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Readiness for Implemented Sustainable Procurement in Indonesian Government Construction Project

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Abstract: Procurement is the process of obtaining goods and services in a construction project and is a crucial point for the success of a design and build (DB) project. The success of a DB project has an effect on work performance metrics such as cost, quality, and time. Therefore, this research aims to develop a readiness model for implementing sustainable procurement in a DB project with a financing system in the state/regional budget (APBN/APBD). By using previous literature reviews, this research adopted a mixture of qualitative and quantitative methods. Specifically, the qualitative method was conducted using in-depth interviews, and conclusions were drawn using the Delphi method and focus group discussion (FGD). Meanwhile, the quantitative method was used to analyze secondary data from the current DB project in order to examine sustainable procurement. The projects examined were spread across the country and had a value of at least 100 billion. Consequently, the results showed that various factors influenced sustainable procurement in the DB management project. In addition, this research impacted better procurement management in the DB project based on APBN/APBD funding, thereby increasing project productivity and innovation, as well as other beneficial values to stakeholders. Typically, the result could be used as a readiness model for implementing sustainable procurement in a DB project with APBN/APBD funding schemes, serving as a guide for construction management in the future and being useful for decision making on government projects.

Keywords: procurement; design and build; sustainability procurement; readiness procurement; government project; performance project; construction project

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1. Introduction

The construction industry is one of the largest sectors, making significant contribution to the gross domestic product of most countries [1]. A similar situation also obtains in Indonesia, which reached 10.79% and continues to increase every year (BPS, Kemenkeu, 2021). Despite being a significant contributor to the economy, the construction industry faces problems with punctuality and fragmentation [2–4], leading to inefficiencies and performance issues in construction projects [5–10]. To improve the implementation of construction projects, various methods can be adopted. These methods include procurement engineering [11], design evaluation and innovative procurement [12–14], sharing of risks in projects [15–18], and optimizing transport and equipment costs to achieve high productivity in projects [14,19,20].

Recent results on supply chain and project management show the importance of selecting suppliers and/or subcontractors [21]. The results suggest that delivery and service should be associated with the satisfaction of customer needs [21,22]. Therefore, evaluations

are required before selecting suppliers and subcontractors [21]. The attributes for the success of project vary across stakeholders, with different and broad perspectives regarding key performance indicators [23]. Three important measures are cost, quality, and time, which most stakeholders spend in evaluating the results of a construction project [23,24]. In general, time is the duration of a project, consisting of delays, actual construction time, construction speed, time fluctuation, etc. Cost measurements refer to the total costs incurred since the start of project, while quality refers to the punctuality of the project according to the planned budget.

Procurement is a strategy necessary for the successful implementation of project. A study of data from a state-owned company explored 30 projects executed between 2018 and 2023. These projects were made up of 30% DB, 67% Design–Bid–Build (DBB), and 3% Engineering–Procurement–Construction (EPC). The findings show that at least five projects, which amounts to 17%, suffered losses. Among these, five were DB projects valued at over USD 6.2 billion, categorized as significant government projects. Some of the identified factors are due to the lack of detailed baseline design from the government, meaning that the owner (government) and contractor may have different views when submitting bids [25–27]. Therefore, it is necessary to develop an anticipatory method in the form of sustainable procurement to face DB project challenges in government projects [27,28]. Government projects with a fixed rate provide opportunities to develop innovation and creativity in both designing and executing the projects. This is especially true for DB projects, which benefit from a streamlined process of design and implementation [29–32].

1.1. Government Project

Government projects are crucial for the development of Indonesia and it is essential to manage state-financed projects effectively to ensure the delivery of optimal performance and significant benefits to communities. Typically, a project financed by the state budget should have good performance in terms of cost, quality, and time. This requirement is shown in Statutory Mandate No. 2 (2017), which governs the procurement of goods and services for projects and establishes objectives for sustainable budget use and project results.

There are two project delivery systems for government projects, namely the Design–Bid–Build method, which includes separate phases of design, bidding, and construction (a non-integrated method), while the second combines DB, engineering procurement, and construction (integrated project). The trend eventually shifted to government DB project models as the planning and implementation stages of the project became more integrated. This integration is intended to reduce project delays caused by design changes [33] and material scarcity [6,8], leading to significant waste in the project [34,35].

