
7	One element is absolutely essential to the other.
9	One element is clearly more important than the other.
2,4,6,8	Values between to close consideration values

3. Synthesize the result
   a. Step 1: total each column's values.
   b. Step 2: Each matrix component is divided by the sum of its columns. The sum of each column in the normalized pairwise comparison matrix is 1.
   c. Step 3: Average the element in each row. The result is usually represented as the (relative) priority vector (eigen vector)

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

4. Consistency checks
   The formula to calculate consistency index using the following equation.

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Then consistency ratio can be calculated using following equation

$$CR = \frac{CI}{RI}$$

Random Index (RI) can be determined based on table below:

n	1	2	3	4	5	6	7	8	9	10
Random Index (RI)	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

The following stages are used to complete this research:

a. The study of contractor selection is carried out at PT KPI RU V Balikpapan in the case of Reactor Effluent Air Fin Cooler (REAC) repair during Turnaround.
b. The critical path is identified in the activity of REAC repair so that the contractor selection is important for ensuring the project is met with project principle: on time, on budget, on scope, and on quality (OTOBOSQU). Many experiences in projects due to inadequate contractor evaluation, projects are facing delays, cost overruns, and even safety problems. In this stage, The Five Whys method is used to identify problems.
c. Interview with SME and Management was carried out to determine alternative solutions and authorization in decision making in RU V Balikpapan. In this study, SMEs profile consist of Senior Manager, Manager, Section Head, Engineer, and Planner in RU V Balikpapan. Literature review as secondary data also obtained in typical cases of contractor selection
d. In the decision-making processes of contractor selection, Value-Focused Thinking (VFT) helps decision-makers identify, assess, and prioritize project values and objectives. In this VFT analysis, it was found that the criteria that will be reviewed as consideration in selecting a contractor are technical ability, reputation, financial, management capability, work safety and health.
e. The Analytic Hierarchy Process (AHP) method is used to calculate and make decisions in relation to the survey results. Each criterion is given weight based on the criteria that were developed based on the findings in the VFT analysis, and their relevance to each alternative is compared. The processed data will be examined to determine contractor priority criteria based on the study.
f. The analysis will generate conclusions to address the purpose of this study as well as recommendations in the phase of technical evaluation of goods and services in RU V Balikpapan.

ANALYSIS

A. FIVE WHYS METHOD

The Management and Several Subject Matter Experts (SME) from RU V Balikpapan and Head Office of PT Kilang Pertamina Internasional (PT KPI) participated in a Focused Group Discussion (FGD). The participants of FGD are General Manager, Reliability Manager, Maintenance & Support Manager, Turn Around Manager, Technical Advisor, Section Head and Lead from Maintenance.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

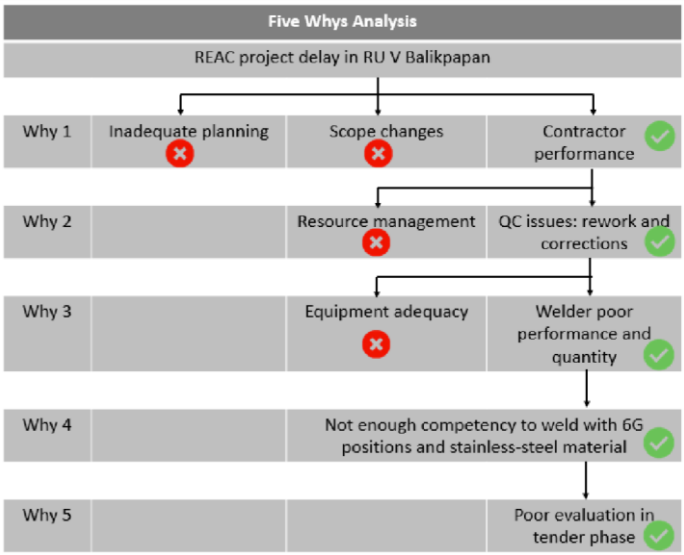

Figure 3. The Five Whys Analysis of REAC Project Delay

Potential factors that can cause delays of REAC project including:

