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DELAY OF AS-BUILT DRAWINGS SUBMISSION FOR MALAYSIAN TOLL HIGHWAY

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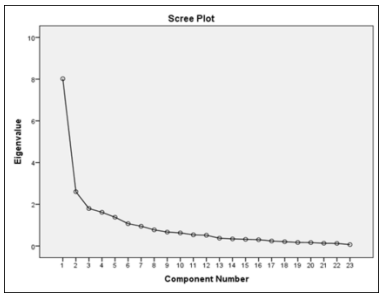
Graphical abstract



Abstract

Construction projects are difficult to be built exactly as stipulated in the original contract or construction drawings. Most of this agreement requires As-Built Drawings (ABD which represent construction modifications. Despite of the importance of ABDs, producing accurate and timely ABDs have been persistent problem in the construction industry including toll highway construction. This paper provides an integrated approach in analysing the influence factors to the delay of ABDs submission for Malaysian toll highway. A questionnaire survey was conducted to solicit the factors from authority, concessionaire/contractor and consultant viewpoint. This study identified the major factors that influence submission of ABDs. Factor Analysis is conducted in order to study the items correlation. The perspective of authority, concessionaire/ contractor and consultant has been analysed and ranked based on Relative Importance Index (RII). The findings indicate that six (6) component were classified as a delay factors in submission of ABDs which includes: (1) field personnel skills and tools (2) data collection process skill (3) planning and coordination skills by project management team (4) financial capabilities (5) personnel interpersonal skills and competency (6) client related factor. The findings provide a conceptual studies in developing the submission framework for future research.

Keywords: Influence factor, delay and factor analysis

1.0 INTRODUCTION

Delay in ABDs submission has been a continuous issue for Malaysian Highway Authority (MHA) in related to post-construction matter. According to MHA statistic, 94% of concessionaires are delayed from the time specified in Concession Agreement (CA) [1]. As a result, the approval of ABDs become time consuming and partly affects the accuracy of actual ABDs for operation and maintenance used [1].

"ABDs is defined as an original contracts drawings adjusted to reflect all the changes that occurred; they defined the project as it is being received" [2]. ABDs are the drawings that prepared at the final stage of the project, once the project is on its completion [2]. Among them are any changes or amended that were made on the final construction drawings such as change of design, amendment of notes or type of materials, and any other information for a contractor requires to finish the works [2]. The common problem of ABDs is the long delayed of submission [3]. It also time consuming process, oftentimes and inaccurate [4]. Timely and complete ABDs are vital to ensure the project is able for progress monitoring, repair works and to analyse the overall schedule [5]. They are few researchers discussed about the subject of As Built Drawings (ABDs) but least information is secure in the industry with regards of the literature that link to the construction of ABDs and its processes[6]. An accurate documentation of ABDs is vital to personnel who take charge on the maintenance of the facility [7]. The importance of ABDs is also for land use history where serve a record needed [6]. Factor that seems

to be a problem to the submission of ABDs is the time required on site to collect data for ABDs is lengthy with no apparent benefit to current construction activities [7]. In addition, repeat site visits also frequently required because of incomplete or inconsistent information [8]. Changes are not considered high priority task as quoted by [7]. While, field personnel lack in assuring all ABDs kept up to date and the contract requirements are ignored [9]. Improper planning contribute to delays in construction and similarly to ABDs preparation when contractor and consultant were unable to submit the reasonable schedule during early stage of the construction [10]. The objective of this study is to identify the factors that influence the delay of submission ABDs.

