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Strategies to Improve Conceptual Cost Estimates Accuracy of Flyover Development in the Provincial Government of DKI Jakarta

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ABSTRACT

This study identifies the dominant factors in the conceptual cost estimate process of flyover development in the Provincial Government of DKI Jakarta that affect accuracy, based on the relationship model between the conceptual cost estimation process of flyover development in the Provincial Government of DKI Jakarta with the accuracy. Furthermore, this study also develops strategies to improve the accuracy based on the dominant factors. Two parts of the method are used in this study. The first method is to obtain the dominant factors in estimating the conceptual cost of flyover development in the DKI Jakarta Provincial Government, which affects accuracy using the SEM-PLS method, which involved 151 respondents. Second, the method to obtain strategies to improve accuracy based on these dominant factors, using the gap analysis. The result shows that four dominant factors affect accuracy: information quality, project definition, cost information, and project characteristics. Improving strategies are obtained based on those identified dominant factors. The finding of this study suggests that these strategies can be compiled into the guideline of the conceptual cost estimate process, which can be a tool to assist relevant agency personnel in carrying out the stages in the process of conceptual cost estimation of flyover development.

Keywords: Accuracy, Conceptual Cost Estimate, Flyover, Strategy

JEL Classification Code: L99, R59, Y80

INTRODUCTION

Conceptual cost estimation is an estimation approach that looks at the project in outline and is calculated on a top-down basis. This estimate is the basis for decision-making for funding, so if this estimate is not accurate, it will result in an incorrect funding decision (Gardner, 2015). In long-term estimation planning, conceptual cost estimates are initial estimates generated for future project requirements. The conceptual cost estimation is needed to provide priority levels of activity programs in the transportation sector and determine the financing level for long-term programs (Anderson et al., 2006). In addition, conceptual cost estimation is the basis for programming data before design (Ballard & Pennanen, 2013). Meanwhile, a flyover is built to avoid areas that are always facing the problem of traffic jams, to pass railroad crossings, and to improve traffic safety and efficiency (Latief et al., 2018).

To measure the accuracy of the cost estimation is the percentage that describes the difference between the estimated cost and the contract cost (Doyle & Hughes, 2000). In comparison, the definition of accuracy is also a description of the closeness of the estimated cost to the actual cost of the project (Serpell, 2004). Based on the literature, the range accuracy of the conceptual cost estimate is in the range of 20% to 30% (AACE International, 2020), or ±10% to ±20% (Asal, 2014), or -10% to +10% (Ballard & Pennanen, 2013).

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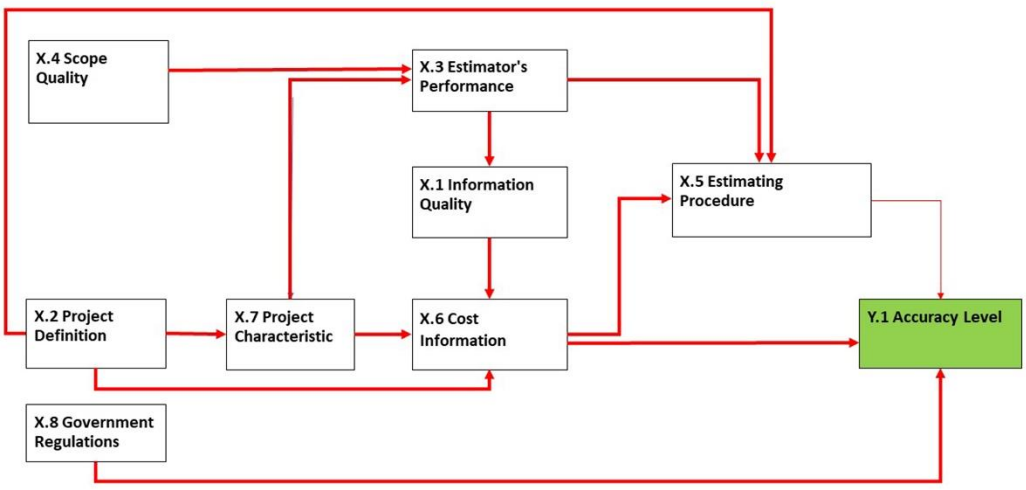
The DKI Jakarta Provincial Government uses the conceptual cost estimate for the proposed Multi-Year Activities proposal for flyover construction activities that don't have complete data planning. For example, based on Dinas Bina Marga's data, there are some conceptual cost estimations with 104,21%, 23,67%, and 12,47% for conceptual cost estimate accuracy. However, compared to the range of accuracy based on the literature, the flyover with 23,67% and 12,47% conceptual cost estimate accuracy has not yet reached optimal accuracy based on Ballard & Pennanen (2013) and Asal (2014). And the flyover with 104,21% accuracy, beyond the conceptual cost estimate accuracy range based on Ballard & Pennanen (2013), Asal (2014), and AACE International (2020). It means that the accuracy of the conceptual cost estimation of flyover development in the Provincial Government of DKI Jakarta still needs to be improved.