1. Why 1: Contractor performance
   Inadequate contractor evaluation can cause project delays and cost overrun. As mentioned in business issues, RU V Balikpapan suffers a potential loss of around 2.4 million USD per day for 7 days delays in REAC project. Similar cases happen with other equipment, many delays in completing work are caused by the contractor's performance.
2. Why 2: QC issues
   When performing work in the field, there are many issues that are related to quality control; therefore, revisions are required in the form of repairs to be carried out. In cases where repairs are performed multiple times, it is necessary to complete several processes, including re-inspection, before it can be stated that it satisfies QC or has been included into the reference standard. Detailed flow process of the REAC welding tube shown in Figure below:

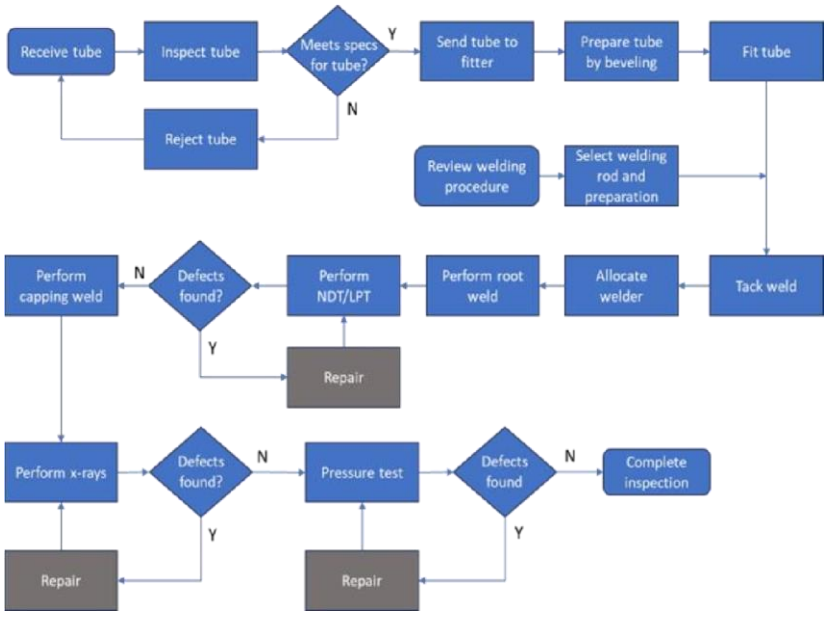

Figure 4. Flow Process of REAC Welding Tube

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

3. Why 3: welder poor performance and quantity
   There are various negative impacts that a welder's poor performance might have on a project. Many construction and manufacturing processes depend on welding, and poor welding performance can lead to safety risks, rework, project delays, and higher costs.
4. Why 4: welder competencies
   A welder that is competent for 6G welding has a great degree of experience and proficiency in welding, especially pipe welding. The "6G" designation designates the most difficult position, where the welder does the welding. According to a number of the industry's best practices, the rejection rate for turnaround should not exceed 2% (Anderson and Kovach, 2014).
   Figure 5 shows the rejection rate for every unit of REAC equipment. The main problem is the extremely high rejection rate, which is far higher than the 2% limit threshold. The type of stainless-steel material utilized as the welding object and the welder's ability complying with the 6G work criteria both have an impact on this rejection rate.
5. Why 5: poor evaluation of contractor
   To enhance the quality of the contract management aspect, it was advised in the Post Implementation Review that limited tenders be held based on selected suppliers who meet both general and specialized qualification requirements. Ensuring vendor capabilities during vendor selection and reducing the number of vendors by single vendor or main contractor strategy may improve contractor management.

