Identification of dominant factors for the delays in building construction project in kepulauan Anambas

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Abstract. Delay is a serious issue and most often happens in construction projects. There are a lot of factors affecting delays in a construction project. Each construction project has its own characteristic which is different from other projects regarding the nature of the project and its location. Kepulauan Anambass Regency is several islands located on the remote and outmost of Indonesia which makes construction projects in this area unique according to its location. The aim of this research is to identify the dominant factors that cause delay in building construction project located in Kepulauan Anambass Regency. The results show that the dominant factors are delay in material delivery, transportation problems in material delivery, shortage of material in the market and adverse weather condition.

Keyword: Kepulauan Anambas, building construction project, delay, dominant factors

1. Introduction

Development in the construction sector is very important as an engine driving economic and social growth in an area [1] & [2]. One of them is the construction of a building that has a very important role as a place to conduct activities as the purpose of building construction [3]. This is intended to create a prosperous and prosperous society [4].

Kepulauan Anambass Regency is one of Indonesia's outermost islands which are a group of Kepulauan Anambass in the South China Sea that are directly adjacent to other countries or international seas. The administrative area of the Kepulauan Anambass Regency is in large part the open seas with an area of sea reaching 98.7 percent of the total area of 46,664.14 km² or 2.47 percent of Indonesia's total area of 1,890,754 km².

Kepulauan Anambass Regency which consists of a group of 255 islands scattered in vast open seas. Natural phenomena such as wind direction have the potential to affect the socio-economic life of the community. This is due to the accessibility to Kepulauan Anambass Regency which can only be done using sea and air transportation modes.

As a new area established in 2008, development in Kepulauan Anambass District has many challenges. Referring to the 2015-2021 Kepulauan Anambass District Medium Term Development Plan, it is planned that there will be construction of 10 government buildings in the office centres, and several construction of other public facilities and places of worship. But in 2017 there were several
construction projects that has experienced delays, one of which was a planned three-story building project that would have a function as a regent's office.

Delay is a very serious problem [5] and most often [6] in most construction projects [7]. Delays in project completion can adversely affect the economic sector [8] and can be felt by all project stakeholders such as the emergence of acceleration fees and fines for contractors and the loss of value of the benefits of the building experienced by the owner, but the contractor is the one who carries a lot of risk delays in the completion of the project [9].

2. Delay in Construction Project

2.1. Definition

Every stakeholder in a construction project has the same goals in achieving project that finishes on time which is the essence in the contract [10]. Delay in project is defined as delay in finishing the project as planned [11] or an added time frame beyond the scheduled planned written on the contract document [10, 4, 12]. Delay in a project can be represented in mathematical as the net duration subtracted by duration based on the contract; where as the net duration is from the beginning of the project until the project is handing over to the owner [12].

2.2. Delay in Construction Project

The reason for delays in construction project can originate from anywhere [4], it can be caused from the internal project itself such as unavailability of resources and delays in project designs, or external factors such uncertain weather condition [10]. Using the Ishikawa (fishbone) diagram in Figure 1, there are factors such as external, workers, equipments, design, material, contractor, owner, consultant and project condition which is the prime source affecting directly to the delays in construction projects [13].

![Fishbone Diagram](image)

**Figure 1.** Fishbone Diagram

2.3. Factor Affecting Delay in Building Construction Project

There are several factors affecting the delays in building construction projects. Based on past literatures there are 66 factors identified [14], [15], [16] & [17]. These factors are classified in 9 categories based on the fishbone diagram in Figure 1. The factors affecting the delays in building construction projects can be seen in Table 1.

