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Identification of the Causes of Construction Delay in Malaysia

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Abstract**—**Construction delay is unavoidable in developing countries including Malaysia. It is defined as time overrun or extension of time for completion of a project. The purpose of the study is to determine the causes of delay in Malaysian construction industries based on previous worldwide research. The field survey conducted includes the experienced developers, consultants and contractors in Malaysia. 34 causes of the construction delay have been determined and 24 have been selected using the Rasch model analysis. The analysis result will be used as the baseline for the next research to find the causes of delay in the Malaysian construction industry taking place in Malaysian higher learning institutions.

Keywords**—**Causes of construction delay, construction projects, Malaysian construction industry, Rasch model analysis.

I. Introduction

CONSTRUCTION industries are fast growing in Malaysia. Fundamentally, construction activities are derived from the local economic activities in Malaysia. The construction of non-residential and residential buildings contributed between 40 to 55 percent of the total construction market between the year 2006 and 2009. The market revenues for building construction reached approximately $7.21 billion in 2008 and $6.67 billion in 2009, and it will potentially hit the $9.00 billion mark by 2015 [1].

The Ministry of Housing and Local Government (KPKT) is the agency responsible in managing and monitoring the residential buildings construction in Malaysia [2]. "Project delay" is the project which is experiencing delays in the construction period where there are different gaps between the actual in-progress sites work compared to the work scheduled, which is between 10% and 30%. Meanwhile, "sick project" is the project that is experiencing delays in the construction period where gaps between actual work progresses compared to the work scheduled is more than 30%, or the projects fail to be completed in the construction period.

Failure to achieve: targeted time, budgeted cost and specified quality can result in various unexpected negative effects on the projects. Usually, when the projects are delayed, they are either extended or accelerated and therefore, this incurs additional costs. The standard practices usually allow some percentage of the project cost to be reserved as contingency allowance in the contract price and this allowance is usually judgement-based. Although the contract parties agree upon the extra time and cost associated with the delay, in many cases some problems tend to emerge between owner client and a contractor as to whether or not the contractor is entitled to claim additional time and extra cost. [3]

A lot of construction projects do experience delay. By definition, suspension means stoppage of work directed to the contractor through a form issued by the client, while delay is a slowing down of work without stopping it completely. Delays increase the disturbance of work and loss of productivity, while late completion of project increases time-related costs, and third party claims and abandonment or termination of contract. It is important that general management keeps track of the project's progress to reduce the possibility of delay occurrence or identify it at early stages [4].

II. Objective

The objective of this study is to identify the causes of construction delay in Malaysia from the list of construction delays established from previous research. The causes of delay are collected from the previous research paper. The purpose of this study is to open up a door for future study about the causes of delay in projects in the higher learning institutions, where the projects are owned by the Ministry of Higher Education Malaysia.

III. Literature Review

A. Review

There are two types of delay, namely non-excusable delays and excusable delays [4]. A non-excusable delay is delay caused by the contractor or its suppliers and through no fault by the owner. The contractor is generally not entitled to relief and must either make up for lost time through acceleration or pay compensation to the owner. Therefore, non-excusable delays usually incur no additional money and no additional time being granted to the contractor.

Excusable delays are divided into two: compensable and non-compensable delays. Compensable delays are caused by the owner or the owner's agents. Meanwhile, non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. These delays are commonly called "acts of God" because they are not the responsibility or fault of any particular party. [4, 5]

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Future study has added another type of delay, which is the concurrent delay[5]. If there is only one factor that is delaying the construction project, it is usually quite easy to determine as both time and money can well be affected from that single issue. Concurrent delay is a more complicated occurrence and this is very typical in construction projects. This situation happens when more than one factor delaying the project at the same time, or in overlapping periods of moment.

B. Previously Reviewed Literature

Construction delay is a common issue in most developing countries in the world. Furthermore research about construction delay has been done in a few countries and the summary is outlined in Table I. The table shows the causes of construction delay as derived from respective authors. The causes of delay were selected based on the top ten factors of the authors' research. Each of the delay factor was given a code for analysis purpose.

