

## A Case Study of S-Curve Analysis: Causes, Effects, Tracing and Monitoring Project Extension of Time

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Received 16 June 2020; Revised 27 February 2021; Accepted 05 March 2021; Published 01 April 2021

### Abstract

S-Curve analysis in the construction interpreted as managing project with knowledge and traceable in the context of sustainable construction while displays the cumulative costs, labour hours or other quantities plotted against time. In the contract administration, delays in completing a construction project led to the breach of contract but, in contracts itself allow the construction period to be extended where there are delays that are not the contractor's fault. Under those circumstances, a presentation of a case-study regarding the analysis of S-Curve of a life project drew comparative interpretation of project performance towards project delivery schedule has been conducted in private initiative project. This study aims to investigate and examine the factors that cause delays in construction projects from the perspective of S-curve representations. The paper aims to provide in depth light about the existing causes of project delay and describe the key sources of financing problem and identify the consequences of contraventions of contract. Two distinct parts divided which are refers to the methods used to assess the perceptions of clients, consultants, and contractors on the relative importance of causes of delay in a project and referred to the procurement and documentation to analyse the delay. As a result, an Extension of Time (EOT) granted and identically changed the progress towards extension time where better planning demanded for improvement and restoration progress kept on track. This paper presented a practical and comparative S-Curve within extension of time to ensure delivery of project on schedule. In the long run, the identified causes are combined into 16 factors. Finally, the result of this match was brought in order to critically understand and provide a guideline to contractor in preparing EOT application and choose reliable factor based on the specific circumstances of project delay factors thorough review conducted to reveal the nature of EOT application techniques.

*Keywords:* S-Curve; Causes; Extension of Time; Monitoring Project; Management.

### 1. Introduction

Presentation of a case-study with reference to the analysis of S-Curve to trace of a real project has been marked as complete with regards to successfully project delivered as per schedule. S-Curve has been used as a procurement performance model for construction frameworks to trace and track status of project for guidance in reporting progress

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 <http://dx.doi.org/10.28991/cej-2021-03091679>



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in contract management. The S-curve is quite suitable to represent the relationship between project duration and complete progress in practical usage of construction management [1].

The necessity is compatible to the needs of project analysis and innovation in this paper will be able to assist contractors to provide the EOT application documentation based on identified delay factors based on the specific circumstances of each project. In fact, contractor initiatively to identify the root cause of the problem and determined all the possible consequences of a fact in relationship between different root causes of a problem for detailed parts. After decades, the use of appropriate procurement method to implement construction projects was brought to the fore after the release of a model [2] and subsequently reported evolved [3]. Construction industry in Sabah, Malaysia are on the right track with positive variance of development driven by rapid economic growth and domestic demand. Unfortunately, there are some triggers that interfered with or reduced the smoothness of development teams, among which is delay in project execution. Various issues of delays raised by contractors.

Notwithstanding, the problems of delays in Sabah's construction industries is not a major problem or unusual phenomenon. It has been researched; the causes of projects being executed in Sabah East Malaysia allowing a mitigation plan to be prepared [4]. In Sabah itself, the enormous developer was driven by government in construction industry and private sector become a minority in development sector to fulfilled domestic demand. Obviously, the biggest customer of the construction industry in most countries is the government [5]. It was observed that the performance of private sector in the construction industries in terms of time was quite manageable in Sabah. However, in construction sector there are tremendously productivity with skills, but overall seemed to industry not merely a solving in delays in execution, but a kind of sufficient human capital. Additionally, building construction often occupies the bottom of industrial productivity rank reports worldwide [6]. Construction typically involves a deadline for work completion that started from commencement date. In general, contractual agreements will be forced attention to schedules and delays in execution will imply construction, represent additional costs due to late facility occupancy or other factors. A study of construction industry delays carried out in Hong Kong, the execution of project related to timely delivery of projects within budget and to the level of quality standard specified by the client is an index of successful project delivery [7].

The traditional approach to estimating an S-curve is based on a schedule of planned activity times and progress calculation using the percent weight of each activity in the project and the percent complete of each activity at each time point [8]. Thus, this case-study conducted review to the contractor's technique to overcome their delays. In order to overcome the difficulties of controlling projects, the S-Curves based on financial are applicable to project management applications in this situation. Costs versus Time S-Curve be a baseline in monitoring project progress. The schedule and actual percentage are compared in every month to accelerates the remedial plans. Contractors and developer believed the S-Curve as a productive medium in reporting progress. Consequently, the S-type distribution is believed to be suitable in regression on construction management and social economy [1].

The objective of this case-study is to determine the practical cumulative S-Curve that will best represent the project progress report and to improve the performance after first extension of time agreed by developer and contractor by negotiation. In this study, S-Curve representing the standard distribution of costs over time and a cumulative flow of money over a time period. The optimization process of second phase in construction during extension of time are greatly monitored using the S-Curve and doesn't change the relationship between activities.