2.0 METHODOLOGY

A questionnaire is developed to obtain the perceptions from authority, concessionaire/ contractor and consultant in preparation of ABDs submission for Malaysian toll highway. The questionnaire were designed consists of four sections. The first part of the questionnaire requires the respondents' information of their background. The second part of the questionnaire focuses on factors influence the delay of submission of ABDs. Using five-point Likert scale ranging from 1(Strongly Disagree), 2(Disagree), 3(Neutral), 4(Agree) and 5(Strongly Agree) to determine the level of agreement among the respondents on factors of delay in submission of ABDs. Twenty three (23) possible factors delay were identified from the literature review and discussion with subject matter experts. Prior to the distribution of the questionnaire, a pilot study was conducted to check whether the questions were clearly understood by the respondents [11]. Three (3) experts were selected in this surveybased on their vast experience of toll highway. All three experts agreed that the questionnaires were sufficient to covers the influence factors to delay submission of ABDs. Reliability test with of Cronbach's Alpha of 0.92 shows that the questionnaires are reliable and internally consistent [11]. Eighty (80) sets of questionnaires were randomly distributed to the respondents whom involved in ABDs process for Malaysian toll highways [12]. From the 80 questionnaires, 67 (83.75%) were successfully returned. It consists of 28 sets (41.8%) from authority, 28 sets (41.8%) from concessionaires/contractors and 11 sets (16.4%) from consultants.

2.1 Relative Important Index

The Relative Importance Index (RII) method is used to determind the relative importance of various factors that effect the delay [13]. This is also vital in determining the ranking of different factors of different group of respondents [14]. In this study, RII is used to rank the factors. The ranking obtained from RII provides comparison study on the relative importance of the factors as perceived by the three groups of respondents (i.e. authority, concessionaire/contractor and consultant).

2.2 Factor Analysis

Factor analysis is conducted to ascertain factors that are measured by items that have constructed. This is sometimes called 'data reduction technique'. In factor analysis it will be able to tell which items are strongly correlated and lump together to forms a component. By looking at these items, collective name will be able to give to represent these items or factor. Statistical Package for Social Science (SPSS) software will be able to tell how many factors there are and how many items fall in the component/group [15].

3.0 RESULTS AND DISCUSSION

The demographic characteristics of the respondents are shown in Table 1. From the analysis of respondent position shows that the respondents are competent and eligible person to give the opinion in research and base on experience, the respondents may provide a better understanding and more precise in answering the questionnaire form.

Table 1 Demographic characteristic of respondents

Description	Frequency	Percent
Position		
Director	8	11.9
Manager	25	37.3
Engineer	29	43.3
Executive	1	1.5
Other	4	6.0
Experience		
<5yrs	12	17.9
5-10 yrs	16	23.9
10-15 yrs	14	20.9
15-20 yrs	11	16.4
>20 yrs	14	20.9
Organization		
Authority	28	41.8
Concessionaire/ Contractor	28	41.8
Consultant	11	16.4

3.1 Identify the Factors Influence on Delay of ABDs Submission Approval

The primary data collected from the second section of the questionnaire was analysed from the perspective of authority, concessionaire/contractor and consultant. Using RII method, ranking of factors were obtained in order to identify the main factors of delays in submission of ABDs for highway project to MHA, as tabulated in Table 2. The analysis of the result shows that two out of three groups agreed that the main factor delay in submission of ABDs is due to changes are not recorded which result to inaccurate and incomplete ABDs (RII=0.79, Rank 1). Lack in coordination between parties is ranked as second.

The result indicates that there is agreement between the groups of the factors that causing delay of ABDs.

The remaining major factors based on ranking based on overall data of the ten most important factors were: (3) Ineffective planning and schedule (RII = 0.77); (4) Poor data collection by site representative (RII = 0.76); (5) Lack of communication between parties (RII = 0.76); (6) Field personnel lack in preparation and contract requirements to furnish are ignored (RII = 0.73); (7) Repeated site visit are frequently required because of time and site constraint (RII = 0.7); (8) Lack of motivation in preparing ABDs (RII = 0.70); (9) Work interference between parties (RII = 0.70); and (10) Time consuming for a construction to manually verify dimensions and mark changes. However, most of factors are ranked differently among three groups, to translate that each group has a different perspective of responding, MHA is an authority, concessionaire or contractor is an implementer, and consultant is the designer. Therefore, difference opinion due to their organization, scope of work, experience and working environment were obtained.

