

Determining The Winner of LPG Project Tender with A Multi Expert Multi Criteria Decision Making

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ABSTRACT

In the implementation of construction services, the government actively encourages the optimal use of domestic products in these construction projects. Law Number 3 of 2014 regulates the obligation to use domestic production in every government procurement of goods and services. This study aims to determine the most relevant criteria and sub-criteria in the process of determining the tender winner for the Tanjung Sekong-Banten Pressured LPG Terminal project contractor using the Delphi MCDM method. The research design used in this research is a case study (observational case studies) with a quantitative approach that combines input from qualitative data and from quantitative data in one study (mixed method). The researchers succeeded in showing that with a multi-expert multi-criteria decision making approach, AHP could determine the right contractor in determining the winner of the tender process in the LPG project.

Keywords

Tender winner; *LPG project contractor; multi expert multi criteria decision making.*

1. Introduction

Industrial development in 2020 in supporting construction services is considered to still have considerable business prospects in the years to come, this is in line with the incessant infrastructure development program in Indonesia. Improvements have been made to the capabilities and capacities of the construction sector and other supporting industries. In the third quarter of 2019, the construction sector contributed 10.6% to the national GDP. This is a fairly large number for industrial development in Indonesia (Laoli, 2020)

In accordance with the development needs, EPC projects began to emerge. The project owner simply appoints an agency or company to realize what is desired and the planning and construction process is carried out by one party, so that the design optimization process can be carried out throughout the project period, faster and more efficiently. In fact, not all existing EPC companies carry out all three processes. Some are only doing engineering and some are only doing *engineering* and *procurement*. In addition, there are also EPC companies that carry out two additional processes, namely commissioning and installation. This type of company is referred to as an EPCCI company. Most of the existing EPC companies are engaged in the oil and gas sector. However, several SOEs (State-owned enterprises) have added EPC units engaged in power plant construction, such as the PT PP EPC Division, Wijaya Karya EPC and Adhi Karya EPC (Prima, 2016).

EPC projects are more complex than regular construction projects. This project has very big challenges, such as phase *overlaps* and interdependencies between activities, very accurate details of activities, and uncertainty in the accuracy of predictions that arise during the project. Of course, it is also a matter of budgeting and implementing an implementation schedule that can guarantee the level of efficiency of an activity or project.

Currently, the Government opens wide opportunities for the private sector to participate in national infrastructure projects. However, large capital and business risks must be considered by private business actors. The Director of

Planning and Development of Development Funding at Bappenas/Ministry of National Development Planning said that the small portion of pure private financing involvement in national infrastructure projects was due to the massive amount of capital and business risks, while the ability of private companies to make large and long-term investments such as infrastructure would vary. On the other hand, for basic infrastructure development, SOEs are still considered more capable, especially in making large and long-term investments (Alaydrus et al., 2017).

In addition, the current weakness of EPC contractors in participating in tenders for oil & gas projects is that they have not been able to free themselves from their dependence on capital and technology problems. Not only that, the unfamiliarity of Bank Indonesia in the international world has caused obstacles to bid guarantees. For this reason, there needs to be a restructuring of the National EPC construction market, good infrastructure development, as well as improving the quality of the contractors who will work on these projects.

The process of evaluating the selection of the winning contractor for the tender is an important element in conducting the evaluation. Tenders or in other words procurement of goods and services or auctions can be defined as a series of activities designed to meet product or service needs by establishing fair competition between suppliers of goods and services that are fair and meet specifications based on certain methods and procedures that have been agreed upon by the related parties (Nugroho et al., 2012). According to Presidential Decree No. 16 of 2018, tender is a selection method to obtain goods/construction work/other service providers.

In winning the tender, the appraisal process is an important factor needed to determine the selection of the winning contractor. The supplier selection and evaluation process are one of the main activities that must be integrated by the organization into the company's core strategic decisions (Enyinda et al., 2010). This happens because there are many requirements or criteria that are considered by contractor service users. The process of selecting the winning bidder for the procurement of construction services is carried out by the Procurement Service Unit (ULP) working group with a thorough procedure and an assessment of all bid files and qualification files submitted by the bidders. Errors in evaluating the proposal files and company qualifications will have an impact on errors in determining the company that wins the auction and this results in the quality of the goods or services that will be produced by the company winning the tender (Pio et al., 2015).