This study is discussed the restoration and improvement from the origin S-Curve to the modified S-Curve to suit the first granted extension of time. From the S-Curve, there are several causes and project delays effect widely shared. A remedial action and time to time procurement that need to be supervised, monitored and acquired by the contractor to protect their current interest to make an application for extension of time as be conclusive evidence of contract administration in future. In order to identify the unusual activities in S-Curve, this paper is organized in the section 1, conflict in the construction issues for determination of causes and effect. The basics of S-Curve are analyzed based on the origin S-Curve before extension of time granted in section 2, modified S-Curve according to new regime of time based on the extension period and the core of a progress are presented in section 3.

In many circumstances, delay project was ended with dispute between involved parties from client, consultants and contractor. There are many arguments was present to prove their representations to the court. Determining the contractual responsibility of delay is the most likely source of dispute in construction projects and many techniques have been used in the courts to demonstrate the criticalities of a delay event on the project schedule [26]. Most compelling evidence, finance-related causes as the most critical causes of delay in any projects. Contractors facing difficulties when it comes to financial problem or late of payment and releases of interim certificates. This factor widely discusses by many researchers. Delay in settlement of claims, contractor's financial difficulties, delay in payment for extra work/variations by owner, late payment from contractor to subcontractor or suppliers, variation orders/changes of scope by owner during construction and changes in design by owner were the highly ranked delay causes [27].

Poor consultant performance and inefficient site management discovered as a part of contributor to the causes of project delay. Inefficient will invite major problem in management. Consultants must perform their professionalism in well verse as middle party between client and consultant. Failure in delivering good performance causes improper project implementation. Six of the ten most important causes are in the top ten universal delays in construction projects. Factor analysis revealed six underlying causes: improper planning, poor consultant performance and inefficient site management [28]. To ensure project delivery on time, ability to control the risk of delays is very important. About 60% of project less delay, this happened when the effectiveness and managing the risk carefully. Attention given to project knowledge management, record and review past events, record keeping, information evaluation, data ratings, quantify their importance, utilize expert knowledge in rooting and data analysis [29].

## 2. Background of Case Study

A case study of S-curve analysis by planning, tracing and monitoring model during project extension of time are carried out in a construction package located in Sabah, Malaysia. A contract has been signed represent third parties between developer, consultant and project has awarded to local main contractor. Project is developed under private initiative scheme with cost USD\$ 30 Million in rural area to support positive economic, social and environmental links between urban and rural areas by strengthening state and regional development planning. The proposed development is a major commercial development that are set to change the face of state rural area. The development not only big in terms of size and gross development value but also special in concept and design that makes new township area for daily activities. With type of building known 2 and 3 storey shop lot. The contract period are 26 weeks. Unfortunately, due to unforeseen scenario the project undeliverable and contractor has decided to apply the first extension of time (EOT) and conditional approval are granted. This project is behind 25.22% from schedule.

This approval is granted based on a thorough review of all information available and facts related to project. The developer unanimously agreed to grant preliminary conditional approval to contractor with proven statement by the causes of delay in project. Contractor has managed to prepare probe procurement that become a backbone to the application. Strong recommendation finally made by consultant after careful review. The granting of an extension of time relieves the contractor from penalty for failure to achieve the contract period and free from legal action to enforce against developer rights. The contractor is granted the appropriate extension of time for 6 months from the duly completion date. Contractor has the right to claim an extension of time which limits the time within which certain contractual rights can be enforced. In addition, the contractor has the right to assume any missing information, but all assumption made should be qualified clearly in the schedule narrative that is submitted along with the schedule [8].

The development plan has prepared by consultant accordingly and contractor has the right on their obligation to follow the shown plan. In consequence, the interpretation of S-Curve is derived from this figure. In this study, contractor has issued claim on extension of time for the late delivery from various causes are presented and documented and widely discussed in the next section. The contractor scope of work applies to the development project as stated in formal plan sheets and construction documents and clearly stated, as main contractor their obligation and work are to complete the physical development such as building under building works contract including mechanical and electrical services.

Scope, budget and schedule constraints are core characteristics of the production of projects [9]. At the early stage of construction, contractor moved smoothly and time to time, they are facing problem and occasionally disturbed by few internal discrepancy issues. Contractor wisely manage the arising matter and prepared any written instructions for every event and obviously the contractor show their professional experienced as a good practice. The key findings reveal that in achieving the best practice in the Malaysian Construction Industries, project manager should straighten their capability in term of knowledge, skills and personal characteristics [10]. A well-organized development programme is a critical strategy for construction companies [11].

During the construction period, as a contractor there will be question running in mind whether, will the project be completed as scheduled. Thus, from the experienced, contractor has taken consideration from any angle and perspective to use opportunity to fully. All work requests will be prioritized by contractor. Approaches to controlling performance cost, time and quality are examined, the importance of working to a programme and to a preconceived specification is stressed [12]. Figure 1 shows the research methodology and conducting analysis from various parties involving client, consultant and contractor. Analysis including documentation extractions and interim certificate analysis.