TABLE I
SUMMARY OF FACTORS OF DELAY FROM A VARIETY OF AUTHORS

Causes of construction delay / Author (Country)	Code	Assaf [6] (Saudi)	Acharya [7] (Korea)	Sweis [8] (Jordan)	Ahmed [9] (Florida)	Hoai[10] (Vietnam)	Odeh [11](Jordan)	Tumi [4] (Libya)	Alaghbari [5] (Mas)	Abdullah [12] (Mas)	Sambasivan [3] (Ms)	Faridi [13] (UAE)	Tabtabai [14] (Kuwait)
Poor workmanship	L1	/										/	
Shortage of labour supply	L2	/								/	/	/	
Labour Productivity	L3						/				/		
Shortage of materials	M1							/	/		/		
Delivering materials on site	M2									/			
Escalation of material's price	M3			/						/			
Insufficient equipment	E1									/			
Financial difficulties faced by contractors	F1	/		/			/	/	/	/			
Financial difficulties faced by owners	F2								/		/		
Problem during inspection	CO1				/								
Inadequate contractor's experience	CO2						/			/	/		
Poor site management	CO3	/						/	/	/	/	/	
Improper planning	CO4	/					/	/		/	/	/	
Subcontractor problems	C05						/			/	/		
Construction mistakes and defective work	CO6								/				
Poor supervision	CO7	/										/	
Unrealistic project time	DE1		/										
Too many changes as ordered by owner	DE2			/	/								
Failure to provide required construction site	DE3		/										
Slowness in making decision by the owner	DE4				/		/	/	/			/	
Changes in design/design error	CT1	/	/					/					
Slow preparation and approval of shop drawings	CT2	/			/						/		
Incomplete document	CT3				/			/					
Slowness in making decision by the consultant	CT4								/				
Supervision too late	CT5								/				/
Lack of consultants' experience	CT6								/				
Lack of effective communication	AL1							/		/	/		
Mistake in implementation	AL2										/		
Weather condition	W1										/		
Interruption from the public	O1		/										
Change in law and regulation	G1				/							/	
Building permit Approval	G2				/								
Change site condition	U1										/		
Sub-surface soil condition	U2		/										

Construction management is different from other managements because it involves a lot of manpower of various skills to develop the products. As default construction involves many parties to complete the project; there are the owner, consultants and contractor, it will altogether make a large and complex management system. An Open Conversion

System (OCS) has been developed involving the interaction of process, from the input to the product in the construction management as shown in Fig. 1 [15].

The OCS shows the processes in the construction management with labour, capital, energy, material and equipment as the input factors to the internal environment. The involvement of contractors, developers and owners are influenced by exogenous factors. All those processes will produce products and projects and this serves as the output factor. However, the disturbance will occur along the process between the factors involved.

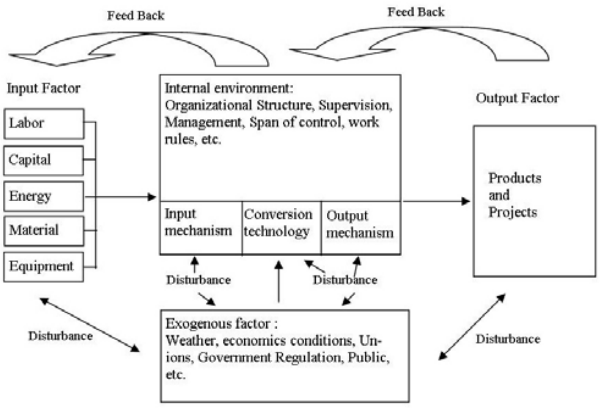

Fig. 1 Open conversion system

Therefore, this research will use the OCS as the baseline for the research. There are three main factors of construction delay; Input factor, internal environment and exogenous factor. Input factor is the factor related with labour, capital, energy, materials and equipment. Internal environment is concerning the parties involved in the construction itself; contractors, consultants and owners, and there are the organizational structures, supervision etc. The exogenous factor is the factor that cannot be controlled by the main parties in the construction; it may be the act of God and nature, decision or policy change of the government etc [15].