According to Herdiyanti (2018), the conditions that are prerequisites for participating in a tender so as to facilitate the process of selecting the tender winner by the organizers are: (1) it is necessary to pay close attention to the qualifications required and the applicable regulations in the company offering the tender; (2) the need to conduct any research that will help his work if he wins the tender; (3) ensure that the funds to be used to carry out the work given by the tender provider are sufficient; (4) it is necessary to pay attention that the tender will increase the profit of the company winning the tender.

For companies holding tenders, there are several factors that will be used as assessment material for determining the winner of the tender, namely completing all administrative, technical, cost, and qualification requirements for construction service providers that affect the selection of the winner of the tender or contractor who will carry out construction services.

In determining the winner of the tender, which is quite time-consuming, due to having to look at the determining factors of a bidder's victory such as the price offered by the participant and the adjusted needs of the procurement of goods and services, a method is needed that can determine the winner of the tender more precisely. and accurate.

PT. WIKA itself has regulations related to the process of procuring goods and services through a technical selection process, HSE Plan, and price. However, what has happened so far is that the technical documents and HSE Plan which are the main requirements can easily be declared passed if the contractor has already done similar work. In the end, the contractor selection decision was taken by considering the results of the contractor's performance index obtained as well as the tender price offers submitted by the bidding contractors.

Based on the case study that researchers used in this study, the Tanjung Sekong LPG Project at PT. Wijaya Karya, there are no criteria and sub-criteria in selecting contractors, therefore as an initial step in the contractor selection process, it is necessary to use the Delphi method to select criteria and sub-criteria that have a correlation with the Analytical Hierarchy Process (AHP) which will be used as framework for the contractor selection process for the Tanjung Sekong LPG Project at PT. Wijaya Karya.

The aims of this research are as follows:

- 1) Determine the relevant criteria and sub-criteria to determine the winner of the contractor tender using MCDM – Delphi.
- 2) Design the Contractor Tender Winner Selection Model using AHP so that it can support corporate strategy.

2. Literature Review

2.1. Procurement of Goods/Services

Procurement of goods and services must be based on the concept of *Value for Money* (VfM) where the procurement of goods and services includes the entire process of procurement of goods and services from planning needs to obtaining goods and services even to asset management during the economic life and technical goods and services. The Presidential Regulation on government procurement of goods/services formulates the seven most basic principles in the procurement of goods and services consisting of 1) efficient, 2) effective, 3) transparent, 4) open, 5) competitive, 6) fair, and 7) accountable.

This effective and efficient principle supports VfM where there are components that influence, namely: (1) The higher the quality, the higher the price; (2) The higher the quantity in the purchase, the lower the price given; (3) The shorter the time available; and the higher the price obtained; and the last; (4) The shorter the supply line, the lower the price will be (Pengadaan (Eprocurement), 2019).

2.2. Selection of Contractors/Suppliers

Choosing a contractor as a supplier is a very important activity, especially since this contractor is a partner who will work together for a long time (Pujawan & Erawan, 2017). The criteria for choosing a supplier have different interests. There are 3 supplier selections, namely: (1) Supplier Evaluation; (2) Supplier Development; (3) Negotiation (Klos & Trebuna, 2014).

2.3. MCDM in Decision Support Systems

The concept of a Decision Support System (DSS) was first expressed in 1971 by Michael Scoot Morton (Turban, 2001) with the term *Management Decision System*. Then a number of companies, research institutions and universities began to conduct research and build Decision Support Systems, so that from the resulting production it can be concluded that this system is a computer-based system aimed at assisting decision making in utilizing certain data and models to solve various problems (Nofriansyah & Defit, 2017).

2.4. Delphi

The Delphi method is an agreement mechanism from a group of experts, without these experts knowing one another. In this method, the respondent fills out a questionnaire distributed by the researcher, then with a short solid answer (succinct) then the answers in the questionnaire are submitted to a panel of experts to be given a response (in the form of a forecast). The discussion of the results of the questionnaire can be repeated several times until a unanimous agreement is obtained among the experts (Nayyira, 2018).

2.5. Method Analytical Hierarchy Process (AHP)

According to Falatehan (2016), the advantage of the AHP model is its ability to solve *multi objectives* and *multi criteria*. This is due to its high flexibility, especially in the creation of the hierarchy. This flexible nature makes the AHP model able to capture several goals and several criteria at once in a model or hierarchy. Various topics can be analyzed using AHP techniques, such as conflict, planning, projection, resource allocation. In addition, several studies were carried out using the AHP model for priority analysis of water resource development in river basins, program priorities from the government, industrial development strategies, determination of regions that can receive program assistance, application of technology, determination of tender winners and others.

