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Delay Mitigation in the Malaysian Housing Industry: A Structural Equation Modelling Approach

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Abstract: The housing industry is one of the major contributors to the economy in Malaysia due to the constantly high housing demand. The housing demand has increased due to the rapid growth in population and urbanisation in the country. One of the major challenges in the housing industry is the late delivery of housing supply, which in some instances leads to sick and abandoned housing projects. Despite being extensively investigated, this delay is still a common phenomenon of the housing industry in Malaysia. As delay in delivery could result in a negative impact, there is a strong need to review the housing delay mitigation measures practised in Malaysia. This paper aims to evaluate the current delay mitigation measures and its main objective is to explore the relationship between the mitigation measures and delay in housing via a Structural Equation Modelling (SEM) approach. A questionnaire survey through an online survey tool was conducted across 13 states and three Federal Territories in Malaysia. The target respondents are the local authorities, developers, consultants (principal submitting persons) and contractors. The findings show that 17 mitigation criteria can be extracted using principal component analysis. These measures were categorised as predictive, preventive, organisational or corrective. This paper demonstrates that preventive measures are the most influential mitigation measures for housing delivery delay.

Keywords: Structural equation modelling, Delay mitigation, Housing delivery, Malaysia

INTRODUCTION

Housing is a major issue for every nation because it is a basic need for every citizen. Housing is viewed from different perspectives, such as investment, social and economic. Among the issues related to housing include whether state/government or the market should play a primary role in housing provision. The government in some countries plays an active role in addressing housing problems, as it can be used as a political weapon in determining which party will run the country. Hence, the failure to overcome housing problems could lead to political catastrophe. Most research agrees that there are several common problems inherently associated with the housing issue. As identified by Bourne (1981), the most probable reason is that housing is a real physical artefact. Despite its visibility and usage as a shelter in our daily lives, it is immensely diverse, complex and closely interrelated with its social-economic, political and neighbourhood environment.

Urbanisation and industrialisation brought about the housing dilemma as the process involved the migration of local rural or foreign migrants to urbanised areas for better opportunities. The broken linkage between the demand for housing and supply has worsened the scenario due to the insufficient supply of housing and high house prices (Aminah and Azimah, 2004).

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Issues pertaining to housing are major concerns for most households in Malaysia. Although the demand and supply chain of housing are factors in all property markets, the ability of construction parties to sustain the demand for housing has become a major issue in the country (Aminah and Chai, 2012). There are complaints regarding project abandonment, rejection of planning approvals, delays in hand-overs, poor quality and workmanship, reluctance to pay compensation for late delivery, rework, and conflict, as highlighted by the Ministry of Housing and Local Government of Malaysia (Ministry of Housing and Local Government [MHLG], 2013). The problems have involved different parties (local authorities, developers, consultants and contractors) and occurred at different stages of housing delivery (development approval, design, construction and handing over).

In housing projects, the deliverance of completed housing units is crucial to the pursuit of fulfilling the "promise" stipulated in the Sales and Purchase Agreement between the developers and buyers. Thus, time management issues are currently given significant attention in relation to housing delivery. Several researchers and practitioners involved with the industry have stressed the fact that time has its own essence and has proven to be one of the most important factors for the success of the housing industry. Additionally, the revenue of the industry depends greatly on the time taken by the housing businesses (Soon, 2010). It is noted that housing delays in the construction sector have become a norm due to their frequent occurrence and uncontrollable measures.

The above discussion leads to the major concern regarding whether the delay in housing project undertakings has been well investigated, and if so, the question is whether delays have been given serious consideration by the housing sector's players. As all realise that the impact of delays on stakeholders could be financially and physiologically disastrous, efforts should be made to explore the possibility of mitigating and compensating for the damages accrued to the stakeholders. Finally, the question to be addressed is whether Malaysia has appropriate measures, administratively and legally, to address the common sources of delay. If so, have these measures been exercised effectively in this country? It is essential to review the current delay mitigation practices in the Malaysian housing industry and examine the effectiveness of such mitigation measures in mitigating housing delivery delay.

This paper explores the delay mitigation of housing delivery measures in Malaysia. The study further investigates the interrelationship of the mitigation measures in relation to housing delays.

DELAY

According to the Oxford Dictionary, delay is defined as lateness or slowness, postponement or deferral. Although prior research defined delays using different terminologies, the same idea was intended. This is mainly due to the term's global use, affecting not only the construction industry but the overall economy as well. Delays in the construction industry are practically defined in terms of contract delay, construction, the client and even the effects of the delays.

