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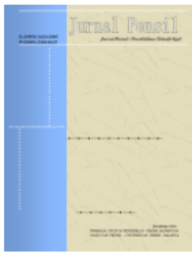

# A FRAMEWORK FOR SUCCESSFUL PROVISION OF SUSTAINABLE INFRASTRUCTURE WITH A PPP SCHEME IN INDONESIA

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**Abstract**

In the development of infrastructure projects with the PPP scheme, the government needs a way to assess the level of success and sustainability of related projects. This study will identify criteria that can be used to assess the success provision of sustainable infrastructure under the PPP scheme in Indonesia. After that, these criteria are arranged in a framework that will be tested against an infrastructure project. Analytic Network Proces (ANP) method is used to determine the ranking of each criterion so that a new development framework can be made and used in Indonesia. In this study, a questionnaire was developed which was distributed to four (4) experts in the field of infrastructure development in Indonesia. The results obtained are the framework for the success of providing sustainable infrastructure with the PPP scheme in Indonesia consists of 6 (six) success criteria with the percentage of involvement, which are Financial and Economy (30,47%), Law and Political (10,63%), Health Safety and Environmental (12,18%), Managerial and Technic (14,58%), Operational and Maintenance (16,70%), and Social and Stakeholder (15,44%). The six (6) success criteria are composed of twenty (20) derived sub-criteria. The PLTU Batang project which was chosen as the object of validation in this study did not meet 6 sub-criteria of the existing 20 sub-criteria. With this development framework, it can be taken into account in making decisions to determine the success of sustainable infrastructure projects with PPP schemes in Indonesia.

**Keywords:** Success Criteria, Sustainable Infrastructure, PPP scheme

## Introduction

Infrastructure provision becomes one of the most important programs in advancing country's development, especially the economic sector. In infrastructure, provision, Indonesia ranked 50 out of 141 countries which indicates poor infrastructure facilites recorded in The Global Competitiveness Report of the World Economic Forum (Schwab, 2018). This was caused by the Indonesian government's poor ability in infrastructure funding. One of the government's strategies in restoring infrastructure provision in Indonesia is to collaborate with enterprises to overcome cost problems, here in after known as Public Private Partnership (PPP). PPP is collaborative infrastructure provision for public interest by referring to predetermined specifications using enterprise resources by observing risk division amongs each parties (PerPres, 2015)

The term PPP was once recognized in 1998, when Indonesia experienced a financial crisis which caused a significant depreciation of inability to fund infrastructure development (Kemenkeu, 2016). Overtime, the Indonesian government implemented the PPP scheme for infrastructure provision to overcome infrastructure funding difficulties. The PPP is believed to be the most innovative way for the government to resolve the government financial constraints (Dolla & Laishram, 2020). Indonesia as one of the countries in Asia that has the greatest opportunity for investnment in the national infrastructure sector also applies the PPP scheme in the provision of infrastructure. The implementation of this PPP can provide benefits such as optimal risk sharing among stakeholders and opportunities for innovation and long-term contractual relationships (Mingo, 2020).

Implementation of PPP scheme on infrastructure in Indonesia can be said that it is not optimal (Priyarsono et al., 2019). Apart from the various success stories of PPP implementation, there are still several problems and issues that need to be addressed. These problems include high cost in the tender process, complicated negotiations, limited costs in innovation and conflicting goals between stakeholders (Kristiawan et al., 2020). The implementation of PPP requires improvements to identify and dispel these problems at the beginning to achieve successful implementation of infrastructure. Efforts to control and underlie the success of sustainable infrastructure implementation with the PPP scheme are made an indicator of success.

Many indicators can be used to measure and asses infrastructure performance. Criteria for a success project are a set of principles or standards by which the success of a project can be judged (Kristiawan et al., 2020). In general, the success of the project is described by the achievement of a number of criteria that are applied. The application of the success criteria helps direct the efforts and resources of the project team towards the achievement of the success objectives (Almarri & Boussabaine, 2017).

One of the evaluation criteria that can be considered is sustainability. Sustainability is now an important issue in Indonesia, and recently sustainable development is one of the Indonesian government's commitments regarding infrastructure financing(Medianti, 2022). Not only in Indonesia, the United Nations (UN) has adopted the New Urban Agenda (NUA) related to the implementation of the 2030 agenda for sustainable development (UN, 2015). This sustainable infrastructure development is implemented to meet the needs of the present generation, without sacrificing the ability of future generations. The Sustainable Development Goals (SDGs) have a target to make cities and human settlements inclusice, safe, resilient and sustainable which can be achieved by building partnerships among actors operating at various level and scales (Haque et al., 2020). Sustainable development systems often adopt 3 (three) dimensions which include economic, social and environmental sustainability (Wang & Ma, 2021). There are several models that can

be used as examples to show the orientation of sustainable infrastructure criteria, such as the UN5 People First Outcome model, the IDB4 Dimension of Sustainable Infrastructure Framework model, and the GFC6 Global Future Council on Infrastructure model (World Economic Forum, 2020)..

