

# Genset Selection in Thamrin Nine Development Project Area in Central Jakarta

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**ABSTRACT:** Procurement management is an important part of the construction industry. The procurement process on the construction project occur during the construction phase. The selection of generators in the Thamrin Nine project carried out through tender process and very risky if the process is not carried out properly due to the distributors who participate in the tender have different classifications. The developers shall take control to ensure that the specification of generators that required at the Thamrin Nine project is valid in order to avoid any errors may occur in selection of generators process. There are three criteria may influence the selection of generators i.e. economic criteria, environment criteria, and technical criteria. The method to analyse the three criteria is Analytic Hierarchy Process (AHP) which has several stages of assessment that is pairwise comparison, normalization, eigen vector determination, consistency test, and priority value. The purpose of this study is to determine the criteria that influence the selection of generators and to discover the results of the analysis of the criteria on the hierarchy structure of the selection of generators on the project Thamrin Nine Development Jakarta.

**KEYWORDS:** *Thamrin Nine Project, Electrical Equipment, Analytic Hierrarchy Process, Material Selection*

## I. INTRODUCTION

The construction industry is an industry that has grown and developed for thousands of years. According to Bower[4]Historically, construction has been project-oriented in its organisationand management. Construction project tasks are frequentlyone-off undertakings and custom-built to specification. Each projectmarks the establishment of a new and temporary production systemand organisation located at the point of consumption. In otherwords, there is comparatively little continuity in the form ofproduction system established between projects in the constructionindustry.In a construction project to obtain the materials and tools required in the construction of the project is generally carried out tender process to the supplier. Tender process can be done either by the main contractor or done directly by the project owner. The function ofa tender on a construction is for the project owner to obtain comprehensive information to compare each item offered by each supplier in terms of cost, quality, brand, length of manufacture and delivery of goods from the factory to the project.

According to Walker and Hampton [21] that open or pre-qualified tender competition using the traditional approach almost always results in acceptance of the 'cheapest' fixed price for the specified work. Tenders are called after design completion and the construction cost is then assumed to be 'fixed'. However, in practice the design is almost never completely finalised and, in most cases, this results in many opportunities to claim for 'extras'. The final end cost of a project, however, also includes the costs of design changes approved during construction, charges based on errors or omission in design and contract documents used during the tender period and others claims made for consequential delays arising form cost claim noted above. Thus, the 'traditional' procurement method often ends up delivering the tendered lowest price for a project and subsequent claims for additional works mean that many clients feel at the mercy of contractors seeking opportunities to create profit and additional revenue.

Electricity is the most prevalent form of energy in a modem building. It suppliesnot only electric outlets and electric lighting, but also the motive power for ventilation, heating, and cooling equipment; traction power for elevators and materialtransport; and power for all signal and communications equipment. An electric power failure can paralyse a

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facility. If properly designed, the facility will return to partial functioning by virtue of emergency equipment that will furnish some part of the facility's emergency needs for a limited time. Given this complete dependence on electric power for normal functioning, it is apparent that system designers in other disciplines must be familiar with normal electrical systems According to Ahuja [1].Electricity needs in a high-rise building is very large and generally all the equipment in the building using electricity and according to Merritt and Ambrose [13] that in most buildings, electric equipment and wiring are provided to bring electric power into the interior and distribute the power where needed, for lighting, heating, operating motors, control systems and electronic equipment. Gensets is currently an electrical equipment that is very important existence as a supporter of electrical power required by a building so it is important that the selection of generators is done correctly in accordance with the required specifications for the building. The purpose of this study is to specify and verify the criteria that affect the selection of generators in Thamrin Nine Development Project area in Central Jakarta and discover result of analysis on criteria of generators selection method in Thamrin Nine Development Project area in Central Jakarta.