Two statistical measures generated by SPSS help assess the factor - ability of the data: Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity [15]. Table 3, shows that validity test for the factors to the delay of submission of ABDs. The KMO index ranges from 0 to 1, with more than 0.5 suggested for a good factor analysis while Bartleett's test of sphericity should be significant ($p < .05$) [15]. In Table 3 gives the Bartlett's test of sphericity and KMO values to test validity on the factors. From the tables, the index KMO by Kaiser-Meyer Olkin is 0.790 which is more than 0.5 and is significant due to the range indicated. As a result, it satisfied and acceptance for the next step to conduct and undergoing of factor analysis.

Table 2 Relative Importance Index (RII) and rank for the factors to the delay of submission of ABD

Item	Description	Overall		Authority		Concessionaire/ Contractor		Consultant	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Change order by client	0.61	18	0.50	23	0.71	12	0.64	18
2	Work interference between parties during preparation of ABDs	0.70	9	0.63	14	0.77	6	0.75	8
3	Cost of ABDs preparation are high	0.54	23	0.60	20	0.51	23	0.56	22
4	Financial problem (late payment, financial difficulties)	0.59	21	0.61	17	0.59	21	0.60	20
5	Ineffective planning and scheduling	0.77	3	0.83	2	0.79	4	0.75	7
6	Lack in coordination between parties	0.78	2	0.79	3	0.81	1	0.76	3
7	Lack of communication between parties	0.76	5	0.78	4	0.79	5	0.73	9
8	Lack of motivation in preparing ABDs	0.70	8	0.71	9	0.75	9	0.65	17
9	Staffing problems	0.64	16	0.60	19	0.65	16	0.75	6
10	Poor data collection by site representative	0.76	4	0.71	8	0.80	3	0.80	2
11	Insufficient personnel experience	0.66	15	0.61	16	0.69	13	0.69	12
12	Inadequate qualification of technical staff	0.63	17	0.61	18	0.64	19	0.67	14
13	Time consuming for a construction to manually verify dimensions and mark the changes	0.69	10	0.65	12	0.74	10	0.75	5
14	No quality control during inspection	0.61	19	0.59	22	0.64	18	0.56	21
15	Repeated site visit are frequently required because of time and site constraint	0.70	7	0.64	13	0.76	7	0.69	11
16	Conflict between parties	0.67	14	0.68	11	0.68	14	0.67	13
17	Equipment availability and failure	0.60	20	0.59	21	0.61	20	0.62	19
18	Changes are not recorded which result to inaccurate and incomplete ABDs	0.79	1	0.84	1	0.80	2	0.82	1
19	Major or minor revision is not high priority task	0.68	11	0.71	7	0.72	11	0.68	10
20	Field personnel lack in preparation and contract requirements to furnish are ignored.	0.73	6	0.76	5	0.75	8	0.75	4
21	Lack of high technology	0.57	22	0.61	15	0.54	22	0.53	23
22	Inadequate managerial skill	0.67	13	0.69	10	0.66	15	0.65	16
23	Lack of enforcement by Authority	0.67	12	0.74	6	0.64	17	0.65	15

Table 3 KMO and Bartlett's test for the factors to the delay of submission of ABDs

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.790
Bartlett's Test of Sphericity	Approx. Chi-Square	906.150
	df	253
	Sig.	.000