1.2. Sustainability Procurement

According to Hawkins (2011) [36], procurement is a series of activities performed to meet the need for goods and services in various construction projects, considering various factors such as cost, quality, time, and worker safety. Dzeng and Lin (2004) [37] stated that procurement is related to fulfillment and also includes negotiating costs and time, accompanied by agreements benefiting both parties. Furthermore, Chang (2013) [38] succeeded in building a government procurement system that focuses on fulfilling the need for goods and services to ensure good performance. Based on Rivas and Serpell (1999) [39], effective and efficient procurement is achieved through the knowledge of participants. In government construction projects, procurement refers to the guidelines shown in Statutory Mandate No. 2 (2017) for construction services. These guidelines state that procurement for government projects is conducted electronically and can include financial mechanisms and direct appointments, as stated in Article 27.

Procurement plays a crucial role in a project and ensures high performance in terms of cost, quality, and time [11–14,30]. Consequently, procurement should be managed and planned appropriately as it influences various phases of the project life cycle. However, it is crucial to be aware that procurement faces significant challenges in DB projects funded

by APBN/APBD, particularly those following a DB model. This scenario is because there are no clear design specifications from the outset, as contractors (state-owned enterprises) are awarded contracts by the government without a detailed design basis. Therefore, procurement faces significant challenges due to the lack of clear material specifications from the start. A key challenge lies in procurement planning, particularly in DB projects, where design and execution are integrated. According to Asmar [40], the moment design readiness reaches 20%, the main contractor can initiate comprehensive planning, including procurement. In the context of this research, procurement planning includes coordination with buyers, suppliers, and subcontractors to ensure the contribution of these parties from the initial stages [30,40,41]. This method is crucial to ensure seamless procurement from the planning phase, ensuring that the selected design meets material requirements and establishes commitments between subcontractors/suppliers from the beginning of the project. The method addresses concerns about potential competition and disagreements between main contractors and subcontractors during project implementation [42,43].

Procurement in the execution of DB mainly focuses on how a project has a single advantage in organizing procurement because it is an integral part of project planning and implementation. The main contractors are faced with control by subcontractors and suppliers, each of whom has a different opinion. In procurement projects [44–46], it is not uncommon for delays to occur in project implementation. Therefore, a critical success factor is needed to measure the success of procurement projects [11,23,47–50]. Previous exploration regarding procurement has not been conducted in an integrated manner, since the project initiation and planning phases create productivity and reduce waste in the project.

1.3. Design and Build Project

In a DB project, the roles of designer and contractor become one unit, allowing the owner to work solely with the general contractor (GC) [2,32,33,51–55]. This method offers the advantage of streamlining the transition between design and project execution [33,56]. In practice, government-led DB projects benefit from strong procurement management because they have a fixed rate and easily controllable design and planning stages [11,53,56,57]. According to Sari et al. (2023) [32,52], DB projects facilitate various forms of collaboration, including joint operations and ventures, thereby promoting deeper partnerships. Additionally, Katar (2019) [33] conducted a comparison between DB and other project delivery systems, proving that DB provides better benefits in project management. These advantages are also applicable to government projects in Indonesia, where DB is selected for projects, as shown in Figure 1.

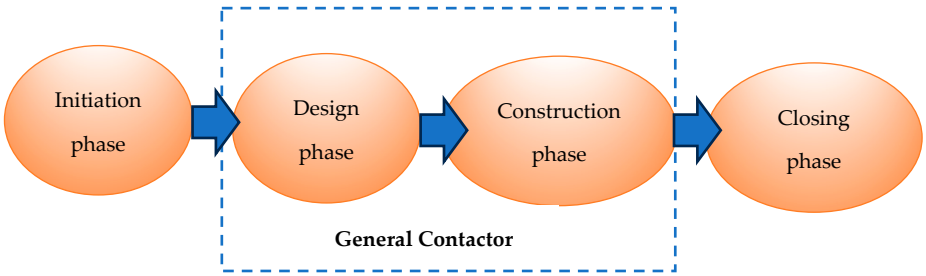

Figure 1. Design and Build framework [40,56,57].

Figure 1 shows that a DB project has single-entry advantages in DB [44,57]. This is useful when executing government projects that include fixed-rate payments.