## II. LITERATURE REVIEW

### Procurement Management

Part of project procurement management provides additional consideration for planning, execution, monitoring, controlling, and ending of procurement in construction projects. This includes the processes necessary to obtain design and engineering services and construction related materials, equipment, machinery and services. Construction projects often have multiple layers of hierarchy characterized by numerous buyers and sellers as well as with many project stakeholders serving in the procurement capacity of goods and services, a typical contractual relationship between the owner and the main contractor and the subcontractor with the subcontractor and its suppliers. Examples of project procurement include property acquisition, engineering and design or turnkey services, construction, and even operational services, materials and equipment from vendors and suppliers. Basically, procurement in construction is carried out to further transfer performance risks to specialized sellers and experts within a specific scope of work according to PMBOK Construction Extension 2016 [16]. Procurement from the owner's perspective, the decision to build a new project may depend on the variety of project delivery methods, which largely affect the overall cost and timing of completion. Variations in traditional delivery methods may then result in a special or hybrid contract method, which may dictate the scope of work subcontracted together with the maximum price guarantee. For example, the fast-tracking method computes the project schedule by running the design and construction phases simultaneously. The design may run as little as 1 week earlier than construction, and often design decisions are made in the field. Fast tracking methods have been around for decades and are used with significant amounts on all building projects. Figure 1 shows a comparison illustration between the completion time and the procurement component for three common types of commonly used method of project delivery methods according to PMBOK Construction Extension 2016 [16].

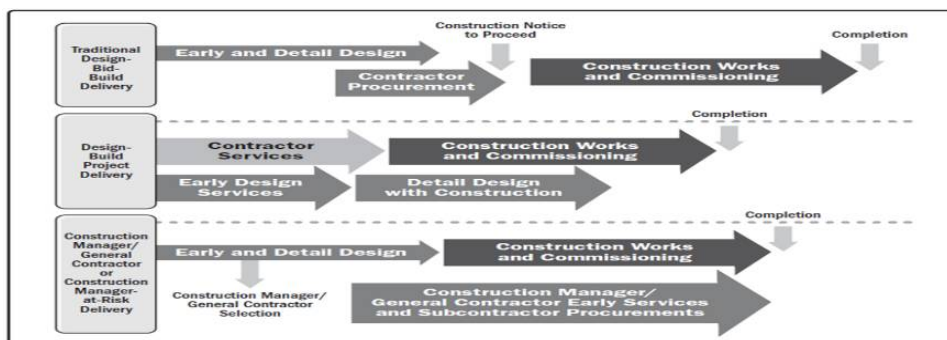


Figure 1. Illustration of comparison of project completion time with procurement component

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The bidding process can be very wide for contractors looking for work. If that does not work, the organization needs to focus on the next opportunity and the bidding process begins again. The perspective of a property organization, offer exercise is considered as the cost to do business for the contractor. Successful offers are often dictated by contractual clauses formed between the seller and the buyer, therefore special attention is required in managing the scope, risks, costs and time through the integration process and activities undertaken given the competitive nature of the procurement construction. For that reason, the organization needs to have expertise in preparing the bid to win according to PMBOK Construction Extension 2016 [16].

## Risk Management

According to Flanagan and Norman [7] attention to risk is important to ensure good performance. Whether you are managing a company, a project or a work package, some will deny the importance of risk management, but some others analysed risk in practice by using intuition and experience. Risk management is nothing new in the world of construction, risk management is a system that aims to identify and quantify all the risks of a business or project faced so that conscious decisions can be made about how to manage risk

Project risk management includes processes for risk management planning, identification, analysis, response planning, and project control. Project risk management is critical to successful project management and should be implemented throughout the project cycle. The main objective of project risk management is to increase the likelihood and impact of positive events or opportunities while reducing the likelihood and impact of negative events or threats to the project. Project risk management can be considered as an extension of other project management processes, for example, overcoming the uncertainty in project estimates and the validity of assumptions. Project risk management interest holders by providing greater assurance about project outcomes, reducing the risk of making mistakes, defining project strategies for bid and contract negotiations, and estimating contingency cost according to PMBOK Construction Extension 2016 [16].

