

Analysis of Project Cost Estimation as an Effort to Improve Construction Project Time Performance

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ABSTRACT

Construction project management aims to manage time, cost, and resources effectively and efficiently so that the project can be completed according to plan. However, in practice, many construction projects, especially in the Medan City area, experience significant delays and cost overruns. This is due to inaccurate cost and time estimates, as well as lack of attention to various internal factors. This study aims to analyze project cost estimation as an effort to improve construction project time performance. Data were collected from 201 respondents working in the construction sector with varying educational backgrounds and work experiences. The analysis was conducted using the covariance-based Structural Equation Modeling (CB-SEM) approach with the help of AMOS software, as well as the Maximum Likelihood Estimation technique to estimate project duration. The results of the study indicate that project cost estimation is significantly influenced by three main factors, namely Budgeted Cost of Work Schedule (BCWS), Actual Cost of Work Performed (ACWP), and Budgeted Cost of Work Performed (BCWP). Meanwhile, the time performance factor does not have a significant effect on cost estimation. On the other hand, project time performance is influenced by the availability of labor, main equipment, funding, and implementation methods. The feasibility test of the model using Goodness of Fit indicators such as CMIN, RMSEA, TLI, NFI, and CFI shows that the model used meets the Absolute Fit Model criteria, so it can be concluded that the relationship between variables in this research model is valid and can be used to support decision making in construction project management.

Keywords: Cost Estimation; Construction Projects; Time performance.

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INTRODUCTION

A construction that runs effectively and efficiently will produce optimal products. A project that is implemented must follow the schedule that has been prepared through Project management. Scheduling in construction projects is a key component in project management that requires detailed planning, so that project implementation can run according to the set time and budget targets [1]. Project management is a way to manage time and use of resources to achieve a project that is in accordance with planning. Construction management is part of Project management that aims to manage and control construction projects from the beginning until the establishment of the Project.

The success of a construction project management can be seen from various factors such as the

achievement of quality costs and planning time that have been done previously. The results of a construction project are said to be successful if various project estimates can run efficiently, effectively and in accordance with the specified time. One of the crucial aspects that affect the success of a construction project is the accuracy of its implementation schedule [2]. The appropriate implementation time is vital because delays can have an impact on various things, such as increased costs, decreased quality due to rushed work, failure to meet planning standards and technical specifications, and frequent dismantling and reinstallation of work [3]. Cost and time performance are an inseparable unit and can be achieved if costs can be controlled and the construction implementation time is calculated based on the factors that influence it.

Project duration is the time required to perform all project tasks [4]. Project estimation is not only about the cost aspect but also estimates various factors such as time, material, human resource requirements and other equipment. The function of construction management is to control the project from the time factor where each project has time limitations. Several cases have been found that construction projects are often unable to meet targets for the specified time duration, this will have a negative impact and also cause losses not only in terms of funds but also in terms of time.

The research was conducted by sorting several construction projects owned by several consulting companies and protators which are generally located in Indonesia and in particular in the city of Medan. The projects targeted by the research are the construction projects of bridges, roads, buildings, housing and so on. Each construction project studied has its own characteristics regarding the application of the time estimate given or sometimes the project does not have a time estimate. And the contractors who carry out the project are analyzed to obtain the basic factors and variables related to the cost estimate of the project. The estimated project is like the one analyzed. How does it affect the time performance of the project built and planned by consultants and contractors along with the increase in time performance, the application of time estimates for the project work process in the future can be carried out.

Project Estimation is a process to estimate the time needed from the beginning to the completion of the Project. The description of the activities required in the Project estimation is to determine the purpose of the project itself and define the Project targets, create a detailed work plan including the activities and tasks of each individual and identify activities that affect the Project style, estimate the time for each activity, determine the dependencies and relationships between activities and create a Project schedule based on the estimated time.

Some mistakes that occur when planning project cost estimates are ignoring the risk of a lack of historical data about the project environment, lack of communication with the team, not using estimates, or planned estimates that are not in accordance with the project and not considering external factors.

Factors that influence the estimation of the cost of implementing a project are influenced by internal and external factors. Internal factors such as resources, team capabilities, project complexity, number of activities and activity dependencies. Internal and external factors identified are government policy, climate, availability of project budget, risks that can affect the project and technological changes that affect the project. Therefore, research needs to be conducted to identify what factors are part of the project cost estimate to control the performance of the project time, both those carried out directly and those that will be carried

out in the future.