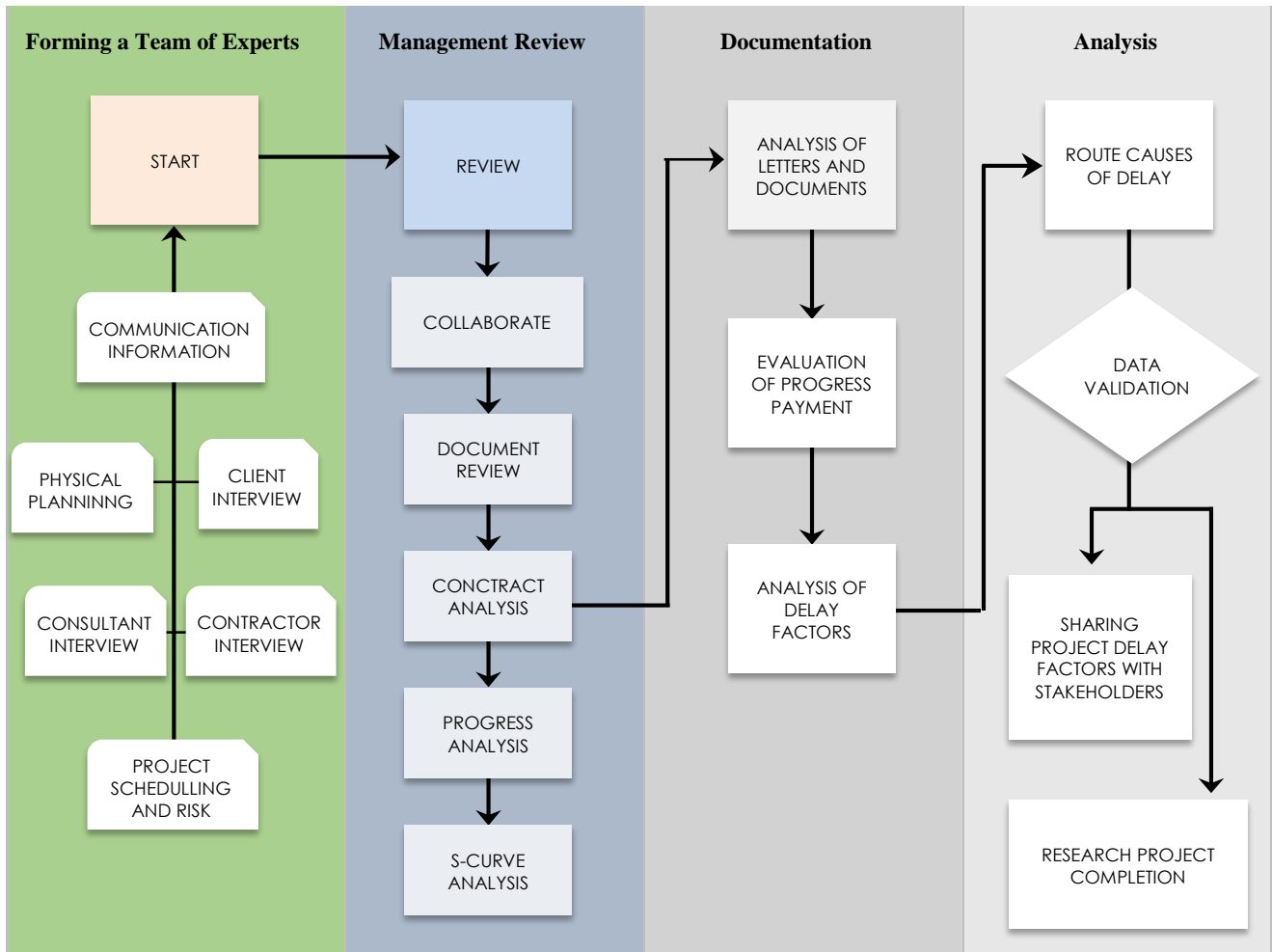


Figure 1. Flowchart performing investigation and analysis

### 3. Conflicts, Causes and Effect

Understanding the causes and effects of conflict is fundamental to personal and professional management skills in construction. It happened under the pressure in every angle of project and seemed the most normal. Conflict seems to be very synonym with construction projects and giving the impressions of problems includes in increasing project cost, project delays, reduce productivity, loss of profit or damage in business relationships [13]. Like any construction project, the development of this project has been a team effort. Unfortunately, the construction team are beset with disputes in professional way. Generally speaking, most conflict begins when there is a difference. This argument increases the possibility of delay in progress by dispute decided that sometimes taking time to settle at the contractor's risk. Poor site management influencing factors in causing delay arranged in descending order [14].

In this case-study, the mentioned project is faced with some conflicts. This report on project delivery and lessons learned, in undertaking the granted extension of time, contractor take the first step started to identify a problem, investigate and finding possible solutions to problem. Professionally, contractor manage the conflict by not taking into account personal interests or conflicts and they come with conclusive idea to solve the delay. Contractor comes with monitoring plan using financial S-Curve reports. Prior to the implementation of new S-curve based on the granted extension of time, there are three conceptual ideas decided in identifications problem and solution firstly, identify the root causes of delay. Secondly, restructuring of manpower and thirdly, monitoring by using financial S-Curve as crucial reporting medium to developer and as indicator to the warning strength of team and allow the progress of a project to be tracked visually over time. In projects the S-curve is driven by the multiple interconnected activities that occur in the middle of a project [15]. In what follows, this paper only discussed the first and third conceptual ideas that highlighted by contractor. Where, causes and S-curve are eligible to be discussed with generated a S-curve in construction studies to fit project management data. Table 1 shows the factors causing delay in this project. There are 16 major points that contributed to the delay root causes from particular parties.