This research will focus on determining a number of criteria that reflect sustainable infrastructure under the PPP scheme. These criteria will be compiled into a framework for the success of providing sustainable infrastructure with the PPP scheme in Indonesia. This framework is expected to assist the government in making decisions to assess the success of sustainable infrastructure development with the PPP scheme in Indonesia.

## Research Methodology

This study uses the Analytic Network Process (ANP) method to show and identify the existence of an attachment relationship amongst sub-criteria (Ascarya, 2005). For this reason, a hierarchical model of the ANP was developed as can be seen in the illustration in Figure 3. The number of criteria and sub-criteria of the hierarchical model, the detailed names of the criteria and sub-criteria can be seen in Table 2 in column 1 and column 2. The hierarchical model is then developed by a research instrument in the form of a questionnaire in order to obtain scores and associations between indicators. In the questionnaire, respondents answered a number of comparative questions between 2 (two) indicators at the same level, both at the criterion and sub-criteria level. Respondents were asked to give a score of importance level on the indicator that is considered more important than other indicators at the same level. The importance level uses a scoring method with a scale of 1 to 9, with an explanation as shown in Table 1. By filling out this questionnaire, the selected respondents are experts who are engaged in related fields, namely sustainable infrastructure provision with the PPP scheme with a profile as shown in Figure 1 and Figure 2.

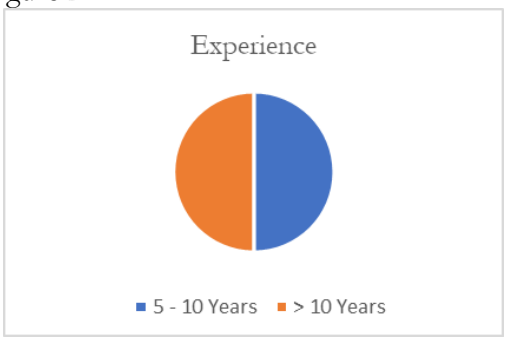


Figure 1. Respondents' work experience

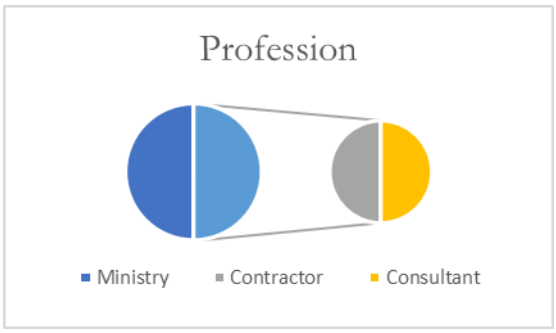


Figure 2. The profession of the respondents

The experts who were respondents in this study were 4 (four) people who were evenly divided, where 2 experts are engaged in the ministry sector (R1 and R3) and 2 other experts are in the business entity field (R2 and R4). In addition, the respondents have sufficient experience to manage projects with PPP schemes, namely 2 experts have sufficient experience for 5 to 10 years (R3 and R4), 2 other experts have good experience for more than 10 years (R1 and R4). R2). R1 has experience in a number of electricity and drinking water projects. R2 has experience, especially in the document's preparation for the PPP projects, one of which is the dam project. R3 is experienced in PPP projects, especially unsolicited ones that contribute to the preparation, evaluation of proposal documents and pre-feasibility studies. R4 is experienced in the management and optimization of state-owned land and building assets.

Table 1. Importance Level (Saaty, Thomas L; Vargas, 2006)

| Description | Importance Level | Explanation |
|---|---|---|
| Very, very, very strong level of importance | 9 | Evidence in favor of one activity over another has the highest order of affirmation possible |
| Very, very strong | 8 | Compromise value between two values, 7 and 9 |
| Very strong level of importance | 7 | One element is more important than the other, its dominance is shown in practice |
| Strong level of importance | 6 | Compromise value between two values, 5 and 7 |
| Greater level of importance | 5 | Experience and strong judgment favor one element over another |
| Great level of importance | 4 | Compromise value between two values, 3 and 5 |
| A little higher in importance | 3 | Experience and judgment strongly support one element over the other elemnts |
| Very slightly greater in importance | 2 | Compromise value between two values, 1 and 3 |
| Equally importance | 1 | Two elements contribute equaly to the goal |