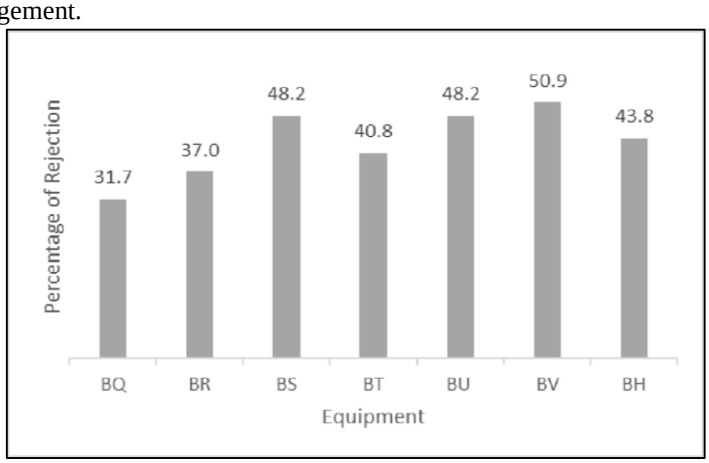

Figure 5. Rejection Rate of REAC Welding

B. VALUE-FOCUSED THINKING

According to the literature used for the determination of supplier selection criteria based on research conducted by Watt, et al (2009) there are 9 criteria for contractor selection, including past project performance, technical expertise, tendered price, project management expertise, workload, client supplier relations, technical solution, company standing, and organizational experience. While Hatush (1997) define the main criteria for contractor evaluation are financial, technical ability, management capability, safety aspects, and reputation.

Result on interview with Management and SME as decision maker, the criteria selected for REAC repair project based on VFT analysis are technical ability, reputation, financial, management capability, work safety & health. Based on the results of interviews and brainstorming with SMEs and Management, combined to literature review, it was found that the criteria and sub-criteria along with alternatives in the form of contractors to be selected can be defined in Table 3. The processed data will be reviewed to determine contractor priority criteria based on the AHP analysis.

The criteria of contractor selection for the REAC project can be adopted to a similar project in PERTAMINA's refinery. The description of criteria above can be elaborate as follows:

1. **Technical ability**: selecting a contractor with strong technical knowledge is important for the success of any project. Regarding the contractor's skills, technical ability is important. Some important things to think about when choosing a contractor to do the competent and project-related parts of the job are listed below.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

2. **Reputation**: an important factor in figuring out a contractor's previous achievements and ability to meet project goals is their reputation. Prior to hiring a contractor, it is important to carefully check their reputation by looking at their past performance, references, and suggestions.
3. **Financial**: Emphasizes the economic stability of employees. The lack of adequate financial stability of a suitably chosen contractor may result in project delays and substandard performance.
4. **Management capability**: The contractor's approach to risk, contract strategy, claims, and variations, as well as their managerial organization and skills, are considered at. Managerial skills also help get the job done on time, as long as the project is handled well and is delivered on time as planned.
5. **Safety & Health**: prioritizing health and safety when choosing contractors not only lowers the chance of accidents, injuries, and the costs that come with them, but it also makes the workplace better and more productive. A successful job with no accidents should include safety as a major factor in choosing a contractor.

Table 3. Criteria and Sub-criteria of Contractor Selection

Goal	Criteria	Sub-criteria	Alternatives
Contractor Selection of REAC Repair Project	Technical ability	▪ Personnel ▪ Facilities and equipment ▪ Competencies	▪ Contractor A ▪ Contractor B ▪ Contractor C ▪ Contractor D
	Reputation	▪ Experiences with demands/claims ▪ Frequency of contractor failure ▪ Length of time in business ▪ Other relationship	
	Financial	▪ Financial stability ▪ Banking arrangements and bonding	
	Management capability	▪ Project management control ▪ Management organization and coordination ▪ Quality guarantee ▪ Fulfillment of contract scope ▪ Workload ▪ Comply with local content policies (TKDN)	
	Safety & Health	▪ Comply with HSE regulation ▪ Delivery of HSE Plan ▪ Management safety	