Delay in terms of the construction contract has no precise meaning but characterises the condition of the project execution. Thus, the term is widely used to describe the postponement or extension of time for any activities in a project (Braimah, 2008).

Previous studies defined delay as time overruns that go beyond the completion date as specified in the contract document or beyond an extension of time granted (Assaf, Al-Khalil and Al-Hazmi, 1995; Muhd Zaimi, 1997; Fugar and Agyakwah-Baah, 2010). However, Bartholomew (1998) introduces a different view of delay, in which the progress of work has not entirely stopped but has slowed down. His perception emphasises the slowing of progress, as opposed to that of others who focused on the postponement and stoppage of work.

Nunally (1980) simplifies construction delays by showing construction activities, completion dates, and delays in a figure form. Figure 1 shows the philosophy of delay in the construction industry, which is essential in assisting stakeholders in identifying the causes and types of delays.

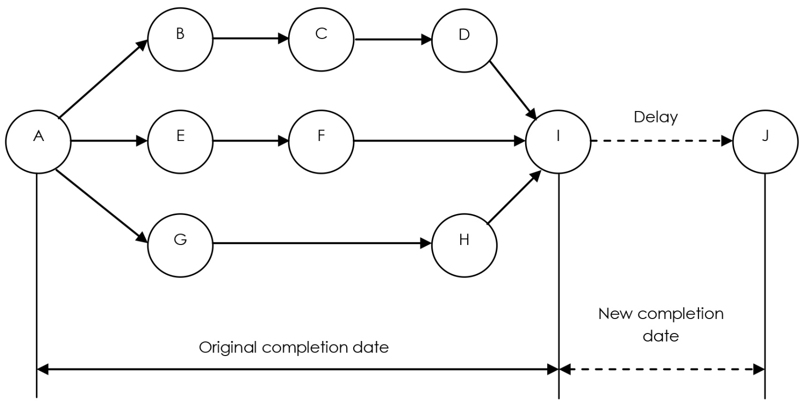

Figure 1. Philosophy of Delay in the Construction Industry

In brief, construction delay is defined as follows (Pickavance, 2005):

1. Delay causing the postponement of one or more completion dates,
2. Prolongation of the contractor's and/or subcontractor's time-related costs,
3. Delay to progress causing loss and/or expense to be suffered by contractors or subcontractors,
4. Reduction in productivity (or disruption) causing loss and/or expense to be suffered by contractors and/or subcontractors.

A proper understanding of delays is essential for the contractors, subcontractors, and the developers, as well as the owners. If issues of delays are unable to be solved by these parties, then involvement of the government or other third parties might be needed. This might include laws and legal procedures as well. Thus, it is necessary to choose suitable techniques and processes for the completion of the construction work while also considering all the relevant facts, probable causes of delays, time of delivery, and the potential conflicts that might take place so as to take preventive measures to overcome difficulties associated with these factors (Keane and Caletka, 2008).

DELAY IN HOUSING DELIVERY IN MALAYSIA

Delay in the context of housing delivery refers to the entire process of construction and delivery of the housing and buildings to the customers. There might be buyers of a house who need the house within a specific timeframe because they are timing ending their rental agreements. In such cases, the timely delivery of the house becomes highly essential. Inspections are part of the construction and delivery process. However, if the inspection activity is called for before the completion of the work or too long after its completion or if there is a failure in the process, it might lead to delay. Delays are also caused by subcontractor involvement in the construction and delivery because they may try to manage several projects together. Moreover, there could be unpredictable issues leading to delays in the shipping of the materials that a construction factory ordered (Bennett, 2012).

There are numerous causes that might lead to delays that need to be considered before deciding on the completion and delivery time of the housing. Time is the most significant part of the housing construction industry. Being unable to maintain time constraints is the definition and cause of delay in the housing delivery system. The causes include those caused by authorities, developers, consultants and external factors.

The general perception in the construction industry is that delay is common in the project cycle. Considering the issues of delays, there are detailed provisions as well as events referenced in different clauses of the contracts. Events unusually mentioned include bad weather, damages caused by floods or fires, upheavals in the public, strike or lockout, problems conforming with the architect's instructions, delay in supply of information from the designer, delays on the part of selected subcontractors or suppliers, delays on the part of artists, tradesmen or others engaged by the employer in executing their work, delay in the supply of materials and goods, opening up and inspection of covered works, and breach of contract by the employer (Mohammed Alias, Noraziah and Zulhairuse, 2007).