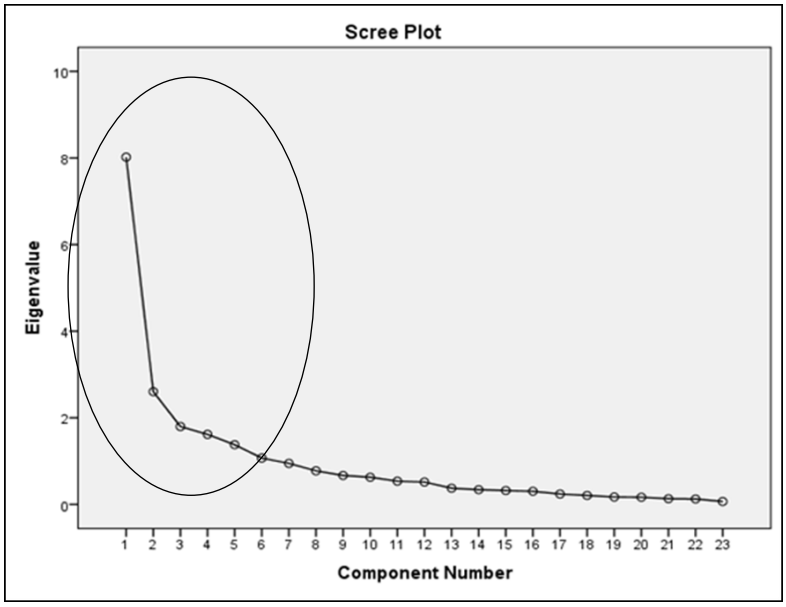


Figure 1 Screen plot for the factors to the delay of submission of ABDs

Table 4 Rotated factor matrix for the factors to the delay of submission of ABDs

	Component					
Factors	1	2	3	4	5	6
Inadequate qualification of technical staff	.814					
Time consuming for verification	.760					
Major or minor revision is not high priority task	.705					
Repeated site visit	.692					
Insufficient personnel experience	.642					
Fields personnel lack in preparation and contract requirement	.632					
Inadequate managerial skills	.622					
Conflict between parties	.596					
Equipment availability and failure	.523					
Changes are not recorded properly		.781				
Poor data collection		.720				
Lack of motivation		.717				
Staffing problem		.517				
Lack of coordination			.875			
Lack of communication			.872			
Ineffective planning			.821			
Cost of ABDs are high				.845		
Financial problem				.778		
Change order by client					.838	
Work interference between parties					.765	
Lack of enforcement by authorities						.819

Table 5 Classification of the rotated component for the factors to the delay of submission of ABDs

Component	Factors of delay
Field personnel skills and tools	- Inadequate qualification of technical staff - Time consuming for a construction to manually verify dimensions and mark the changes - Major or minor revision is not high priority task - Repeated site visit are frequently required because of time and site constraint - Insufficient personnel experience - Fields personnel lack in preparation and contract requirements to furnish are ignored - Inadequate managerial skills - Conflict between parties - Equipment availability and failure
Data collection process skills	- Changes are not recorded which result to inaccurate and incomplete ABDs - Poor data collection by site representative - Lack of motivation in preparing ABDs - Staffing problems
Planning and coordination skills by project management team	- Lack in coordination between parties - Lack of communication between parties - Ineffective planning and scheduling
Financial capabilities	- Cost of ABDs preparation are high - Financial problem
Personnel interpersonal skills and competency	- Change order by client - Work interference between parties during preparation of parties
Client related factor	- Lack of enforcement by authority

The number of factors can be determining by Scree Plot graph as shown in Figure 1. The determination of number of major factors prior to graph is before a linear plateau. It is used to determine the appropriate number of components. Figure 1 shows a distinguish break up to the six component number whereas after six component the curve drop before a linear plateau follows. Thus, consideration can be take on the six (6) factors that should be analysed (8.019, 2.604, 1.798, 1.616, 1.378, and 1.069) for the 1st, 2nd, 4th, 5th and 6th respectively.

Factor analysis was used in this study to determine for group among the inter-correlations of a set of variables in which the data may reduce or summarized using smaller set of factor or components [15]. Based on the result analysis in Table 4, shows that the component matrix after rotation with value of factor loadings more than 0.5 [16]. Whereby factor loadings less than 0.5 are omitted which are two factors (1) Lack of high technology (.489) and (2) No quality control during inspection (.395).