2.6. Previous Study

Research on the selection and assessment with the MCDM approach that uses the Delphi method and the AHP has been widely studied by previous researchers. Previous research that is relevant to the research to be carried out is summarized in Table 1.

Table 1. Previous Research related to ME-MCDM

No	Researcher	Objective	Method	Outcome
1	(Borissova, 2020)	Selecting a Project for sustainable and sustainable developmen.	SAW, WPM, AHP, ELECTR and TOPSIS.	The results showed that using weights influenced the decisions of the experts in the selection of a <i>Green Building</i> .
2	(Te-eun K. & Steven M., 2020)	1) bridging the knowledge gap 2) evaluating the application of leadership requirements 3) identifying and prioritizing leadership competencies.	Delphi AHP	The current STCW (<i>Standards of Training Certifications and Watchkeeping</i>) framework is not fully relevant to MASS (<i>Maritime Autonomous Surface Ships</i>)
3	(Shao, 2020)	Summarizing the exclusion criteria and evaluation criteria in the selection of five energy source locations (Renewable Energy)	AHP ANP	Obtained 5 stages in choosing the location, (1) selection of criteria, (2) normalization of data, (3) weighting of criteria, (4) evaluation of alternatives and (5) validation of results.
4	Cipta & Husein (2019)	Strict selection process for outstanding students, best employees and best tourist destinations.	AHP, FUZZY - PROMETHEE	With AHP, preference criteria are generated to determine the best students.
5	(Razi et al., 2019)	Decision-making for Risk Management in Construction	AHP	AHP can be the best solution in Civil Engineering Work because it can help produce decisions in a short time.
6.	(Morkunaite, 2019)	Selecting contractors for the construction of protection and restoration of cultural heritage buildings.	AHP PROMETHEE	AHP to determine the important criteria and to obtain a weight for each criterion. PROMETHEE technique is applied for the selection of alternative contractors.
7	(Muhendra and Hasibuan, 2018)	Measuring the weight of the criteria in the selection of subcontractors for the flyover construction project.	AHP ANP	Produced the criteria used for the selection of sub-contractors, namely: financial criteria, technical criteria, managerial criteria, reputation criteria and security criteria
8	(Darko, 2018)	Reviewing 77 journals discussing <i>Construction Management</i> AHP-based	AHP Fuzzy Delphi	With AHP combined with Fuzzy and Delphi produce criteria that can be the basis for decision making in <i>Risk Management</i> and <i>sustainable construction</i> .
9	(Borissova, 2018)	Proposes a multi-criteria decision-making methodology to determine the right suppliers for <i>green buildings</i> .	MAUT SAW SMARTER AHP TOPSIS	Research has resulted in various methodologies used to produce various criteria to be able to select <i>suppliers</i> .
10	(Cheaitou, 2018)	Develop <i>Decision Making Framework</i> (DMF) to assist public organizations in selecting the most appropriate construction contractor	MCDM with a Fuzzy approach	By using MCDM and FUZZY, the contractor selection process can be more effective
11	(Kusuma, 2018)	Analyzing contractor assessment model on electric power projects.	AHP and Fuzzy TOPSIS.	PT. CA resulted in a score of 0.723 being selected as the best contractor for the electricity project.
12	(Simanungkalit, 2017)	Looking for a Decision Support System for Selection of Alternative Raw Material Suppliers	AHP SAW	The system can produce decisions for determining suppliers of raw materials in the form of: bed products, <i>over bed</i> and <i>bedside</i> .
13	(Chen, 2017)	Identify a set of key indicators by weighting for tourist attractions in Taiwan.	Delphi AHP	Using the AHP method shows that the most significant dimension is managing quality, with tourism services and public sector facilities being the most important sub-dimension.

No	Researcher	Objective	Method	Outcome
14	(Morkunaite, 2017)	Determine criteria for selecting contractors, and determine evaluation criteria for contractor selection for the development of cultural heritage	Delphi and AHP	With quantitative research, criteria and sub-criteria are generated in determining contractors for the construction of nature reserves
15	(Pangsri, 2015)	Determine the method of decision making by project managers in construction companies	Delphi, AHP, and TOPSIS	Produce 5 criteria, namely: (1) labor, (2) capital, (3) responsibility, (4) experience of workers and machines and the last is (5) equipment.