Sub-criteria that have been determined by the score of the respondent will then be made into a matrix which is referred to as a comparison matrix in pairs. From the matrix, the level of consistency will be determined using equations (1) and (2), if the consistency ratio is less than 0.1 then the degree of consistency has been met.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad \dots (1)$$

$$CR = \frac{CI}{RI} \dots (2)$$

Where;

N = Number of **elements**
CI = Consistency Index
$\Lambda_{max}$ = Maximum eigen value
CR = Consistency Ratio
RI = Random Index

The next step is to construct a large matrix called a supermatrix. Unweighted Supermatrix is a supermatrix whose constituents are all eigenvectors of each criterion. Weighted Supermatrix is a supermatrix whose constituent is a multiplication product of unweighted supermatrix with paired comparison matrices. Lastly, Limiting Supermatrix is a supermatrix whose constituent elements consist of a ranked product of weighted supermatrix until the value in one row has the same value. If the value in one row has the same value, then a limiting supermatrix has been formed and the final score for each sub-criterion is obtained.

## Results and Discussion

Indicators of the success for providing sustainable infrastructure in the PPP scheme in Indonesia are arranged in a hierarchy which consists of six criteria, each of which consists of six sub-criteria. The illustration concerning diagram-related criteria is depicted in Figure 3. All indicators considered to be a success criterion in providing sustainable infrastructure with the PPP scheme in Indonesia are taken from previous studies, especially in countries that have successfully implemented a framework for the successful provision of sustainable infrastructure with the PPP scheme. References to the use of indicators are shown in table 2.

Table 2. Indicators of sustainable infrastructure provision with the PPP scheme

| | | | (Rostiyanti & Pangeran, 2018) | (Zhou et al., 2013) | (Ogunsanmi, 2013) | (Chou & Pramudawardhani, 2015) | (Kościelniak & Górka, 2016) | Liyanage, 2016) | (Villalba-Romero & | (Hashim et al., 2017) | (Kavishe et al., 2018) | (Osei-Kyei & Chan, 2018) | (Hope et al., 2012) | Yanbing; Olatunji, 2018) | (Leviakangas, Pekka; Ye, | (Hansen et al., 2019) | (Ismail et al., 2019) | (Li et al., 2019) | (He et al., 2020) | (Hu, 2020) | (Talib et al., 2018) | (Chourasia et al., 2021) | (Kristiawan et al., 2020) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Financial and Economy | 1 | Life cycle cost | v | v | | | | | | | | | | | | | | v | v | | v | | v |
| | 2 | Sustainable Investment | | v | v | | v | | | | | v | | v | | v | | | | v | v | | |
| | 3 | Sustainable cash flow | | | | | | v | | | | | | v | | | | v | v | | v | | v |
| | 4 | Profitability | | | | | | v | | | | | | | | | | | v | | | v | v |
| | 5 | State economic conditions | | | | | | | | | | v | | | | | | | | | v | | v |
| | 6 | Equity, Liability and Fluctuation | v | | | v | | | | | | v | | | | | | v | | | | | |
| Law and Political | 1 | Clarity and uniformity of legal policy | v | | | | | v | | v | v | v | | | | | | | v | | | | |
| | 2 | Stability of government conditions | v | | v | | | | | | | | | | | v | | | v | | | | |
| | 3 | Transparency of the entire process | | | | | | | | | v | v | | | | | | | | | | v | |
| | 4 | Public protests & disputes | v | | | | | | | | | v | | | | | | | | | | | v |
| | 5 | Guarantees | | | v | | | v | | | | | | | | | | | | | | v | v |
| | 6 | Law & political support | | | | v | v | | | | | | | | | | | | | | | v | |
| Managerial and Technical | 1 | Information and documentation | v | | | | | | | | | v | v | | | | v | | | | v | | |
| | 2 | Contract change order | v | | | | | | | | | | v | | | | | | | | | | |
| | 3 | Communication man. | | | | | | | | | | | v | | | | v | | v | | v | | |
| | 4 | Risk Management | | | v | v | | v | | | | v | | | | v | | | | | | v | v |
| | 5 | Conflict Management | | | v | | | | | | | v | v | | | | | | | | | | |
| | 6 | Innovation and transfer technology | | | v | | | | | | | | v | | | v | | v | | v | | | v |
| Health, Safety, and Environment | 1 | Environmental conditions | v | | | | | | | | | v | | v | | v | v | | | | v | | v |
| | 2 | Resources consumption and construction waste | | v | | v | | | | | | | | v | v | | | v | | v | v | | |
| | 3 | Biodiversity | | v | | | | | | | | | | v | | | v | v | v | v | v | | |
| | 4 | Eco-friendly materials | | v | | v | v | | | | | | | v | | v | | v | v | | v | | |
| | 5 | Renewable energy | | | | | v | | | | | | | v | | | | v | v | v | | | |
| | 6 | Safety and Health controls | | v | v | | | | | | | v | v | | | | | | | | | | v |
| Operational and Maintenance | 1 | O&M Cost | v | v | | | | | | | | v | | | | | v | | | | v | | |
| | 2 | Durability and quality | v | | v | | | | | | | v | | | | | v | | | v | | v | v |
| | 3 | Project on target | v | | | | | v | | | v | v | | | | | | | | | | | v |
| | 4 | Problems quickly resolved | v | | | | | v | | | | v | | | | | | v | | | | | |
| | 5 | O&M philosophy | v | | | | | | | | | | | | | v | v | v | | v | | | v |
| | 6 | Concept and complexity | | | v | | v | | | v | v | | v | v | v | | | | v | | | v | v |
| Social and Stakeholder | 1 | Support and impact on social communities | v | | v | | | v | | | v | v | v | | | | | v | v | v | | | v |
| | 2 | Power and stakeholder justice | v | v | | v | | v | | | | | | | | | v | | | | | | |
| | 3 | Commitment level | | | v | | | | | v | v | | | | | v | v | | | v | | | |
| | 4 | Level of satisfaction | | | v | | | | | | | v | v | | | | | v | | v | | | |
| | 5 | Relationship and coordination among stakeholders | | | v | v | | | | | | v | | | | v | v | v | | v | | | v |
| | 6 | Stakholder skills and knowledge | | v | | | | | | | v | v | v | | | | v | v | | | v | | |

