Study of factors influencing construction delays at rural area in Malaysia

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Abstract. Construction is one of an important industry which contributes to the economic growth in Malaysia. However, it has been revealed that 79.5 percent and 66.7 percent of the public and private projects were not completed within the time specified in the contracts out of 359 projects in Malaysia. Therefore, the purpose of this study is to investigate the delay factor caused project delay at rural area. A 5-points Likert scale questionnaire survey were answered by 111 respondents which having experience with rural construction project. The questionnaire data were analysed by using Relative Importance Index (RII). Five top factors were determined from this study based on their RII values which are improper construction method implemented by contractor, weather condition, difficulties in providing delivery to site, breakdown of site equipment, and poor qualification of contractor’s technical staffs.

1. Introduction

Construction sector plays important role in economic development of country. In Malaysia, construction is an essential and productive sector for economic growth to improve the quality of life and living standard of Malaysian people [1]. Department of Statistics Malaysia stated that the value of construction works in 1st quarter 2017 had increase of 8.1% compared to the 4th quarter of 2015 in which major type of the activity are civil engineering works following with non-residential building, residential buildings and lastly special trade activities [2]. However, Malaysia is suffering challenges in construction industry in such of poor performance of time and budget, wastage of construction, low productivity and over-reliance on foreign labours [3]. Despite from all challenges, project delay is categorised as major component of construction management process and has become the key factor to gain success in a project [4]. Malaysian Treasury Secretary-general, Datuk Dr Wan Abdul Aziz Wan Abdullah said that construction projects of 30% or three months behind the schedule are considered as
‘Sick’ project [5]. It has been revealed that 79.5 percent and 66.7 percent of the public and private projects were not completed within the time specified in the contracts out of 359 projects in Malaysia [6]. Other than that, it has been reported that 80 percent of Malaysian government projects were delayed [7]. It can be seen that public projects needs more attention in order to complete the project according time schedule given.

One of the topic that had been discuss in the Eleventh Malaysia Plan of the rural area is the Transforming Rural Areas to Uplift Wellbeing of Rural Communities which indicate issue of fewer basic infrastructure and other amenities in rural area such as road network [8]. This statement can be supported with the statistics of construction project in Malaysia 2015 by Construction Industry Development Board (CIDB). From this statistics, urban area such as Johor, Selangor and Wilayah Persekutuan shows a greater number of construction project compared to other area such as Kedah, Kelantan and Perlis for three years [9]. A project construction at rural area of East Coast Expressway Project Phase 2 (LPT2) was declared delay in completion time due to changes in the entire design and structure from a Federal highway to Toll highway [10]. Another project in rural area of Bakun Hydropower in Sarawak was reported experienced an extensive delay which cause cost overrun [11]. Due to the delay project issues, the demand of studies to overcome the problems has increase. However, lack of research has been done on project delay at rural area in Malaysia. Therefore, it has become necessity to investigate the factor caused project delay at rural area.

2. Construction Delay

Delay in construction is define as a time over-run beyond completion date of stated project timeline which can affect the owner and also contractor especially in term of budget [12]. All the construction project in the world might have completed project with time overrun by give an example of Asian Development Bank project whom awarded with the “Outstanding Award” but still facing the 9 months project delaying [13].

Every construction project should have high productivity rate. When construction project faced with the construction constraint, it will have an impact on three major element which are time, cost and quality of the project thus it will have low in a productivity rate [14]. The whole construction phase is a critical phase of any project in which many unforeseen factor could occur. Failure to identify the unforeseen factor that cause the problem in construction project will resulted in the completion time delays and cost [15].

Inappropriate planning during early stage of project will triggered delays at various stage throughout the project [14]. Therefore, an experienced contractor and labour is needed especially in large and mega project. A good planning and management is important to accelerate the project plan, to overcome time burn during delays.

2.1. Some of Factor Influence Construction Delay at Rural Area

Based on previous research, there are many factors that cause delay in construction project at rural area. The following are factors which have been studied by the researchers.