Table 5 shows the classification of the rotated component for the factors to the delay of submission of ABDs based on factor analysis. Based on the factor analysis done by SPSS, it is found that factor influence submission of ABDs can be classified into six groups of factors.

4.0 CONCLUSION

The findings of this study may assist project team in ABDs submission recommended as follows:

i) Establish work procedure on ABDs where concessionaire or contractor should prepare ABDs in stages as part of their milestone in the work schedule and documented in the progress meeting.

ii) The authority, need to emphasize the enforcement to the project team in monitoring the ABDs preparation throughout the work progress.

iii) Review the ABDs clauses in the new agreement and highlight the early preparation and submission of ABDs in stages.

iv) The cost in preparing the ABDs needs to be reviewed during tender preparation. The review is necessary in order to achieve the quality and timely ABDs submission at the completion of the project where it is able to safe cost for any future expansion works.

v) The utilization of technology may assist the user to get the accurate and immediate output. Geographic Information System (GIS) could be an option to for future highway development where data can easily be obtained, extracted and updated for operational use in future planning.

vi) Document management system to be implemented to keep all physical data where data can be easily assessable and updated for operational and expansion works.

References

[1] MHA. 2014. As-Built Drawing Registration Book. Kajang: Department of Development And Project Monitoring MHA.

[2] Gould, F. E. 2002. *Managing the Construction Process: Estimating, Scheduling, and Project Control.* New Jersey: Prentice Hall.
[3] BEM. 2005. A Guide to Engineering Practices. Retrieved Mac 14, 2014, from http://www.bem.org.my.
[4] Woo, J., Wilsmann, J., and Kang, D. 2010. Use Of As-Built Building Information Modelling. *Construction Research Congress*. 538-548.
[5] Abdel-Monem, M., and Hegazy, T. 2013. Enhancing Construction As-Built Documentation Using Interactive Voice Response. *Journal of Construction Engineering and Management*. 13(7): 895-898.
[6] Pettee, S. R. 2005. As-builts-Problems & Proposed Solutions. Construction Management Association of America.
[7] Raynar, K. A. 1994. Integrating Computer Vision With Computer Aided Design To Produce Construction As-Built Drawings. ProQuest/Dissertations and Thesis; 1994; ProQuest Dissertations & Theses Full Text.
[8] Bracewell, P. A., and Klement, U. R. 1983. The Use of Photogrammetry in Piping Design. Proceedings of the Institution of Mechanical Engineers. Part A. *Power and Process Engineering*. 97: 25-138.
[9] Fisk, E. R. 2003. *Construction Project Administration*. 7thed. New Jersey: Prentice Hall.
[10] Hamzah, N., Khoiry, M. A., Arshad, I., Tawil, N. M., and Che Ani, A. I. 2011. Causes Of Construction Delay - Theoretical Framework. *Procedia Engineering*. 20: 490-495.
[11] Sekaran, U. 2003. *Research Methods for Business A Skill Building Approach*. New Jersey: John Wiley & Sons.
[12] Krejcie, R. V., and Morgan, D. W. 1970. Determining Sample Size For Research Activities. *Educational and Psychological Measurement*. 30: 608.
[13] Kometa, S. T., Olomolaiye, P. O., and Harris, F. C. 1994. Attributes Of U.K Construction Clients Influencing Project Consultants' Performance. *Construction Manage Form Econ*. 12: 433-43.
[14] Odeh, A. M., and Battaineh, H. T. 2002. Causes Of Construction Delay: Traditional Contracts. *International Journal of Project Management*. 20: 67-73.
[15] Pallant, J. 2007. *SPSS Survival Manual: A Step-By Step Guide To Data Analysis Using SPSS for Windows (Version 15)*. 3rd ed. Sydney : Allen & Unwin
[16] Kaiser and Rise. 1974. *Little jiffy, Educational and Psychological Measurement*. 111–117.