Each sub-criterion is explained on below:

1. Financial and Economic Criteria;
   a. Project life cycle cost; life cycle costs will generally affect money value or money flow on the project inversely
   b. Investment in sustainable development; investments made in

sustainable infrastructure provision can be carried out stably and in the long term
   c. Sustainable cash flow; the ideal sustainable cash flow should be able to contain estimated costs and without excess on the other cost elements
   d. Profitability; continuous profit is the result of providing good operational infrastructure services
   e. State economic conditions; providing infrastructure services contribute to the economic development of neighbor community that provides economic value and benefits
   f. Equity, Liability and Fluctuation; the ability of the proponent to return the borrowed capital and the fluctuating currency value will affect life cycle cost project
2. Law and Political Criteria
   a. Clarity and uniformity of legal policy; clear legal framework and adequate guidelines will help to sustain the implementation of construction projects
   b. Stability of government conditions; good governance management is expressed in clearly defined infrastructure governance
   c. Transparency of the entire process; the implementation process that is not transparent often creates ambiguity and instability for all parties involved
   d. Public protests and disputes; public protests and disputes will affect sustainability in every project aspect, such as finance and legality
   e. Guarantees; every party involved in infrastructure projects is entitled to various guarantees according to the provisions
   f. Law and political support; a system of regulations and political arrangements is needed at every sustainability stage of projects
3. Managerial and Techinical Criteria
   a. Information and documentation Project; information and documentation needs to be centralized so that all stakeholders learn accurate and equal information
   b. Contract Change Order; poor planning will lead to job changes and a mismatch between planning and existing conditions
   c. Communication management; communication in work that involves many people is very necessary to ensure information delivered properly
   d. Risk management; risks need to be properly identified for future allocation and agreement between the two parties
   e. Conflict management; conflicts that are often ignored will result in miscommunication and even disputes
   f. Innovation and technology transfer; innovation level of the proposed project throughout its life cycle including innovative planning, innovative contracting and automation that needs to be done to keep up with the times
4. Health, Safety, and Environmental Criteria
   a. Environmental conditions and performance; the implementation of construction projects is endeavored not to affect the safety and health of the community and the surrounding environment
   b. Resources consumption and construction waste; management of construction waste and resources is needed to prevent any activities and environmental interference
   c. Biodiversity; ecological environment needs to be maintained to preserve ecological balance and various types of animals and plants and their habitats
   d. Eco-friendly materials; materials need to be chosen properly, especially those that do not harm the environment

e. Renewable energy; adoption of renewable energy related to green building technology applied during infrastructure development to achieve energy conservation, emission reduction and environmental protection
f. Safety and Health controls; K3 control and zero accident implementation should have been implemented