3. Methods

The research design used in this research is a case study with a quantitative approach that combines *input* from qualitative data and from quantitative data in one study (*mixed method*). The flow of this research, the author starts from a case study that produces *input* qualitative data *expert* with the help of questionnaires distributed by the author. In this study, the author uses the Delphi method approach to determine the criteria and also sub-criteria that will be used to determine the winner of the contractor tender at PT WIKA in general and the LPG project in particular. From the qualitative results of the Delphi method, it will be used to make the best decision in choosing the winner of the PT WIKA LPG project contractor, then the data will be processed into quantitative data using the AHP method approach, where the results of the analysis will be described in more detail. and detailed in qualitative form.

Secondary data is obtained indirectly by researchers, for example through other parties in the form of individuals and supporting documents (Sugiyono, 2015). Secondary data in this study were collected through a study of literature and company documents related to this research.

Data collection techniques used are:

1. Questionnaire, a data collection technique carried out by giving a set of questions or written statements to respondents (in this case the experts) to be answered. In this study, closed or open questions/statements can be given to the experts directly or via the google form link. The form of the questionnaire used in this study was to determine whether or not the sub-criteria had an effect or no effect in selecting the LPG project contractor. Furthermore, the form of the questionnaire used to make good decisions in choosing LPG project contractors is carried out by comparing criteria, sub-criteria and alternatives (contractors).
2. Interviews conducted in this study are structured interviews, where structured interviews are interviews that are used as a data collection technique, if the researcher or data collector already knows for sure what information will be obtained. The questions in the structured interviews in this study are related to sub-criteria which are suggestions of researchers to be used by PT WIKA in the future when holding contractor tenders again.
3. Literature Study Method is a method used to search for theories, concepts, generalizations related to the selection of contractors that can be used as a theoretical basis for the research conducted. The theoretical basis is used so that the research has a solid foundation and is not just a trial and error.

4. Data Collection

Primary data and secondary data are the types of data needed in this study. Primary data according to Sugiyono (2015) is data directly collected by researchers. Primary data obtained through the distribution of questionnaires to respondents in this study is the procurement of staff at PT. WIKA, which is the committee for the procurement of goods and services, has agreed to be a respondent and fill out the questionnaire. The development of the questionnaire as a research measuring tool was carried out based on the theory from previous research combined with conditions in the field from the experience conveyed by resource persons who became experts in this research.

Secondary data is obtained indirectly by researchers, for example through other parties in the form of individuals and supporting documents (Sugiyono, 2015). Secondary data in this study were collected through the study of literature and company documents related to this research.

In this study, the authors need data and other information in operations, namely in the form of variables used for research, criteria, work indicators and their measurements. The following is an explanation of the variables used by the author in operations:

1. Quality (quality)
2. Service (service)
3. Flexibility (flexibility)
4. Price (price) and
5. Safety and environment (safety and environment).

5. Results and Discussion

5.1 Numerical Results

The priority weights for the aggregate criteria, sub-criteria and alternatives can be seen in Figure 1 and the alternative priorities for the best LPG project contractors can be seen in Table 2.