1.4. Delphi Method

The Delphi method is a way to collect individual opinions collectively on a topic based on the experience of each expert, which leads to consensus through the unity of each individual [58]. The experts used in the Delphi method are people who know about a

topic, with at leastfour people. Furthermore, the Delphi method can fill gaps in qualitative and quantitative methods, such as bias that often occurs in exploration [58]. The Delphi method is used for unclear problems requiring expert consensus [58–61]. Several criteria are determined in the Delphi method, which include:

(a) Minimum of 5–20 experts [58,59,61].
(b) A minimum of two rounds or three rounds is advised openly [58,59,61].
(c) Experts should be competent and heterogeneous in skills [58–62].
(d) A mean and median are calculated for drawing up conclusions and experts should be treated equally in decision-making scores [58,59,61].

2. Materials and Methods

Qualitative and quantitative methods were used in line with the research questions to generate the desired result. Table 1. shows the research questions consisting of input, process, and output in order to achieve the objectives. Subsequently, six national-level project sites that implemented sustainable procurement practices were evaluated, resulting in the production of greater value. The projects showed reduced losses and better benefits.

Table 1. Research questions.

Main Steps	Research Procedure	Results
RQ1	Literature review, monthly progress report	What are the factors affecting procurement in DB government projects?
RQ2	Results RQ1 Delphi method	What are procurement models in government DB projects?
RQ3	Results RQ2 Empirical research in the field, results and analysis	Reporting of results and conclusion

From Table 2. DB projects with a large category project value were accepted by state-owned enterprises, with the large category having project value above USD 6.2 billion. Subsequently, an analysis of successful sustainable procurement steps was conducted in the six selected projects. The detailed methodological steps followed in this research were as follows.

Table 2. List of projects for the research.

No	Title	Value (USD Million)	Location
1	DB "A"	12.5	DKI Jakarta
2	DB "B"	10.0	DKI Jakarta
3	DB "C"	16.5	Bukittinggi, West Sumatera
4	DB "D"	18.3	DKI Jakarta
5	DB "E"	9.0	DKI Jakarta
6	DB "F"	16.5	East Kalimantan

Figure 2 shows the research objective, namely to determine the procurement strategies that could improve project value. Many projects that were about to be launched experienced losses because they were commissioned directly by the government and were intended to be implemented by state-owned companies. Typically, procurement requires analysis and evaluation of the factors directly affecting productivity and waste in the project life cycle. To finalize the implementation strategy, experts used the Delphi method to improve understanding. This process ensured that the strategy became a guiding factor and variable in government project procurement.

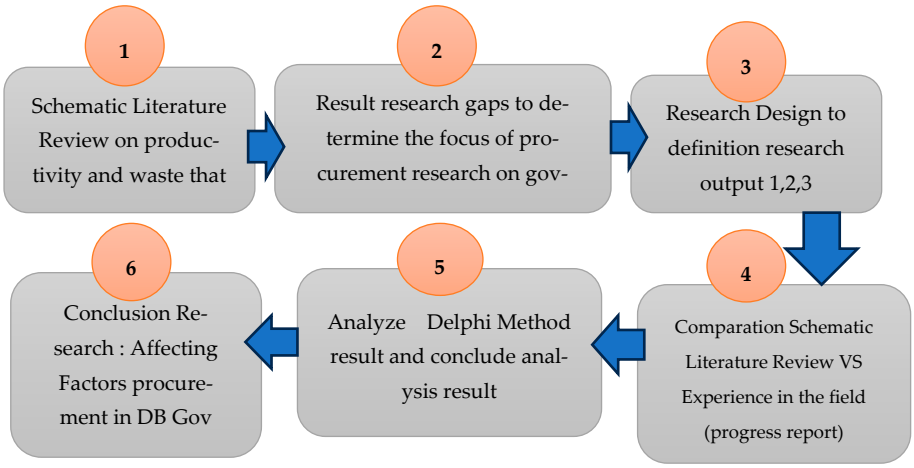

Figure 2. Research methodology.

The analysis used the Delphi method to draw conclusions, and the success of the method essentially depended on the selection of competent partners. Experts provided opinions regarding the suitability of procurement with DB project criteria. The following criteria were determined for the selection of experts, which included:

(a) Practitioners from contractors that had broad experience in construction.
(b) Experts that understood construction management in government projects.
(c) Experts that understood procurement.

Experts gave opinions on the Delphi method and a consensus was taken to formulate the factors and variables that affected procurement in government projects.