BUSINESS SOLUTION

This study applies decision analysis in contractor selection process of REAC project in RU V Balikpapan so that it can meet with the turnaround principle: On Time, On Budget, On Scope, and On Quality (OTOBOSQU). The following is a list of company of the alternative contractors:

1. APL, a manufacturer that focuses mostly on working with shell and tube heat exchanger as well as air cooled heat exchanger in accordance with the REAC type of equipment. Experienced in national oil and gas industries.
2. VJ, local contractor, experienced in construction and repair of boiler and piping system, a well-known contractor in RU V Balikpapan
3. TUB, a reputable contractor, experienced in construction and repair of boilers, furnace, and piping system. Many experiences in RU IV Cilacap
4. NSP, an engineering, manufacturing and services company of boiler, reactor, reformer, shell-tube heat exchanger, pressure vessel, piping, fan, pump, steel structure of power plant, refinery, and fertilizer

The Analytic Hierarchy Process (AHP) is a method used to choose the best option from a list of options created in the idea phase. One step in AHP is making comparisons between pairs of elements. To do this, a survey is done to figure out how important one element is compared to another. Subject Matter Experts (SMEs) can be interviewed to get their opinions during this ranking process, helping in decision-making. Ultimately, the AHP method is employed to select the most suitable option. The AHP method is employed to choose the best solution by getting input from multiple Subject Matter Experts (SMEs) as described in Table 4.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Table 4. Subject Matter Experts

No.	Subject Matter Expert	Job Description	Work Experience
1	Senior Group Leader Stationary Inspection	Lead of inspection in process and offsite facilities	11 Years
2	Senior Group Leader Statutory Inspection	Lead of inspection in utilities, responsible for compliance of government regulation	10 Years
3	Stationary Engineer Reliability	Responsible for developing reliability programs	10 Years
4	Engineer Harbor Infrastructure Inspection	Perform inspections of equipment and make evaluation of technical aspect in tender phase	9 Years
No.	**Subject Matter Expert**	**Job Description**	**Work Experience**
5	Engineer Stationary Inspection	Perform inspections of equipment and make evaluation of technical aspect in tender phase	6 Years
6	Engineer Turnaround	Develop resources for Turnaround, contract and material preparation, post turnaround evaluation	6 Years

A. *Analytical Hierarchy Process (AHP) Modeling Structure*

Based on the VFT analysis that was completed above, there are five criteria that need to be considered: technical ability, reputation, financial, management capability, and safety & health.

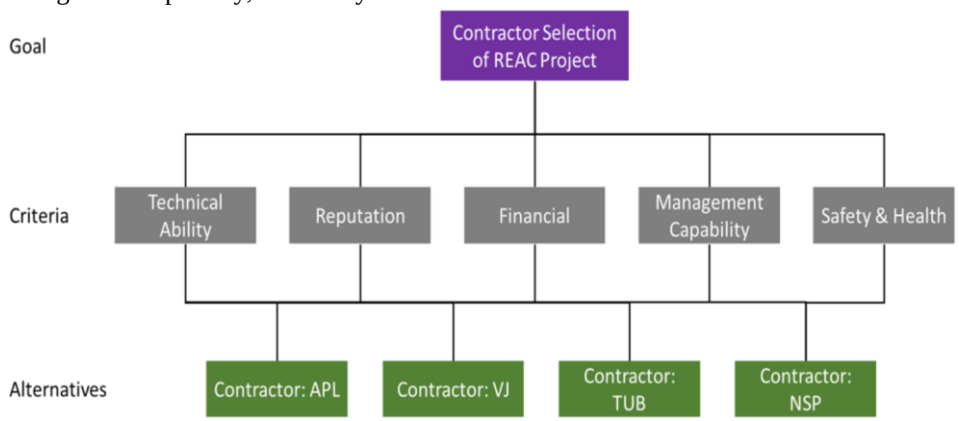

Figure 6. Structure of AHP Hierarchy

B. *Pairwise Comparison of AHP Model*

The available criteria and alternatives must be converted into a comparison table, which is next arranged into a questionnaire to develop Pairwise Comparison into a questionnaire. The Subject Matter Experts (SMEs) involved are given this questionnaire, which they are then requested to complete with their evaluation of each comparison table. A basic value scale, which is a paired numerical value as indicated in the table, is used for this assessment. The sample result of interview with SME shown in Table 5 below:

