Analysis of the dominant factors causing cost overrun in building construction projects

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Abstract. In building construction projects there are 3 factors that are used to measure project performance, one of which is cost. Efforts that can be made to minimize the cost overrun are knowing the causative factors and knowing how to mitigate them. The purpose of this study is to identify the causative factors, determine the dominant factors causing cost overrun, and efforts to mitigate them. The methodology in this research is desk research or research that uses relevant secondary data analysis, such as previous research with similar problems. The results of this study were 65 causative factors divided into 10 groups. The dominant factor causing cost overruns includes material, implementation and employment relationships, project documents, and project finance groups, one of them is fluctuations in material prices. Mitigation efforts have been obtained for the dominant factor, namely quality control in the field must be good, selection of professional workforce, and building good relations between parties.

Keyword: cost overrun, building construction, dominant factors, mitigation

1. Introduction

The development of the construction industry is closely related to the development and implementation of all areas that are still actively implemented. Construction activities include several stages, where the most decisive stage is the planning and implementation phase of construction, because the overall quality of the project depends on the construction and management of this stage[1].

In the implementation of the construction process, the cost factor is a major consideration, because it usually involves a large amount of investment by the transferor. Therefore, project costs must be managed well to minimize the possibility of cost overrun[2].

Now, many high-rise buildings are being built all over the world, especially in Asian countries. The distribution of high-rise buildings changed drastically, in 2006, around 32% of high-rise buildings were in Asia and 24% were in North America. This data shows the rapid growth of high-rise buildings in Asia during this period[3].
Project time delays, cost overrun and building quality have long been a common problem in the construction sector, especially in large-scale construction projects that have become a global phenomenon, in the past 70 years the average cost overruns by 28% [4]. Problems in the construction sector will have a direct impact on contractors in the form of losses, especially due to cost overrun. This involves an unexpected excess of costs incurred due to underestimating the estimated construction project budget [5].

2. Cost Overrun in Building Construction Project

2.1. Definition

Three factors are usually used in project management to measure project performance, namely cost, quality, and time [6]. Cost overrun refers to the cost of project construction that exceeds the project budget (estimated cost) set at an early stage (budget) during the implementation phase, which results in significant losses for the contractor [7]. Cost overruns are very important in the cost control process because cost overruns increase the final cost of the project and minimize profits. This is due to cost overruns which can also occur on indirect costs which also have overhead and estimated profits in it.

2.2. Cost Overrun in Building Construction Project

The Excess costs incurred in construction projects can be caused by internal and external factors of the construction project itself. Cost overruns are divided into three parts [7], namely:

a. Cost Overrun in the Early Stage of a Construction Project
b. Cost Overrun during the construction project process
c. Post-Construction Cost Overrun

The cost overruns at the project implementation stage are highly dependent on the planning, coordination, and control of the contractor, and are dependent on budget estimates. Therefore, project construction according to the type of construction requires professional knowledge, knowledge, and experience, including planning, construction managers, and contractors [8].

3. Methodology

Data collection in this study uses the desk research method, desk research or also known as secondary research involves a summary, examination, and / or synthesis of existing research. Secondary research is contrasted with primary research because primary research involves making data, while secondary research uses primary research sources as data sources for analysis. When conducting secondary research, the author can retrieve data from published academic papers, government documents, statistical databases, and historical records [9].

Based on definition it can be concluded that the data used in the research desk in this study are academic papers or previous research journals that have similar research results. Interviews will also be conducted with experts who are experienced in the world of construction, especially in building construction. This interview technique was carried out to obtain ways [10] to mitigate and prevent these dominant factors.