In actual condition, this problem can cause regional development planning to be less effective or wasteful and less beneficial because other shifting allocations prioritize. Meanwhile, from a literature review, concerning the Government budget, budget expenditures need to be limited. Overbudgeting would imply a waste of resources that could otherwise be owned and used for productive purposes elsewhere (Odeck, 2004).

This research continues from previous research conducted by the author, namely research on Relationship Model Between Conceptual Cost Estimation Process of Flyover Development in the Provincial Government of DKI Jakarta with The Accuracy Level. Based on the author's previous research, 8 variables in the conceptual cost estimation process of flyover development affect the accuracy. The variables are information quality, project definition, estimator's performance, scope quality, estimating procedure, cost information, project characteristics, and government regulations. Furthermore, the author's previous research also obtained 12 significant relationships and 1 less significant relationship between variables in the relationship model between the conceptual cost estimation process of flyover development in the Provincial Government of DKI Jakarta with the accuracy level, analyzed with SEM-PLS. The following figure 1 describes the 12 significant and 1 less significant relationship between variables in the relationship model between the conceptual cost estimation process of flyover development in the Provincial Government of DKI Jakarta with the accuracy level, analyzed with SEM-PLS.

Figure 1. Relationships between Variables in the Relationship Model between Conceptual Cost Estimation Process of Flyover Development in the Provincial Government of DKI Jakarta with The Accuracy Level based on SEM-PLS Analysis



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Note: The arrows on the model illustrate that one variable significantly affects the intended variable

Based on the existing's problem and supported by previous research conducted by the author, this research's aims to identify the dominant factors that affect the accuracy based on the relationship model between the conceptual cost estimation process of flyover development in the Provincial Government of DKI Jakarta with the accuracy level, and to develop strategies to improve the conceptual cost estimate accuracy based on those dominant factors.

Literature Study

Strategies to Improve the Accuracy of Conceptual Cost Estimates.

According to Martin (2000) in Mohyi (2020), one of the problems faced by an organization is how to achieve the organization's goals by improving employee performance (Mohyi, 2020). Furthermore, according to Truijen et al (2013) in Sinaga et al. (2020), employees need to work and learn together to develop novel and innovative solutions due to the complexity of the challenges (Sinaga et al., 2020). Due to the problem mentioned before, the organization, in this case, the DKI Jakarta Provincial Government, needs to find a way to solve the problem of accuracy. One of them is by developing strategies to be applied to the employee, so they can improve the conceptual cost accuracy.

Based on the literature study, strategy is an action plan to set the direction for the coordinated use of resources through programs, projects, policies, procedures, organizational design, and the establishment of performance standards (AACE International, 2019). In addition, strategy is accurate planning of activities to achieve specific goals (Pusat Bahasa Departemen Pendidikan Nasional, 2008). There are six common approaches to formulating a strategy: planning, fit, emergent, positioning, resource-based, and stakeholder (Mishra & Mohanty, 2020). Based on those literature definitions, this study concludes that strategy is careful planning of activities through planning, fit, emergent, positioning, resource-based and stakeholders, determining the direction of coordinated use of resources and establishing programs, policies, procedures, and performance standards to achieve specific goals.