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Table 5. Pairwise Questionnaire of Criteria

Interview question:
Which one do you think is more important in contractor selection for REAC (E-3-02/20) project?

Attribute	Alternative	Numerical Rating																	Alternative
Criteria	Technical Ability	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reputation
	Technical Ability	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Financial
	Technical Ability	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Management Capability
	Technical Ability	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Safety & Health
	Reputation	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Financial
	Reputation	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Management Capability
	Reputation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	**9**	Safety & Health
	Financial	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Management Capability
	Financial	9	8	7	6	5	4	3	2	1	2	3	4	5	6	**7**	8	9	Safety & Health
	Management Capability	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Safety & Health

C. Results and Analysis

Matrix Criteria

The pairwise comparison matrix's total column is obtained by adding the values in each of its columns. Table.. shows the calculation results.

Table 6. Comparison Matrix Criteria

Criteria	Technical Ability	Reputation	Financial	Management Capability	Safety & Health
Technical Ability	1.00	6.67	5.00	3.00	0.43
Reputation	0.15	1.00	0.32	0.20	0.11
Financial	0.20	3.17	1.00	0.33	0.14
Management Capability	0.33	5.00	3.00	1.00	0.20
Safety & Health	2.33	9.00	7.00	5.00	1.00
Total	4.02	24.83	16.32	9.53	1.88

Devide each element of the pairwise comparison matrix by its column total and average the elements in each row to get priority vector. Table 7 shows the result of calculation.

Table 7. Criteria Priority Vector

Criteria	Technical Ability	Reputation	Financial	Management Capability	Safety & Health	Row Average
Technical Ability	0.25	0.27	0.31	0.31	0.23	0.27
Reputation	0.04	0.04	0.02	0.02	0.06	0.04
Financial	0.05	0.13	0.06	0.03	0.08	0.07
Management Capability	0.08	0.20	0.18	0.10	0.11	0.14
Safety & Health	0.58	0.36	0.43	0.52	0.53	0.49
Total	1.00	1.00	1.00	1.00	1.00	1.00

The result of priority vector or eigen vector of the solution criteria shown in the Table 8.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Table 8. Priority Vector of Solution Criteria

Solution Criteria	Priority Vector
Technical Ability	0.27
Reputation	0.04
Financial	0.07
Management Capability	0.14
Safety & Health	0.49

Matrix of Alternative Solution

The results of the average row are typically shown as alternative solution priority vectors or eigen vectors:

Table 9. Alternative Solution's Result Vector Priority

Alternative Solution	Technical Ability	Reputation	Financial	Management Capability	Safety & Health
APL	0.59	0.63	0.52	0.58	0.55
VJ	0.07	0.07	0.06	0.06	0.09
TUB	0.13	0.13	0.15	0.13	0.13
NSP	0.21	0.18	0.26	0.22	0.23

Development of Priority Ranking

The last stage is to rank the priorities in a hierarchy based on the weights of all alternative solutions and criteria by using the criteria priority vector.

