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Job Cat Egory Prioritization and Selection in PT.MAI 88 Using Analytical Hierarchy Process (AHP)

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ABSTRACT: PT. MAI 88, one of the government company divisions in the Pekanbaru City which operates in the fields of Public Works, Spatial Planning, Housing, Settlement Areas and Land. PT.MAI 88 experienced difficulties, namely that material resources were not allocated properly. With the main aim of prioritizing the procurement of goods for road and bridge construction maintenance, this research focuses on one of the uses of Multicriteria Decision Making (MCDM), namely the Analytical Hierarchy Process (AHP) to determine the ranking of each construction goods procurement job. The AHP method itself has been discussed with stakeholders involved in the project. It has four categories and thirteen subcategories that have been determined and lead to 12 job alternatives. The results of the AHP show that the criteria with the highest weight starts from Urgency followed by Public Satisfaction, Quality, and Cost Management. Then for the Sub criteria with the highest weight, namely Reports from local public, followed by Traffic Management, Long-term Durability and Reliability, Compliance with specifications and Standards, Labor Cost, Public Safety, Rent Construction Equipment, Resources Availability, Material Cost, Public Engagement and Communication, Stakeholder Expectations, Ease of Installation and Integration, and finally Subcontractor Cost. The alternatives with the highest weight are Procurement of Road Signs, Procurement of "Urugan Pilihan", Procurement of Base A Stones, Procurement of Base B Stones, Procurement of Several Construction Equipment, Procurement of Asphalt Concrete Binder Course, Procurement of Non-subsidized diesel fuel , Procurement of Dump Truck, Procurement of Binder Absorbent layer, Procurement of material for Culvert Channels and Boxes, Procurement of Construction Retaining Wall, Procurement of Cementation Work.

KEYWORDS: Construction Management, Job Prioritization, MCDM, AHP, Road and Bridge Maintenance.

INTRODUCTION

Road maintenance aims to ensure that the condition of a completed and operational road remains stable, consistent with the level of service and capability at that time, until the designated design life is exhausted. PP 34 of 2006 concerning Roads and Minister of Public Works Regulation No. 13/PRT/M/2011 concerning Procedures for Road Maintenance and Surveillance are the fundamental regulations governing road maintenance. The foundation of this Journal is centered on the indispensable role that project management plays in the domain of road and bridge maintenance projects. As construction endeavors evolve in complexity, effective project management emerges as a critical determinant of success. This function ensures the judicious allocation and utilization of resources, including machinery, materials, manpower, finances, and oversight from stakeholders. Specifically, within the context of road and bridge maintenance, the significance of job prioritization is underscored as an integral component within the broader framework of project management. The longer the delay in handling road maintenance will result in increasingly severe damage, the costs for carrying out repairs to road damage will also be greater. Road managers should be aware of this. However, it is not easy to carry out road maintenance properly, if the funds provided for this are very limited. Job prioritization is a critical factor in road and bridge maintenance projects as it significantly impacts the order and schedule of tasks to achieve the intended project goals. An effectively delineated prioritization strategy promotes efficient operations, increased output, and compliance with predetermined schedules. The acquisition of construction materials represents a complex and diverse endeavor. The primary aim of the procedure is to procure appropriate products to execute predetermined duties with optimal efficiency, productivity, and economic viability. The construction sector in Indonesia has the fifth position in terms of its contribution to the country's economy, as seen by its representation of 9.77 percent in the Gross Domestic Product (GDP) during the year 2022. Construction developments in Indonesia are monitored by the Central Statistics Agency (BPS) through the implementation of the Quarterly Construction Company Survey (SKTR). This survey specifically targets medium and largescale construction enterprises operating in the country. Government investment on public works initiatives, such as public buildings, bridges, and highways, has the potential to completely change the construction sector. This means

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that construction companies have access to a broad range of projects and contracts, opening opportunities for growth and increased profitability.

