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Extension of Time (EoT) Considerations in Construction Duration Estimate for Public Construction Projects

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Abstract. Construction duration is defined as the time frame given by the Client of a project use to complete the project under normal working conditions, practice of construction. However, often times, projects faced time overruns and hence, needing to activate contractual remedies like Extension of Time (EoT). This paper aims to investigate the factors related to award the Extension of Time (EoT) for construction projects in especially in the public sector in Sarawak. A structured checklist was created as an instrument and employed to accomplish the objective of this research. A total of 111 previous public projects which were granted EoT were studied. The findings revealed several detailed factors that had typically led to project delays in the State. These findings are expected to offer the construction industry stakeholders in Sarawak a focal point on those delay that could be included in construction project duration estimates and management of construction performances, followed by the appropriate corrective and improvement measures for time management for construction projects.

1. Introduction

The construction sector is among the industrial sectors contributing significantly to development and the economic system in the State [1]. However, most construction projects nowadays are much more complex [2] involving many specialised material, equipment, labour and also complicated project delivery and contractual relationship. This has led to more problems and difficulties with construction duration estimation, bringing on board another issue frequently extensive project schedule and timeline [3]. Delays occurrence are becoming more rampant and this may not be cause by mismanagement of the projects but poorer time planning in the first place.

Contractual remedy laid out that if a project delay occurs, contractors are penalised and requird to pay the sum of liquidated damages (LAD) as stated in the contract. And to prevent such loss and to gain additional time for completion of the projects, contractors often times will find ways to apply for extension of time (EoT). The definition for EoT by The Society of Construction Law (SCL) as contained in the Delay and Disruption Protocol (SCL 2002), is "*the additional time granted to the contractor to provide an extended contractual time period or date by which work is to be, or should be completed and to relieve it from liability for damages for delay (usually liquidated damages)*".

It is not unusual for delays to take place in construction projects, and in other projects which the schedule is used for planning of activities. Delay dictates whether a project or some other date is finished late, such as a milestone. A number of unforeseen incidents during construction can result in a delay in completing the project, or increase the amount of work to be done within a given time frame.

Ibironke, Oladinrin, Adeniyi and Eboreime [4] believes that delays in construction may be caused by the client, the contractor, the consultants, acts of God, or a third party and they may occur early or late in the job.

2. Problem Statement

The construction sector in Sarawak is no exception to the worldwide delay trend whereby major projects are carried out beyond the initial project time set out in the contract agreements. According to most researches conducted during the last two decades, the important factors that must be taken into account during construction duration estimation and causes of delays related to construction projects summarised as below. The following are factors which have been studied by the researchers and detailed in Table 1 as given below:

Table 1. Factors taken into construction duration estimation and causes of delays by past researchers.

Researchers	Country	Findings
[5]	Australia	Ground floor area, number of floors, facility type
[6]	UK	Facility type, type of client, contractor selection method, procurement method
[7]	Turkey	Weather conditions, construction methods, labor productivity, site condition, project cost, facility type, number of floors, floor area, project complexity, design comprehensiveness, experience of consultant, experience of owner, experience of contractor, procurement method
[8]	US	Precipitation, wind velocity
[9]	US	Number of floors, floor area
[1]	Australia	Shortage of labor, skill shortage, site condition, design comprehensiveness
[10]	Singapore	Equipment availability and failure, construction methods, shortage of labor, availability of staff, availability of material, site condition, experience of consultant, experience of owner, project duration set, experience of contractor
[11]	Vietnam	Site condition, design comprehensiveness, subcontractor skills
[12]	Palestine	Terrain condition, soil and rock suitability, soil and rock drill ability, project size, road length, road width,
[13]	Malaysia	Late equipment delivery, insufficient number of equipment, equipment availability and failure, construction methods, shortage of labor, shill shortage, labor productivity, availability of material, late material delivery
[2]	India	Weather conditions, air quality, equipment availability and failure, shortage of labor, availability of material, late material delivery, site preparation time, site condition, project cost, complexity, reworks and repair
[14]	Egypt	Project location, facility type, floor area, total height, finishing quality, design comprehensiveness, type of client. Contractor selection method, procurement method
[15]	Korea	Site condition, bedrock, number of floors, floor area, lot area, number of households, structural system, foundation