2.1.1. Accessibility

Provide an access to the site construction is one of the responsibilities for the owner as owner must make the site construction are available to perform the work for the contractor before the construction project can be started. Failure of the owner to provide the access of the worksite will cause the delay of the construction project and other organization such as contractor can claim the payment due to the delay of site access [15]. In rural construction project, limited access to the project site is one of the factor can cause the delay. A lot of matter need to be considered about the access to the site where usually rural projects are far from any headquarters thus to manage the travel time and efficient use of vehicle can be one of the challenging matter to access the site construction in rural area [16].
2.1.2. Site Condition
Site condition is one of the factors that can influence the time of the completion of the construction project which are involves underground condition and works that start at the beginning of the construction project [17]. A detailed investigation and preparation before commencement of construction project are required to avoid the unforeseen ground condition where usually the condition of natural ground cannot be predictable [18]. National Vocational Training Institute (NVTI) [19], explained that rural builders deal with some difficulties situation as not all the construction site has a flat and level ground. Some of the difficulties situation are:

a) Interfering/Obstruction object
b) Uneven ground
c) Sloping Sites

2.1.3. Space Constraint
Space constraint or the workspace congestion is regarded as one of a main cause of productivity loss on construction site [20]. Space in the construction site are limited while construction in the progress due to many circumstances or conflict such as space needed for equipment, workers to move from one place to another place, transportation of material and to store the material [21].

2.1.4. Underground Utilities
In the Rural Road Standards from the Public Works Department (PWD) of Baltimore country (2008), state that, due to the narrowness of the rural road, all the utilities should be relocated or place in order to maintain the scenic or history road characteristic [22]. In this case, all the utility are advisable to be made to underground for purposes of aesthetics and safety.

2.1.5. Fluctuation/Suitability Material
Price fluctuation of material is one of the factor that can lead to the cost overrun of the construction. In rural area of Morocco, the mobilization of the local materials to the rural site construction such as steel, cement, gravel and sand are brought with high price and it is unavoidable solution. So, they tend to use materials that taken from the soil directly to avoid the price fluctuation of local material thus can avoid the delay of construction project [23].

2.1.6. Material Delivery
Factors that cause the delay of the large construction project are comes from the consultant, contractor and owner [12]. From the study, material delivery is one of the major factor that cause the delay in construction project based from the consultant perspective. As material plays a big role in the productivity of the construction project, materials procurement in rural area are more complicated compared to the urban area. This is due to some of the procurement company have a different strategies which acquire additional cost such as for mobilization or delivery to the rural site construction [24].

2.1.7. Availability of Labour
Most of the ‘ruralness’ site project area has a problem to recruit and retain staff [16]. Hence, the project lack of expertise worker to handle certain work such as scheduling, project control, quality control and safety management. Besides that, a survey found out that there have a negative impact towards the employee’s family life due to the employee working in a rural area of the construction site [24].

2.1.8. Productivity of Labour
Knowledge and consideration of numerous aspects that affect productivity of construction labour is required to avoid project cost overrun and delay in the completion time of the construction project [25]. In rural areas, due to the labour shortage and also pressure from the project schedule, working
overtime has become one of the factors that can decrease the labour productivity which eventually caused delay of the project [4].

2.1.9. Number of Skilled Labours
One of the factors that can cause delay of the construction project is lack of skilled or experienced labour which is out of contractor’s control [13]. In order to increase the productivity of labour, skilled workers for the project construction in rural area are highly needed compared to urban area. However, due to the ‘ruralness’ area with limited access to the project site, it is challenging to get skilled workers [16].

2.1.10. Qualification of Contractor
Inadequate experienced contractor is one of the factors that can affect completion date of construction project. In some cases, incompetence contractor are awarded with large and complex project because of the lowest bid by the contractor [26]. Project in rural area, contractor are less interested to bid the competition compared to the urban project due to low rates of skilled labour [16].

2.1.11. Performances of Contractor
The performance of the contractor is reflected by successful to complete the construction project on time while inadequate of experienced or incompetence contractor will result of project delay [26]. In rural project, one of the challenges for the contractor is the limitation of ability to communicate and normally they do not using scheduling software to reduce the risk of delayed project [16].

2.1.12. Site Management
Poor site management is one of the sources that affect the timeline of construction project. Difficulties of material delivery to the site and challenging to handle waste or disposal from project site is related to management of project site [27].

2.1.13. Decision Making
Slow decision making during will affect the construction project in a whole. In rural construction area, delay of decision making happened due to the extensive physical distance from one to another whom involve in the construction project [28]. One of study in rural area revealed the fact that supervisor at the project site primarily used mobile phones and digital camera to monitor the project progress and also used e-mail communication to communicate to each other which make the process of decision making longer [29].

2.1.14. Feasibility Studies
One of the factors that caused delay in construction project is insufficient knowledge and feasibilities studies of the project [18]. Limited resource of historical data and information of the project area are one of the challenges facing in rural area [16].

