Promoting efficient and effective road infrastructure procurement

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Abstract. Road infrastructure plays an essential role in supporting the economy of a region. The importance of road performance has implications for the government in arranging good road infrastructure. One aspect of the government's efforts to realize good road infrastructure is through the provision process implementation. Recently, the provision or procurement of maintenance projects uses conventional methods. Although the supply of road infrastructure projects is based on contractors who work effectively, procurement alternatives are using integrated ways that can support an efficient and efficient procurement process. This study aims to compare the procurement process between conventional and mixed methods and identify the factors that drive the success of the procurement of effective and efficient road projects. The Delphi questionnaire survey was conducted to obtain data on factors that support an effective and efficient procurement process. Data analysis shows that the constraints in implementing integrated methods, which are practical and useful methods, are regulation, the competence of stakeholders, and adaptation to new approaches. These obstacles can then be overcome by establishing clear rules, training to improve human resources, and socialization from the government.

1. Introduction

Road infrastructure is part of transportation infrastructure that plays an important role in the economy, social culture, politics, environment, and defense and security. Roads based on the law can be divided into national, provincial and district roads [1]. Therefore, based on the road classification, the central government and regional government are authorized to operate the roads.

Road infrastructure provision is the authority of the government. Currently, the procurement in Indonesia road infrastructure projects still uses traditional methods. Although the procurement with this method is fair to contractors, it is felt to be less effective and efficient. Several alternative methods of procurement offer benefits to the government as road operators. The integrated methods are an alternative to procurement methods that can overcome the shortcomings of traditional methods.

The previous study concluded that the integrated method is more popular than any other method such as conventional which was previously stated to be the most common method implemented. Besides, this method is increasingly being used extensively over the past ten years [2]. The advantage of this conventional that well known as Design Bid Build method is that early contractor participation in planning can result in time and cost efficiency, more maintained communication so that the project can be completed earlier and with less cost and guaranteed quality.

In Indonesia, procurement projects using integrated methods exist in Law number 2, 2017, on the construction service industry [3]. In article 12 states that design, construction and supervision services can be carried out in an integrated method. Regulation of Minister of Public Works No. 19, 2015, also explained the standards and guidelines for the procurement of integrated construction works [4].
Currently, road infrastructure projects still use traditional or conventional methods, where this method has several disadvantages. Public projects which are owned by the government, also use this method. In fact, this non-profit project will certainly have more value and benefit if it can be completed earlier.

This study aims to identify obstacles to effective and efficient procurement and factors that can encourage effective and efficient procurement. Starting from the traditional and integrated procurement concept and then proceeding with the constraints of implementing more efficient and effective procurement alternatives and finally with factors that can encourage effective and efficient procurement.

2. Project procurement method

2.1. Traditional Procurement Method
The traditional method or design bid build is a procurement method where the government as the party that has the authority to implement a separate contract between planning and implementation. In this method, the project procurement is awarded by the bidder with the lowest bid. This method is a standard method used in the procurement of road infrastructure projects. After the project is won, the government is responsible for the operation and maintenance of this road infrastructure project. In this case, the government as the owner and authority, has financial responsibility in all aspects of this road infrastructure project.

This method provides the reason for implementing a more equitable system for contractors who take part in procurement tenders, directly responsible to the government as project owners, clear and established procurement implementation rules, clear guarantee mechanisms, and there are no obstacles from legal aspects [5]. However, this traditional procurement method has limitations such as the need for longer time because previously there was a planning stage which also needed to be tender, higher costs due to separate planning and implementation contracts, unsatisfactory quality, lack of input from contractors in planning matters in terms of implementation methods and specifications, causing conflicts between planners and implementers. This leads to the traditional method has disadvantages compared to other procurement methods such as integrated methods.

2.2. Integrated Procurement Method
Currently, the integrated procurement method is widely applied in other countries such as the United States, Britain, Korea, Singapore, Malaysia, Hong Kong, and Kuwait. Integrated procurement is procurement where the planning and implementation stages are under one contract. So it can be said that the owner has a contract with a business entity or contractor to plan and implement a road infrastructure project so that one company is responsible for project planning and implementation. It can also be stated that integrated procurement is the procurement of a construction project from a contractor who is responsible for the planning and implementation of a project. Alternative integrated methods such as Design Build or DB vary in forms such as Novated Design Build, Package Deals, Develop-and-Construction, Novation DB, Enhanced DB, Traditional DB, Turnkey, warranty with DB, DBOM, DBFO, BOT, Full delivery method [6], [7].

The advantage of using procurement with an integrated method is the shorter time of the project implementation because procurement is carried out simultaneously for the planning and implementation stages [7]. This method also allows the fast track to provide an opportunity to overlapping the planning and implementation stages [8], [9]. Constructability or the opportunity to provide an optimum knowledge in the field of construction also plays an important role in this method, which causes the time needed for this method to be shorter [9], [10].