		system, roof type,
[16]	Kuwait	Project cost, number of floors, floor area
[17]	Slovak Republic	Project cost, number of floors, floor area
[18]	Serbia	Earthworks, amount of crushed stone, number of curbs, amount of asphalt base layer, number of asphalt surface later, amount of concrete prefabricated elements, drainage works, traffic signalisation works
[19]	Korea	Number of floors, number of buildings,
[20]	Korea	Construction commencement month, facility type, number of floors, floor area, number of building, lot area, structural system
[21]	Iraq	Site accessibility, facility type, number of floors, floor area, total height, structural system, foundation system,

Through the understanding of delay factors and reasons for delays in construction projects, better time management measures can be executed. It is important to identify the reason of delays, so that stakeholders can take appropriate steps in order to prevent such scenarios once these causes become noticeable. More importantly, from these factors and reasons for delays, those that are eligible for EoT will be further studied and considered so that initial planning for schedules can also be inclusive of these factors. Besides avoidance and mitigating them when they occurred, this research advocate incorporating them especially in time planning especially in construction duration estimation

2.1 Research objectives

The main objective of this research is to identify the factors of EoT that has been awarded to the contractors for the Sarawak construction projects. This will enable the construction industry stakeholders in Sarawak not only to understand factors that most delays and affecting project time performances but also to include them in planning the project schedule.

3. Research methodology

From the literature review, these 61 factors of delay in construction projects were chosen and were divided into 10 groups. Characterisation of delay factors are as follows: contractors; consultant; client; environmental; equipment; labor; material; project characteristics; site; and others.

A structured checklist was used as the main instrument in the data collection and is found to be useful to gather the data to be used in the analysis. Three (3) checklists was prepared based on project type (buildings, roadwork/bridges and others). Each of the checklist was separated into two sections: section I and section II. Section I comprises of inquiries associated with the project's title, tender number, year of project, project duration (predicted and actual) and project budget. The total days of EOT was measured by substituting the actual and predicted project duration. Section II comprises of the category of delay factors and its detailed factors (gathered from relevant materials through a detailed literature review of previous related researches), each with a checkbox and a remark section for any additional or important information, e.g., total days of delay.

Data collection was conducted at Quantity Survey (QS) Branch, Jabatan Kerja Raya Head Quarters (JKR HQ) Sarawak and it took place in February 2020 for a period of 10 days. A total of one hundred and eleven (111) projects data with EoT were managed to be collected. The raw data obtained from the checklists were compiled, organised and analysed with the aid of Microsoft Excel. A quantitative interpretation was found to be the most appropriate analysis to analyse the data.

4. Results and discussions

The analysis from structured checklists led to development of several reasons behind these construction projects' EOTs. There are in fact many factors which influence the actual duration of project, these factors include: inclement weather; site possession; low water level; change in design; contractor selection method; delay by SESCO; SO instruction; authority inspection and approval; unforeseen reasons; suspension of work; existing utilities; site condition; client late decision making; land blockage; 3rd party obstruction; air quality; flooding; and other reasons.

The results showed that some of the factors gathered from the literature reviews from related papers, does happen to be the reason for project's EOT. However, these factors have been lumped into a few major categories based on the nature of the factor itself.

4.1. Inclement weather

Inclement weather level is one of the factors that will be considered in granting the EoT to contractors. Based on the data of past construction project's EoT collected, the factor of inclement weather has affected most of these projects, 92 projects out of 111 projects. According to the EoT approval form, this factor will be taken into consideration if the rainfall intensity is more than 10mm in a day. The contractor will apply for the EoT due to exceptionally inclement weather based on the rainfall data in the Malaysia Hydrological Yearbook by Malaysian Meteorological Department (MMD).