Other studies have identified strategies to increase the accuracy of cost estimation. For example, Anderson (2006) states that several strategies increase the accuracy of cost estimates. For example, there are management strategy, risk strategy, quality document strategy, and quality estimation strategy (Anderson et al., 2006). According to AASHTO (2013), to develop information, the estimator must visit the project site (site visit) to estimate the potential of existing constructions and estimate things that can affect costs. In addition, in selecting historical cost data, the estimator must ensure that the historical information used can represent the current project cost estimation needs because selecting appropriate historical information is vital to the conceptual cost estimation process. After getting the right historical information, adjustments to the information are made (adjustments to cost data). Then it is necessary to compile a cost estimate documentation in which there is an explanation of all adjustments (adjustments) and how the estimator calculates the costs for each adjustment (AASHTO, 2013).

According to Pasco & Aibinu Ayodeji (2008), strategies to improve accuracy are by ensuring proper design documentation, establishing effective communication and coordination between project team members, ensuring sufficient information that is available for estimation, checking all assumptions with clients and consultants, establishing formal feedback for designing and forecasting activities, providing a

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realistic time frame for estimating activities, using standard estimation methods, improving cost planning and control activities during the design phase, improving the method of selecting, adjusting and applying cost data, and updating cost database with new cost analysis (Pasco & Aibinu Ayodeji, 2008).

According to Azman (2012), there are several ways to improve the estimation process. For example, implementing information documentation management, conducting effective communication and coordination, providing sufficient design information, providing a mean for exchanging ideas, identifying risks, selecting and updating cost information, dividing the project into smaller components, providing enough time to calculate cost estimates, do cost data sharing, and conduct training to calculate estimates (Azman, 2012).

RESEARCH METHOD

The method in this study is a continuation method from previous research conducted by the author regarding the relationship model between the conceptual cost estimation process with the level of accuracy. In this study, the method used is a method to get the strategies to improve the accuracy of the conceptual cost estimation of flyover development in the DKI Jakarta Provincial Government based on the relationship model between the conceptual cost estimation process with the accuracy level.

In this study, there are two parts of the method, namely:

1. The method to obtain the dominant factors in estimating the conceptual cost of flyover construction in the DKI Jakarta Provincial Government affects accuracy based on the relationship model between the conceptual cost estimation process with the accuracy level using the SEM-PLS method. The steps of this method are:
   - The first step is to identify the dominant factors in the conceptual cost estimation process of flyover construction in DKI Jakarta Provincial Government that affect estimation accuracy based on SEM-PLS analysis, which involved 151 respondents. The SEM itself can examine a series of dependency relationships simultaneously. SEM is especially useful in testing theories that contain multiple equations involving dependency relationships (Hair et al., 2014). SEM is an essential method for describing the possible interrelationships among the influential factors, testing the hypotheses, and exploring the relationships between the measurement indicators and corresponding latent factors (Zhao et al., 2019). And for this research, the requirement for Average Variance Extracted (AVE) value should be bigger than 0,5 (Hair et al., 2011). The value of composite reliability ≥ 0,7 and the value of Cronbach alpha ≥ 0,6 (Kula et al., 2021).
   - Then, the results of the SEM-PLS are validated by three experts in relevant fields with the criteria of having a minimum education of bachelor's degree and having work experience of at least ten years in construction or flyover planning.