METHOD

The subject of the study is on a construction project that applies case studies in the work of improving the performance of time management points, effective time management of construction projects is a top priority in the success of the project. The stages of the study include, 1) a literature study by collecting several literatures related to the study, 2) data collection is carried out through the observation stage by conducting direct observations in the field, interacting with respondents through competent interviews, distributing questionnaires which are a set of questions and statements that have been systematically arranged, documentation, and 3) Research Analysis. The research analysis is carried out with factor analysis to test the relationship between variables. Factor analysis is a multivariate statistical analysis that is used to reduce and summarize the relationship of all variables and how they are interdependent. The stages of the research are depicted in Figure 1 below.

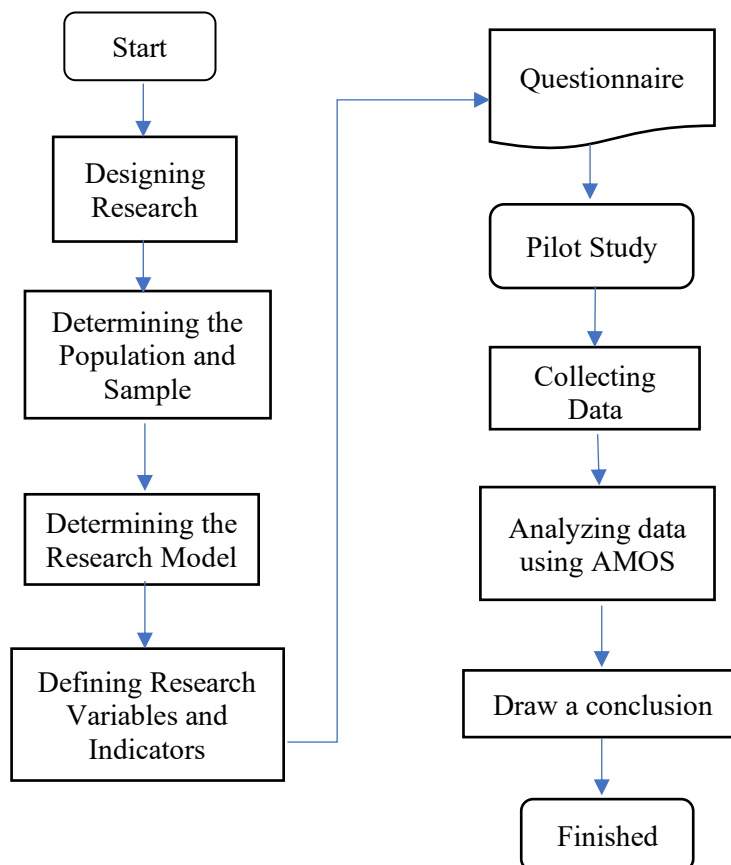


Figure 1. Research flow

a research instrument is a tool that can be used to measure a measurement object or collect data on a variable for research needs [5]. The instrument used in this study was a questionnaire. The questionnaire was made based on the predetermined research instrument grid. And for the validation of this research which is Expert Judgement. To measure the desired variables, the author uses a Likert scale that wants a firm answer such as a score of 0 - score 7 with answer choices from disagree to strongly agree. The Likert scale used uses the following intervals. The indicators of the dependent variable questionnaire, namely the Estimated Time Duration, are as follows:

- a) Delay in signing the contract
- b) Delay in the process of requesting and approving the working drawings by the owner.
- c) Delay in the owner's handover/use of the land.
- d) Delay in construction work will affect the results of the Budgeted Cost of Work Schedule (BCWS)
- e) Delay in construction work will affect the results of the Actual Cost of Work Performed (ACWP)
- f) Delay in construction work will affect the results of the Budgeted Cost of Work Performed (BCWP)

Instrument test aspects are divided into categories

- a) Time Management based on Project Owner (5 variables)
- b) Time Management based on Manager (10 Variables)
- c) Labor (5 variables)
- d) Main Equipment (6 variables)
- e) Material (5 variables)
- f) Finance (5 variables)
- g) Implementation Method (5 variables)
- h) Design Suitability (5 variables)
- i) Job Location (5 variables)

RESULTS AND DISCUSSION

Respondent Data

From the distribution of the questionnaire, respondent data was obtained based on positions in the construction project (Figure 2) the largest of which were construction supervisors at 50.75% (102 respondents), followed by contractors at 16.91% (34 respondents), Planners at 14.93% (30 respondents), project owners at 11.94% (24 respondents) and others at 5.47% (11 respondents). From the large number and variety of respondents' positions, it is hoped that this study can answer the objectives of the research being conducted.