Contractually, contractor should be handing over this whole project by middle of 2015 unfortunately, as per schedule, this project determined behind the schedule at the stage of second year at December 2014 after 21 months' progress of works. After 21 months, this project actual percentage identified behind 5.69 from total 80.47% schedule

to actual only 74.78% only. This phenomenon has been decided by client, consultant and contractor as unusual progress where clearly stated in contract and breach the terms. This regards to the Sale and Purchase Agreement between clients to customer where, there will be a penalty for late delivery. According to clause, developer guarantee that the buyer will receive the compensation for late delivery. Nonetheless, in contract itself has stated that, in any condition that proven, contractor may apply the Extension of Time (EOT) for their non-cause problem if the project conditionally determined as behind schedule after 70% of work progress. Contractor decided to follow up the progress by putting forward the causes. The weightage of delay percentage presented in Table 1 based on the total number of days taken by each issue to be solved.

EOT is one of the provision clauses in the standard contract form. The purpose is to preserve an employer's right in liquidated damages. In the circumstances that the delays are caused by inevitable reason, EOT allows contractor to set an agreed completion date [16]. Slow decision making by particular parties with 1.12% mean index of delay cause. The most preferred factor as causing delay in this project with mean index 3.74% are bad weather with total number of rainy days is 443 days during the construction period. Contractor has been advised to get the rainfall official data associated the locality of project as supported documents in applying EOT. This is closely followed by the shortage of skills worker with mean index 2.76% as part of the delay contributor and weightage of S-Curve derivation.

At the beginning of handing over the site construction, the main physical contractor has recorded in delay for almost three months started from January to March 2013 for late delivery from earth work contractor with 2.22% factor. The developer aware and put into record the delay causes as a compulsory option in consideration of approval EOT. Discrepancies of drawing and specifications happened between architecture and structural drawing that involved both parties architect and consultant. Document review and checking should always be under the responsible of contractor and should reporting any discrepancies to the architect or engineer be mandatory. In this case-study, the mean weightage delay causes by these issues contributed 2.04% and seen has lots of effect on project. The problem that arises is that discrepancy between drawings and specifications often occur [17]. Variation order weightage 1.91 and is not a major cause but it always viewed in changing, disturbing the main task significantly and expanding time to the additional works that could be committed by contractor though, cost is borne by developer. A lack of adequate manpower prevents contractor from completing tasks by 1.79%. It also caused decreasing working hours and productivities. Amendments of drawing increase in cost of work and wasting productive time by 1.61%, consultant aware their responsibilities and there a must to follow government agencies rules in design specification from time to time.

Inadequate details involved 1.11%, in order to convey the complete concept of the project design and resulting work exposed to greater delays where time consuming due to pending adequate confirmation by particular parties. Partial development plan approval by government agencies causing the slow decision making by developers to provide the results to the contractor. As an example, partial approval given by public authorities regarding the detention pond for surface water management, Bin center specification, road works and sewerage treatment plant with 0.91% weightage. In the life cycle of this project, there will almost always be unexpected problems and questions that crop up.

The improper execution of project management derailed project progress having 0.90%. Failing to have the experienced personnel on site involved 0.67% in the construction phase reflected to the mistake during construction stage. Control of human errors during structural construction analyzed to be the key of prevention. Discrepancies of documents in contract, bill of quantities and many procurements linking to the delay in small weightage, 0.23% then again cause reduces the effectiveness of work and re-negotiations among particular parties is taking some time. Public complaints for non-critical issue concerning on environmental impact are properly solved and government authority enforcement dissolved with closed consultation with specialist have shown good results and basically are not minoring cause in delay by which 0.01% respectively.

The physical environment within which a construction project is sited may impact considerably on its development as construction projects are always affected by physical influences [18]. Table 2 shows one of the major delays causes in project. Late monthly progress payment vitally alarming at that time. Developer is taking time to proceed the monthly progress payment with five consecutive months building work interim are delay. Issues over late or withheld payments have touched all parts of the construction especially contractor margin, revolving income and settlement of claims from particulars parties under main contractor such as sub-contractor and supplier. Late and non-payment can create cash flow problems, stress and financial hardship on the contractors and that some reactions to late and non-payment adopted by the contractors may have adverse effects on their own businesses [19].

Figure 1 shows the delay of progress payments against day. In real situation, contractor faced with major pocket account problems in running this project when delay of payments is not solved immediately. The effect of late payments obviously gives impact to the progress with greater weightage. In some cases, contractor has given and had to absorb the cost by late payments to the supplier particularly. Contractor under agreements or any amounts not paid within 30 days from the date of the demand for payment will bear interest. Hence, late payment is a predicament

which is difficult to be dealt with due to different interests of the parties involved [20]. In relation to advancing or borrowing additional capital to fund cost overruns, there will be an increment in interest cost in collecting on another defaulted promise [21].