5. Operational and Maintenance Criteria
   a. Operational and maintenance costs; projects that have been operationalized should ideally have reasonable profitability and good operational power
   b. Durability and quality; good infrastructure has a long operational term, durable and good quality
   c. Project on target; The main goal of a construction project is that the project is completed on time, with the right quality and cost
   d. Problems quickly resolved; problems need to be handled as soon as possible to avoid failures and delays in the whole project
   e. Operational and maintenance philosophy; guidelines for maintaining adequate and safe operations over long periods of time focusing on operational control and maintenance
   f. The concept and complexity of the infrastructure; strategies identification to reduce the number of procedure or equipment required in innovation and technology focused designs
6. Social and Stakeholders Criteria
   a. Support and impact on social communities; the application of social aspects is supported by the existence of public involvement, local opposition support, and strategies to increase community involvement
   b. Power and stakeholder justice; Organization Breakdown Structure (OBS) is a guide in the implementation of construction projects that identifies the authorities, obligations and duties of each stakeholder
   c. Stakeholder commitment level; every stakeholder must be involved in every stage of construction and consistently contributed in carrying out their work
   d. Level of satisfaction; the level of satisfaction is related to the support and impact from the community on the construction project
   e. Relations and coordination among stakeholders; a need to have good relations and coordination among stakeholders
   f. Stakeholder skills and knowledge; skills and knowledge should be possessed by every personnel involved in infrastructure services

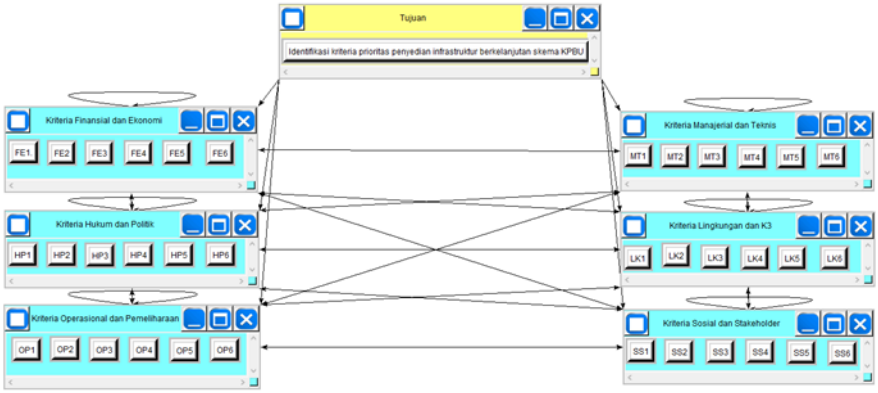


Figure 3. ANP Network Model

The criteria and sub-criteria for providing sustainable infrastructure with the PPP scheme need to be ANP-modeled as the first step in conducting research, as shown in Figure 3. In this case, the criteria are modeled as clusters, and the sub-criteria are modeled as nodes. After the ANP model is formed, data is processed using the ANP method, namely score determination for each criterion and sub-criteria by respondents who are engaged in providing sustainable infrastructure with the PPP scheme. Based on the test, the consistency ratio of all pairwise comparison matrices did not exceed 0.1, which means that all pairwise comparison matrixes were consistent and could be processed further. After confirming that all the data provided by the respondents were consistent, the three supermatrixes were calculated, namely the unweighted supermatrix, weighted supermatrix, and limiting supermatrix. The results of the limiting supermatrix stage show the ranking from the highest to the lowest that can influence decision making in successful sustainable infrastructure provision with the PPP scheme in Indonesia, can be seen in table 3.

Table 3. Final weight of each sub-criterion

| Sub-Criterion | Normalized | Limiting |
|---|---|---|
| FE1 | 0.0996 | 0.0248 |
| FE2 | 0.1194 | 0.0297 |
| FE3 | 0.1681 | 0.0418 |
| FE4 | 0.0717 | 0.0178 |
| FE5 | 0.4508 | 0.1121 |
| FE6 | 0.0904 | 0.0225 |
| HP1 | 0.1705 | 0.0240 |
| HP2 | 0.4025 | 0.0566 |
| HP3 | 0.0717 | 0.0101 |
| HP4 | 0.1238 | 0.0174 |
| HP5 | 0.1356 | 0.0191 |
| HP6 | 0.0956 | 0.0135 |
| LK1 | 0.0650 | 0.0099 |
| LK2 | 0.1739 | 0.0266 |
| LK3 | 0.0878 | 0.0134 |
| LK4 | 0.1334 | 0.0204 |
| LK5 | 0.1091 | 0.0167 |
| LK6 | 0.4307 | 0.0658 |
| MT1 | 0.1153 | 0.0176 |
| MT2 | 0.1130 | 0.0173 |
| MT3 | 0.0480 | 0.0073 |
| MT4 | 0.4381 | 0.0669 |
| MT5 | 0.1352 | 0.0206 |
| MT6 | 0.1503 | 0.0229 |
| OP1 | 0.1516 | 0.0231 |
| OP2 | 0.3418 | 0.0521 |
| OP3 | 0.1881 | 0.0287 |
| OP4 | 0.1475 | 0.0225 |
| OP5 | 0.1156 | 0.0176 |
| OP6 | 0.0554 | 0.0085 |
| SS1 | 0.1133 | 0.0173 |
| SS2 | 0.2152 | 0.0328 |
| SS3 | 0.1716 | 0.0262 |
| SS4 | 0.1560 | 0.0238 |
| SS5 | 0.2240 | 0.0342 |
| SS6 | 0.1200 | 0.0183 |