## Building Arrangements at Thamrin Area in Central Jakarta

Thamrin area located in Tanah Abang subdistrict, Central Jakarta is one of the business centre in Jakarta which is designated as shopping centre and office, shopping centre which is diverse ranging from shopping centre to middle class down to upper middle class. this is evidenced by the establishment of several shopping centres such as Tanah Abang Area, Grand Indonesia, and Plaza Indonesia are reserved for upper middle class. Complete objective of Tanah Abang subdistrict spatial planning is explained in regional regulation number 1 year 2014 about detail plan of spatial and zoning regulations clause 113 that is:

1. The realization of a high-intensity textile trading centre with international service scale integrated with mass public transportation at Tanah Abang Primary Centre
2. Implementation of the development of integrated transportation infrastructure with pedestrian paths, mass public transport, and other public transport
3. The realization of environmental parks and greenways as water absorption infrastructure, air pollution control, social, and urban aesthetics
4. Realization of the development of trade centre and services with environmental insight and integrated with the arrangement of the surrounding area
5. The realization of the provision of parks and / or situ as water, social, and recreational infrastructure
6. The realization of the development of roof gardens, green walls, and hedgerows in residential areas and offices
7. Realization of the development of public flats equipped with infrastructure that is integrated with mass public transport.

## III. RESEARCH METHODOLOGY

### Research Process

This research process begins by formulating the problems of background, so it is necessary to study literature on those problems by finding information from books and journals related to this research and also determine the basic of construction management used as a reference such as the management procurement and risk management are very

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influential on the selection of Genset. After conducting literature study then the next process is to determine the research instrument as a method to obtain data in the form of an assessment of the criteria of Genset which according to the respondents strongly influence the selection of Genset. The next process is the collection of research data in the form of primary and secondary data that will be used for the analysis so that the results obtained from the analysis of conclusions and recommendations to further studies.

## The first method to resolve 1<sup>st</sup> research problem

The first method to resolve 1<sup>st</sup> research problem is literature study. According to Sarwono [18] that at this stage researchers do what is called literature review, which is studying reference books and similar research results previously done by others. The goal is to get the theoretical basis of the problem to be studied. Theory is a foothold for researchers to understand the issues studied properly and in accordance with the scientific framework. In this research, literature study was conducted to understand and get more detailed information about the procurement of Genset and also how to select the Genset so that there is no error in the selection of Genset. In addition, another important thing from literature study is to study similar studies that have been done so as to have a good understanding of the research being done.

## The second method to resolve 1<sup>st</sup> research problem

The second method to resolve 1<sup>st</sup> research problem is expert interview. According to Raco [17] that interviews were conducted to obtain information that could not be obtained through observation or questionnaires. This is because researchers cannot observe all and not all data can be obtained by means of observation. Therefore, researchers should ask questions to participants. The question posed is very important to capture the perceptions, thoughts, opinions, feelings of people about a symptom, event, fact or reality. Asking researchers to enter into the minds of others, get what they have in mind and understand what they think because perceptions, feelings, people's minds are so meaningful, understandable and can be explicitly and scientifically analysed. Genset selection process requires the opinion of the experts. Information from the experts can complement the information from the literature study because the information obtained from the experts is information directly obtained from experience in using Genset and sometimes from experience in using several different types of Genset so that they are able to give opinions on some brands of Genset commonly used.

## The method to resolve 2<sup>nd</sup> research problem

### Research Respondents

Respondents in this study are persons who are members of the MEP engineering team from the Client side directly involved in the process of procurement of generator sets through the tender to meet the criteria as respondents in this study. The respondents who will follow the survey should have the following criteria:

1. Have experience working in the field of MEP in high-rise building project at least 5 years.
2. Minimum education background S1, majoring in mechanical engineering or electrical engineering

### Research Instruments

According to Raco [17] In quantitative methods research tools or research instruments that are often used is a questionnaire and often also referred to as a measure. Unlike the exact sciences where the measuring instruments have been standardized, in social science there is no standardization of measuring tools, so this tool needs to be created, tested, and validated so that it can actually be used to measure the object of research. In qualitative methods, the researcher himself is a data collection tool and cannot be represented or delegated. That means that researchers are directly involved with participants or participants. Researchers collect their own data directly. Therefore, researchers really know them. Their selection is based on their credibility as well as the wealth of information they have.