**Table 1. Factors causing delay in development project**

No.	Causes of Delay	Particular	Frequency	Percentage
		Client	13	1.12
1	Slow decision making	Consultant	27	1.13
		Contractor	21	1.01
2	Mistake during construction stage	Contractor	9	0.67
3	Discrepancies of documents	Developer	4	0.23
4	Discrepancies of drawing and specifications	Consultant	22	2.04
5	Bad weather and force majeure	Nature	443 (days)	3.74
6	Amendments of drawing	Consultant	31	1.61
7	Variation order	Developer	41	1.91
8	Lack of manpower and resources	Contractor	39	1.79
9	Shortage of skills worker	Contractor	47	2.76
10	Late delivery from earth work contractor	Developer	1	2.22
11	Late payment received	Developer	5	2.05
12	Partial development plan approval	Developer	3	0.91
13	Inadequate details	Consultant	19	1.11
14	Project management problem	Contractor	11	0.90
15	Public complaints	Contractor	5	0.01
16	Government authority enforcement	Contractor	1	0.01
<b>Total Percent of Delay</b>				<b>25.22</b>

**Table 2. Delay of progress payment**

Item	Building Work Interim (Month/year)	No. of Days Delay
1	No. 13	51
2	No. 14	36
3	No. 15	50
4	No. 16	40
5	No. 17	12

From different perspective, there are many parties involved being a major cause problem. Payments, which implies a major problem as monies, is needed to pay for materials, labour, plant, subcontractors' account rendered, preliminaries and general overheads expended during the progress of the work [22]. In every detail of linking to the project, late payment affects personnel and labour on site. When there is late payment, there is a chance to labour quit from working and contractor facing with shortage manpower. In some cases, labour strike and rarely occurred. Referred to the Figure 1, developer late of payments has been delay for almost 2 months in certain interim. The longest late payments period in the interim number 13 with 51 days' delay. Secondly with interim number 15 with 50 days, interim number 16 within 40 days and interim number 14 are 36 days and interim number 17, delay in days started from interim submission date to client. For overall delay, these issues contributed 2.05% weightage. Developer has acknowledged this issue and point takings in considering contractor's extension of time application.

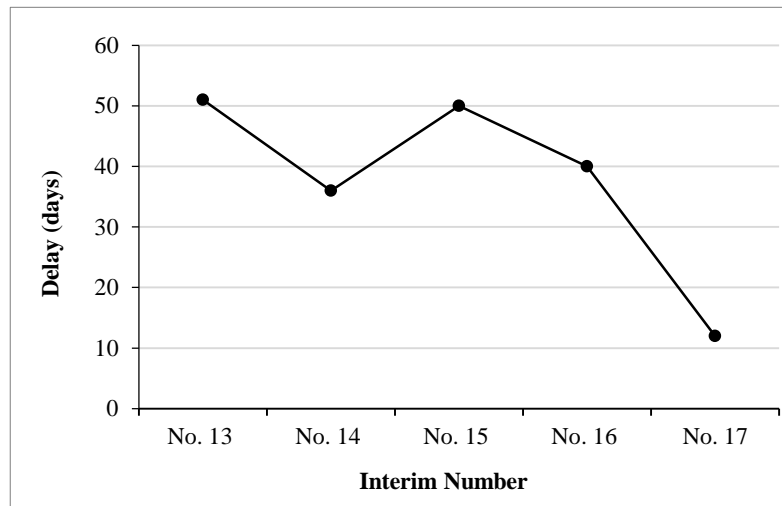


Figure 1. Late of progress payments

To put it another way, late payment received is also a similar issue and problem discussed by other researchers as a delay factor. Delay in settlement of contractor claims are believed is a resultant of payment delays from owners. Contractor or sub-contractors are in the challenge of managing stressed cash flow, contractors are forced to delay payments to vendors and worker wages [27]. Variation order contributed 1.91% to the delay percentage in the project. Variation orders or scope changes resulting in significant changes especially time and sources. In fact, the variation orders issued during construction are major causes of time and cost overruns. Weather grouped as external-related factors. Unfortunately, in this case study, the said project was delay for 443 days or equal to 3.74%. This factor argued as a major contributor to the delay. Compared to the causes of delay to public infrastructure projects [30], weather remained as indisputable factor. In the Malaysian construction industry and Sabah in general, financial problems, poor management, consultant’s supervision problems, consultant’s incompetency and lack of materials in the market were the main delay causes in projects [31].

Figure 2 shows the monthly rainfall analysis for two years starting from the date of commencement in the construction weeks’ period. Contractor in their obligation prepared the weather record that proven by government agencies where there are 443 days of rainy day within 26 months of construction period. Acts of God and Force Majeure Clauses become a claimable reason, where indisputable the extent of weather-related time extensions. Severe weather conditions can be disruptive to construction. Contractors typically obtain time extensions for weather days beyond normal conditions [23]. This situation reinforces the main reasons for the extension of time application’s approval.