The purpose of this research is to get the factors that cause cost overrun in building construction projects, the dominant factors, and how to mitigate them. Data analysis is a qualitative analysis of Miles and Huberman methods, where qualitative data analysis is the process of systematically searching and collecting data obtained from interviews, on-site notes, and other materials so that they can be easily understood, and their findings shared with others [11]. The methodology of the research can be seen in Figure 1.
4. Desk Research

Desk research or secondary research methods, with the aim of getting the factors causing cost overrun. This stage was carried out by reviewing the research literature and scientific journals relevant to the problems in this study, the literature used amounted to 25 previous scientific journals both international and domestic. Table1 is data from the scientific journals used in this study which are composed of title, year of publication, country, and author.

| Title                                                                 | Year | Country        | Author |
|----------------------------------------------------------------------|------|----------------|--------|
| An Exploration of Cost Overrun in Building Construction Project       | 2018 | Malaysia       | [12]   |
| Cost Overrun Factor Analysis for Hospital Projects in Vietnam         | 2015 | Vietnam        | [13]   |
| Assessing The Frequency of Factors Engendering Cost Overruns          | 2015 | Ghana          | [14]   |
| Using Frequency Indices and Factor Analysis for Public Building Project in Ghana | 2015 | Ghana          | [14]   |
| Causative Factors of Cost Overrun in Building Projects of Pakistan   | 2018 | Pakistan       | [15]   |
| Revisiting Causative Factors of Project Cost Overrun in Building Construction Projects in Nigeria | 2019 | Nigeria        | [16]   |
| Title                                                                 | Year | Country  | Author |
|----------------------------------------------------------------------|------|----------|--------|
| Cost Overruns Analysis in Several Construction Project in Ambon City | 2017 | Indonesia | [17]   |
| Factors causing Cost Overruns in Construction Building Project in Cirebon City | 2018 | Indonesia | [18]   |
| Cost Overrun Variable Analysis that Influences Construction Building Project in JABODETABEK Causes and Comparison Analysis of Cost Overrun | 2019 | Indonesia | [19]   |
| Factors towards High Rise and Low Rise Building in Surabaya Frequency and Impact Analysis of Factors affecting | 2019 | Indonesia | [20]   |
| Cost Overrun in Construction Cost in Building Projects in Bandung City | 2017 | Indonesia | [21]   |
| Cost Overrun Factors Analysis in Construction Building in Medan City | 2017 | Indonesia | [22]   |
| Risks Leading to Cost Overrun in Building Construction from Consultants’ Perspective | 2013 | Palestine | [23]   |
| Identification of Cost Overrun Factors in the Overhead Cost in the Construction of Manado Town Square III Factors Causing Cost Overruns in Construction of Residential Project: Case Study of Turkey | 2015 | Indonesia | [6]    |
| Cost Overrun Dominant Factors Analysis in Construction Building in Large and Medium Category in Padang City in 2017/2018 | 2019 | Indonesia | [25]   |
| Cost Overrun Analysis in Construction Building Project | 2019 | Indonesia | [26]   |
| Cost Overrun Factor Study in Construction Building Project | 2017 | Indonesia | [1]    |
| Factors Influencing Time and Cost Overruns on Freeform Construction Projects Factors Analysis causing Cost Overrun in Cost Realization towards Budget Implementation Plan in a Construction Building Project | 2019 | Korea | [27]   |
| Cost Overrun Factors Analysis in Construction Building Project in Ambon City Causes and Effects of Cost Overrun on Construction Project in Bahrain: Part I (Ranking of Cost Overrun Factors and Risk Mapping) | 2011 | Indonesia | [29]   |
| Factors Affecting the Contractor's Cost Overrun of Building Project in Kano State, Nigeria Identification of Factors Affecting Cost Overrun in The Construction of Industrial Buildings Most Critical Factors Responsible for Cost Overruns in Nigeria Building Construction Industry Components of Cost Overruns in China Construction Projects | 2017 | Bahrain | [30]   |
|                                                                      | 2016 | Nigeria  | [31]   |
|                                                                      | 2016 | Indonesia | [32]   |
|                                                                      | 2019 | Nigeria  | [33]   |
|                                                                      | 2019 | China    | [34]   |
5. Analysis