LITERATURE REVIEW

The construction field is intricate due to its mix of players like contractors, clients, and consultants. How well the construction business does directly affect the national budget. So, if we are leading a project, we have got to dig into efficient tools and techniques. Planning must be spot-on for smooth project execution. Considering how construction impacts globally, checking how well the project's doing becomes crucial. Project success in construction is a hot topic, especially figuring out the standards for measuring how well it's going. But, getting a project to be successful isn't a walk in the park these days. With people being more eco-conscious and customers always changing their minds, there are hurdles. These include dealing with global market ups and downs, not having enough resources, a shortage of skilled team members, budget worries, and fierce competition in the construction game. To tackle these, everyone involved needs to constantly step up their game. Loads of studies have investigated what makes a project a success. Some say it's all about managing time, quality, budget, and making sure the publics happy. But when it comes to project success, the big studies focus on getting the timing right, keeping costs in check, ensuring quality, being productive, and keeping everyone safe. A construction project is a win when it wraps up on time, doesn't break the bank, and meets all the specs (Ingle, P. V., & Mahesh, G.,2022). A considerable challenge in evaluating productivity lies in pinpointing the specific factors that contribute to variances in project performance (Klanac and Nelson, 2004). Making sure our bridges and roads stay in top-notch shape is crucial for our transportation system. I've come across research and insights from professionals, all diving into different aspects of managing bridges. They've been figuring out ways to predict when a bridge might start showing wear and tear, optimizing how we use resources for maintenance, keeping a real-time eye on conditions, and deciding what should take priority in maintenance (Contreras-Nieto, C., Shan, Y., Lewis, P., & Hartell, J. A., 2019). When it comes to construction, I've learned that getting different organizations to collaborate seamlessly is a big deal. It's all about blending their goals, needs, and ways of doing things into a team that supports each other. They really emphasize this in construction because, let's face it, you've got all these different groups working on one project, and they need to be on the same page. In construction lingo, team integration means bringing all these different project parties together, breaking down any barriers between them, and forming one strong, multi-disciplinary team (Hu, X., & Chong, H. Y., 2022). Without an effective construction management strategy, it is likely that small rural transportation projects will experience cost overruns, rework, and damage, resulting in a lower quality end product. Therefore, special Job prioritization is required for managing these projects (Tran, D. Q., Hallowell, M. R., & Molenaar, K. R., 2015).

MCDM, or Multi-Criteria decision Making, is an operational research technique commonly employed to address intricate choice problems. Multi-Criteria Decision Making (MCDM) allows for the evaluation and incorporation of multiple expert opinions and is used to address the issue of imprecise and ambiguous information in the assessment process. Optimization can be thought of as a decision-making process subject to certain restrictions to get the greatest possible outcomes with the given resources. The literature has used multicriteria decision-making (MCDM) to exploit the search space after examining it with optimization methodologies inspired by nature. Analytic hierarchy process (AHP), a well-known MCDM technique, was created by Thomas Saaty. Its forty-plus years of use have seen it adopted by a wide range of sectors. According to Kumar, A., & Pant, S. (2023), AHP can streamline decision-making by first cataloguing all the aspects that could affect the result and then arranging them in a hierarchical fashion. By decomposing complex decision-making problems into a sequence of pairwise comparisons and subsequently integrating the outcomes, the Analytic Hierarchy Process (AHP) may effectively tackle both the subjective and objective elements of decision making. AHP facilitates tasks such as allocating resources, making alternative choices, formulating plans, and resolving conflicting and subjective categories. In AHP, an issue is organized hierarchically, with the objective at the top, followed by the criteria, and then the alternatives, with an analysis of the relationship between the goal, the criteria, and the alternatives. The foundations of AHP are found in earlier mathematical developments, such as pair-wise comparison and the assignment of weights directly to alternatives (Darko, A., Chan, A. P. C., 2019). In two separate studies AHP is a decision-support tool which can be used to solve complex decision problems. In AHP, the decision-maker should choose each choice that is a linguistic phrase. Some examples of such linguistic phrases are: “A is more important than B”, or “A is of the same importance as B”, or “A is a little more important than B”, and so on (Seo, H., & Myeong, S,2020).

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RESEARCH METHOD

The research method used in this study uses a mixed approach between two research methods, namely Qualitative and Quantitative methods. Qualitative research method is a non-numeric research method that is used to examine the condition of natural objects, where the researcher is the key instrument itself. Meanwhile the Quantitative research method is a numerical research method based on the philosophy of positivism, which is used to examine certain samples, statistical data analysis which aims to test the hypotheses that have been set at the beginning (Rahman, M. S.,2020).