As mentioned earlier, 82% of the 111 construction projects in Sarawak with EoT was affected by the exceptionally inclement weather. These projects include RC pontoon, jetty, roadwork, building, waterworks, airport, bridge, earthwork, agriculture sub-station, playground, gate and electrical system projects. However, based on the data, only 1 project was seriously affected by this factor, which is a jetty project, having an EOT of 397 days due to inclement weather. Other than that, only twenty-three (23) projects were least affected by inclement weather, having EoT less than 10 days.

Besides that, it is also noticeable that all of 92 projects affected by exceptionally inclement weather are located all around Sarawak. This suggests that the EoT due to this factor is not depending on its location, but it is based on the rainfall intensity distribution data provided by the MMD, which will be updated annually.

Based on the data analysed, the predicted project cost of the 92 projects is between RM488.6k to RM302.6mil. However, it is noticeable that the percentage of project delay due to inclement weather is not highly affected by the cost of project. As for instance, the jetty project with a cost of RM187.62mil was having a delay of 27.94% project delay due to inclement weather as compared to a project of RM302.6 with 100% delay. There is no pattern of any cost that will result in a high or low EoT due to this factor.

4.2. Internal issues

Internal issues area another main category that will be considered in granting the EoT to contractors. Based on the data of past construction project's EoT collected, the factors under internal issues has affected 42 projects out of 111 projects. A few factors that has been lumped into internal issues are including site possession, change in design, contractor selection method, variation order, etc.

As indicated earlier, 42 out of 111 construction projects in Sarawak with EOT was affected by the internal issues. These projects include building, roadworks, waterworks, bridges, airport, jetty and seashore projects. However, based on the data, only 13 projects were affected 100% by this factor, which most of them are building projects, with a maximum EoT of 162 days. Other than that, only 2 building projects having less than 20% project delay due to internal issues with maximum EoT of 30 days.

It is notable that all of 42 projects affected by internal issues have different locations, which included Asajaya, Bau, Betong, Bintulu, Julau, Kapit, Kuching, Lawas, Limbang, Lundu, Marudi, Miri, Mukah, Pusa, Sarikei, Serian, Sri Aman. It is noticeable that these projects are affected by its location, especially projects with 100% delay due to this factor. As for instance, a building project located in Miri with no access available have the highest EoT of 162 days, solely due to internal

issues, but another building project in Miri which is considered accessible, have the lowest EoT which is 10 days due to internal issue alone.

Based on the data analysed, the predicted project cost of the 42 projects affected by internal issues is between RM599.5k to RM187.6mil. However, it is noticeable that the EoT is not highly affected by the cost of project. As for instance, the jetty project with a cost of RM187.6mil has 49 days EoT, which is almost similar EoT to a project cost of RM888k with 48 days EoT. This means that there is no pattern of any cost that will result in a high or low EoT due to this factor.

4.3. Environmental and unpredictable reasons

Environmental and unpredictable causes are one of the main categories that will be considered in granting the EoT to contractors. Based on the data of past construction project's EoT collected, the factors under environmental and unpredictable reasons has affected 27 projects out of 111 projects. A few factors that has been lumped into environmental and unpredictable reasons includes unforeseen reasons, air quality, flooding event, etc.

As mentioned earlier, 27 out of 111 construction projects in Sarawak with EOT was affected by the environmental and unpredictable reasons. These projects include building, roadworks, bridge and waterworks projects. However, based on the data, only 3 projects were affected 100% by this factor, which all of them are building projects. The project with a most EoT is a roadwork project with 238 days of EoT while, only 1 roadwork project having less than 10% project delay due to environmental and unpredictable reasons with EoT of 28 days.

It is notable that all of 42 projects affected by environmental and unpredictable reasons have different locations, which included Asajaya, Bau, Belaga, Betong, Bintulu, Dalat, Julau, Kabong, Kanowit, Kapit, Kuching, Miri, Samarahan, Sarikei, Simunjan, Song and Sri Aman. It is noticeable that these projects are affected by its location. As for instance, a building project located in Kuching of less than 25km from nearest city, have a lower EoT of 5 days, compared to a roadwork project in Dalat, of 25 to 50km from nearest city, have a higher EoT which is 238 days due to environmental and unpredictable reasons.