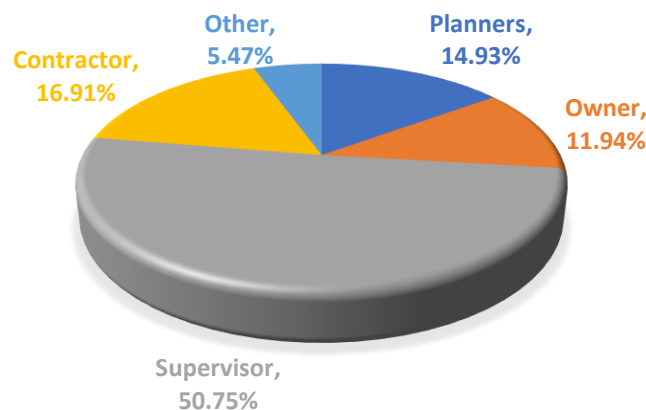


Figure 2. Percentage of respondents based on position in construction projects

Respondent education data distributed through questionnaires obtained respondent data based on their education level (Figure 3) from various levels of education S1, S2, S3 and others. The S1 education level is the largest education level of the group of 67.16% (135 respondents), followed by S2 of 27.36% (55 respondents), Planners of 3.99% (8 respondents), and others of 1.49% (3 respondents). Looking at the respondent education data, it can be concluded that the respondents have had higher education, so that they can represent the results of the research

carried out

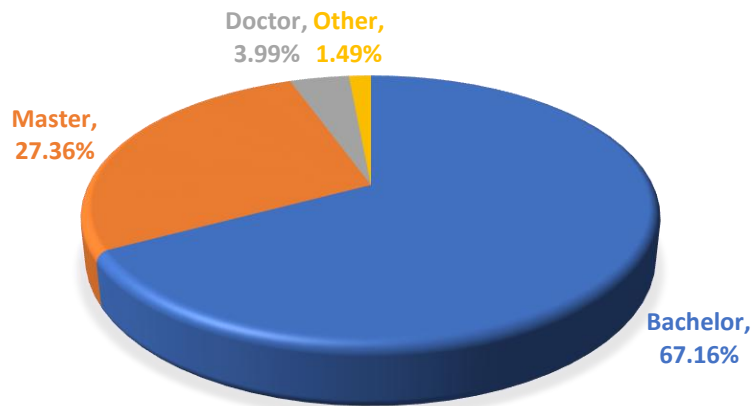


Figure 3. Percentage of respondents based on education level

Respondent data based on the length of work in the construction world, which is divided into 4 levels, where the largest is > 10 years as much as 74.63% (150 respondents), followed by 5 - 10 years as much as 18.42% (33 respondents), 2 - 5 years as much as 6.47% (13 respondents), and < 2 years as much as 2.49% (5 respondents). Seeing the data on the length of time respondents have worked in the construction world which is dominated by > 10 years, it states that respondents have had quite high experience in the construction world so that they can represent the results of the research carried out.

Analysis Of Questionnaire Distribution Results

The designed questionnaire grid was then analyzed based on the test aspects of each variable.

a. Time Duration Estimation

The time duration estimation variable consists of 6 questions with the average score in Table 1. below.

Table 1. Results of the distribution of the time duration estimation indicator questionnaire

No	Indicator	Average
1	Delay in signing the contract	4,68
2	Delay in the process of requesting and approving working drawings by the owner	4,94
3	Owner's delay in handing over/using land	4,41
4	Delays in construction work will affect the results of the Budgeted Cost of Work Schedule (BCWS)	6,04
5	Delays in construction work will affect the results of Actual Cost of Work Performed (ACWP)	6,21
6	Delays in construction work will affect the results of the Budgeted Cost of Work Performed (BCWP)	6,09
Average		5,40

Based on Table 1. it is stated that the indicator of Delay in construction work will affect the results of Actual Cost of Work Performed (ACWP) with an average score of 6.21, then delay in construction work will affect the results of Budgeted Cost of Work Performed (BCWP) with an average score of 6.09 and Delay in construction work will affect the results of Budgeted