Approaches utilized for data collection are of critical importance in the field of research. The approach to data collection is contingent upon the research method selected. The principal approach employed to gather data for this study is through the utilization of Focus Group Discussion (FGD). Focus group discussion (FGD) is a qualitative research methodology in which a cohort of individuals who share a common interest participates in a directed dialogue to share their perspectives, ideas, beliefs, experiences, thoughts, and personal insights regarding the subject (Ahmad, S., Wasim, S., Irfan, S., Gogoi, S., Srivastava, A., & Farheen, Z., 2019). The focus group discussions (FGD) completed for this study examined the Sub criteria and Criteria that are utilized as standards for job ranking. Additionally, the participants deliberated on alternatives to my position that are ranked by PT.MAI 88. The FGD was utilized to assess pairwise comparisons in the research in accordance with the predetermined criteria and sub-criteria. An overview of the stakeholders who were in attendance during the FGD session is presented in Table 1.

Table 1. List of FGD Participants

No	Initial Name	Location	Role
1	EIK	Pekanbaru	Head of Roads and Bridges UPT Region X
2	YSH	Pekanbaru	Head of Administrative Subdivision
3	DWW	Pekanbaru	Head of Regional Roads and Bridges UPT Administrative Subdivision X
4	RHH	Pekanbaru	Head of Roads and Bridge Network Maintenance Section Region X UPT Road and Bridge Region X

Source: Author, 2023

Additional data to support this journal was obtained from sources outside the company. As for the Literature Review, it was obtained from relevant journals, books and articles related to the discussion of Construction Management, Job Prioritization, MCDM and AHP

ANALYSIS

The initial stage of this research involved the establishment of criteria. The primary source for this determination was a literature review, which provided explanations for each criterion determination based on studies of the literature pertaining to location selection. In Table 2, explanations of the criteria and sub-criteria, along with definitions derived from the sub-criteria, are provided, drawing from research findings in pertinent journals and literature.

Table 2. Criteria and Sub criteria References and Definition

Criteria	Subcriteria	Reference	Definition
Cost Management	Material Cost	H. Islam, M. Jollands, and S. Setunge (2015);	Raw material prices are evaluated here to guarantee that affordable, high-quality materials are used in the building process.
	Labor Cost	J. Auer, N. Bey, and J.-M. Sch¨afer (2017)	Assesses the costs of both highly trained and lowly trained workers to guarantee

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			competitive pay and safe working conditions
	Rent Construction Equipment	K. S. Woon and I. M. C. Lo (2016).	Considers the expenditures connected with machinery and equipment necessary for building activities, guaranteeing efficient use and upkeep.
	Subcontractor Cost	J. Auer, N. Bey, and J.-M. Sch¨afer (2017)	Assesses the expenses related to subcontracted services, ensuring competitive pricing and reliability.
Quality	Compliance with Specifications and Standards	Waris, M., Panigrahi, S., Mengal, A., Soomro, M. I., Mirjat, N. H., Ullah, M., ... & Khan, A. (2019)	This comprehensive assessment confirms if the material or equipment adheres to the specified technical requirements, ensuring its intended operation and smooth integration into the building project.
	Ease of Installation and Integration		This criterion evaluates multiple factors, such as installation simplicity, compatibility with existing infrastructure, prerequisites for worker training
	Long-term Durability and Reliability		The focus is on utilizing durable materials and advanced procedures to ensure the longevity and resilience of buildings against natural calamities.
Urgency	Resource Availability	H. Islam, M. Jollands, and S. Setunge (2015);	Determines whether goods such as labor, materials, and equipment can be obtained in time for the project to begin.
	Reports from local public		This research emphasizes the concerns that the community has about the decline of infrastructure, which makes it harder for everyday activities to go smoothly. These concerns include issues with

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			accessibility and potential safety dangers.
	Stakeholder Expectations		Expected outcomes and requirements held by stakeholders in relation to the project's completion.
Public Satisfaction	Public Engagement and Communication	S. J. Ray and J. Teizer (2016);	Maintains transparent dialogue between the project team and the neighborhood on the scope, schedule, and potential impacts of the work being done.
	Traffic Management		Takes effective methods to regulate traffic flow, reducing delays for drivers and easing the burden on locals.
	Public Safety		Take precautions to ensure the safety of pedestrians and locals, particularly in areas where development is taking place

Source: Author, 2023

Below is an Analytical Hierarchy Process Structure which functions to map criteria and sub-criteria to job alternatives. Figure 1 is the AHP structure of this study