Normalized data is created to rank the sub-criteria for each criterion. Limiting data is made to rank the sub-criteria as a whole regardless of the criteria. Table 3 provides information on the final score of each sub-criterion.

Providing sustainable infrastructure services does require a stable economic condition. Infrastructure is generally the main factor to increase productivity and encourage higher economic growth, however most infrastructure provision will facilitate large-scale economic activities. In addition, the economic condition itself will have an impact on the financial ability to fund infrastructure provision. If the economic condition is unstable, the ability to finance infrastructure will also be limited. This naturally happens, because the infrastructure development of proper and quality infrastructure requires large funding that cannot simply be covered by the APBN, so the PPP scheme is needed.

Risk management is an important point in the success of sustainable infrastructure projects with the PPP schemes. The risk allocation becomes a substance of risk analysis in the feasibility study. In addition, the optimal contractual risk allocation will proportionally affect the value for money.

As service providers strive to support sustainable infrastructure development that has excellent quality, most service providers have started to apply the concept of 'zero accident' in their project implementation. This is considered in several cases of work

accidents in the past so that it can be considered as a lesson to reduce work accidents for future projects. Work accidents will certainly have an impact on the sustainability of the project which can obstruct the progress of infrastructure development which will ultimately harm the overall project in terms of cost, quality and time.

The government's political condition is one of the important elements in the implementation of the PPP. In the distribution of risk allocation, the government is in control of political risk, so that apart from economic conditions, a stable government's political condition is needed to control the provision of infrastructure projects.

The ideal and quality of sustainable infrastructure development should at least consider environmental factors, resilience, inclusion and good governance. On the operational and maintenance factors, there are sub-criteria of durability and good quality as considerations in the priority of providing sustainable infrastructure with the PPP scheme. These indicators seek to minimize the risk of loss during the implementation stage by carefully planning all resource. It is undeniable that these efforts can control construction costs, so that smaller errors are obtained during the operational and maintenance stages. With careful planning, the infrastructure built will be on target, so that it has good durability and quality.

The continuous provision of infrastructure projects does not escape the involvement of many parties. The involvement of numerous parties will lead to misunderstanding and miscommunication. According to the respondent, the relationship and coordination among stakeholders is ranked first, while good relations and coordination are needed for project continuity. Sustainable infrastructure provision with the PPP scheme involves two or more parties, including the government and business entities. To minimize the risk of errors or work accidents, it is necessary to convey precise and accurate information so that errors do not occur. Furthermore, the risk sharing of each stakeholder must be considered, especially authorities and responsibilities, so that the coordination of each work will run smoothly and create a harmonious and good working relationship.

The number of sub-criteria that will develop the framework that will be used in the successful provision of sustainable infrastructure with the PPP scheme in Indonesia is analyzed using Pareto analysis. Pareto analysis was conducte to find a limit on the number of sub-criteria that have a high contribution in the development priority framework. According to the pareto 80/20 law, 80% of the success of the priority framework comes from 20% of the sub-criteria that have a high contribution. In this study, we obtained a pareto diagram as shown in Figure 4. From the resulting Pareto Chart, the Pareto law of 80/20 is not obtained as in general conditions, so an approach is needed that takes into account the difference between each cumulative, namely the difference in the number of sub-criteria (P value) and the difference in the percentage of involvement (C value) (Priambudhi, 2019). The P value is 41,52% and the C value is 36,39%. Because the value of C is smaller than P then:

Number of sub-criteria = 20%+ ΔC
= 20%+ 36,39%
= 56,39%

Number of sub-criteria = 56,39% × 36
= 20,3 subkriteria
≈ 20 subkriteria

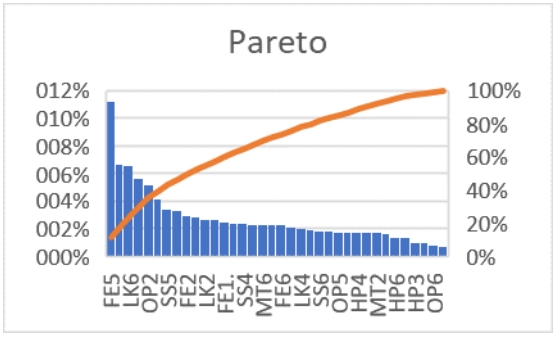


Figure 4. Pareto chart

Based on the results of the Pareto analysis calculation, it was found that 20 sub-criteria have a high percentage of involvement in the preparation of the framework for the successful sustainable infrastructure provision with the PPP scheme in Indonesia. This development framework is composed of six criteria, each with a percentage of involvement as shown in Figure 5.