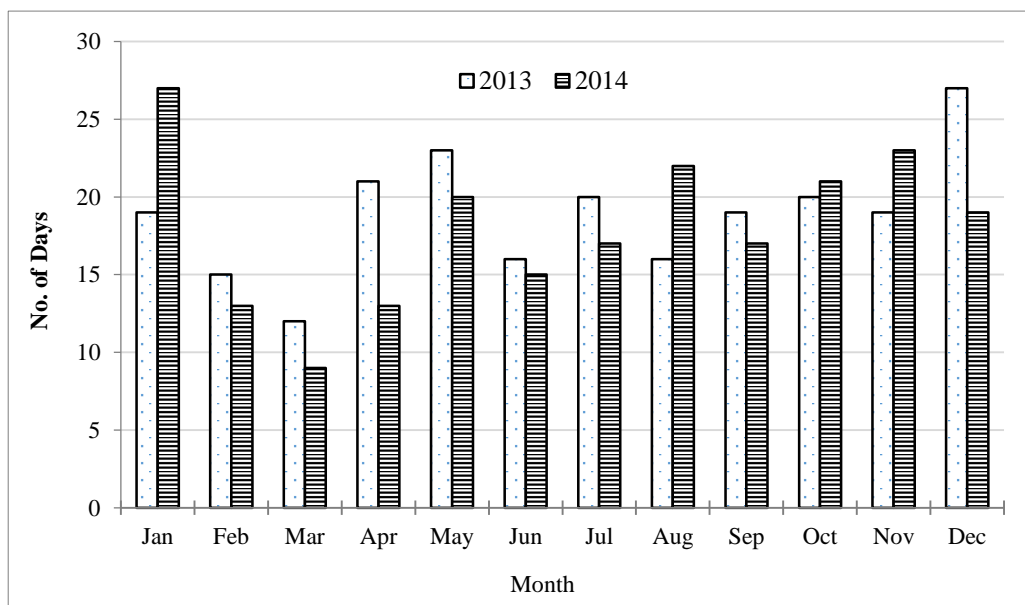


Figure 2. Monthly rainfall analysis

#### 4. S-curve Analysis

Contractor has won the work from the consultants and agreed by client in 2012. Contractor ensure the project is built to the agreed quality, budget and timeframe. This project an initial completion within 26-month period from an agreed start date. Unfortunately, project has triggered a breakpoint during the construction period. Regrettably due to unforeseen circumstances contractor have had to extend this event. Contractor are rearranging the amendment completion date so that they can deliver the project in appropriate execution. By applying extension of time, contractor had been to award a full extension of time claim for an extension of time for practical completion. In this case-study, a first stage of postmortem to the initial S-Curve has been identified. Conflict, causes and effect of delay have been discussed in previous section where, the problem identified and dissolved by follow up closely. The initial analysis of S-curve brings the dramatic break point to depict a clear picture this were considered sick project.

In this breakpoint events dynamically changing along the path of project progress and growth before maturation stage achieved. As shown in Figure 3, the initial project S-curve growth progressively up to the first two months from April to May 2013. This project supposed to start from January 2013, due to the late handover from earth work contractor to main contractor, the preliminary works began from April and behind schedule three months. At the first breakpoint, the actual weightage slightly decreases from 5.35% on schedule to delay 4.77%, 0.58% difference. Previously, the movement positively growth 1.56% ahead from schedule. The following months S-Curved planned are updated in line with monthly interim claim throughout the period of the project. Unfortunately, who would have thought that these updates based on financial weightage kept shown decreasing trend until a cumulative delay 5.69% or determined behind schedule up to the 21 months without positive signs. From time to time, contractor has been advised to put more on effort to catch up the delay. December 2014, 21 months' time elapsed and all particular parties has decided to meet and work out to sort the delay. Contractually, there are still have 5 months to go and seemed all effort are useless without extension of time. In terms of quality and appropriate execution, it has been decided that, contractor should apply for the extension of time. Approved, conditionally in terms of mandatory completion.

From Figure 3, it can be seen that the actual weightage is behind than allocated in schedule. Figure 3 illustrate the changes and shortfalls in monthly progress. It can be clearly seen in January 2014 where, the actual percentage followed closely to schedule with increment 1.42% with overall delay 3.83%. The mean variance is closely monitored, but seemed fail to achieve due to the cumulative work yet to be done. Contractor without intention of deliberately to delay the progress. From Figure 3 initial project S-Curve itself, it is clear that the actual S-curve is far behind the schedule S-curve. There are countless things to learn from some practicality of S-curve figure as following.

- Concurrent delay occurs;
- Poor project management;
- Inappropriate work sequence;
- Double handling;
- Unsystematically time management;
- Priority work is yet to begin.

However, the identified lesson learned a picture of situation, the real condition of causes and effect as per discussed in previous section. An overview of project are governed by many factors. Quality is a phenomenon, it is an emergent property of people's different attitudes and beliefs, which often change over the development life-cycle of a project [24]. The initial S-curve has been modified to match the approval 6 months' additional time of extension. By eliminating high steep and any lope hole from commissioning the rebound phase, process to modify the S-curve and introducing turning point by adding 6 months' time of extension starts with sorting the high delay weightage to minor activities. The outstanding problem previously identified. This Figure 5, modified project S-curve has been projected as accumulated data from the monthly progress claim since this S-curve are generated from financial progress claim.