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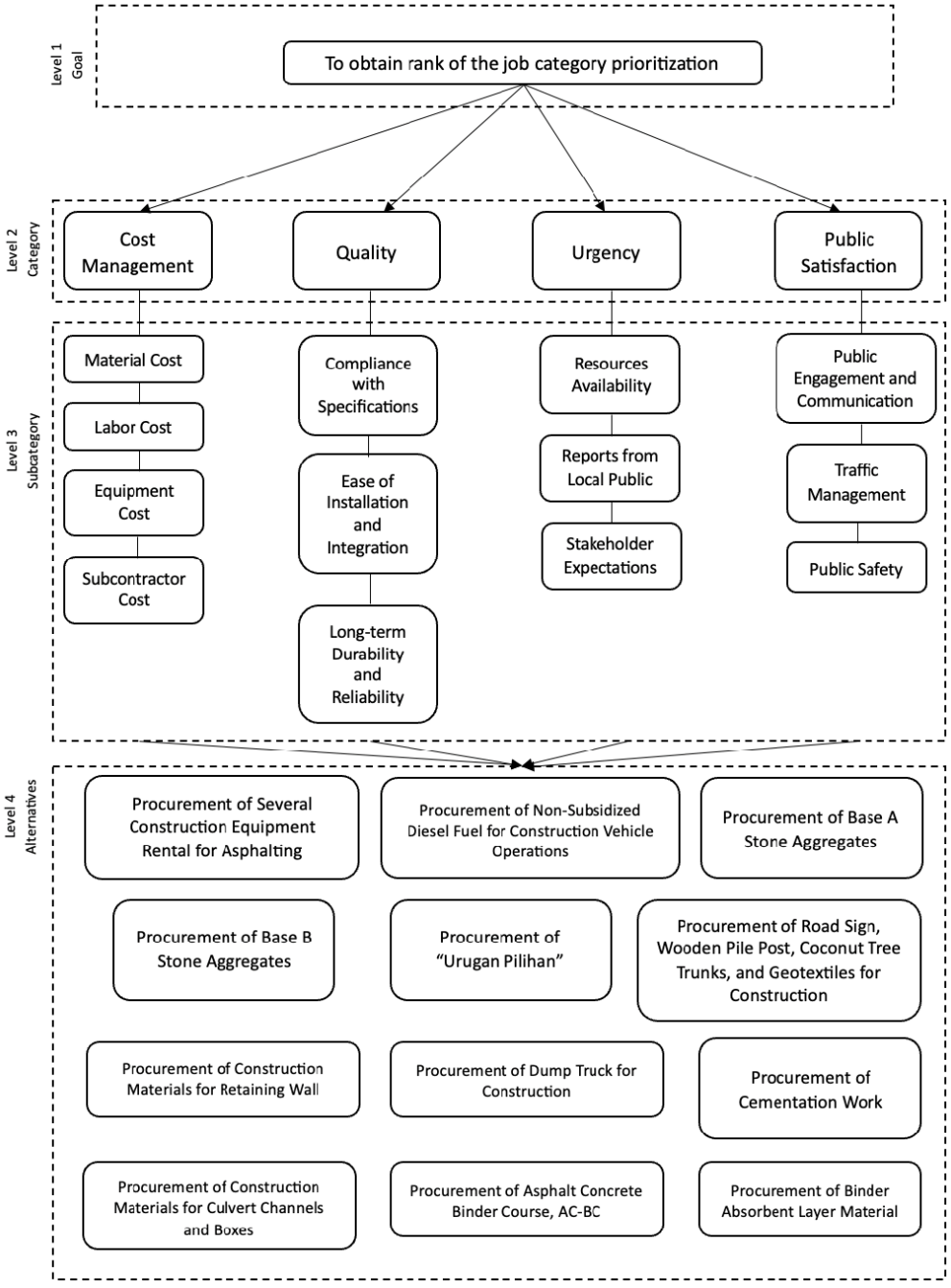

Figure 1 Analytical Hierarchy Process Structure

Researchers developed the Analytical Hierarchy Process Structure to facilitate structured and methodical decision-making through the decomposition of complex issues into more manageable components. There are 4 levels such as Goal in level 1, Category in Level 2, Subcategory in Level 3, and the last is Alternatives in Level 4.

AHP is a method used in decision-making processes such as planning, determining alternatives, resource allocation, determining needs, sales forecasting, and so on. AHP was first introduced by Dr. Thomas L. Saaty from the Wharton Business School in 1991. The steps for the AHP method are as follows:

1.) Arranging a Hierarchy.