The input factors may stem from labour, capital, energy, design, material and equipment. As the outcome, the causes of delay based on the literature review are enlisted as such; poor workmanship, shortages of labour supply, labour productivity, shortage of materials, problems in delivering materials ~~on~~ to sites, escalation of material price, equipment failure and financial difficulties faced by the contractors.

Next is the internal environment; from the study, the factors of delay involve contractors, clients and owners; these people make up the group who run the project in pursuit of the product of the project. The factors caused by the contractor are problems arisen in inspection, inadequate contractor's experience, mismanagement by the contractor, improper planning, problems with subcontractors, construction mistakes and defective work, and poor supervisions.

On the other hand, the internal environment factors related to the owners or clients are unrealistic project deadlines, too many changes as ordered by the owners, failure to provide required construction site, and slowness in making (important) decisions. Then, the next group which is the consultants do have their own problems in the construction. Some of the factors are; changes in the design or design errors, slow preparation and approval of shop drawings, incomplete document, too late supervision and slowness in making decisions, slow in giving instruction, and inexperience consultants. Last but not least, the factors that involve all groups are lack of effective communication and mistake in implementation.

The final delay factor is the exogenous factor, the factor that originates from the outside. They involve the weather, government regulation, code related, and etc. The factors include weather condition, interruption from the public, building permit approval, change in law and regulation, sub-surface soil condition and changing site condition. Therefore, to get the product or building in the construction management there are few components to be considered to avoid delay. Fig. 2 shows the simplified version of the framework, where it illustrates the main factors of delay; they are the input factors, exogenous factors and internal environment that will disrupt each other in the construction industry, in the process getting the products.

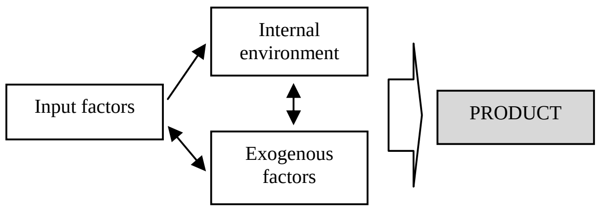

Fig. 2 Simplified framework of the factor of construction delay

IV. Methodology

Resulting from the developed framework of construction delay, a pilot survey has been conducted to detect the factors of delay in Malaysian construction. The survey has been focused in the Klang Valley area , the prominent development hub in Malaysia. Respondents are among experienced owners or developers, consultants and contractors in the Malaysian construction industries. From 34 factors listed, the delays will be partially selected based on the respondents' answers of the survey. The statistic method will be used to determine the selected factors of the research.

The analysis of the causes of delay in Malaysia makes use of the Winsteps software. The fundamental of the analysis is the use of the Rasch model method. The analysis' objective is to eliminate unwanted factors which are not related to the factors of delay in the Klang valley. The Rasch model is an alternative 'modern' measurement method that provides a sound platform of measurement which matches the following SI Unit criteria, where it acts as an instrument of measurement with a defined unit and, is thus, replicable [16]. Rasch moves the concept of reliability from establishing the "best fit line" of the data into producing reliable repeatable measurement instrument [17].

V. Analysis and Discussion

The study was administered on Malaysian construction industries consisting of the experienced owners, consultants and contractors. The results from the survey were tabulated and run in the Winsted and the Rasch Analysis software. For the analysis purpose the factors of delay are represented by the component codes from the OCS such as L#, M#, E#, F#, CO#, DE#, CT#, AL#, W#, G#, I#, O#, and U# which are labour, material, equipment, financial, contractors, developers, consultants, all parties, weather, government regulation and unforeseen condition and # indicates the number of factors as shown in Table I.