In term of time frame based on the projected S-curve accordingly to extension of time, the turning point of work progress moved along to the adjacent stride towards time. This means that, contractor has to emphasize the bigger delay percentage and concurrently finish the small variance of remaining work. To uplift the growth of progress, project management have committed to the time given. Figure 4 shows the adjustment S-curve figure where, 32 months have been projected with rebound percentage strengthening the monthly progress by eliminating delay factors. In that events, the break point from delay to catch up the schedule broke the trigger in July 2014 where, the percentage reportedly increase against time. This is where, monitoring skills from S-curve has been pictured and control closely. Again, contractor reportedly almost broke the events to behind schedule where actual percentage drop significantly in July 2015, 4 months before the dead line. Problem identified immediately and dissolved due to unexpected material late delivery from market disruptions that resulted in reduction percentage. Contractor carefully planned the work,



resulted in good achievement in remaining months to go. As can be seen, at 30th month, contractor has achieved almost 97% of work, this is where the time line has achieved success, where the remaining 3% for provisional sum.

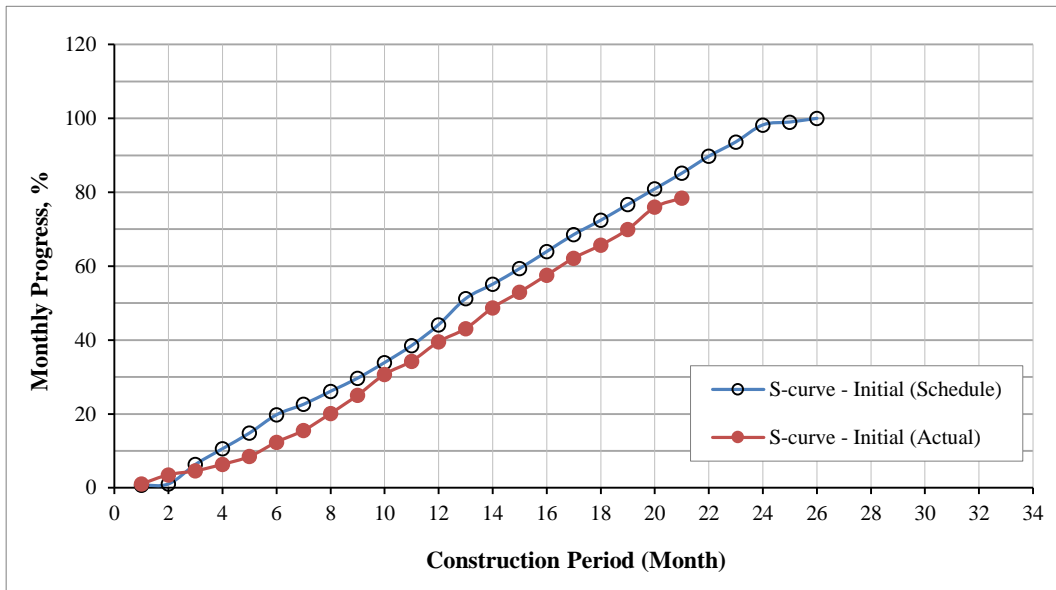


Figure 3. Initial Project S-Curve

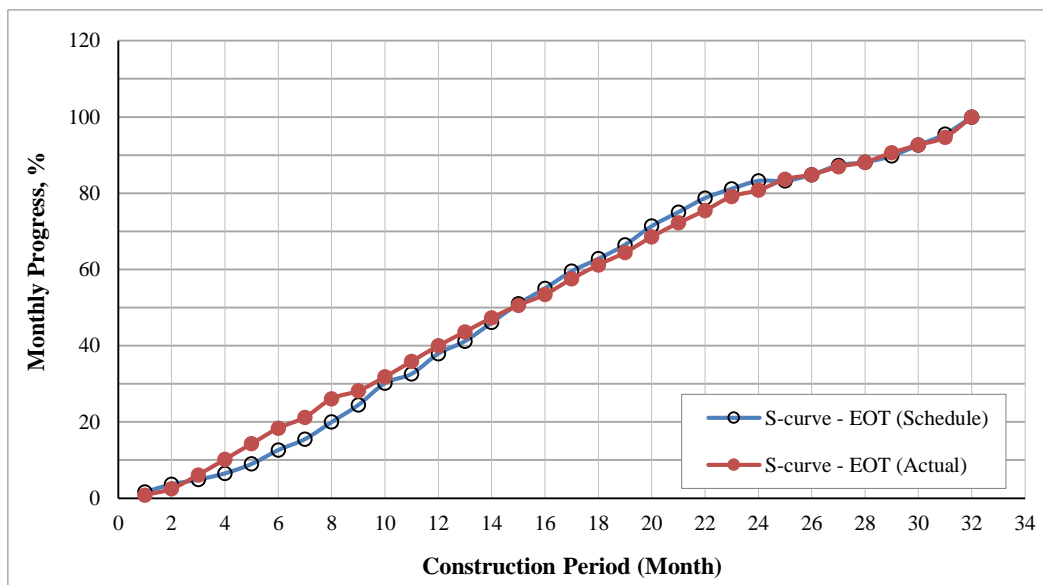


Figure 4. Modified S-Curve with extension of time (EOT)

An understanding of S-curve practically and its analyses will help contractor and particular parties grasp the importance of monitoring the progress and growth of an ongoing project. By generating a S-curve comparison of baseline to actual values, contractor or site personnel can evaluate the accuracy of cost or work estimates used to approve projects. However, the matter of understanding the significance of its practically and its analyses is of utmost importance. Figure 4 depicts the following brief of modified S-curve in this case-study’s project, as important information related to the modification factor. Moreover, weather also known as the major relative factor in the mentioned area due to climate change that are manifested by changes in temperature, precipitation and the annual mean rainfall is 3599 mm and the timing of peak month in May and November [39].