In accordance with the explanation of the research instruments of quantitative and qualitative methods, the research instrument used in this study is a questionnaire with researcher's role directly at the time of data collection process from expert validation to the dissemination of questionnaires to the respondents and the data to be obtained is the primary data and data secondary

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## Analytic Hierarchy Process (AHP)

In this study the main goal to be achieved is to be able to choose the Genset in accordance with the specification that required in Project Thamrin Nine Jakarta. There are several stages to be done in using the AHP method i.e. create structure of hierarchy to decompose problems, pairwise comparison, and consistency test. According to Bhusan and Rai [3] the problem is decomposed into a hierarchy of objectives to be achieved and consists of criteria, subcriteria and alternatives. This is the most creative and important part of decision making. Arrangement of decision issues as hierarchy is essential for AHP processes. The hierarchy shows the relationship between the one-level element and the level below it. This relationship propagates to the lowest level of the hierarchy and in this way each element is connected to each other, at least indirectly. Hierarchy is a more orderly form of network. After the decomposition process is complete and the hierarchical structure has been arranged properly then the next step is the preparation of matrix in pairs to normalize the importance of the weight of each element in each hierarchy. The pairwise comparisons of the various criteria generated are organized into a reciprocal matrix whose number of ordinands depends on the number of criteria and subcriteria. Once the interrelationships between attributes are mapped by the hierarchy, the relative weight of the attributes is determined by comparing them in pairs and separately for each circuit in the hierarchy. This is the second stage of the process that AHP is offering to deal with complexity in decision making.

## IV. ANALYSIS AND RESULTS

### Analysis on 1<sup>st</sup> Research Problem

Based on literature review determined 3 criteria with sub criteria under each of criteria. Those 3 criteria that influence selection of Genset shown on table 1.

Table. 1 List of the Criteria for Genset Selection

No.	Criteria	Sub Criteria	Reference
1.0	Economic		
1.1		Fuel Consumption	Lewis (2016)
1.2		Distributor	<a href="#">Prasertrunguang</a> (2009)
1.3		Safety Features	Said dan El <a href="#">Rayes</a> (2011)
1.4		Telematic System	<a href="#">Monnot</a> (2011)
1.5		Operational Cost	Alarcon et al (2012)
1.6		Purchase Price	Kannan (2011)
2.0	Environmental	Gas Emissions	Yan et al. (2009)
2.1		Energy Saving	Kim et al. (2012)
2.2		Noise Control	Kwon (2018)
2.3		Vibration Control	<a href="#">Koo and Ariaratnam</a> (2008)
3.0	Engineering		
3.1		Equipment Age	Fan et al (2008)
3.2		Equipment Capacity	Caterpillar (2011)
3.2		Equipment Reliability	Kannan (2011)
3.4		Equipment Efficiency	<a href="#">Prasertrunguang</a> (2009)
3.5		Equipment Productivity	Kannan (2011)
3.6		Equipment Operating Life	<a href="#">Valli dan Jevasehar</a> (2012)
3.7		Easy Repair and Maintenance	<a href="#">Valli dan Jevasehar</a> (2012)
3.8		Spare Parts Availability	<a href="#">Prasertrunguang</a> (2009)

The basic principle of the AHP method is to avoid criteria or sub criteria that have the same meaning because it will affect the assessment on the pairwise comparison. The decomposition of the above table can be seen in the hierarchical structure described on figure 2

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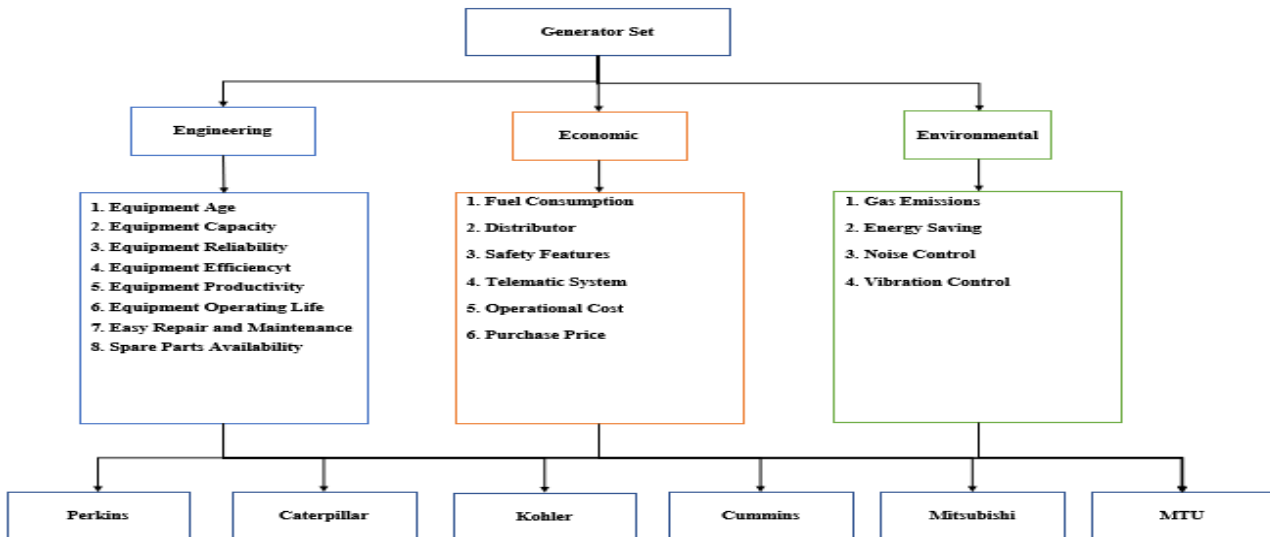