Fig. 3 shows the summary statistics of the result, where the reliability provided by the instrument yields a Cronbach-alpha value of 0.90 which is in the good range of reliability. In addition, the person and item reliability values are 0.90 and 0.72. The person reliability value is in the good range, while the item reliability lies in the fair range. This indicates that the respondents are reliable and the items or delay factors are reasonable for this study. The reason for the fair range of value for item reliability is that the factor is in a very wide range, where it consists of plenty of factors which have low quality to the research due to the objective of this research (minimizing the numbers of delay factors from the lists of delay from different authors).

SUMMARY OF 42 MEASURED Persons

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	145.8	38.0	1.00	.21	1.00	-.3	1.00	-.3
S.D.	16.5	.0	.76	.06	.55	2.4	.53	2.4
MAX.	186.0	38.0	4.10	.52	3.01	5.2	2.93	5.1
MIN.	86.0	38.0	-.87	.16	.09	-6.3	.09	-6.4

REAL RMSE .24 ADJ.SD .72 SEPARATION 3.01 Person RELIABILITY .90
MODEL RMSE .22 ADJ.SD .73 SEPARATION 3.36 Person RELIABILITY .92
S.E. OF Person MEAN = .12

Person RAW SCORE-TO-MEASURE CORRELATION = .94
CRONBACH ALPHA (KR-20) Person RAW SCORE RELIABILITY = .90

SUMMARY OF 38 MEASURED Items

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	161.1	42.0	.00	.19	1.01	.0	1.00	.0
S.D.	11.0	.0	.38	.02	.24	1.1	.23	1.0
MAX.	179.0	42.0	1.00	.23	1.50	2.0	1.51	1.9
MIN.	128.0	42.0	-.72	.16	.50	-2.5	.47	-2.7

REAL RMSE .20 ADJ.SD .33 SEPARATION 1.61 Item RELIABILITY .72
MODEL RMSE .19 ADJ.SD .33 SEPARATION 1.73 Item RELIABILITY .75
S.E. OF Item MEAN = .06

UMEAN=.000 USCALE=1.000
Item RAW SCORE-TO-MEASURE CORRELATION = -.99
1596 DATA POINTS. LOG-LIKELIHOOD CHI-SQUARE: 3624.80 with 1514 d.f. p=.0000

Fig. 3 Summary Statistics

A summary of the analysis shows of point measure correlation as in Fig. 4. The range of the item point measure is acceptable when the point as of PT-measure corr. $0.32 < x < 0.8$, MNSQ outfit $0.5 < y < 1$ and ZSTD outfit $-2 < z < 2$ [18]. Therefore, to obtain the misfit item for the factors to be removed from the delay factors in Malaysian construction industries, the values must be out of the range stated. The misfit items are U2, M1, U1, CO1, O1, L1, L2, G1, CO6, CT4 and CO5 referring to factors of change in site condition, shortage of materials, change in site condition, problem during inspection, interruption from the public, poor workmanship, shortage of labour supply, change in law and regulation, construction mistake and defective work, decision in the development stage and subcontractor problems, respectively. All are shown in the Fig. 4.

Most of the misfit factors are significant to the study except for one factor. The factor is "construction mistake and defective work" which is due to fact that the factor can really affect the time of work. It will influence the next process of work [19] since the structure needs to be hacked and redone. For example, in the conventional formwork system; if the column of the second floor cannot be done if the beam structure below needs to be hacked due to the wrong reinforcement bar installed, as a result the new structure needs to be constructed due to the time taken for the concrete to dry. Therefore, the factor will be considered in the next stage.