| Risk No. | Risk Factor                           | Risk No. | Risk Factor                           |
|---------|--------------------------------------|----------|--------------------------------------|
| OW₁     | Changes in the project scope         | MT₉      | Unreliable supplier                  |
| OW₂     | Late payments by the owner           | MT₁₀     | Bad quality construction material     |
| OW₃     | Late decision making by the owner    | WO₁      | Short supply of workers               |
| Risk No. | Risk Factor                                                                 | Risk No. | Risk Factor                                      |
|---------|------------------------------------------------------------------------------|---------|-----------------------------------------------|
| OW_4    | Delay in construction work caused by the owner                               | WO_2    | Delay in mobilising workers                   |
| OW_5    | Tendency in corruption by the owner                                           | WO_3    | Lack of motivation and spirit of the workers   |
| OW_6    | Complicated bureaucracy system                                               | WO_4    | Inadequate number of qualified and experienced workers |
| OW_7    | Lack of communication and coordination with other parties by the owner       | WO_5    | Low workers’ productivity                     |
| OW_8    | Financial difficulties by the owner                                          | WO_6    | Absence of construction workers               |
| CS_1    | Delay in checking and approving finished construction works result           | WO_7    | Conflict between workers                      |
| CS_2    | Delay in reviewing and approving material samples and design changes         | WO_8    | Incompetent team on the field                 |
| CS_3    | Lack of consultant’s experience in construction project                      | WO_9    | Worker strike                                 |
| CS_4    | Misunderstanding of the requirements given by the owner                      | EQ_1    | Improper equipment selection                  |
| CS_5    | Lack of communication and coordination with other parties by the consultant  | EQ_2    | Technology used is outdated                   |
| CO_1    | Problems in managing contractor’s cash flow                                  | EQ_3    | Equipment damage often occurs                 |
| CO_2    | Difficulties in funding by the contractor                                     | EQ_4    | Lack of equipments                            |
| CO_3    | Ineffective project design and scheduling                                    | EQ_5    | Low equipment efficiency and productivity     |
| CO_4    | Bad management and supervision on site                                       | EQ_6    | Slow equipment mobility                       |
| CO_5    | Repetition of work due to mistakes during construction                       | EQ_7    | Bad equipment maintenance                     |
| CO_6    | Incompetent subcontractor                                                     | PR_1    | Lack of feasibility studies                   |
| CO_7    | Not using the right construction method                                       | PR_2    | Unconventional construction method used       |
| CO_8    | Lack of communication and coordination with other parties                    | PR_3    | Impact on the lack of soil testing            |
| DS_1    | Delay in preparing shop drawings                                             | PR_4    | Unavailable utilities on the project site    |
| DS_2    | Frequent design changes                                                       | PR_5    | Traffic control and work zone restrictions at the project site |
| DS_3    | Mistakes and discrepancies in design                                          | PR_6    | Work accident during construction             |
| DS_4    | Design drawing incomplete                                                     | EX_1    | Adverse weather condition                     |
### 3. Methodology

The object of the research is 29 low-rise buildings which have been completed in Kepulauan Anambass Regency within the fiscal year of 2015-2017 using the Regional Revenue and Expenditures Budget. The low-rise building is not more than four floors. The data needed for this research is obtained by handing out questionnaires to former contractors handling the 29 low-rise building projects. Project managers or site supervisor will be the respondents in this research. The questions in the questionnaire will analyse the level of frequency and impact of each factor affecting the delay in building construction projects in Kepulauan Anambass Regency identified through literature study.

The aim of this research is to identify the dominant factors or the highest risk factors affecting the delay in building construction projects in Kepulauan Anambass Regency. Level of risk of each factor are found by analysing the scale factor of each factor using the Frequency Adjusted Importance Index (FAII) which is then plotted into the standard level of risk according to Table 3 [14]. Dominant factors are factors which are qualified as High and Very High. The methodology of the research can be seen in Figure 2.
4. Frequency Adjusted Importance Index (FAII)

The level of frequency from the Frequency Index (FI) factor is categorised in 5 category: 1) never, 2) seldom, 3) sometimes, 4) frequent and 5) always. The same of the Severity Index (SI) which is also categorised into 5 category; not significant (1), slightly significant (2), moderately significant (3), very significant (4) and extremely significant (5). The limit of each category is determined by the number of samples available as in Equation 1 [15].

\[
B_{max} = \left( \frac{a \cdot N}{A \cdot N} \right) \cdot 100 \quad \ldots \ldots (1)
\]

\[
(FI)\% = \left( \frac{\sum W_{frequency}}{A \cdot N} \right) \cdot 100 \quad \ldots \ldots (2)
\]

\[
(SI)\% = \left( \frac{\sum W_{impact}}{A \cdot N} \right) \cdot 100 \quad \ldots \ldots (3)
\]

\[
FAII = \frac{(FI)\% \cdot (SI)\%}{100} \quad \ldots \ldots (4)
\]

Where as:

- \(B_{max}\) = the maximum limit score of a category
- \(a\) = category score (1, 2, 3, 4, or 5)
- \(A\) = the highest weight on the Likert scale used
- \(W\) = given weight for each factor
- \(N\) = number of respondent
By inputting the highest category score from Equation 1, with a free number of samples, then the category parameter of frequency and impact index is achieved such as in Table 2.