2. The method to obtain strategies to improve accuracy based on these dominant factors, using the gap analysis method. This gap analysis helps to assess how big the gap between actual performance and an expected work standard. The analysis is used to know the performance improvement needed to cover the gap and become one of the bases for decision-making related to priorities and costs needed to meet the service standards set (Muchsam et al., 2011). The steps of this method are:
   - Identify existing and desired conditions (determined based on dominant factors and indicators significant) through interviews with users, existing

documents, and literature studies. Then, request experts' validation of the existing conditions and desired conditions.
- Develop gaps/problems based on current conditions and desired conditions that experts have validated. Then, request experts' validation of the gap/problem formulation.
- Formulate the causes of problems based on gaps/problems that experts have validated. Then ask for an expert's validation of the formulation of the cause of the problem.
- Formulate strategies based on the causes of problems that experts have validated and request expert validation of the strategy
- After getting validated strategies, then those strategies are compiled into a guideline. The preparation of the guideline is based on reference guides that other agencies have published.

The following table 1 is the format of the analysis process using the gap analysis method that is used in this research.

Table 1. Format of the Analysis Process Using the Gap Analysis Method

Validated Dominant Variables	Validated Indicators with Significant Influence	Validated Current Existing Conditions	Validated Desired Conditions	Validated Gaps / Problems	Validated Causes	Validated Strategies

RESULTS AND DISCUSSION

Dominant factors in the process of estimating conceptual costs for flyover development in the DKI Jakarta Provincial Government that affect the level of accuracy

From the relationship model between the conceptual cost estimation process and the level of accuracy (see fig.1), the two variables that directly affect the level of accuracy are cost information and government regulations, in which cost information has a T-statistic value greater than government regulations. And to get the dominant factors that affect the level of accuracy, this is based on the T-statistic value > 1,96 on the specific indirect effect. The following table 2 contains the path in indirect effect that the T-statistic value is bigger than 1,96 based on SEM-PLS analysis.

Table 2. T statistic value > 1,96 on the specific indirect effect based on SEM-PLS analysis

Path	T Statistics
X7 -> X6 -> Y1	2,739
X2 -> X7 -> X6 -> Y1	2,282
X2 -> X6 -> Y1	2,180
X1 -> X6 -> Y1	1,983

Based on the results of SEM-PLS, it can be seen that the paths which have a significant influence on the level of accuracy are those with a T-statistic value above 1,96. These paths are:
- X.7 Project Characteristic → X.6 Cost Information → Y.1 Accuracy
- X.2 Project Definition → X.7 Project Characteristic → X.6 Cost Information → Y.1 Accuracy
- X.2 Project Definition → X.6 Cost Information → Y.1 Accuracy

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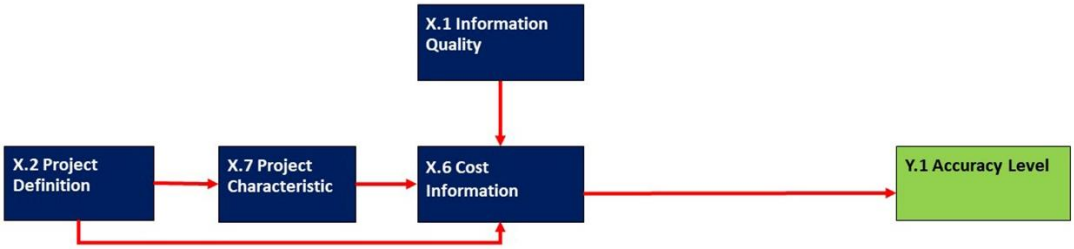
- X.1 Information Quality → X.6 Cost Information → Y.1 Accuracy

Based on those paths, the dominant factors in the conceptual cost estimation process that affect the accuracy of the conceptual cost estimation for flyover development in the DKI Jakarta Provincial Government consist of information quality, project definition, cost information, and project characteristics. The following figure 2 describes the paths that significantly affect the accuracy, that consist of dominant variables that affect the accuracy.

Figure 2. The Dominant Variables/Factor that affects to Accuracy Level in the paths that Significantly Affect the Accuracy Level based on SEM-PLS Analysis



Note: The arrows on the model illustrate that one variable significantly affects the intended variable. The blue boxes illustrate the dominant variable/factor.