After implementation, the next step was to conduct focus group discussions (FGDs) aimed at validating the results, and steps were taken to ensure that stages could serve as a guide for future project executions. In this FGD, nine experts were invited to explain the consensus reached. The profiles of experts in this research included owners (CEOs), contractors (CEOs, directors, project managers), designers (senior designers), as well as academics (associate professors and construction management professors). Following this, proportional expert information is presented in Table 3.

Table 3. Profile of respondents for FGD.

Actors	Resp.	Position/Role
Owner	1	Chief Executive Officer
	2	Chief Executive Officer
Designer	3	Senior Designer
	4	Senior Designer
Contractor	5	Chief Executive Officer
	6	Project Manager
	7	Operational Director
Academic	8	Professor of Construction Management
	9	Ph.D in Construction Management

Table 3 was the criteria for experts that conducted FGDs, where the result was later analyzed using the Delphi method.

3. Results

3.1. Schematic Literature Review

M. Suresh and R.B. Arun Ram Nathan (2020) [22] stated that four factors affect strategy procurement implementation, including Autonomous factors, Dependent factors, Linkage factors, and Driving factors [22]. These factors are detailed in Table 4.

Table 4. SLR factors for procurement.

Factors	Reference
Supplier selections	[63–66]
Reviewing material selection/product evaluation	[67–69]
Unavailability of material	[69]
Method of awarding purchase contract	[70]
Negotiating with supplier	[71]
Cost of material	[70]
Delay in material delivery	[72–75]
Payment term	[70,76–78]
Risk management	[76–82]
Skills of supplier	[83,84]
Ability to state clear end-user requirements	[29,85]
Track record past project	[22,60]
Price competition	[63–66,86–90]
Time predictability	[87,89,90]
Certainty of cost Without fluctuation	[78,90]
Flexibility for change	[30,91,92]
Size Project	[22,60]
Contribution	[93,94]
Responsibility	[18,60]

3.2. Delphi Round 1: Identification of Factors Affecting Procurement

In the first round of the Delphi method, the experts were invited to participate in an FGD. Questionnaires were later distributed to ask experts to write down at least 10 important factors for the sustainability of construction project procurement. The results of the previous research mapping in Table 3 were also attached to the questionnaire as a reference. The experts had four days to return the first questionnaire and in this round, each opinion was analyzed by experts, as shown in Table 5. There were at least 22 factors that influenced the sustainability of government project procurement and the detailed results were as follows.

Table 5 shows that 22 factors influenced the preparation of sustainable procurement for government projects, where negotiations with suppliers were the most important factor in determining sustainable procurement for government projects. Experts also signified that compliance with government regulations was a considerable factor in procurement.

Table 5. Factors provided by the panel of experts in Delphi round one.

Factors	Percentage of Panels
Supplier selections during bidder	5.56%
Reviewing material selection/product evaluation	3.33%
Negotiating with supplier	8.89%
Cost of material	7.78%
Delay in material delivery	7.78%
Payment term	6.67%
Risk management	4.44%
Skills of supplier	5.56%
Track record in the past project	3.33%
Price competition	7.78%
Time predictability	4.44%
Certainty of cost Without fluctuation	3.33%
Flexibility for change	4.44%
Size of Project	1.11%
Participation	4.44%
Responsibility	1.11%
Partnering	4.44%
Comply with government regulations for procurement	4.44%
Competence of personnel	2.22%
Mobilization	1.11%
Adaptability	4.44%
Risk sharing during project execution	3.33%

3.3. Delphi Round 2: Refining the Affecting Factors

The second round of the Delphi method took the results of the first round and added a measurement scale of "very important", "important", and "not important". In addition, several open procurement readiness questions related to project design readiness were also added. This was important, because for DB projects funded by the APBN/APBD, project design was often imperfect and projects were fixed-rate. Apart from design readiness, the importance of risk sharing was also questioned when there were changes to work orders from the government that did not affect changes in work volume. Adaptability, risk sharing, and partnerships were important factors to overcome this situation. Table 6 shows the results of the second round of the Delphi method.

Table 6. Delphi round 2 results.