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2.) Assess criteria and alternatives.
3.) Choose Priorities.
4.) Determines the logical consistency value.
The steps to determine logical consistency are as follows:
   a. Calculate the comparison value that has been set by dividing the scale value in each cell by the priority cell value.
   b. The calculation results of step a in each cell are divided by the total number in each column.
   c. Find lambda (λ) by multiplying each eigenvalue per row by the total number per column.
   d. Find the maximum lambda (λmax) by adding up the lambda results.
5.) Determine the consistency index (CI) value.
   a. The CI formula is as follow:

$$\mathrm{CI} = \frac{(\lambda Max - n)}{(n-1)}$$

6.) Determine the consistency ratio (CR).
   a. The CR Formula is as follow:

$$\mathrm{CR} = \frac{(CI)}{(IR)}$$

7.) Checking hierarchy consistency. If the calculation results 6 is more than 0.1 then a recalculation needs to be done. If it is less than or equal to 0.1 then it can be stated that the calculation is correct.

The "Consistency Ratio" (CR) is a key metric in AHP, and its verification is essential. Pairwise comparisons are most useful when decisions are made based on the maximum allowable consistency ratio. This is the point at which we can see whether the decision matrix is consistent or inconsistent. When making a pairwise comparison, it is common practice to verify for cardinal and ordinal consistency. If an is greater than b and b is greater than c, then c must be greater than a, according to the principle of ordinal consistency.
Cardinal consistency, on the other hand, mandates a tighter connection between the categories. If an is twice as significant as b and b is three times as significant as c, then an ought to be six times as significant as c. The ratio of weight stability was developed by using a consistency index. In this context, a CR of 0.10 or lower is considered suitable. If CR is above this cutoff value, however, a recalculation of the pairwise comparison must be performed.

Level 0	Level 1	Local Weighted Category	Level 2	Local Weighted Sub Category	Global Priority	Procurement of several construction equipment	Procurement of Non-subsidized diesel fuel	Procurement of Base A Stone Aggregates	Procurement of BaseB Stone Aggregates	Procurement of "Urugan Pilihan"	Procurement of Road Signs, wooden pile posts	Procurement of Construction Retaining Wall	Procurement of Dump Truck for Construction	Procurement of Cementization Work	Procurement of Construction Materials for Culvert Channels and Boxes	Procurement of asphalt concrete binder course	Procurement of Binder Absorbent Layer
Job Prioritization	Cost Management	0,104	Material Cost	0,314	3,3%	0,102	0,094	0,094	0,119	0,128	0,037	0,060	0,086	0,064	0,074	0,073	0,069
			Labor Cost	0,379	3,9%	0,110	0,118	0,072	0,097	0,099	0,053	0,067	0,099	0,067	0,067	0,052	0,099
			Rent construction equipment	0,209	2,2%	0,218	0,175	0,055	0,067	0,074	0,049	0,047	0,168	0,047	0,032	0,023	0,045
			Subcontractor Cost	0,098	1%	0,101	0,094	0,075	0,099	0,101	0,099	0,065	0,148	0,046	0,063	0,037	0,071
	Quality	0,227	Compliance with Specifications and Standards	0,376	8,5%	0,038	0,021	0,145	0,170	0,260	0,032	0,056	0,030	0,057	0,063	0,066	0,063
			Ease of Installation and Integration	0,103	2,3%	0,103	0,147	0,049	0,044	0,022	0,280	0,052	0,128	0,069	0,024	0,026	0,056
			Long-term Durability and Reliability	0,520	11,8%	0,180	0,057	0,061	0,050	0,075	0,051	0,080	0,133	0,069	0,112	0,051	0,082
	Urgency	0,462	Resource Availability	0,245	11,3%	0,181	0,075	0,080	0,086	0,085	0,135	0,046	0,084	0,067	0,036	0,076	0,050
			Reports from local public	0,640	29,5%	0,019	0,020	0,176	0,147	0,159	0,137	0,056	0,019	0,046	0,054	0,112	0,055
			Stakeholder Expectations	0,115	5,3%	0,037	0,040	0,168	0,154	0,205	0,033	0,038	0,042	0,036	0,063	0,092	0,093
	Public Satisfaction	0,207	Public Engagement and Communication	0,191	3,9%	0,023	0,020	0,127	0,158	0,161	0,169	0,064	0,029	0,057	0,055	0,069	0,068
			Traffic Management	0,525	10,9%	0,163	0,139	0,059	0,055	0,047	0,263	0,056	0,086	0,045	0,028	0,029	0,028
			Public Safety	0,284	5,9%	0,121	0,202	0,071	0,063	0,048	0,224	0,037	0,110	0,042	0,026	0,028	0,027
					1	9,4%	6,9%	11,4%	10,9%	12,4%	12,7%	5,6%	6,7%	5,4%	5,6%	7,2%	5,9%