ENTRY NUMBER	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
38	128	42	1.00	.16	.87	-.7	1.24	1.2	.37	.50	38.1	35.0	U2
22	143	42	.60	.17	.92	-.4	.89	-.5	.47	.48	40.5	39.9	DE3
4	146	42	.51	.17	.55	-2.5	.52	-2.7	.62	.47	61.9	41.2	M1
6	146	42	.51	.17	.71	-1.5	.69	-1.6	.52	.47	50.0	41.2	M3
7	147	42	.48	.17	.81	-.9	.83	-.8	.46	.47	47.6	41.3	M4
28	148	42	.45	.17	.96	-.1	.94	-.2	.49	.47	35.7	41.3	CT5
30	149	42	.42	.17	1.00	.1	.99	.0	.48	.47	40.5	42.2	CT7
20	151	42	.36	.17	1.09	.5	1.03	.2	.47	.46	42.9	43.8	DE1
11	154	42	.27	.18	1.10	.5	1.13	.6	.44	.46	42.9	45.5	F2
19	154	42	.27	.18	.80	-.9	.82	-.8	.42	.46	54.8	45.5	CO8
33	156	42	.21	.18	1.07	.4	1.02	.2	.41	.45	45.2	47.7	W1
37	156	42	.21	.18	1.32	1.4	1.25	1.1	.36	.45	33.3	47.7	U1
12	159	42	.11	.18	.93	-.2	1.08	.4	.24	.45	42.9	48.5	CO1
13	159	42	.11	.18	1.06	.4	.99	.1	.40	.45	50.0	48.5	CO2
26	159	42	.11	.18	.73	-1.2	.73	-1.2	.56	.45	54.8	48.5	CT3
35	159	42	.11	.18	1.16	.8	1.08	.4	.47	.45	35.7	48.5	G2
36	159	42	.11	.18	1.28	1.2	1.30	1.2	.21	.45	50.0	48.5	O1
8	160	42	.07	.19	1.50	2.0	1.46	1.8	.41	.44	42.9	49.1	E1
32	162	42	.00	.19	.91	-.3	.84	-.6	.57	.44	61.9	50.7	AL2
21	163	42	-.04	.19	1.18	.8	1.10	.5	.40	.44	45.2	51.3	DE2
23	164	42	-.07	.19	.92	-.3	.82	-.7	.56	.43	59.5	51.4	DE4
1	165	42	-.11	.19	1.17	.7	1.14	.6	.31	.43	45.2	51.5	L1
5	165	42	-.11	.19	.61	-1.8	.64	-1.6	.59	.43	64.3	51.5	M2
9	165	42	-.11	.19	1.28	1.2	1.19	.8	.48	.43	47.6	51.5	E2
29	165	42	-.11	.19	1.05	.3	1.03	.2	.45	.43	54.8	51.5	CT6
2	166	42	-.15	.20	1.30	1.2	1.35	1.4	.34	.43	50.0	51.5	L2
10	168	42	-.23	.20	1.15	.7	1.07	.3	.48	.42	45.2	52.7	F1
34	168	42	-.23	.20	1.41	1.6	1.51	1.9	.32	.42	38.1	52.7	G1
31	169	42	-.27	.20	1.16	.7	1.01	.1	.51	.42	64.3	53.2	AL1
17	171	42	-.35	.21	.87	-.5	.85	-.5	.25	.41	50.0	52.9	CO6
27	171	42	-.35	.21	.50	-2.4	.47	-2.5	.62	.41	66.7	52.9	CT4
24	172	42	-.39	.21	1.11	.5	1.01	.1	.45	.41	52.4	52.9	CT1
25	172	42	-.39	.21	.92	-.3	.88	-.4	.55	.41	52.4	52.9	CT2
3	175	42	-.53	.22	.76	-.9	.82	-.6	.41	.40	59.5	53.3	L3
14	175	42	-.53	.22	.94	-.2	.83	-.6	.52	.40	64.3	53.3	CO3
15	177	42	-.62	.22	1.43	1.6	1.29	1.1	.44	.39	45.2	52.9	CO4
18	177	42	-.62	.22	.88	-.4	.86	-.5	.46	.39	52.4	52.9	CO7
16	179	42	-.72	.23	1.10	.5	1.16	.7	.19	.38	47.6	53.1	CO5
MEAN	161.1	42.0	.00	.19	1.01	.0	1.00	.0			49.4	48.7	
S.D.	11.0	.0	.38	.02	.24	1.1	.23	1.0			8.8	4.7	