Factors	% of Experts Who Stated Very Important or Important	Very Important	Important	Not Important
Supplier selections	100%	56%	44%	0%
Reviewing material selection/product evaluation	100%	0%	100%	0%
Negotiating with supplier	100%	22%	78%	0%
Cost of material	100%	33%	67%	0%

Table 6. *Cont.*

Factors	% of Experts Who Stated Very Important or Important	Very Important	Important	Not Important
Delay in material delivery	100%	33%	67%	0%
Payment term	89%	33%	56%	11%
Risk management	78%	11%	67%	22%
Skills of supplier	100%	33%	67%	0%
Track record in the past project	100%	56%	44%	0%
Price competition	100%	0%	100%	0%
Time predictability	78%	0%	78%	22%
Certainty of cost Without fluctuation	89%	0%	89%	11%
Flexibility for change	100%	0%	100%	0%
Size of Project	89%	0%	89%	11%
Contribution	100%	0%	100%	0%
Responsibility	100%	0%	100%	0%
Partnering	78%	0%	78%	11%
Comply with government regulation	100%	22%	78%	0%
Competence of personnel	89%	0%	89%	11%
Mobilization	100%	0%	100%	0%
Adaptability	89%	0%	89%	11%
Sharing risk	78%	0%	78%	22%

Table 6 shows the second round of the Delphi method, including all the factors that experts agreed were critical and had to be considered in sustainable procurement.

3.4. Delphi Round 3: Utility Factors from Experts

In the third round of the Delphi method, benefit questions were added for each factor, where the benefit factor was a determinant of the degree of suitability for each procurement [95]. Respondents were asked to give a score of 1–10 to avoid a zero score, with 1 being **"low suitability"** and 11 being **"high suitability"**.

From the third round of the Delphi method in Table 7, ten sustainable procurement factors were selected that had the highest scores, including supplier selection, project size, and compliance with government regulations. Other selections included price competitiveness, contribution, staff competence, partnerships, track record in past projects, negotiations with suppliers, and material costs.

Table 7 above describes the level of importance of each factor. for an importance level above 5, it is used as a reference to determine factors that influence procurement management on Government Design and Build (DB) projects.

Table 7. Results of Delphi round 3.

No	Factors	Suitability
1	Supplier selections	9.111
2	Size of Project	7.889
3	Comply with government regulation	7.889
4	Price competition	7.667
5	Participation	7.667
6	Competence of personnel	7.667
7	Partnering	7.556
8	Track record in the past project	7.444
9	Negotiating with supplier	7.444
10	Cost of material	7.444
11	sharing risk	7.444
12	Delay in material delivery	7.333
13	Payment term	7.333
14	Mobilization	7.222
15	Responsibility	7.111
16	Certainty of cost Without fluctuation	6.222
17	Time predictability	6.111
18	Flexibility for change	5.778
19	Adaptability	5.566
20	Skills of supplier	5.444
21	Risk management	5.222
22	Reviewing material selection/product evaluation	5.000

3.5. Progress Report Project

The third round of the Delphi method was used in case research of six projects and was proven to have produced better project progress. The progress report for the sustainability project is provided in the chart below.

Figure 3 shows that there was a deviation for DB "A" and DB "B", which experienced loss, while DB "C", DB "D", DB "E", and DB "F" experienced positive deviation and the project was profitable. Several factors that caused loss in DB "A" and DB "B" were as follows.

1. Iron prices rose 30% due to the COVID-19 pandemic, as this project has been ongoing since 2020-2022, and at that time, the COVID-19 pandemic occurred.
2. Workers were not productive and efficient during the COVID-19 pandemic.
3. Overhead costs increased due to the longer project duration.
4. There were changes in the corridor from 1.8 m to 2 m without considering the area offered during the tender, and this was not accompanied by a change order.

Although efforts made through sustainability procurement were very effective, when it was not accompanied by said efforts, losses were bigger.

For a detailed progress report of the projects in terms of value, see Table 8 below.