2.1.15. Weather Condition
Climatic factor can disrupt the project’s labour productivity in the construction project. From the past study for the rural and urban climate, it was found that urban areas has wetter climate compared to the rural area due to the effect of the topography and urbanization [30].

3. Methodology
A set of questionnaire was developed based on the factors that are cited in literature review in this study. The questionnaire is consists of 24 questions where 5 questions are related to the respondent’s age, respondent’s profession, years of experiences in the field, organisation and etc. The other 19 questions are related to the factors that causes delay in rural area. Likert Scale has been used to rank the factors that affect delay in a construction project at rural area. There are 5-point scale ranging from
“Strongly Disagree” on one end to “Strongly Agree” on the other with neither “Neither Agree nor Disagree” in the middle. Each agreement will tabulate a scale that is from the scale of 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree and 5 = Strongly Disagree. In this study, the method to analyse the data from the survey is Relative Importance Index (RII) and ranking factor. Relative Importance Index (RII) method is used to determine the relative importance of the various factors of causing delay in a construction project at rural area as in equation (1) [31].

$$RII = \frac{\text{Sum of weights}}{A x}$$

(1)

Where;
RII = Relative Important Index
W = weighting given to each factor by respondents and it ranges from 1 to 5
X = frequency of it response given for each factor
A = highest weight (i.e. 5 in this case)
N = total number of participants

4. Data Analysis and Discussion
A total of 111 respondents has been participated in this survey by professional who are currently working in construction industry as shown in Table 1.

| Position Level       | No. of Respondent |
|----------------------|-------------------|
| Non-executive        | 70                |
| Executive            | 31                |
| Middle Manager       | 7                 |
| Top Management       | 3                 |
| **Total**            | **111**           |

4.1. Ranking of Factors
Based on the calculation of Relative Importance Index, each of the factors have obtain its RII value. The maximum value of the RII value is 1.0. Table 2 shows the list of factors with RII values. The 5 major causes of delay at rural area are as follows;

4.1.1. Improper Construction Methods Implemented By Contractor
Zumrawi[32] stated that insufficient geotechnical investigation is the first factor that causes project delays, disputes, claims, and project cost overruns. According to report prepared after the disaster, from the outcrops exposed after the landslip, the geological structure at the site is primarily composed of sandstone and shale. The sandstone in the upper strata was weathered with well-developed joints [33].

4.1.2. Weather Condition (Heavy Rain)
Weather can have a major effect on any construction project such as highway construction due to the continuous exposure to the environment [34]. In addition, surroundings such as air temperature, rainfall and air velocity cause delays in construction project. Forecasting plan delays caused by weather circumstances such as snow, rain and cold temperature is essential as it is obviously weather plays the role to contribute delay [35]. It shows level of consequences on project activities were different depends on type of weather condition.

4.1.3. Difficulties in Providing Delivery to Site
Accessibilities is one of major challenges in rural area to manage construction project [36]. The ‘ruralness’ and long distance of the project complicates the process of provide delivery to the
construction; for example, machinery for excavation. Machinery for excavation and bore piling machine are extremely heavy and need lorry trailer to deliver to the construction site. When these types of machinery are unable to reach to the project site, it will definitely cause delay. Bad condition of road will increase the level of difficulties in delivering material and equipment to the site [29]. Therefore, a good management to handle project is important in order to overcome problems that arise during construction phase and limit the cause of delay issue.

**Table 2. Ranking of Factors**

| No. | Factor                                                                 | Relative Important Index |
|-----|------------------------------------------------------------------------|--------------------------|
| 1.  | Accessibility of human resources.                                      | 0.654                    |
| 2.  | The loose control over communication and management.                   | 0.621                    |
| 3.  | Availability of the required resources.                                | 0.637                    |
| 4.  | Inaccurate estimations of certain work progress. (work progress timeline and inaccurate estimation slope stability) | 0.674                    |
| 5.  | The extensive physical distance between project participants, sometimes extending over national boundaries. | 0.623                    |
| 6.  | Lack of project pre-planning, certainty, and/or clarity concerning project process integration. (e.g. mounting details of machineries, power feed layout and connection is site, wrongly scheduling of work progress) | 0.664                    |
| 7.  | Difficulties in providing delivery to site. (Delay in term of time arrival) | 0.705                    |
| 8.  | ‘Ruralness’ of the project location.                                   | 0.649                    |
| 9.  | Lack of management skills.                                             | 0.638                    |
| 10. | Unpredictable site condition                                           | 0.640                    |
| 11. | Weather condition (Heavy rain)                                         | 0.719                    |
| 12. | Timely decision-making.                                                | 0.661                    |
| 13. | Improper construction methods implemented by the contractor            | 0.732                    |
| 14. | Low performance of the selected contractors. (e.g. Slow work progress by contractor) | 0.681                    |
| 15. | Delays and or shortages within materials and equipment.                | 0.668                    |
| 16. | Poor qualification of contractor technical staff. (e.g. Unqualified personal doing high technical work) | 0.683                    |
| 17. | Poor site management.                                                  | 0.676                    |
| 18. | Breakdown of site equipment.                                           | 0.692                    |
| 19. | Material fluctuation                                                   | 0.677                    |