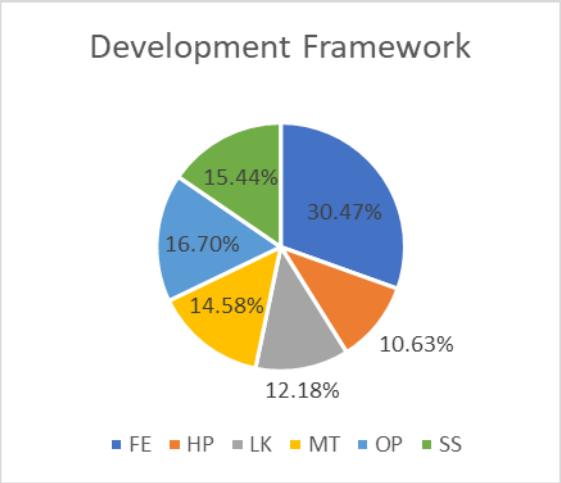


Figure 5. Contribution of criteria to the development framework

The development framework for the successful provision of sustainable infrastructure with the PPP scheme in Indonesia, which has been assisted by 20 sub-criteria, will then be validated for similar project. One of the sustainable infrastructure projects under the PPP scheme in Indonesia is PLTU Batang or Central Java Power Plant (CJPP). PLTU Batang was built by the Special Purpose Vehicle (SPV) PT. Bhimasena Power Indonesia, which is a joint venture of J-Power (34%), Adaro (34%), and Itochu (32%). This project received guarantees from PT Penjaminan Infrastruktur Indonesia (PT PII) and the central government for political risk and force majeure (KPPIP, 2019).

The PLTU Batang project is planned to start with the handover of the field to the contractor in 2016. During that year, Indonesia had an economic condition that was stable and experienced an increase compared to the previous year. The Indonesian economy in 2016 as measured by Gross Domestic Product (GDP) at current prices reached 12 trillion and grew 5.02 percent higher compared to the 2015 achievement of 4.88 percent (Badan Pusat Statistik, 2017). Thus, the first sub-criteria, namely Indonesia's economic condition has been improved by this project.

To ensure that it can operate and have good quality during operation, PLTU Batang conducts periodical monitoring activities to see potential risks and alternative mitigation measures which are then carried out in the form of coordination meetings of the Ditjen Pengelolaan Pembiayaan dan Risiko (DJPPR) and PT PII (Persero) (DJPPR Kemenkeu, 2018). With regular meetings, it will improve relations and coordination among stakeholders through distributed communication, so that everyone can express their opinions and thoughts verbally without any miscommunication. Besides prioritizing good quality, PLTU Batang uses environmentally friendly technology, namely Ultra Super Critical Boiler (USC) which was adapted from Japan. The use of this technology is intended to increase generator efficiency up to 15 percent higher than non-USC(KPPIP, 2022). The use of this technology minimizes the emissions produced so that it is said to be an environmentally friendly technology. The use of environmentally friendly technology is intended to have a long-life service without damaging the environment(Syukra, 2021), which refers to sustainable investment efforts, as later this PLTU will supply electricity to a wider area, namely Java and Bali. The following explanation validates the sub-criteria for the infrastructure durability and quality, the sub-criteria for relations and coordination among stakeholders, the sub-criteria for Resources consumption, the sub-criteria for innovation and transfer technology and construction waste and the sub-criteria for sustainable investment.

PLTU Batang faces various obstacles, one of the biggest obstacles is land acquisition. These land acquisition or

licensing issues proved detrimental to the project itself which resulted in project delay for several years. The President saw that the problem was starting to be disturbed, because the problem could have an impact on other aspects such as the government's growth. As a result, the president inaugurated the PLTU Batang project in Central Java on August 28, 2015 after being delayed for four years due to land acquisition problems (Lestari, 2015). This is one of the considerations to avoid an electricity crisis in the upcoming year. After the problem of land acquisition was resolved, another problem arose again, namely the loss of numerous livelihoods for local residents caused by the acquired land. Overcoming these problems, the PLTU Batang project immediately opened up opportunities for hundreds of workers so that people did not have to worry about losing their jobs due to project establishment (Pramanik et al., 2020). This proves the validity of the sub-criteria problems that are quickly resolved, the sub-criteria for problem quickly resolved and the sub-criteria for conflict management.