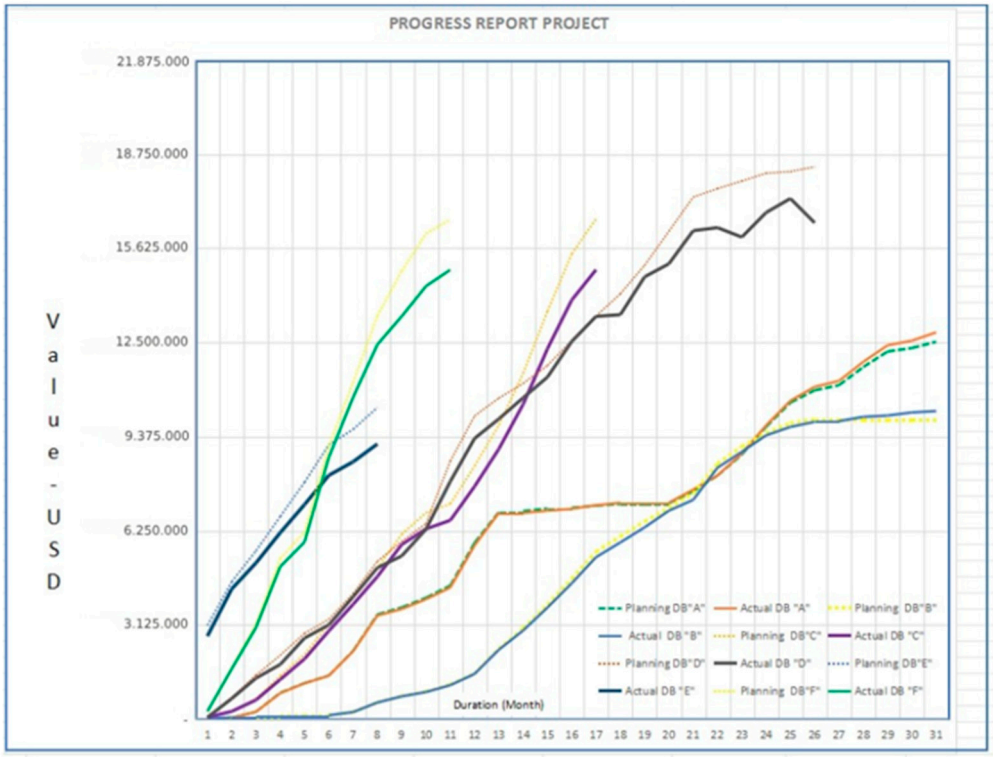

Figure 3. Progress report of the projects.

Table 8. Detailed progress report of the projects.

	DB "A"	DB "B"	DB "C"	DB "D"	DB "E"	DB "F"
Plan (USD)	12.525.500	9.947.000	16.607.809	18.332.938	9.100.770	16.588.117
Actual (USD)	12.837.750	10.224.805	14.918.812	16.477.141	8.091.399	14.914.933
Deviation (USD)	−312.250	−277.805	1.688.997	1.855.796	1.009.371	1.673.185

Table 8 shows the progress values of DB "A" and DB "B", comparing the plan and the actual outcome, showing negative values.

4. Discussion

The collected data were analyzed using standard qualitative research procedures, namely data reduction, data presentation, as well as conclusion verification, and the interview transcripts were first transferred to organize the data. The first round was classified as data mining based on the perspectives of prerequisites, strengths and advantages, and challenges and obstacles. In addition, the experience of each respondent in implementing the project, as well as the possibility of deeper sustainability procurement practices in the organization allowed for different time positioning of events. In the next step, the data were classified based on the six procurement dimensions found in the literature, namely contracting from the owner (government), supplier selection, financial and technical, operations, and sustainability. This allowed a deeper understanding of the characteristics of sustainable procurement, which was used to analyze step by step the sustainable procurement implemented to improve performance and value in construction projects. Several major respondents were also contacted to support the validity of the analysis and make conclusions.

- *Owner/Government*: The implementation of sustainable procurement was necessary in government projects to prevent unclear work orders that arose due to urgent orders and to execute the projects in the public interest. General contractors had to ensure long-term contracts and partnerships with suppliers [32,52] to produce value for those

included in the project. Achieving project aims was a shared task that was a concern of every party [96–100].

- *Contractor*: When obtaining mandates and contracts from the government, specifically for national priority projects, DB project management was required to achieve consistent performance in project planning and implementation [33,42,52,100–103]. Contractors innovated creatively, specifically in procurement, to advance the project, following expected aims and sustainability for every stakeholder [11,53,54,104]. In addition, the contractor developed a continuous planning system, identified problems hindering site operations, and ensured that engineering acted as an effective check and control for the planned materials [22,30,104].
- *Consultant (Designer)*: Value engineering changes affected the whole project design and right value engineering led to a project that was beneficial and sustainable in the long term. Design maturity determined the accuracy of material purchasing in the project [105–109].
- *Academics*: Achieving superior project performance requires collaboration from different sectors. In Indonesia, infrastructure development was conducted on a large scale [32]; hence, construction management could not be separated from various necessary innovations. Furthermore, procurement was a way of obtaining goods and services needed to manage projects [25,108,110–113]. The success of procurement was the first step in ensuring that the project was beneficial and valuable for every stakeholder [110,114]. Procurement included placing orders, managing finances, supplier selection, collaboration and partnerships [32,40,51,52,114,115], and operations, all in order to create an organization, ensuring its continuity even in challenging circumstances, where contracts might lack clarity [87,98,99,116].