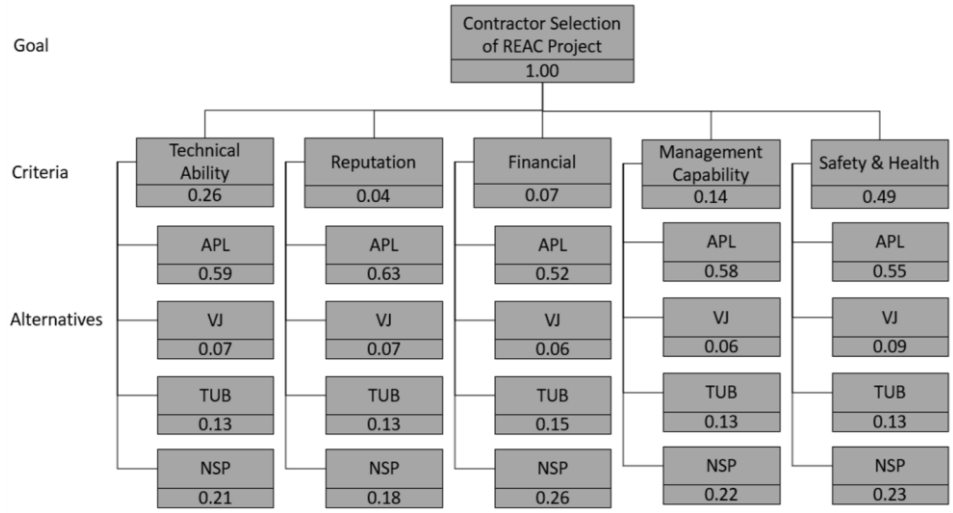

Figure 7. Criteria and Alternative Solution Weights

The sum of the criteria priority (weight) product and the decision alternative's priority (preference) with respect to that criterion determines the overall priority for all alternatives. Multiplying all the weights in every path generates the ranking rate of alternatives, and the results for several paths are summed together.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Table 10. Calculation of Priority Vector with Criteria Weight

Alternative Solution	Technical Ability	Reputation	Financial	Management Capability	Safety & Health
APL	0.59	0.63	0.52	0.58	0.55
VJ	0.07	0.07	0.06	0.06	0.09
TUB	0.13	0.13	0.15	0.13	0.13
NSP	0.21	0.18	0.26	0.22	0.23

X

Solution Criteria	Priority Vector
Technical Ability	0.27
Reputation	0.04
Financial	0.07
Management Capability	0.14
Safety & Health	0.49

The selection of the best alternative solution from the alternative ranking results is displayed in Table 11.

Table 11. The Contractor Ranking

Alternatives		Score	Rank
Contractor 1	APL	57%	1
Contractor 2	VJ	8%	4
Contractor 3	TUB	13%	3
Contractor 4	NSP	22%	2

Consistency Ratio

a. Multiply each value in the first column of the pairwise comparison

$$0.27\begin{pmatrix}1.00\\0.15\\0.20\\0.33\\2.33\end{pmatrix}+0.04\begin{pmatrix}6.67\\1.00\\3.17\\5.00\\9.00\end{pmatrix}+0.07\begin{pmatrix}5.00\\0.32\\1.00\\3.00\\7.00\end{pmatrix}+0.14\begin{pmatrix}3.00\\0.20\\0.33\\1.00\\5.00\end{pmatrix}+0.49\begin{pmatrix}0.43\\0.11\\0.14\\0.20\\1.00\end{pmatrix}=\begin{pmatrix}1.52\\0.19\\0.37\\0.74\\2.67\end{pmatrix}$$

b. Divide the elements of the vector of weighted sums obtained in step 1 by the corresponding priority value (row average)

Table 12. Average Value of Criteria

Criteria	Weighted Sum (A)	Row Average (B)	Average Value (A/B)
Technical Ability	1.52	0.27	5.62
Reputation	0.19	0.04	4.63
Financial	0.37	0.07	5.25
Management Capability	0.74	0.14	5.27
Safety & Health	2.67	0.49	5.45

c. Compute the average of the values computed in step 2, as λmax

$$\lambda \max = \frac{5.62 + 4.63 + 5.25 + 5.27 + 5.45}{5} = 5.24$$

d. Compute the consistency index (CI) of comparison.