Figure 2. Criteria, Sub Criteria and Alternatives Weighted

Figure 2 above describes the Local Weighted Category, Local Weighted Subcategory, Global Priority and Weighted Sum of each alternative. To make it easier to read and understand, the researcher created a simpler data visualization represented by figure 3 using the barchart from figure 2.

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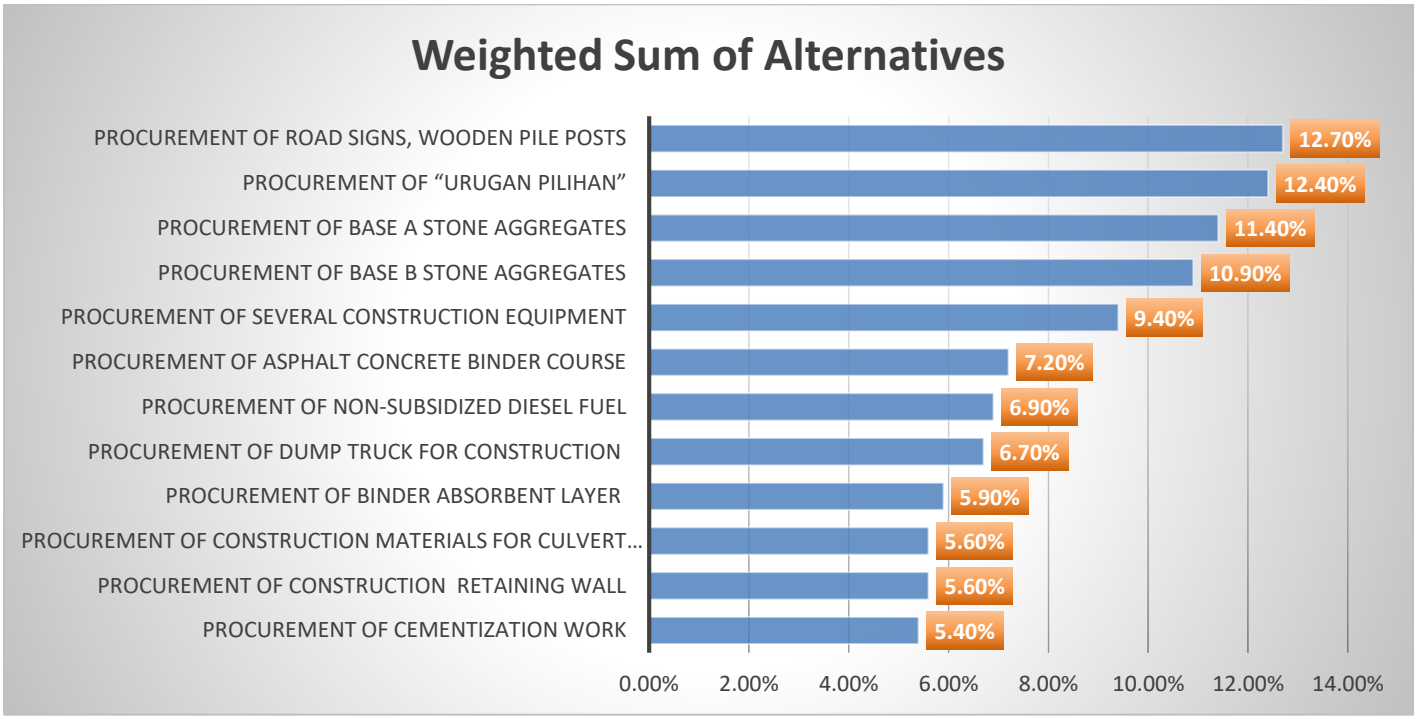

Figure 3. Weighted Sum of Alternatives

The Figure 3 is a chart based on the Figure 2 which is the result of Alternatives produced by ongoing AHP processing. From the Figure 3, it shows that Procurement of Road Sign, and Wooden Pile Post is the most important job ranking for procurement of goods for PT. MAI 88.