Based on the results of the FGD, several recommendations were obtained. Additionally, the development of sustainable procurement to increase productivity and avoid waste in DB government projects [117] can be seen in Figure 4.

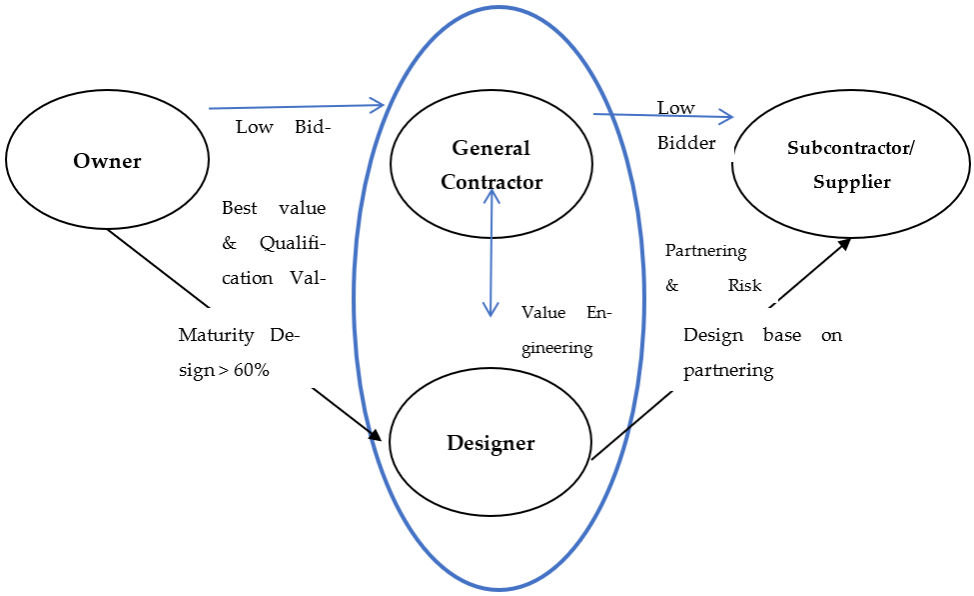

Figure 4. Procurement model for DB projects.

From Figure 4, the owner had two options to change the procurement selection basis from low bidder to best qualifying value, and design maturity level was above 60% before bidding. General contractors, in selecting subcontractors/suppliers, had the opportunity to establish partnerships and share risk for the low bidder.

5. Conclusions

1. In conclusion, this research contributed to the ongoing discussion of sustainable project management, particularly in improving procurement.
2. Analysis and results of FGD using the Delphi method showed at least 22 important factors that needed to be analyzed to achieve sustainable procurement. Supplier selection factors were considered in procurement, and government compliance factors were also important and mandatory because government projects used financing from the APBN/APBD. Apart from these factors, the price of materials and the participation of both parties from the start were also important [32,40].
3. Participation of all stakeholders started with DB projects, which was very important for promoting partnership. This was particularly significant because the characteristic of the project was not complete when contractors bid project prices [40]. Consequently, this scenario could be an opportunity or challenge for contractors and suppliers to create long-term and sustainable procurement. Additionally, the track record was an important factor in supplier selection because long-term collaboration was required to achieve sustainable project performance [3,41,64].
4. The procurement process included every stakeholder by considering the factors that influenced procurement implementation [52,118]. Supplier experience was a very important factor to evaluate based on the results of the Delphi method submitted by owners and general contractors [11,12,119]. Project performance was achieved by maximizing productivity increases and reducing waste in procurement philosophy (Lean Construction), specifically on government projects in Indonesia [117].
5. The research was deepened through FGD to create standard operating procedures that were developed more systematically for sustainable procurement in government projects. The Indonesian government had many development projects in the new national capital (IKN) with different field conditions compared to previous projects. Developing sustainable procurement to face challenges in IKN projects was critical to achieving better project performance.

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