Figure. 2 Hierarchy Structure of Genset Selection

## Analysis on 2<sup>nd</sup> Research Problem

Pairwise comparison is done by forming a matrix that compares between each criteria and sub criteria. The value used as an assessment is taken from the value of the scale. The value of this scale is also the basis of the assessment in filling out the questionnaire. The scale that have been used for scoring in the matrix described on table 2.

Table 2. The Fundamental Scale

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

By using Microsoft excel to quantify the priority value can be seen the result of priority value for Genset selection is the highest priority value is obtained by the Caterpillar Genset and then the value is used as the basis value to compare the priority to other Genset alternatives as described on table 3as follows:

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Table 3. Priority Value

Alternative	Economic	Environmental	Engineering	X	Eigen Vector Sub Criteria	=	Value
Caterpillar	0,2985	0,2678	0,2715		0,5942		0,2866
Cummins	0,1942	0,1926	0,1527		0,2615		0,1878
Kohler	0,1963	0,1974	0,2291		0,1442		0,2013
Mitsubishi	0,1098	0,1216	0,1169				0,1139
MTU	0,0863	0,0900	0,0823				0,0867
Perkins	0,1149	0,1306	0,1475				0,1237

1. Caterpillar vs. Cummins:  $(0.2866 / 0.1878) = 1.53$  which means that Caterpillar 1.53 times better than Cummins
2. Caterpillar vs Kohler:  $(0.2866 / 0.2013) = 1.42$  which means that Caterpillar 1.42 times better than Kohler
3. Caterpillar vs Mitsubishi:  $(0.2866 / 0.1139) = 2.52$  which means that Caterpillar is 2.52 times better than Mitsubishi
4. Caterpillar vs. MTU:  $(0.2866 / 0.0867) = 3.31$  which means that Caterpillar 3.31 times better than MTU
5. Caterpillar vs. Perkins:  $(0.2866 / 0.1237) = 2.32$  which means that Caterpillar is 2.32 times better than Pekins

The result also concludes that Caterpillar Genset becomes the main choice in selecting Genset which will be used in Thamrin Nine Development Project area. If sorted by priority value then the result is as follows:

1. Caterpillar (Priority as first choice)
2. Kohler
3. Cummins
4. Perkins
5. Mitsubishi
6. MTU

## V. CONCLUSION

The conclusions of this research are:

1. The result of the analysis of 1<sup>st</sup> research problem indicated criterion that influence Genset selection are economic, environmental, and technical.
2. The result of the analysis of 2<sup>nd</sup> research problem can be concluded the criteria on the hierarchy structure of Genset selection is for the second hierarchy which is the criterion hierarchy found that the economic criteria is the most important criteria when compared with environmental criteria and technical criteria. In the third hierarchy which is a sub criterion of the economic, environmental, and technical criteria, the result for sub criteria on economic the purchase price of Genset has the greatest importance value when compared to other sub criteria and the sub criteria of the environmental criterion of gas emissions have the highest importance level compared to other sub criteria such as gas emissions, energy saving, noise control, vibration control. Sub criteria on the technical criteria that have the highest importance value is the efficiency. The alternative priority chosen is Genset Caterpillar with greatest importance value compared to other Genset brand.

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