$$CI = \frac{\lambda max - n}{n-1} = \frac{5.24 - 5}{5-1} = 0.06$$

e. Compute the consistency ratio (CR) by comparing consistency index (CI) to random index (RI), where RI = 1.12

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

$$CR = \frac{CI}{RI} = \frac{0.06}{1.12} = 0.05 < 0{,}1 \quad \boldsymbol{consistent}$$

The summary of consistency ratio for alternative solution can be seen in Table 13:

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

Table 13. Consistency Ratio of Alternative Solution

Criteria	Alternative Solution	CR	Remarks	Degree of Consistency
Technical ability	APL VJ TUB NSP	0.06	Consistent	Acceptable
Reputation		0.06	Consistent	Acceptable
Financial		0.06	Consistent	Acceptable
Management capability		0.06	Consistent	Acceptable
Safety & health		0.01	Consistent	Acceptable

D. *Implementation Plan*

The results of the preceding sub-chapter suggest that to implement improvement of contractor selection in PERTAMINA RU V Balikpapan especially for critical job in turnaround or routine maintenance, an implementation plan must be proposed. The steps, resources, and activities necessary to accomplish objectives or goals are outlined in a comprehensive and organized implementation plan. A process enhancement, project, or initiative is executed in accordance with this blueprint. Assuring that a strategy or concept is efficiently executed is what an implementation plan primarily accomplishes. The implementation plan is described in Table 14. The new procedure will be fully implemented in July 2024 in PERTAMINA RU V Balikpapan. Along with implementation the evaluation also constructs during the plan.

Table 14. Implementation Plan

No	Activity	PIC	Duration (Month)	2024 Jan	Feb	Mar	Apr	May	Jun	Jul
Improvement of Contractor Selection Method										
1	Creating dedicated team (PROC, MPS, HSE)	PROC	1							
2	Preparing procedures									
2.1	Consult AHP Method to Management	PROC	1							
2.2	Focus Group Discussion: evaluating contractor selection method	PROC	1							
2.3	SME review	MPS	1							
3	Validation									
3.1	Finalization of new procedures	PROC, MPS	1							
3.2	Submit to Quality Management	PROC	1							
3.3	Validation by authorized Manager	Management	1							
4	Socialization									
4.1	Deliver the new procedure to the related section	PROC	1							
4.2	Socialize the new procedure	PROC, MPS	1							
5	Implementation	PROC	sustain							
6	Evaluation	PROC	sustain							

CONCLUSION AND RECOMMENDATIONS

Following thorough analysis of the business issues and suggested business solutions, several results are provided to address the study:

1. The criteria involved in the process of selecting a contractor: safety & health, technical ability, management capability, financial, and reputation.
2. The Analytical Hierarchy Process (AHP) Method was utilized to perform calculations subsequent to an evaluation in which a number of criteria were considered as supporting factors for various alternatives. The best contractor for REAC project repair is APL. Hence, APL will propose to continue for commercial evaluation and negotiation.
3. The Analytic Hierarchy Process (AHP) is a decision-making methodology that can be utilized for improving the process of selecting contractors. The Analytic Hierarchy Process (AHP) facilitates a methodical assessment and comparison of criteria and alternatives, allowing the decision-maker to make more well-informed decisions.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 12 December 2023
DOI: 10.47191/ijcsrr/V6-i12-112, Impact Factor: 6.789
IJCSRR @ 2023
www.ijcsrr.org

According to the contractor selection of REAC project repair and to improve contractor selection in PERTAMINA RU V Balikpapan, here are recommendations:

a. To avoid subjectivity and bias, an introduction to the case study must be held prior to taking the interview or questionnaire with the SME.
b. AHP applications can be proposed either in prequalification or in bid evaluation phase. According to the PERTAMINA guidelines, AHP method will be effective for technical submitting together with commercial proposal. Hence the commercial will evaluate as additional criteria.
c. The use of AHP super decision software can be applied to enhance the analysis of contractor selection in the future study