**4.1.4. Breakdown of Site Equipment**

Poor management of plant and machinery[37] and low level of equipment of operator’s skill [12] will definitely cause delay of progress construction project. Equipment or machinery is an essential tool in the construction industry which helps to proceed the heavy task job such as excavation in a construction site. If machinery such as an excavator face mechanical failure, it will affect the work progress of construction project especially if the location of the construction project is at rural area.

**4.1.5. Poor Qualification of Contractor’s Technical Staff**

Contractor selection is a major factor for a construction project to gain success. Success of project is to complete the project within schedule and budget allocate as agreed in the contract. Great leader from
contractor will manage to select and hire technical staff according qualification and experience level. Poor qualification contractor’s technical staff is one of the factors that causes delay in the construction project [38]. This is because a good and qualify contractor’s technical staff will able to perform task and ensure project delivery on time.

5. Conclusion
The objectives of this research study is to determine the factors that causes delay rural area and rank the factors based on perception of industrial workers. Based on the outcome of questionnaires that have done, this research study is able to find out the factors that causes delay.

These are the top 5 factors that contribute delay at rural area:
1. Improper construction method implemented by contractor.
2. Weather condition. (Heavy Rain)
3. Difficulties in providing delivery to site.
4. Breakdown of site equipment.
5. Poor qualification of contractor technical staff.

References
[1] Ali Khan R, Shahir Liew M and Ghazali Z 2014 Malaysian Construction Sector and Malaysia Vision 2020 : Developed Nation Status Procedia - Soc. Behav. Sci. 109 507–13
[2] Department of Statistics Malaysia 2017 Quarterly Construction Statistics, First Quarter 2017 Dep. Stat. Malaysia
[3] Memon A H, Rahman I A and Azis A A A 2012 Time and cost performance in construction projects in southern and central regions of peninsular Malaysia Int. J. Adv. Appl. Sci. 1 45–52
[4] Durdyev S, Omarov M and Ismail S 2017 Causes of delay in residential construction projects in Cambodia Cogent Eng. 134 1–12
[5] Singh S 2007 The Star Online Star Online Available: http://www.thestar.com.my/news/nation/2007/06/06/treasury-puts-its-foot-down-on-project-delays/ [Accessed: 17-Aug-2017]
[6] Rohani Endut I, Akintoye A and Kelly J 2005 Cost and Time Overruns of Projects In Malaysia 243–52 Fraunhofer IRB Available: https://www.irbnet.de/daten/iconda/CIB10633.pdf [Accessed: 17-Aug-2017]
[7] Joshi M 2009 80 per cent of Malaysian government projects delayed, minister says TopNews.in Available: http://www.topnews.in/80-cent-malaysian-government-projects-delayed-minister-says-2173299 [Accessed: 17-Aug-2017]
[8] Economic Planning Unit 2016 Strategy Paper 4: Transforming Rural Areas to Uplift Wellbeing of Rural Communities (Putrajaya.)
[9] Construction Industry Development Board and CIDB 2015 Construction statistics quarterly bulletin 2015 Constr. Ind. Dev. Board CIDB
[10] Bernama Delay in LPT2 due to major amendment in design, structure New Straits Times Available: https://www.nst.com.my/news/2015/09/delay-lpt2-due-major-amendment-design-structure [Accessed: 17-Aug-2017]
[11] The Star 2014 Bakun project firms in deal to withdraw all claims Star Online Available: http://www.thestar.com.my/business/business-news/2014/08/13/bakun-project-firms-in-deal-to-withdraw-all-claims/ [Accessed: 17-Aug-2017]
[12] Assaf S A and Al-Hejji S 2006 Causes of delay in large construction projects Int. J. Proj. Manag. 24 349–57
[13] Acharya N K, Yong Kim S and Dai Lee Y 2004 Factors affecting timely completion of construction projects Proceedings of the Fifth Asia Pacific Industrial Engineering and Management Systems Conference 2004 p 22.4.1-13
[14] Sambasivan M and Soon Y W 2007 Causes and effects of delays in Malaysian construction industry Int. J. Proj. Manag. 25 517–26
[15] Ahmed S M, Azhar S, Castillo M and Kappagantula P 2002 Construction Delays in Florida: An Empirical Study. Final Report. Department of Community Affairs, Florida, US