Based on the data analysed, the predicted project cost of the 27 projects affected by environmental and unpredictable reasons is between RM677.7k to RM88.4mil. However, it is noticeable that the EoT do not affected by the project cost. As for instance, the building project with a cost of RM677.7k has 5 days EoT, which is almost similar EoT to a roadwork project cost of RM79.1mil with 3 days EoT only due to environmental and unpredictable reasons. This means that there is no pattern of any cost that will result in a high or low EoT due to this factor.

4.4. Third party obstruction

Third-party obstruction is one of the main categories that will be considered in granting the EoT to contractors. Based on the data of previous construction project's EoT collected, the factors under third-party obstruction has affected 21 projects out of 111 projects with EoT. A few factors that has been lumped into third-party obstruction includes delay by SESCO, authority inspection and approval, existing utilities, land blockage, etc.

As stated earlier, 21 construction projects in Sarawak with EOT was affected by the third-party obstruction. These projects include building, roadwork, riverine terminal, earthwork, bridge, waterwork and agriculture sub-station projects. However, based on the data, only 3 projects were affected 100% by this factor, which the waterworks project having a highest EoT of 135 days. Other than that, only 1 roadwork project having less than 25% project delay due to third-party obstruction EoT of 54 days.

All 21 projects affected by changes in design have different locations, which are Bau, Dalat, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Miri, Pusa, Samarahan, Sarikei and Simunjan. It is noticeable that these projects do not affected by the construction project's location. As for instance, an earthwork project located in Kuching of less than 25km from nearest city, have the lowest EoT of 20 days, but

another building project in Kuching of similar distance from nearest city, have a higher EoT which is 181 days due to third-party obstruction.

Based on the data analysed, the predicted project cost of the 21 projects affected by third-party obstruction is between RM738.1k to RM85.5mil. However, it is notable that the EoT is not affected by the project sum. As for instance, the roadwork project with a cost of RM738.1k has 103 days EoT, which has an almost equivalent EoT to a project cost of RM85.5mil with 124 days EoT due to third-party obstruction. This signifies that there is no pattern of any cost that will result in a high or low EOT due to the third-party obstruction.

5. Conclusion

The general factors that affect a schedule of a construction projects has been identify this research. 61 factors of construction project delay were divided into 10 groups as follows: contractors; consultant; client; environmental; equipment; labour; material; project characteristics; site; and others. From the factors of delays identified, a checklist was put together and was used an instrument to collect the practical data related to delays in 111 public construction projects of various locality, cost, natures and types that had been carried out in the state of Sarawak for the past 5 years. Based on the analysis, these project characteristics such as type of projects, project locality and project cost that may been affect construction projects timeline were analysed through the quantitative interpretation.

From the delay causes identified, those that were awarded with EoT were further studied. Based on the results, construction projects in Sarawak has been awarded EoT for a few reasons, which includes inclement weather, site possession, low water level, change in design, contractor selection method, delay by SESCO, SO instruction, authority inspection and approval, unforeseen reasons, suspension of work, existing utilities, site condition, client late decision making, land blockage, third-party obstruction, air quality, flooding and other reasons. These reasons were further classified into category with the top categories of delays granted with EoTs being Inclement Weather, Third Party Obstruction, Internal Issues and Unpredictable especially environmental factors. It is believed that these factors could have and should be incorporated into initial schedule planning and construction duration estimation.

This research advocates that a good schedule need to be planned properly and then managed rigorously. By understanding the reasons for delays and why EoT are granted, it is much possible to optimised the schedules. Factors that can be incorporated accurately in the schedule can further reduce potential of EoT application. In other words, comprehensive schedules can then be better understood, controlled and executed. Delay reductions efforts should be in both planning and mitigation through a comprehensive and concise time duration estimation effort.

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