REFERENCES

1. Alptekin, Orkun., & Alptekin, Nesrin. (2017). *Analysis of Criteria Influencing Contractor Selection Using TOPSIS Method*. IOP Conference Series: Material Science and Engineering. http://dx.doi.org/10.1088/1757-899X/245/6/062003
2. Anderson, Nicole C., & Kovach, Jamison V. (2014). *Reducing Welding Defects in Turnaround Projects: A Lean Six Sigma Case Study*. Department of Information and Logistics Technology , University of Houston , Houston.
3. Ariyanti, Fransisca Dini., & Putri, Annatania Calista. (2020). *Selection of Subcontractor Vendor Using Analytic Hierarchy Process (AHP) Method in Construction Company*. IOP Conf. Series: Earth and Environmental Science. http://dx.doi.org/10.1088/1755-1315/794/1/012072
4. Direktorat HSSE. (2019). *Guidelines Corporate Life Saving Rules*. PT Pertamina (Persero)
5. Hatush, Zedan., & Skitmore, Martin. (1996). *Criteria for Contractor Selection*. Department of Surveying, University of Salford. United Kingdom. http://dx.doi.org/10.1080/014461997373088
6. Keeney, R. L. (1992). *Value-Focused Thinking: A Path to Creative Decision Making*. Harvard University Press, Cambridge
7. Maintenance Planning & Support. (2022). *Preliminary Inspection Report TA Kilang BPP I, BPP II, & Utilities RU V Balikpapan*. PT Kilang Pertamina Internasional, RU V Balikpapan.
8. Novani, Santi. (2022, August). *Analytic Hierarchy Process: Multi-criteria decision making* [PowerPoint slides]. School of Business and Management, ITB
9. Novani, Santi. (2022, August). *Strategic Decision Making & Negotiation MM5009: Multi Criteria Decision Making* [PowerPoint slides]. School of Business and Management, ITB
10. Procurement Excellence Center. (2019). *Pedoman Pengadaan Barang/Jasa*. *No. A5-001/I00100/2019-S9.* Direktorat Manajemen Aset. Pertamina.
11. Procurement Excellence Center. (2019). *Tata Kerja Organisasi. Pelaksanaan Pemilihan Penyedia Barang/Jasa. No. B5003/I00100/2019-S9.* Direktorat Manajemen Aset. Pertamina
12. PT Pertamina (Persero). (2023). *Company Profile.* https://www.pertamina.com/id/bisnis-kami
13. Policy & Risk Management. (2022). *Pedoman Pelimpahan Otorisasi Perusahaan. No. A09-003/KPI61000/2022-S9.* Direktorat Keuangan. PT Kilang Pertamina Internasional
14. Saaty, Thomas L., & Vargas, Luis G. (2008). *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process* (2nd edition). Springer, New York.
15. Turn Around. (2023). *Post Implementation Review (PIR) Part B – TA Tahun 2022*. PT Kilang Pertamina Internasional, RU V Balikpapan.
16. Watt, D.J., Kayis, B., and Willey, K. (2009). *The Relative Importance of Tender Evaluation and Contractor Selection Criteria*. International Journal of Project Management 28 (2010), 51-60.
17. Yousaf, F. & Ikramullah Butt, S. (2013). *Reduction in Repair rate of Welding Processes by Determination & Controlling of Critical KPIVs*. International Journal of Production Management and Engineering. http://dx.doi.org/10.4995/ijpme.2014.1609

Cite this Article: Kurniawan Dahri, Manahan Parlindungan Saragih Siallagan (2023). Proposed Improvement of Contractor Selection for Maintenance of Reactor Effluent Air Cooler Using Value-Focused Thinking and Analytic Hierarchy Process at PT KPI RU V Balikpapan. International Journal of Current Science Research and Review, 6(12), 8660-8672