Cost of Work Schedule (BCWS) with a score of 6.04. These three variables indicate that respondents tend to agree with this statement. While for the other 3 indicators, respondents tend to somewhat agree with the statement given. Project duration is the time needed to complete a predetermined activity. the project implementation period is the time desired by the owner to use, utilize and rent the building. Delays in work can result in project delays so that it is necessary to increase the duration of the work.

b. Time Management based on Project Owner

Time management based on the project owner is described in a questionnaire with 5 variables (Table 2). Delays in construction projects mean an increase in the time for completing the project as planned and stated in the contract document [6]. The active role of management is one of the main keys to successful project management. This is in accordance with the results of the distribution of the Time Management indicator questionnaire based on the Project Owner that the average respondent answered somewhat agree.

Table 2 shows that Delays in equipment delivery to the location are a high score in time management based on the owner.

No	Variables	Average
1	Lack of communication and coordination	4,45
2	Delay in submission of work designs	4,20
3	Slow decision making by project owners	4,56
4	Delay in delivery of equipment to site	4,61
5	Owner's delay in handing over/using land	4,54
Average		4,47

c. Time Management Based on Manager

Time management for managers is a strategy to manage project implementation time with the aim of achieving targets effectively and efficiently. Managers must be responsible Table 3. The results of the distribution of the Time Management indicator questionnaire based on Managers state an average of 4.34 in the somewhat agree category. The variable of changes in drawings and designs got a low result of 3.50 in the sufficient category (Table 3.). Schedule changes are included in project delays. One of the project delays was caused by changes in drawings and designs [7].

Table 3. Results of the distribution of the Time Management indicator questionnaire based on the Managing Owner

No	Variables	Average
1	Unavailability of labor	4,73
2	Unclear job execution specifications	3,50
3	Lack of experience and limited contractor resources	4,49
4	The results of the work in the field do not match the contract drawings	4,30
5	There are changes to the image or design	5,10
6	Delay in delivery of materials	4,37
7	Planning calculation error	3,54
8	Sudden changes to project completion	3,67
9	Labor shortage	4,33

10	Lack of communication and coordination between parties involved in the project	4,34
Average		4,24

Discussion

The research variables that were statistically tested using the AMOS SEM (Analysis of Moment Structures Structural Equation Modeling) Application are statistical analyses to test the relationship between variables. Based on the results of the research analysis, it can be discussed in Figure 4.

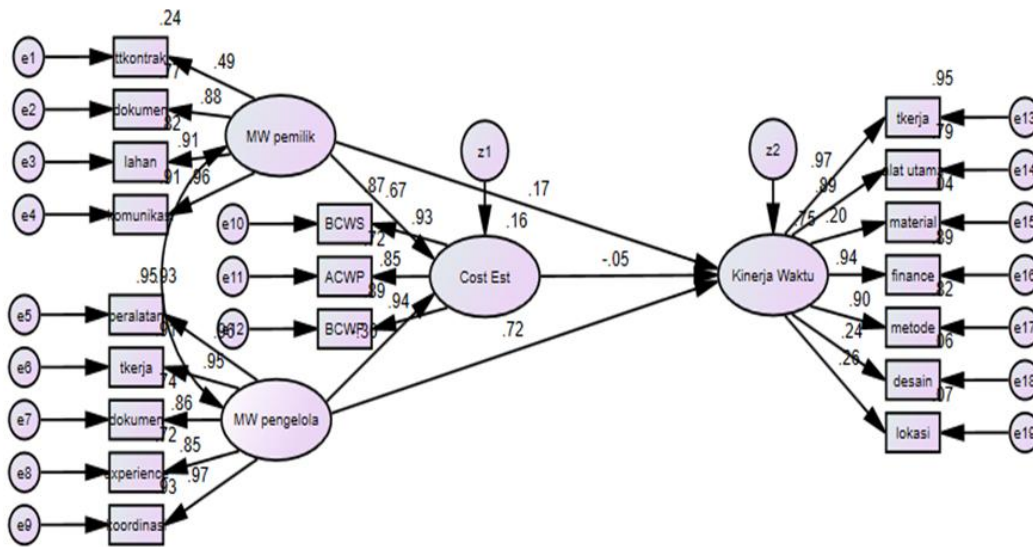


Figure 4. Output Path Diagram Estimation of Structural Equation Model Project Duration Estimation