The risk management in this project can be said to be in a good condition, because it has been stipulated on a written contract and has allocated the risk properly. The risks for design, construction, operation and maintenance as well as technical services are handed over entirely to PT Bhimasena Power Indonesia. Operational and maintenance risks are handed over entirely to PT Bhimasena Power Indonesia. Construction equipment risk is assigned to Sumitomo Corporate and Mitsubishi Hitachi Power Systems Indonesia (MHPS). Coal procurement was handed over to Adaro Indonesia and Kaltim Prima Coal (KPC) (Bhimasena, 2019). Political risk and force majeure are left to the central government. Future ownership of the assets will be handed over to the government at the end of the concession period, then the electricity produced is sold through a Power Purchase Agreement (PPA) to PLN as a State-Owned Enterprise (BUMN) in the electricity sector. The above shows that risk management can be said to be valid in PPP-based sustainable infrastructure projects. As well as the sub-criteria for commitment level indicated by the commitment of each stakeholder signed in the contract.

The Occupational Health and Safety control program carried out in the Batang PLTU project can be classified in the controlled category. In 2018 the WIKA Beton Quality, Safety, Health and Environment (QSHE) Team held a Safety Patrol program at the PLTU Batang Project (WIKA Beton, 2018). Through the program, every project work is monitored to comply with OHS procedures. Occupational safety and health control sub-criteria were validated through this project.

The PLTU Batang operation experienced delays, especially due to the COVID-19 pandemic which required the termination of multiple projects in Indonesia (Kutnadi, 2020). There are many things that have to be pursued and corrected due to the delay. Initially, the Batang PLTU was planned to start operating in early 2022, due to a number of delays in the initial operation, which was reprojected at the end of 2022 or early 2023(Umah, 2021). If observed hierarchically, where the sub-criteria to control occupational safety and health has a higher hierarchy than the sub-criteria for the project on time, right cost and quality. The placement of these sub-criteria is appropriate during the COVID-19 pandemic, the government stopped the project to prioritize the health of the workforce.

PLTU Batang succeeded in validating 14 out of 20 indicators in the framework for successful provision of sustainable infrastructure with the PPP scheme. For the other 6 indicators, it is required to reconsider sustainable infrastructure projects with other PPP schemes. The framework development applied to the PLTU Batang succeeded in providing a match of 70%, so it can be considered for use by the government when makin decisions in the context of the success provision of sustainable infrastructure with the PPP scheme in Indonesia.

## Conclusion

The selection of sub-criteria in the providing sustainable infrastructure with the PPP scheme involves six criteria and thirty-six sub-criteria. Based on the result of the ANP method, the framework development consist of 6 (six) criteria and their contributions per criterion are : (K1 or FE) Finance and economics criteria (30,47%), (K2 or HP) Law and political criteria (10,63%), (K3 or LK) Health, Safety and Environment criteria (12,18%), (K4 or MT) Managerial and Technical Criteria (14,58%), (K5 or OP) Operational and Maintenance criteria (16,70%), and (K6 or SS) Social and stakeholder criteria (15,44%). It consists of 20 (twenty) top level sub-criteria, namely : (K1.5 or FE5) Economic conditions of the country), (K4.4 or MT4) risk management, (K3.6 or LK 6) Control of safety and health, (K2.2 or HP2) Stability of government conditions, (K5.2 or OP2) Durability and quality, (K1.3 or FE3) Sustainable cash flow, (K6.5 or SS5) Relationship and coordination among stakeholders, (K6.2 or SS2) Power and stakeholder justice, (K1.2 or FE2) Investment in sustainable development, (K5.3 or OP3) project on target, (K3.2 or LK2) resources consumption and construction waste, (K6.3 or SS3) Commitment level, (K1.1 or FE1) Life cycle cost, (K2.1 or HP1) Clarity and uniformity of legal policy, (K6.4 or SS4) Level of satisfaction, (K5.1 or OP1) Operational and maintenance cost, (K4.6 or MT6) Innovation and transfer technology, (K5.4 or OP4) problems quickly resolved, (K1.6 or FE6) Equity, liability and fluctuation, (K4.5 or MT5) Conflict management. The framework can be used as consideration for the sustainable infrastructure with the PPP Scheme. The application of the development framework to the PLTU Batang project provides a match percentage of 70%. With this percentage, the government can try to use the development framework for a number of sustainable infrastructure projects with PPP scheme in Indonesia in the future.

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