Based on the results of expert validation, information quality factors, project definitions, cost information, and project characteristics become validated dominant factors in the conceptual cost estimation process for flyover construction that affects accuracy. The following table 3 is the list of validated dominant factors (and their indicators), with supporting references, in estimating the conceptual cost estimation of flyover development that affects accuracy.

Table 3. Validated Dominant Factors (and their Indicators) in the Conceptual Cost Estimation Process that Affect the Level of Accuracy

No	Validated Dominant Variables and Significant Influential Indicator	Reference
X.1	**Information Quality**	
X.1.1	Quality of historical information	(Serpell, 2004)
X.1.2	Quality of current information	(Serpell, 2004)
X.1.3	Accuracy of available information	(Serpell, 2004)
X.1.4	Information accessibility	(Serpell, 2004)
X.2	**Project Definition**	
X.2.3	The level of project complexity.	(AASHTO, 2013) (Honn An et al., 2011) (Anderson et al., 2006) (Hatamleh et al., 2018)
X.2.4	Project communication level	(Kuchta & Chojnacka, 2020)
X.6	**Cost information**	
X.6.1	Accuracy, reliability, and completeness of cost information.	(Trost & Oberlender, 2001) (Hatamleh et al., 2018) (Azman, 2012)
X.6.2	Formulation of construction component costs, in the form of costs per m^2 based on similar previous projects.	(AASHTO, 2013) (Anderson et al., 2006)

No	Validated Dominant Variables and Significant Influential Indicator	Reference
X.6.3	Formulation of construction component costs, in the form of costs per m^2 typical project section based on similar previous projects.	(AASHTO, 2013) (Anderson et al., 2006)
X.6.5	Formulation of the cost of the non-construction component is in the form of inflation	(AASHTO, 2013) (Anderson et al., 2006)
X.6.6	Price regulation.	(Khemani & Shapiro, 1999) (Lai et al., 2008)
X.6.7	Economic conditions, market and price level	(Serpell, 2004)
X.7	**Project Characteristic**	
X.7.1	The physical characteristics of the project are the dimensions of the project.	(Azman, 2012) (Elbeltagi et al., 2014)
X.7.2	The physical characteristics of the project include the type of structure used.	(Arif et al., 2015) (Fayek et al., 2010)
X.7.3	The non-physical characteristics of the project are the project location.	(Washington State Department of Transportation (WSDOT), 2015)
X.7.4	The non-physical characteristics of the project are the type and duration of the contract	(Azman, 2012) (Arif et al., 2015)
X.7.5	Non-physical characteristics of the project in the form of project type.	(Azman, 2012)
X.7.6	The uniqueness of the project conditions and the availability of information on the related data references	(AASHTO, 2013)

The following is a statement in the study of the literature that supports the results of expert validation on the determination of these dominant factors, namely:

- Information is one of the critical factors as input in the estimation process, both current information and especially historical information. In practice, historical information must have the ability to be used to make accurate estimates (Serpell, 2004).
- The project definition is one of the determining factors in the conceptual cost estimation process. Therefore, there is a need to increase the definition detail level to prepare credible conceptual estimates for more complex projects (AASHTO, 2013).
- Cost information is an essential input factor in the conceptual stage (Liu & Zhu, 2007). Furthermore, the cost elements that are part of the cost information can be the basis for estimating the cost of project components (AASHTO, 2013).
- According to Skitmore (1991) in Azman (2012), the characteristics of the project could determine the level of costs. Therefore, most researchers use project characteristics factors as targets that can be measured to measure accuracy because project characteristics can be calculated and interpreted costs (Azman, 2012).

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Strategies to improve the accuracy of the conceptual cost estimation of flyover development in the DKI Jakarta Provincial Government, based on the dominant factors that affect the accuracy

The following are some examples of validated strategies to improve the accuracy of the conceptual cost estimation of flyover construction in the DKI Jakarta Provincial Government based on the dominant factors affecting the level of accuracy.