### 5. Contractor Procurement

Information disclosure throughout the procurement process and application of the extension of time must be thorough and careful preparation. In this case-study’s project, during the construction process contractors to undertake obligations with caution and ensure everything is in satisfactory writing. From the delay causes, late payment has recorded as the contributor to the weightage of delay with almost 51 days. Contractor in written notice reminding client that they had the obligation to delay intentionally effects of late payment. All procurements must be in presentable and written. These documentations a later become supplementary procurements in order to apply an

extension of time. Although it is difficult to measure the delays on the baseline program updates this will help the contractor to ease out some of the problems until the revised programs are approved [8]. Proactive measures include quick responses to complaints from clients, requesting written confirmation on any important verbal conversation or instruction, extension of time requests on excusable delays, records on any disagreements that arise with clients or his representatives, and clarification on any instruction or change order prior to the commencement of such extra works [25].

**Table 3. Comparison of finding in this study with causes of delay in other selected studies**

No.	Causes of delay	Malaysia [36]	Malaysia [37]	Malaysia [38]	Saudi Arabia [32]	Egypt [33]	Turkey [34]	Jordan [35]
1	Slow decision making	3	1	1				5
2	Mistake during construction stage	1		1			8	
3	Discrepancies of documents	2		1				
4	Discrepancies of drawing and specifications	1		1				
5	Bad weather and force majeure	1	1	1				
6	Amendments of drawing				4			
7	Variation order	1			7			
8	Lack of manpower and resources		1	1				
9	Shortage of skills worker		1	1		10		
10	Late delivery from earth work contractor							
11	Late payment received	1				1	2	4
12	Partial development plan approval				3	2	1	
13	Inadequate details		1	1				
14	Project management problem	1	1	1				7
15	Public complaints							
16	Government authority enforcement				8			

Table 3 provides the comparison of statistical measures and discussion about the delay factors from various researchers. Collectively, from the documentations and respondent information's, this study has determined 16 most important causes of delay. From Table 3, these results reveal a strong agreement between each factor and each project history. The causes of delay are common problem and factors. In general, this study has identified various factors of delay contributes by all parties. Comparison with previous studies was done from various countries, 4 from Malaysia, Saudia Arabia, Egypt, Turkey and Jordan each respectively. Seven related studies were compared, to an extent, there are temporal commonalities with the work reported herein which are, the 16 causes that discussed in this study is similar and most important factors that happened to various project background in general. Thus, it can be concluded that, there are 5 groups that contributed to the delay factor described as follows;

- a) Owner-related factors;
- b) Consultant-related factors;
- c) Designer-related factors;
- d) Contractor-related factors;
- e) Labor-related factors;
- f) External-related factors.

## 6. Conclusion

This presentation is a case-study regarding the analysis of S-Curve of a life project draws comparative interpretation of project performance towards project delivery schedule. Based on case-study's history, there are some conclusion can be made through the S-curve of delay project. The remedial and performing a good practice in construction to eliminate delay to catch up progress. Markedly, risk and break point delay are viewed as lessons learned. Significantly, the S-Curves based on financial are applicable to project management applications in this situation. Costs versus Time S-Curve be a baseline in monitoring project progress. Consequently, S-Curve representing the standard distribution of costs over time and a cumulative flow of money over a time period. The

optimization process of second phase in construction during extension of time are greatly monitored using the S-Curve and doesn't change the relationship between activities. Notwithstanding, document review and checking should always be under the responsible of contractor and should reporting any discrepancies to the architect or engineer be mandatory. In the final analysis, failing to have the experienced personnel on site involved reflected to the mistake during construction stage. Eventually, in term of time frame based on the projected S-curve accordingly to extension of time, the turning point of work progress moved along to the adjacent stride towards time. This study encapsulates the risk factor and document analysis strategies, which enable construction firms and to prepare the required document for EOT application and evaluate the risk to deliver construction projects on time and within a scheduled budget.

## 7. Declarations

### 7.1. Data Availability Statement

The data presented in this study are available in article.

### 7.2. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

### 7.3. Acknowledgements

The authors would like to acknowledge support from the particular universities and company in which the author performing his duties especially Universiti Malaysia Sabah. Special gratitude is given to those industry practitioners who responded and contributed in this case-study project. This work was financially supported by Universiti Malaysia Sabah (UMS), Research and Innovation Management Centre.

### 7.4. Conflicts of Interest

The authors declare no conflict of interest.

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