Then the most important project carried out by PT. MAI 88 is Procurement of "Selected Fill" (12.4%), followed by Procurement of Base A Stone Aggregates (11.4%), then Procurement of Base B Stone Aggregates (10 .9%), then Procurement of several construction equipment (9.4%), then Procurement of asphalt concrete binder course (7.2%), then Procurement of Non-subsidized diesel fuel (6.9%), then Procurement of Dump Truck for Construction (6.7%), then Procurement of Binder Absorbent Layer (5.9%), then Procurement of Construction Materials for Culvert Channels and Boxes (5.6%), then Procurement of Construction Retaining Wall (5, 6%), then Procurement of Cementation Work (5.4%).

CONCLUSION

There are several categories and sub-categories in the job priority selection process at PT.MAI 88, there are 4 categories, namely Cost Management, Quality, Urgency, and Public Satisfaction. Cost Management In the context of road and bridge construction, cost management concerns the efficient handling and allocation of financial resources, aiming to guarantee project success while adhering to budgetary constraints. Then there is Quality, Adherence to predetermined standards and the assurance of materials and structures durability and dependability comprise quality in the context of road and bridge construction. Safety, functionality, and the overall success of a project are enhanced through the emphasis on delivering products or services that meet predetermined quality benchmarks. The term "urgency" in road and bridge building procurement refers to the need to address crucial variables that affect project success as soon as possible. It entails being sensitive to community input, having resources available, and meeting stakeholder expectations. and finally, Public Satisfaction focuses on meeting community expectations and ensuring a positive experience during maintenance projects. After the results of the pairwise comparison had been entered into the AHP Method and the results were processed, it was found that the stakeholders' priority for the PT.MAI 88 work category was the Urgency Category, and for the Subcategory, namely Reports from local public. This result could be because the company's orientation is quite focused on community complaints regarding damaged roads or bridges in the area. Future enhancement strategies, as described by the researcher, include PT. MAI. PT. MAI 88 assists decision-makers by providing comprehensive specifications for every job category

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that influences the priorities generated by AHP on BPMSG.com. Incorporate diverse viewpoints into streamlined evaluations using AHP to make effective decisions. For material allocation, establish explicit guidelines. Foster improved communication between the Project Management team and the stakeholders by conducting routine dialogues. Perform interviews with essential stakeholders to attain a thorough understanding.

IMPLEMENTATION PLAN

No	Activities	PIC	2024												Remarks
			January	February	March	April	May	June	July	August	September	October	November	December	
1	The planning team plans what items are needed for the work	Implementation team													The team implementing the project
2	Evaluate vendor companies by procurement officers according to requirements	EIK													Head of road and bridges
3	Signing the contract of vendor	EIK													
4	Plan for the delivery and inspection of materials and equipments	Implementation team													
5	Coordinate with vendors for delivery schedules	EIK													
6	Receive and Inspect delivered materials	Implementation team													
7	Ensure compliance with spesifications and quality standards	Implementation team													
8	Track and manage inventory of received materials and equipments	Implementation team													
9	Update Project Stakeholders on materials and equipments availability	Implementation team													
10	Material Storage Management	Implementation team													
11	Planning for the execution of the procurement goods (drawings and work administration)	Implementation team													
12	Carry out a checklist for work administration	Monitoring team													The team that monitors the implementation team
13	Sign to agree when the project starts and when it is finished	EIK													
14	Carrying out work using existing materials	Implementation team													
15	Monitor ongoing material needs and plan for the next procurement	Implementation team													
16	Make an official report to the EIK stating that the work has been completed	Implementation team													
17	Carrying out a checklist returns to the report that the work has really been completed	Monitoring team													
18	Provide a report letter to EIK that the work has been completed	Monitoring team													

Figure 4. Implementation Plan for overall project for PT.MAI 88

The researcher has justified the implementation plan that the researcher recommends for PT.MAI 88 to the Head of Road of Roads UPT Region X, namely EIK and he has agreed to the implementation plan provided. Then, the researcher also justifies the results of the AHP method that has been carried out previously, namely Job Prioritization for road and bridge maintenance which will be carried out by PT. MAI 88 UPT region x and the company itself has approved the Job Prioritization produced by AHP.

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