Strategies based on X.1 Information Quality

X.1.1 Quality of historical information

- Develop a database of historical information. In the database, there is a standard format to:
  - Make a compilation of historical information accompanied by supporting information, such as previous project data, component description, project type, and cost per m^2 or m according to the grouping results.
  - Group the major components in the flyover.
  - Make costs per unit m^2 or m, according to the group of major components in flyovers or work packages.
  - Validate historical information.
- Improve the estimator's ability in calculating conceptual cost estimates and analyzing projects based on historical information.

X.1.2 Quality of current information

- Improve the estimator's ability to be able to analyze the project based on current information.
- Create a field survey format to describe the project location. The format contains a description of the project location completed with project data, sketches, description of the existing site, and requirements from several local community representatives.
- Renew the dominant material prices.
- Update the design information and the use of technology.
- Prepare documentation on the preparation and processing of current information.

X.1.3 Accuracy of available information

- Increase the estimator's commitment to getting accurate information with a clear division of tasks.
- Validate historical information and current information obtained through the forecast review process.

X.1.4 Information accessibility

- Expand connections to information sources, including suppliers, other agencies, experts, and applicable regulations.
- Provide access records for any information that needs to be searched.

Strategies based on X.2 Project Definition

X.2.3 The level of project complexity

- Create a quality graphic and written representation of the project to be estimated. A graphical representation that makes it easy for the estimator to translate project complexity into a physical concept.
- Divide the project to be estimated into major parts that can be described and quantitatively calculated.
- Conduct a field survey that the survey's results can be used to estimate the complexity of the existing project.
- Prepare documentation of the analysis process of project complexity.

X.2.4 Project communication level

- Prepare identification documentation and requirements from stakeholders related to the flyover development plan.
- Use a proactive method to involve all internal and external stakeholders related to the flyover development plan.

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- Develop a flow chart that describes the stages of the conceptual cost estimation process. The flow chart can be the basis for the SOP (Standard Operational Procedure) of conceptual cost estimating.

Strategies based on X.6 Cost Information

X.6.1 Accuracy, reliability, and completeness of cost information
- Make a specific task of personnel in charge of developing cost documentation.
- Carry out an estimation approach that has been mutually agreed upon to be applied consistently even though personnel and estimation times change.
- Make a checklist to check the completeness of the required information.

X.6.2 Formulation of construction component costs, in the form of costs per m^2 based on similar previous projects
- Expand the database of cost formulations per m^2 of various locations and types of flyover structures. Either from other government agencies or the private sector.

X.6.3 Formulation of construction component costs, in the form of costs per m^2 typical project section based on similar previous projects
- Make a grouping of costs per m^2 for per major flyover section and per structure type.

X.6.5 Formulation of the cost of the non-construction component is in the form of inflation
- Get inflation information from reliable sources and calculate the project's inflation accurately.

X.6.6 Price regulation
- Update cost information from e-catalog and e-budgeting.

Strategies based on X.7 Project Characteristic

X.7.1 The physical characteristics of the project are the dimensions of the project
- Make an outline traffic analysis to support the estimation of flyover dimensions.
- Immediately coordinate with the related Department regarding information maps for the Jakarta area

X.7.2 The physical characteristics of the project include the type of structure used
- Seek opinion from the experts.

X.7.3 The non-physical characteristics of the project are the project location
- Look for benchmarking from other projects in that location.

X.7.4 The non-physical characteristics of the project are the type and duration of the contract
- Estimate the phasing period of project implementation and budget phasing allocations with detailed calculations.
- Make a reasonable estimate of the project implementation period, considering the time the contract starts and the stages of construction implementation.

X.7.5 Non-physical characteristics of the project in the form of project type
- Make guidelines for what things need to be considered to make a conceptual design.
- List the identification of environmental factors that can affect the flyover construction process. Among other things, to identify the flyover effect on the mobilization and interests of the surrounding community.
- Conduct initial analysis of the project site more broadly (e.g., 1-2 km from the planned end of the flyover ramp), not only centered on the site plan.