5.1. Data reduction

From the results of data reduction that have been done also found similarities in several studies in identifying and determining the factors that cause cost overrun. In order to obtain as many as 65 factors causing cost overrun, according to facilitate the identification of these factors, the grouping stage is carried out into 10 groups[1] in Table 2 below.

| Variables                        | Causes                                                        |
|----------------------------------|---------------------------------------------------------------|
| **A. BUDGET ESTIMATION**         |                                                               |
| A1                               | Incomplete Project Data and Information                      |
| A2                               | Incorrect Cost Estimation                                     |
| A3                               | Does Not Calculate Unexpected Costs                          |
| A4                               | Using Incorrect Estimation Techniques                        |
| **B.C IMPLEMENTATION AND WORK RELATIONS** |                                                       |
| B1                               | Does Not Pay Attention to Risk Factors on Location and Construction |
| B2                               | The high frequency of changes in implementation              |
| B3                               | Too Many Repetitions of Work because of Poor Quality         |
| B4                               | Too Many Projects Tackled at Simultaneous Time                |
| B5                               | Lack of Coordination Between Main Contractor and Sub-Contractor |
| B6                               | Lack of Coordination Between Supervisors - Planners - Contractors |
| B7                               | There Are Differences / Disputes in the Project              |
| B8                               | Incompetent Project Manager                                  |
| B9                               | Poor Consultants in Project Supervision                      |
| B10                              | Poor Relationship between Owner - Planner - Contractor        |
| B11                              | Incompetent Sub-contractor                                   |
| B12                              | Contractor's Experience                                      |
| B13                              | Complex construction work                                    |
| B14                              | Collusion between Project Elements                           |
| B15                              | Poor Project Management                                      |
| **C. PROJECT DOCUMENTS**         |                                                               |
| C1                               | Incomplete Contract Document                                 |
| C2                               | Poor Quality Control                                         |
| C3                               | Delay in the Making and Approval of Images                   |
| C4                               | Change in Project Scope                                      |
| C5                               | Change of Design and Working Drawing                         |
| C6                               | Inappropriate Sub-Contractor and Supplier Appointment        |
| **D. MATERIALS**                 |                                                               |
| D1                               | Material Price Fluctuations                                  |
| D2                               | Delay in Material Delivery                                   |
| D3                               | Inappropriate Material Selection                             |
| D4                               | Material Theft                                               |
| D5                               | Error in Arranging Material Storage                         |
| D6                               | Material Shortages                                           |
| **E. LABOR**                     |                                                               |
| E1                               | The Number of Workers That Does Not Fit                       |
| E2                               | Labor Wage Fluctuations                                      |
| E3                               | Poor Workforce Quality                                       |
| E4                               | Low Labor Productivity                                        |
| E5                               | Inadequate Placement of Project Personnel in Organizational Structure |
5.2. Dominant factors

After tabulating the top five ranking data the dominant factors of each study have been carried out. The next stage is to group the dominant factors into 10 groups to simplify the determination of dominant factors. Table 3 below shows an inventory of the dominant factors in the 10 groups at each study review.