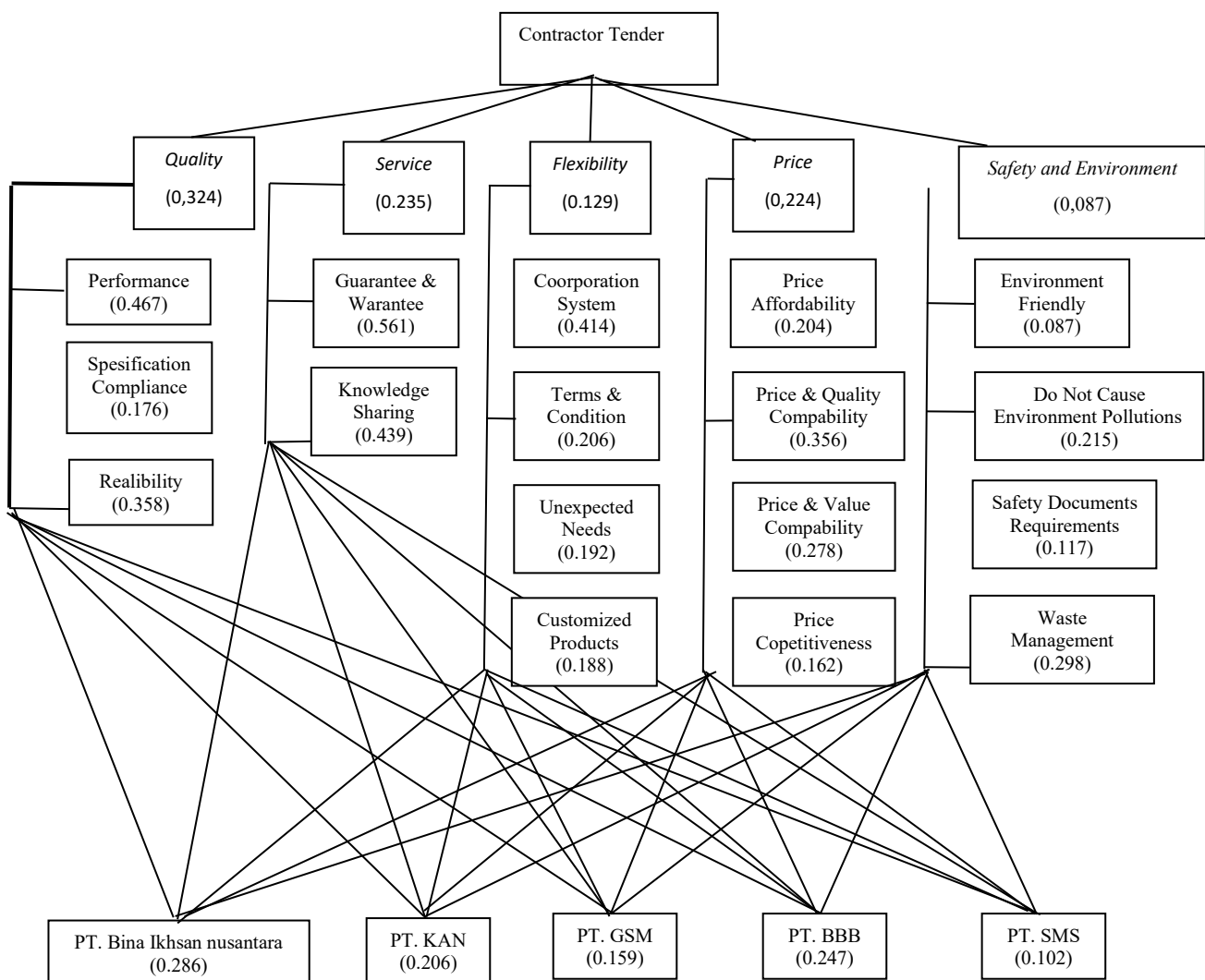


Table 2. LPG Project Contractors

Alternative	Weight	Priority
PT. BIN	0.286	1
PT. BBB	0.247	2
PT. KAN	0.206	3
PT. GSM	0.157	4
PT. SMS	0.102	5

All information analysis processes and the results obtained from this research can be a solution and guide for PT WIKA to overcome the risk of making mistakes in the selection of LPG project contractors. In this regard, carefully assess all the research results criteria as new criteria in selecting contractors who want to cooperate with PT WIKA. Analysis of the contractor selection process as part of the evaluation stage of tender participant qualifications needs to be tried by developing a new procedure stage that specifically addresses contractor priorities from an administrative and technical perspective in addition to the bid price offered by the contractor.

In this research, the elements of the criteria and sub-criteria used are tangible and intangible. Criteria *quality* are the main criteria that are informed by the researchers, because the quality criteria are closely related to a good name, if a product has poor quality then in the future the product will not be used again, and the names of contractors and distributors are bad in the eyes of the public.

5.2 Graphical Results

The criteria was defined by the expert (with the use of Delphi technique). The further analysis use expert choice ver.11 is shown by figure.2 CR value at 0.06 (less than 0.1) concluded that the weighting criteria is consistent