X.7.6 The uniqueness of the project conditions and the availability of information on the related data references

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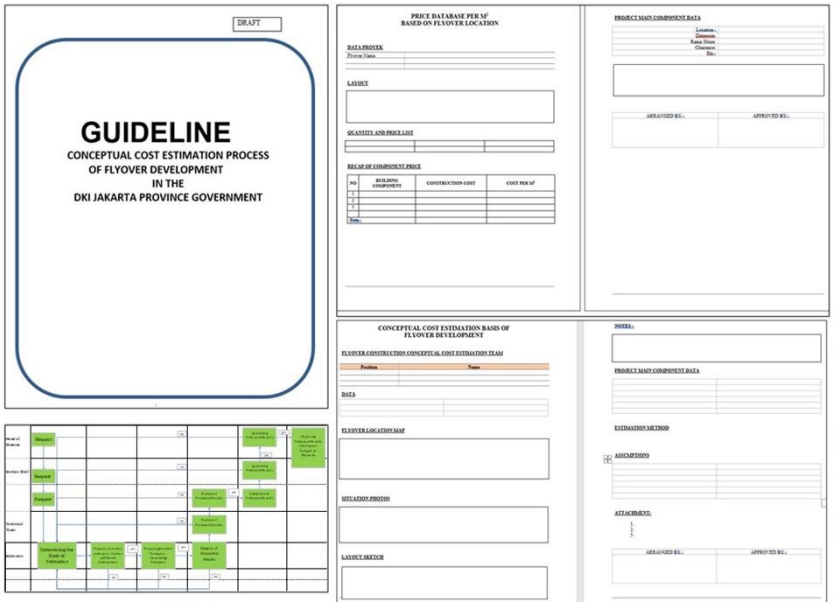
- List the identification of environmental factors that can affect the flyover construction process

After the strategies are validated by the experts, then the strategies are compiled into a Guideline of the Conceptual Cost Estimation Process for Flyover Development in the DKI Jakarta Provincial Government. This guideline is compiled based on a literature study of several guidelines that other agencies have made. The following figure 3 below describes the draft cover of the guideline and some samples of formats and process flow contained in the guideline.

Figure 3. Draft Cover of the Guideline and Some Formats in the Guideline of the Conceptual Cost Estimation Process for Flyover Development in the DKI Jakarta Provincial Government



Some formats have been established in the guideline of the Washington State Department of Transportation (Washington State Department of Transportation (WSDOT), 2020). There is the guideline compiled by Anderson et al. (2006) for the National Cooperative Highway Research Program. The guideline manages cost estimates and project cost estimates to achieve greater consistency and accuracy (Anderson et al., 2006). The study is supported by the AASHTO report (2013), which states that historically, cost increases have been a problem within the appropriate agency environment due to poor estimation practices. And the manual can provide strategies, methods, and tools for developing, tracking, and documenting realistic cost estimates during each phase of project development. Cost estimation involves factors related to project scope and resources and involves anticipating cost impacts that may occur due to changes in project scope and market conditions (AASHTO, 2013). In addition, the Department of Transport and Main Road has developed a Project Estimation Guide which aims to provide direction that refers to appropriate standards, which will maintain the level of consistency and accuracy required for project cost estimates (Queensland Government, 2017).

CONCLUSIONS

4 dominant factors in the conceptual cost estimation process affect the accuracy of the conceptual cost estimation for flyover development within the DKI Jakarta Provincial Government. These factors are Information Quality, Project Definition, Cost Information, and Project Characteristics.

Several strategies were identified based on each significant indicator on the dominant factors using gap analysis and supported by literature study and expert validation. The formulation of these strategies is compiled into a Guideline of the Conceptual Cost Estimation Process for Flyover Development in the DKI Jakarta Provincial Government. The strategies in the guideline can be a tool to assist relevant agency personnel, in this case, the Highways Office, to carry out the stages in the process conceptual cost estimation. In addition, the conceptual cost estimation process guideline can be developed as a basis for further research on the development of systems integrated with information technology so that storing information, processing information, and calculating estimates will be more effective and of high quality.

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