Second, lower costs. This is due to the planners and implementers in one team. Collaboration between planners and implementers can reduce costs during the bidding process so that costs can be reduced [11]. Lower prices can also be caused by the implementation of constructability in this method. Contractors are given the freedom to use innovative methods [12]. The third advantage is the quality aspect. According to USDOT FHWA 2008 integrated methods produce better quality projects because tender winners are not based on the lowest price, but are based on the best value method. The application of constructability also contributes to the quality of the project. The fourth advantage is better project
management because the contractor has one responsibility [13]. The integrated method also provides the opportunity for division planners and implementers to sit together and discuss the projects being handled so that the possibility of conflict occurring is very small. Therefore it is clear that integrated methods have advantages compared to traditional methods. In addition, integrated methods are more effective and efficient in the procurement of road infrastructure projects.

3. Barriers to implementing integrated method
Although this method has potential benefits and advantages, there are also obstacles in applying this method, namely:

3.1. Regulation
Before applying this method, the project owner is the government that must refer to existing regulations. Although it has been regulated in the law, a detailed explanation of the implementation of the integrated method must be clear and not ambiguous. So there must be regulations that are adjusted for the application of this integrated method [14].

3.2. Project owner capability
In implementing integrated methods, competencies, experience, knowledge, understanding, and expertise of project proponents are needed. This method has never been implemented in government projects so that the competence, experience, and skills of project owners are still minimal. Of course, the lack of experience from project owners can be a barrier to the successful application of this integrated method.

3.3. Stakeholder capabilities
Stakeholders are people or organizations and institutions involved in projects such as consultants, contractors and other parties involved in construction projects. The lack of knowledge, understanding, and expertise of these stakeholders can also hinder the successful implementation of this effective and efficient procurement method.

3.4. Method Adjustment
Usually, adaptation to a new method is very difficult. Likewise for the method of procuring a construction project that had never been done before. Stakeholders feel reluctant to apply the new method because anxiety is not successful in applying the new method. Therefore the adaptation to the application of the new method is an obstacle in the success of integrated procurement methods.

4. Data collection
The location in this study is in Bali Province. A research instrument is a tool used for data collection. Data collection was done by a questionnaire survey with Delphi technique. The Delphi technique is a technique of distributing questionnaires more than once until reaching consensus or agreement from the respondents. The contents of the questionnaire were constructed from the variables obtained from the previous literature review. The questionnaire with the Delphi technique is distributed to 15 to 30 experts who have expertise in their fields. The criteria for eligibility to be used as respondents in this study are:

- An expert who has the authority to make decisions in an institution or expert who is involved in his organization related to integrated methods
- Experts involved in the procurement sector
- Practitioners or stakeholders who have extensive knowledge in the field of integrated methods
- Academics from universities who have expertise in integrated methods

5. Data Analysis
Data obtained from the results of the Delphi survey are then tabulated and then processed as follows:

- Calculate the mode value of each question for the results of the first round Delphi survey
- Calculate the frequency from the results of the second Delphi survey
After completing processing the results of the second Delphi survey, consensus or agreement was reached regarding the constraints of the integrated procurement method.

5.1. Barriers to Implementing Integrated Method
This first-round survey was aimed at finding expert opinions on the obstacles in implementing integrated methods.

Table 1. Constraints of integrated methods from regulatory aspects.

| No. | Barriers                                                                 | Mean | Median | Mode | SD    | Rating |
|-----|--------------------------------------------------------------------------|------|--------|------|-------|--------|
|     |                                                                          | 4.7  | 5      | 5    | 0.923 | High   |
| 1   | Lack of detailed rules regarding the characteristics of the DB project   | 4.65 | 5      | 5    | 0.933 |        |
| 2   | Lack of detailed rules regarding the tender process                      | 4.65 | 5      | 5    | 1.089 |        |
| 3   | Lack of detailed rules regarding contractual arrangements                | 4.4  | 5      | 5    | 1.188 |        |

Table 2. Constraints of integrated methods from client capability aspects.

| No. | Barriers                       | Mean | Median | Mode | SD   | Rating |
|-----|--------------------------------|------|--------|------|------|--------|
| 1   | Lack of experience             | 4.95 | 5      | 5    | 1.099|        |
| 2   | Lack of expertise              | 4.85 | 5      | 5    | 1.089|        |
| 3   | Lack of knowledge              | 4.8  | 5      | 5    | 1.005|        |
| 4   | Lack of understanding from the staff | 4.7 | 5      | 5    | 0.923| High   |
| 5   | Lack of capable staff          | 4.65 | 5      | 5    | 0.587|        |
| 6   | Lack of effort to implement DB | 4.65 | 5      | 5    | 0.933|        |
Table 3. Constraints of integrated methods from the capability aspects of other stakeholders.

| No. | Barriers                                      | Mean | Median | Mode | SD   | Rating |
|-----|-----------------------------------------------|------|--------|------|------|--------|
| 1   | A small number of experienced and skilled stakeholders | 4.8  | 5      | 5    | 1.005|        |
| 2   | Less expert DB                                 | 4.65 | 5      | 5    | 0.933| High   |
| 3   | Lack of capability in planning DB projects     | 4.65 | 5      | 5    | 0.988|        |

Table 4. Integrated method constraints from adaptation aspects.