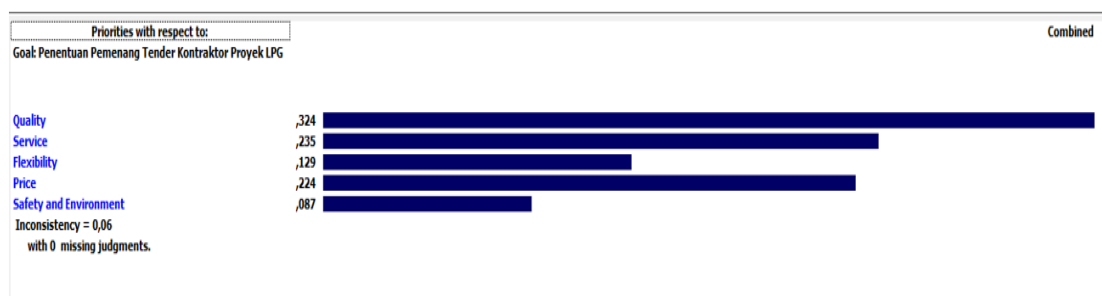


Figure .2 Weight of LPG Project Contractor Selection Criteria

Determination of the weight of the criteria in the selection of LPG project contractors from a combination of three experts based on the results of the AHP, it is known that the quality criteria in selecting LPG project contractors is the main priority with a weight of 0.324. The next priority is the service criteria with a weight of 0.235, the price criteria with a weight of 0.224, the flexibility criteria with a weight of 0.129, and the safety and environment criteria with a weight of 0.087.

5.3 Proposed Improvements

In this study it was found that to make decisions in determining the LPG project contract, the company was obliged to provide the criteria for quality, service, flexibility, price and safety environment as the basis. Companies need to improve this, among others by making SOP (Standard Operating Procedure) in selecting LPG project contractors. By making this SOP, the company can determine the LPG project contractor who is truly competent in his field and this will minimize losses that may arise if the selected contractor does not meet the requirements by the company represented by these criteria.

5.4 Validation

The sensitivity analysis is being use to validate the AHP result. This analysis will determine the sensitivity of each criteria compare to the changes in a weighting value that lead to alternative changing. Presentation of the results

of the performance sensitivity analysis in Figure. 3 can be seen the priority level for each criterion in the selection of LPG project contractors as well as the sensitivity of alternatives if there is a change in the criteria.

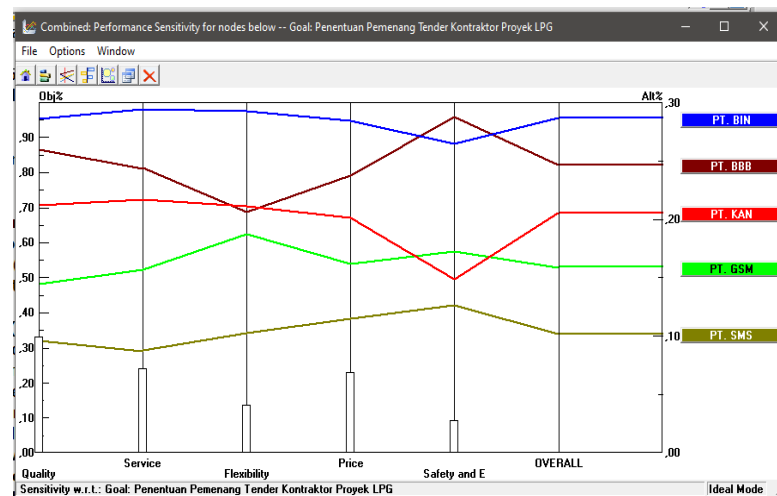


Figure 3. Performance Sensitivity

The results of the calculation of the priority weight of the criteria using Expert Choice Ver. 11 is shown in Fig. 4. The results of the performance sensitivity output from the criteria for quality, service, flexibility, price and safety and environment, the initial priority is PT. BIN as the contractor for the LPG project.

PT. BIN is the initial priority as the contractor for the LPG project, then we will try to compare each criterion from PT. BIN with other LPG project contractors. In Figure .4 it can be seen that universally PT. BIN is superior to other LPG project contractors. This shows that PT. BIN has familiarized its production process with government regulations. Meanwhile, the safety and environment criteria are criteria that need to be paid attention to by PT. In the future, BIN will implement its business strategy so that it can be perfect to compete with its competitors.

6. Conclusion

The model for selecting the winner of the Tanjung Sekong-Banten Pressurized LPG Terminal project using AHP is carried out through data processing with the help of the Expert Choice ver 11 application which has reached an agreement (consensus) from the experts. There are five criteria and seventeen sub-criteria that have been successfully validated as the process of determining the winner of the LPG Contractor tender at the Tanjung Sekong-Banten Pressurized Terminal using the Delphi MCDM method. The quality criteria are the top priority with a weight of 0.324, followed by the service criteria with a weight of 0.235, the price criteria with a weight of 0.224, the flexibility criteria with a weight of 0.129 and the last is the safety and environment criteria with a weight of 0.87. While the most relevant sub-criteria is performance with a weight gain of 0.467.

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