**Table 2. Category Parameter of Frequency and Impact Index**

| Classification Grade | Explanation |
|----------------------|-------------|
| 1                    | FI or SI \( \leq 20 \) |
| 2                    | \( 20 < \text{FI or SI} \leq 40 \) |
| 3                    | \( 40 < \text{FI or SI} \leq 60 \) |
| 4                    | \( 60 < \text{FI or SI} \leq 80 \) |
| 5                    | \( 80 < \text{FI or SI} \leq 100 \) |

After the FI and SI score have been classified using the category in Table 3, the risk scale can be calculated by using Equation 5. Level of risk of each factors can later be classified using Table 3.

\[
RS = GFI \ast GSI
\] . . . . . . . (5)

Details:
- \( RS \) = Risk scale
- \( GFI \) = FI Classification Grade
- \( GSI \) = SI Classification Grade

After calculating the risk scale of each factor, the level of risk is obtained using the risk matrix in Table 3 [16].

**Table 3. Risk Matrix**

| Probability                | 1 (insignificant) | 2 (Minor) | 3 (Moderate) | 4 (Major) | 5 (Catastrophic) |
|----------------------------|-------------------|-----------|--------------|-----------|------------------|
| 1 (Rare)                   | LOW               | LOW       | LOW          | LOW       | MEDIUM           |
| 2 (Unlikely)               | LOW               | LOW       | MEDIUM       | MEDIUM    | HIGH             |
| 3 (Moderate)               | LOW               | MEDIUM    | MEDIUM       | HIGH      | HIGH             |
| 4 (Likely)                 | LOW               | MEDIUM    | HIGH         | HIGH      | VERY HIGH        |
| 5 (Almost certain)         | MEDIUM            | HIGH      | VERY HIGH    | VERY HIGH |                  |

5. Analysis

5.1. **Level of risk factor analysis**

Based on the FAII analysis, the 66 factors affecting the delay of building construction project in Kepulauan Anambass is classified as seen in Table 4.