Fig. 4 Point measure correlation: item validity

The second method adopted to determine the unsuitable factor in the research is by referring to the standardized residual correlation, to identify the dependent item. It can be recognize by referring to the residual correlation values. If the value is 0.7 and more, it comprises the possibility that the item measure similar item. Fig. 5 shows that the items AL1 (lack of effective communication) and AL2 (mistake of the implementation) have the possibility to be the same factors. Therefore, both factors will be considered as one factor because the possibility is that any mistake on implementation committed by all parties can happen due to lack of communication. Thus, the factor will be named lack of effective communication.

The Rasch model is simple and easy to way interpret the result. From 34 causes of construction delay, only 24 are retained for the next stage of survey. Table III shows the remaining causes of delay in Malaysian construction industries.

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LARGEST STANDARDIZED RESIDUAL CORRELATIONS
USED TO IDENTIFY DEPENDENT Items
--------------------------------
|RESIDUL| ENTRY       | ENTRY       |
|CORRELN|NUMBER Ite   |NUMBER Ite   |
|-------+-------------+-------------|
|   .75 |    31 AL1   |    32 AL2   |
|   .69 |     8 E1    |     9 E2    |
|   .68 |    34 G1    |    35 G2    |
|   .65 |    36 O1    |    37 U1    |
|   .64 |    28 CT5   |    29 CT6   |
|   .62 |     4 M1    |     7 M4    |
|   .61 |     5 M2    |     9 E2    |
|   .55 |     5 M2    |     8 E1    |
|   .50 |    16 CO5   |    17 CO6   |
|-------+-------------+-------------|
|  -.50 |     5 M2    |    27 CT4   |
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Fig. 5 Point measure correlation: item validity

VI. Conclusion

For many years, the issue of delay in Malaysian construction projects has been phenomenal. Its impacts are so significant that it tends to decelerate the implementation of projects under the Malaysia Five Year Plans. The improvement of delay factors is not only limited to technical factors, but also factors from the project management perspective; both from the processes involved and the influence of human attitudes, mentality, skills and behavior. In that spirit, a study based on the same issues and problems but looking from a different angle need be conducted. The future study will focus on the construction delay that takes place in public higher learning institutions conducted by the Ministry of Higher Education. Ten factors have been removing from the list of causes of delay. Table II show the comparison of causes of construction delay from the literatur review and after the Rasch analysis.

TABLE II
Causes of Construction Delay in Malaysia Construction Industries

List of causes of construction delay from literature review	Result - causes of construction delay in Malaysia
Poor workmanship	Labour Productivity
Shortages of labor supply	Delivering materials on site
Labour Productivity	Increased material price
Shortage of materials	Insufficient equipment
Financial difficulties faced by contractor	Financial difficulties faced by contractor
Financial difficulties faced by owner	Financial difficulties faced by owner
Insufficient equipment	Inadequate contractor experience
Problem during inspection	Poor site management
Unrealistic project time	Improper planning
Construction mistakes and defective work	Construction mistakes and defective work
Inadequate contractor's experience	Poor supervision
Poor site management	Unrealistic project time
Improper planning	Too many changes ordered by owner
Subcontractor problems	Failure to provide required construction site
Failure to provide required construction site	Slowness in making decision by the owner
Poor supervision	Changes in design/design error
Slowness in making decision by the consultant	Slow preparation and approval of shop drawings
Too many change order by owner	Incomplete document
Delivering materials on site	Supervision to late
Slowness in making decision by the owner	Lack of consultant's experience
Changes in design/design error	Lack of effective communication
Slow preparation and approval of shop drawings	Weather condition
Incomplete document	Interruption from the public
Escalation of material price	Building permit Approval
Supervision too late	
Lack of consultant's experience	
Lack of effective communication	
Mistake in implementation	
Weather condition	
Interruption from the public	
Change in law and regulation	
Building permit Approval	
Changing site condition	
Sub-surface soil condition	

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