[16] Tran D Q, Hallowell M R and Molenaar K R 2014 Construction management challenges and best practices for rural transit projects J. Manag. Eng. 040140721–9

[17] Collins S A, Zack J G and Faace C 2016 Changing Trend in Risk Allocation — Differing Site Conditions Navig. Constr. Forum 31–50

[18] TY L, H F I W and F T K C 2006 Construction Delays in Hong Kong Civil Engineering Projects J. Constr. Eng. Manag. 636–49

[19] Winden J v., Keijzer M de, Hohnerlein M F and Pforte W 1986 Rural building construction (Nederland: National Vocational Training Institute Accra)

[20] Chavada R , Dawood N . N . and Kassem M . 2012 Construction workspace management: The development and application of a novel nD planning approach and tool J. Inf. Technol. Constr. 213–36

[21] Wu I and Yen-Chang Chiu 2010 4D workspace conflict detection and analysis system 10th Int. Conf. Constr. Appl. Virtual Real. 1–8

[22] Department of Public Work 2008 Rural Road Standards: Design Standards and Policies for Rural Baltimore Country Roads (Baltimore)

[23] Khaloufi B 1956 The use of natural resources for housing in rural areas of Morocco (Lunds Tekniska Högskola)

[24] McAnulty, S. and Baroudi B 2010 Construction challenges in remote Australian locations Proceeding 26th Annu. ARCOM Conf. 1247–57

[25] Dheenadhayalan M and Alcan S 2015 A Study On Labour Productivity And Possibilities Of Its Improvement Int. J. Sci. Eng. Res. 3

[26] Salleh R 2009 Critical success factors of project management for Brunei construction project: improving project performance (Queensland University of Technology)

[27] Sidawi B and Email S A 2012 Management problems of remote construction projects and potential IT solutions: the case of Kingdom of Saudi Arabia J. Inf. Technol. Constr. 17 103–20

[28] Deng Z M, Li H, Tam C M, Shen Q P and Love P E D 2001 An application of the Internet-based project management system Autom. Constr. 10 239–46

[29] Sidawi B 2012 Remote Construction Projects’ Problems And Solutions: The Case Of Sec 48th ASC Annual International Conference Proceedings (Associated Schools of Construction)

[30] Bulut Y, Toy S, Irmak M A, Yilmaz H and Yilmaz S 2008 Urban-rural climatic differences over a 2-year period in the City of Erzurum, Turkey Atmosfера 21 121–33

[31] Memon A H, Rahman I A, Akram M and Ali N 2014 Significant Factors Causing Time Overrun in Construction Projects of Peninsular Malaysia Mod. Appl. Sci. 8 16–28

[32] M. E Zumrawi M 2014 Effects of inadequate geotechnical investigations on civil engineering projects Effects of Inadequate Geotechnical Investigation on Civil Engineering Projects Int. J. Sci. Res. 3

[33] Moh Z 2004 Site investigation and geotechnical failures International Conference on Structural and foundational Failures

[34] Sebt M, Rajaei H and Pakseresht M 2007 A Fuzzy Modeling Approach to Weather Delays Analysis in Construction Projects Int. J. Civ. Eng. 5 169–81

[35] Thorpe D and Ebrahim K 2008 Method for calculating schedule delay considering weather conditions Proceedings 24th Annual ARCOM Conference pp 809–18

[36] Usman N and Ibrahim A M 2015 Challenges Associated With Remote Sites Project Management J. Multidiscip. Eng. Sci. Technol. 2 3159–40

[37] Nuwan Randunupura S and Hadiwattege C 2013 Plant and equipement management to minimize delay in road construction projects Second World Constr. Symp. 2013 Socio-Economic Sustain. Constr. 333–42

[38] Abbas Niazai G and Gidado K 2012 Causes of project delay in the construction industry in Afghanistan 63–74