| Variables | Causes |
|-----------|--------|
| **F. EQUIPMENT** | |
| F1 | High Equipment Prices / Rentals |
| F2 | High Equipment Mobilization / Demobilization Costs |
| F3 | Equipment Delivery Delays |
| F4 | Improper Machine Selection |
| F5 | Incorrect Storage and Maintenance of Tools |
| F6 | Device Productivity Control Is Not Maximum |
| **G. PROJECTFINANCE** | |
| G1 | Delay in Payments |
| G2 | Poor Financial Control in the Field |
| G3 | Lack of Sub-Contractor Capabilities in Financial Matters |
| G4 | Fluctuations in Bank Interest Rates |
| G5 | Poor Funding by Owner |
| G6 | Insurance / Health Insurance Costs |
| G7 | Fraud and Embezzlement Practices Occur |
| **H. IMPLEMENTATION TIME** | |
| H1 | Schedule Delay Due to Weather Effects |
| H2 | Job Delays Often Occur |
| H3 | Poor Scheduling / Planning |
| H4 | Overtime Work |
| H5 | Accelerated Schedule |
| **I. ECONOMIC, LEGAL AND POLITICAL CONDITIONS** | |
| I1 | Riot around the Project Site |
| I2 | Changes to Laws and Regulations |
| I3 | New Government Financial Policies |
| I4 | Political Interference |
| I5 | Currency Exchange Fluctuations |
| **J. ENVIRONMENT** | |
| J1 | Access to Project Sites |
| J2 | Surface Condition and Under Surface |
| J3 | Natural disasters |
| J4 | Unpredicted Bad Weather |
| J5 | Environmental Pollution Due to Project Activities |
| J6 | Surrounding Social and Cultural Impacts |
Table 3. Dominant Factors Cause Cost Overrun

| References | Group |
|------------|-------|
|            | A     | B     | C     | D     | E     | F     | G     | H     | I     | J     |
| 1          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 2          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 3          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |

| References | Group |
|------------|-------|
|            | A     | B     | C     | D     | E     | F     | G     | H     | I     | J     |
| 5          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 6          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 7          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 8          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 9          | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 10         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 11         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 12         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 13         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 14         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 15         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 16         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 17         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 18         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 19         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 20         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 21         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 22         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 23         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 24         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| 25         | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     | ✓     |
| Total      | 7     | 16    | 14    | 17    | 10    | 6     | 13    | 11    | 4     | 1     |

This dominant category mode is based on the conditions in which more than half or 50% of the literature reviewed appears, or 13 or more. So, here is the ranking order of the dominant factors by group:

a. Materials
   - Material Price Fluctuations
   - Inappropriate Material Selection
b. Implementation and Work Relations
   - Too Many Repetitions of Work because of Poor Quality
c. Project Documents
   - Change of Design and Working Drawing
d. Project Finance
   • Poor Funding by Owner
   • Delay in Payments

5.3. Mitigations
   From interviews with informants that have been carried out, the following is a dominant mitigation factor that causes cost overrun in construction projects:
   a. Formulate the concept of a complete project management system, especially the management of human resources, materials, equipment and determine the appropriate work methods
   b. Establish good relationships with all parties and key people in the project
   c. Management for claim variations orders
   d. Good cash flow management

6. Conclusion

   Based on the analysis conducted in this study, as many as 65 factors were identified to cause cost overrun which were divided into 10 groups. So, we get the dominant factors causing cost overrun in the order of the group ranking as follows:
   a. Materials
   b. Implementation and Work Relations
   c. Project Documents
   d. Project Finance

   The factors in the material group that are the dominant factors include fluctuations in material prices and inappropriate material selection. Whereas in the implementation and work relations group, there was too much repetition of work because poor quality was the most dominant. In the project document group, the most important factors were the change in design and working drawings, and in the project finance group the poor funding by owner and delays in payment were the dominant factors.

   Preventive actions for material dominant factors are meticulous in the calculation of design analysis by utilizing prior implementation and project experience. Good quality control to prevent rework, and security with one gate access to prevent loss of material assets. The price of material that is always updated can also be a precaution. For the dominant factor of implementation and work relations is understanding stakeholder characteristics and establishing good relationships with other project elements, as well as ensuring that the project team is competent according to job description and the selection of workers and subcontractors must be appropriate.

   Preventive action for the dominant factor of project documents is to study and master the tender and contract documents, and always do documentation of changes in work in the field. Also do the management of variation order. For the dominant factor of project finance is to choose a partner or partner such as the right supplier with the project's financial condition and make a work contract with a term payment method.

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