| No. | Barriers                                      | Mean | Median | Mode | SD   | Rating |
|-----|-----------------------------------------------|------|--------|------|------|--------|
| 1   | Clients prefer traditional methods            | 4.8  | 5      | 5    | 1.005|        |
| 2   | Lack of support for DB                        | 4.7  | 5      | 5    | 0.979|        |
| 3   | Resistance adopted a new method               | 4.7  | 5      | 5    | 1.129|        |
| 4   | The client is not confident in managing the DB project | 4.5  | 5      | 5    | 1.000| High   |
| 5   | Clients are not aware of DB's benefits        | 4.4  | 5      | 5    | 0.940|        |
| 6   | Less attention from clients                   | 4.4  | 5      | 5    | 1.040|        |
| 7   | Clients are anxious about new methods         | 4.4  | 5      | 5    | 1.046|        |
| 8   | Clients are limited in their knowledge of traditional methods | 4.15 | 4.5    | 5    | 1.040| Medium |

Table 1 to table 4 shows that the constraints of the application of integrated methods are very high both from the aspects of regulation, the capabilities of clients and other parties involved and aspects of adaptation, which is indicated by the median and mode values of 5.

Table 5. Integrated method constraints from regulatory aspects.

| No. | Rating | Barriers                                      | %    | IQD | SD  |
|-----|--------|-----------------------------------------------|------|-----|-----|
|     |        | Lack of detailed rules regarding the characteristics of the DB project | 94.4 | 0   | 0.236|
|     |        | Lack of detailed rules regarding the tender process | 94.4 | 0   | 0.236|
|     |        | Lack of detailed rules regarding contractual arrangements | 94.4 | 0   | 0.236|
|     | High   | The lack of a risk management approach        | 100  | 0   | 0   |
### Table 6. Constraints of integrated methods from client capability aspects.

| No. | Rating | Barriers                          | %    | IQD  | SD    |
|-----|--------|-----------------------------------|------|------|-------|
| 1   | High   | Lack of experience                | 88.9 | 0    | 0.323 |
| 2   | High   | Lack of expertise                 | 94.4 | 0    | 0.236 |
| 3   | High   | Lack of knowledge                 | 88.9 | 0    | 0.323 |
| 4   | High   | Lack of effort to implement DB    | 94.4 | 0    | 0.236 |
| 5   | High   | Lack of understanding from the staff | 83.3 | 0 | 0.383 |
| 6   | High   | Lack of capable staff             | 94.4 | 0    | 0.236 |

### Table 7. Integrated method constraints from the capability aspects of other stakeholders.

| No. | Rating | Barriers                                      | %    | IQD  | SD    |
|-----|--------|----------------------------------------------|------|------|-------|
| 1   | High   | A small number of experienced and skilled stakeholders | 77.8 | 0.25  | 0.428 |
| 2   | High   | Less expert DB                                | 83.3 | 0    | 0.383 |
| 3   | High   | Lack of capability in planning DB projects   | 77.8 | 0.25  | 0.428 |

### Table 8. Constraints of integrated methods on regulatory aspects.

| No. | Rating | Barriers                                      | %    | IQD  | SD    |
|-----|--------|----------------------------------------------|------|------|-------|
| 1   | High   | Clients prefer traditional methods           | 83.3 | 0    | 0.383 |
| 2   | High   | Lack of support for DB                       | 77.8 | 0.25  | 0.428 |
| 3   | High   | Resistance adopted a new method              | 94.4 | 0    | 0.236 |
| 4   | High   | The client is not confident in managing the DB project | 83.3 | 0 | 0.383 |
| 5   | High   | Clients are not aware of DB’s benefits       | 83.3 | 0    | 0.383 |
| 6   | High   | Less attention from clients                  | 88.9 | 0    | 0.323 |
| 7   | High   | Clients are anxious about new methods        | 88.9 | 0    | 0.323 |
| 8   | Medium | Clients are limited in their knowledge of traditional methods | 94.4 | 0   | 0.236 |
Tables 5 to 8 show that the experts reach an agreement that the constraints in implementing integrated methods are from the regulatory aspects, the capabilities of clients and other parties involved and adaptation. This is indicated by the frequency above 65%.

5.2. Success Factor Promoting Integrated Method
Once obtaining constraints in implementing integrated methods, it is necessary to find efforts in applying this method. Barriers to implementing integrated methods based on the results of the analysis are:

- Regulation
- Client capabilities
- Capabilities of stakeholders or other parties involved
- Adaptation or method adjustment are:
  - Regulation, the need for detailed rules and adjustments to existing rules in applying this method such as rules regarding the characteristics of the project, the method of contracting and procurement, and risks in using this method.
  - Client and other party capabilities need to be improved, such as training, workshops, seminars on this method and the need for a pilot project.
  - Adaptation, the need for socialization support from the government and other stakeholders regarding the benefits of this method.

6. Conclusions
To be able to implement effective and efficient procurement methods, the integrated procurement method can be an option. But this procurement method is still constrained in its implementation. The constraints are the rules, competencies of the owners, and other stakeholders as well as adaptation to new methods. To overcome this obstacle, the factors that can encourage the implementation are clear rules, training, and outreach from the government regarding benefit from this method.

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