**Table 4. Level of risk factor analysis**

| Ranking | Factor                          | FAII  | Risk Score | Level of Risk |
|---------|---------------------------------|-------|------------|---------------|
| 1       | Delay in material delivery      | 48,0  | 12         | High          |
| 2       | Transportation problems in material delivery | 44,0  | 12         | High          |
| 3       | Shortage of material in the market | 40,0  | 12         | High          |
| 4       | Adverse weather condition       | 40,0  | 12         | High          |
| 5       | Slow equipment mobility         | 32,0  | 9          | Medium        |
| 6       | Traffic control and work zone restrictions | 24,9  | 9          | Medium        |
| Ranking | Factor                                                                 | FAlI | Risk Score | Level of Risk |
|---------|------------------------------------------------------------------------|------|------------|---------------|
| 7       | Complicated bureaucracy system                                          | 24,0 | 6          | Medium        |
| 8       | Delay in checking and approving finished construction works result     | 24,0 | 6          | Medium        |
| 9       | Lack of consultant’s experience in construction project                 | 24,0 | 6          | Medium        |
| 10      | The location and layout of the construction project                     | 24,0 | 6          | Medium        |
| 11      | Frequent design changes                                                 | 21,8 | 9          | Medium        |
| 12      | Late decision making by the owner                                       | 21,3 | 6          | Medium        |
| 13      | Mistakes and discrepancies in design                                    | 21,3 | 6          | Medium        |
| 14      | Fluctuation in material cost                                            | 21,3 | 6          | Medium        |
| 15      | Late payments by the owner                                              | 20,0 | 6          | Medium        |
| 16      | Unreliable supplier                                                     | 18,7 | 6          | Medium        |
| 17      | Equipment damage often occurs                                           | 18,7 | 6          | Medium        |
| 18      | Changes in the project scope                                            | 17,8 | 6          | Medium        |
| 19      | Lack of communication and coordination with other parties by the owner  | 17,8 | 6          | Medium        |
| 20      | Delay in reviewing and approving material samples and design changes    | 17,8 | 6          | Medium        |
| 21      | Lack of communication and coordination with other parties by the consultant | 17,8 | 6          | Medium        |
| 22      | Repetition of work due to mistakes during construction                  | 16,0 | 4          | Medium        |
| 23      | Damage material due to storage issue                                    | 16,0 | 4          | Medium        |
| 24      | Low workers’ productivity                                               | 16,0 | 4          | Medium        |
| 25      | Low equipment efficiency and productivity                               | 16,0 | 4          | Medium        |
| 26      | Bad equipment maintenance                                               | 16,0 | 4          | Medium        |
| 27      | Lack of feasibility studies                                             | 16,0 | 4          | Medium        |
| 28      | Delay in construction work caused by the owner                          | 15,6 | 6          | Medium        |
| 29      | Delay in preparing shop drawings                                        | 13,3 | 4          | Medium        |
| 30      | Design drawing incomplete and unclear                                   | 13,3 | 4          | Medium        |
| 31      | Short supply of workers                                                 | 13,3 | 4          | Medium        |
| 32      | Delay in mobilising workers                                             | 13,3 | 4          | Medium        |
| 33      | Fluctuation in cost/currency                                            | 13,3 | 4          | Medium        |
| 34      | Misunderstanding of the requirements given by the owner                 | 12,4 | 6          | Medium        |
| 35      | Bad management and supervision on site                                  | 11,1 | 4          | Medium        |
| 36      | Lack of motivation and spirit of the workers                            | 11,1 | 4          | Medium        |
| Ranking | Factor                                                                 | FAlI | Risk Score | Level of Risk |
|---------|------------------------------------------------------------------------|------|------------|---------------|
| 37      | Inadequate number of qualified and experienced workers                 | 11,1 | 4          | Medium        |
| 38      | Absence of construction workers                                        | 11,1 | 4          | Medium        |
| 39      | Incompetent team on the field                                          | 11,1 | 4          | Medium        |
| 40      | Lack of equipments                                                     | 11,1 | 4          | Medium        |
| 41      | Changes in government regulations and laws                             | 11,1 | 4          | Medium        |
| 42      | Financial difficulties by the owner                                    | 10,7 | 4          | Medium        |
| 43      | Tendency in corruption by the owner                                    | 10,7 | 4          | Medium        |
| 44      | Incompetent subcontractor                                              | 8,9  | 4          | Medium        |
| 45      | Changes in the material type and specification during construction      | 8,9  | 4          | Medium        |
| 46      | Mistake in choosing the material                                       | 8,9  | 4          | Medium        |
| 47      | Problems in managing contractor’s cash flow                            | 7,1  | 4          | Medium        |
| 48      | Not using the right construction method                                | 7,1  | 4          | Medium        |
| 49      | Lack of communication and coordination with other parties by the contractor | 7,1  | 4          | Medium        |
| 50      | Poor construction material procurement mechanism                       | 7,1  | 4          | Medium        |
| 51      | Bad quality construction material                                       | 7,1  | 4          | Medium        |
| 52      | Improper equipment selection                                            | 7,1  | 4          | Medium        |
| 53      | Technology used is outdated                                            | 7,1  | 4          | Medium        |
| 54      | Unconventional construction method used                                | 7,1  | 4          | Medium        |
| 55      | Impact on the lack of soil testing                                     | 7,1  | 4          | Medium        |
| 56      | Unavailable utilities on the project site                              | 7,1  | 4          | Medium        |
| 57      | Work accident during construction                                       | 7,1  | 4          | Medium        |
| 58      | Geopolitical and regional stability                                     | 7,1  | 4          | Medium        |
| 59      | Delay in obtaining permission from local authorities                   | 7,1  | 4          | Medium        |
| 60      | Conflict between workers                                               | 5,3  | 2          | Low           |
| 61      | Difficulties in funding by the contractor                              | 4,0  | 1          | Low           |
| 62      | Ineffective project design and scheduling                              | 4,0  | 1          | Low           |
| 63      | Worker strike                                                          | 4,0  | 1          | Low           |
| 64      | Natural disasters                                                      | 4,0  | 1          | Low           |
| 65      | Conflict, war and public animosity                                     | 4,0  | 1          | Low           |
| 66      | Problems with social neighbourhood                                     | 4,0  | 1          | Low           |

6. Conclusion

Based on the level of risk factor analysis using the FAlI method there are 4 factors that are identified as high risk, those risk factors are:

a. Delay in material delivery
b. Transportation problems in material delivery
c. Shortage of material in the market
d. Adverse weather condition

Shortage of materials in the market, delay in material delivery, and adverse weather condition were ranked the 7th, 11th, and 17th factor that causes the time overrun in construction industry of central and southern parts of Malaysia [17]. However in Egypt shortage of material in the market in ranked 1st according to the severity index that causes delays in construction project [18].

Whereas the transportation problems in material delivery was identified as a factor in construction projects in Turkey that causes delay but does not make the top 10 factors [19]. These differences can be caused by the geographical position of the object of the research. Kepulauan Anambass Regency is an island that relies on sea transportation to transport goods and material. The weather also plays a big part in the operation of the transportation in or out of the regency of Kepulauan Anambass. These 4 factors identified as the dominant factors that causes delay in building construction project in Kepulauan Anambass Regency needs to be mitigated to lower the risks of further delays.

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