- The Cost Estimation variable does not contribute to time performance in this research analysis, although basically cost estimation and time performance in construction projects are two sides that cannot be separated, Cost estimation includes all elements of financing during project planning and implementation while time performance is guided by the project's ability to complete work that is adjusted to the planning [8]. This is indicated by the loading factor value between cost estimation and time performance of -0.5. which can be interpreted that cost estimation is not related to time performance
- Time Management Variables Based on Manager and Based on Owner are not related to cost estimation because the loading value is below 0.7. In this case it is not entirely true. Time management specifically does not have implications for determining project costs [9] but if time management is bad it will have an impact on cost estimation such as project delays, additional resources which can result in increasing or increasing project costs.
- Cost estimation has an impact on the results of the Budgeted Cost of Work Schedule (BCWS), Actual Cost of Work Performed (ACWP) and the results of the Budgeted Cost of Work Performed (BCWP). This is indicated by the loading values of 0.941; 0.8671 and 0.931 respectively. Cost estimation significantly affects BCWS, ACWP and BCWP [10]. BCWS is a budget that should be used up according to planning, ACWP is the actual cost that has been used while BCWP is a budget that has been spent on the implementation of work that is essentially complete. Effective and accurate cost estimation can control project costs, regulate the level of budget deviation and if necessary can take corrective action.

- d. Time management based on managers is related to time performance with a loading value of 0.719. Managers are closely related to project time performance. Well-planned time management ensures that the project can be completed according to the designed schedule [11]. Manager time management is the competence to manage project time effectively so that the organization's goals run effectively and efficiently.
- e. Time Management Based on Managers with 1) Lack of communication and coordination, 2) Delay in submitting work designs, 3) Delay in sending equipment to the location, 4) Delay in the owner's handover/use of land has a loading value of > 0.7 which means that the variable is related to time management based on managers. Time management based on project managers is related to planning, scheduling management, time scheduling control so that it produces projects that are completed on time and efficiently. Time management based on managers must use various methods and tools to monitor project progress, identify various potential causes of delays, and can make the right decisions as part of the correction, for example by adjusting scheduling or rescheduling resources [12].
- f. Time performance is significantly related to labor, main equipment, finance and implementation methods [13] stated that the availability of skilled labor, working with enthusiasm (not often absent, on strike), main equipment (use of technology, length of equipment delivery), and implementation methods (often changing) can result in delays in project completion. These three variables have a loading value > 0.7 An effective way to overcome this delay is to build effective communication, socialize existing regulations and schedule that is focused and appropriate.
- g. Time performance is not related to materials, design suitability and job location with a loading value of < 0.7 . This is not in line with several studies that have been conducted. Time performance is closely related to materials, design suitability and job location [14][15]. These three variables can directly or indirectly affect time performance. The availability of materials, quality and material scheduling time must be according to the specified time. If there is a delay, it will impact the efficiency and duration of project completion.
- h. Inappropriate design and frequent changes also affect delays and result in additional time. Job locations such as limited accessibility, difficult work fields can affect time performance.

CONCLUSION

The research was conducted to produce a conclusion from the analysis carried out. This conclusion must answer the research objectives. Research conclusions:

- a. The research was conducted on 201 respondents from various workers in the construction sector, varying levels of education and length of time working in the construction world
- b. The project duration estimation analysis was carried out using the Maximum Likelihood Estimation technique with the help of AMOS software (CB-SEM).
- c. Factors that influence cost estimation are Budgeted Cost of Work Schedule (BCWS), Actual Cost of Work Performed (ACWP) and Budgeted Cost of Work Performed (BCWP). Time performance factors, time management based on managers and Time management based on owners do not affect cost estimation
- d. Factors that influence time performance are labor, main equipment, finance and implementation methods. While material factors, design suitability and work location do not affect time performance.
- e. The results of the Goodness of Fit Model test with CMIN, RSMEA, TLI, NFI and CFI state that the analyzed model meets the Absolute Fit Model

To overcome the delay of a construction project, it is not possible to immediately identify only a few factors, but must find the root cause of why the delay occurred. Suggestions that can be submitted:

- a. Cost estimation includes all factors or components related to it, including a complex understanding of the project, historical identification, risk analysis and the use of appropriate technology. The project is not only reviewed based on the final result, but the implementation process must be reviewed thoroughly before implementation, during implementation and finally.
- b. Improving project time performance also requires complex planning and strict supervision during the project.
- c. Communication to all elements involved in the project must be carried out intensively so that the causes of delays that occur can be anticipated early on

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