It is observed that the problems of delays in the construction and delivery of housing in Malaysia have been more prevalent in the Sell-Then-Build system of housing delivery where the customers pay for the houses before the houses even begin to be constructed. Late delivery of houses is a significant issue in this context. The completion of the house and hence the timely delivery of the house to the customers is significantly delayed later than the date mentioned in the agreement of purchase (Ng, 2007).

The weaknesses of the Sell-Then-Build concept of housing in Malaysia can be understood from the statistics computed by MHLG, in that there were 115 abandoned housing projects reported in Malaysia from 2003–2008. The 2011 late and sick projects are presented in the following Table 1.

A sick project is a project that results from project delay. Sick projects with extensive critical delays will be abandoned. To prevent sick projects, government institutions and construction-related professional bodies have taken the initiative to improve the provision of the contract form to allow a certain extension of time to the contractor.

It is agreed that delays occur in every stage of the housing delivery system, i.e., the development approval process, construction stage, and handing over stage. Figure 2 shows the delay factors in the housing delivery system in

Malaysia. As housing delivery is a concern, this research focuses on the mitigation measures that will be discussed in a later section.

Table 1. Numbers of Late and Sick Projects in Malaysia

State	**December 2011**		**April 2013**		
	Late	**Sick**	**Late**	**Sick**	**Recovering**
Perlis	–	1	–	–	
Kedah	–	17	–	13	5
Penang	2	10	4	10	4
Perak	2	8	–	7	1
Selangor	18	86	11	78	17
Federal Territory	8	11	–	6	1
Negeri Sembilan	3	5	–	11	4
Malacca	4	5	–	3	2
Johor	9	30	9	21	9
Pahang	3	19	7	16	2
Terengganu	1	15	–	10	–
Kelantan	3	28	–	16	1
Total	50	235	31	191	46

(Source: MHLG, 2013).

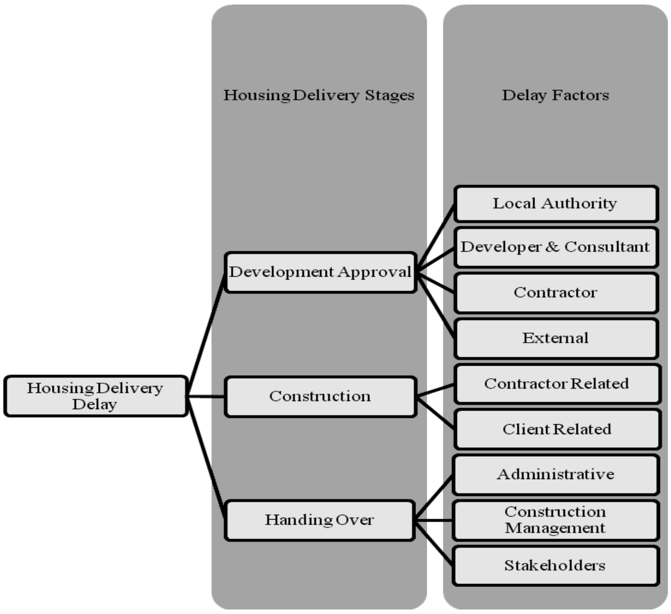

Figure 2. Housing Delivery Delay Systems in Malaysia

DELAY MITIGATION

Despite numerous project control techniques and the availability of project control software, project teams still struggle to meet their time and cost objectives. Project delays are still inevitable in projects, although numerous mitigation plans are taken into consideration. Mitigation efforts are important to minimise the losses, and this can be achieved by predicting and identifying the problems in earlier stages and thereby diagnosing the delay causes to locate and execute the most appropriate economical resolutions. Construction projects are segmented and complicated and involve more variables and uncertainties due to excessive construction activities. This increases the probability of delay occurrence, which makes effective project management important to prevent the diversion of the planned schedule (Ng, 2007).

Previous studies have discussed typical delay mitigation plans in the construction industry to provide a better understanding to construction parties, such as Abdul Rahman et al. (2006) which discusses delay mitigation in the Malaysian construction industry. His research team proposed a quality management system and enhancement of project communication and coordination among the project. Abedi, Fathi and Mohammad (2011) reviewed previous project success factors in the literature and identified 30 delay mitigation methods in practice. Olawale and Sun (2010) classified delay mitigation measures into predictive measures, preventive measures, corrective measures and organisational measures. The following table tabulates the mitigation measures suggested by the researchers.

Table 2. Mitigation Measures

No.	Mitigation Measures	Sources
1	Comprehensive contract documentation	Abdul Rahman et al. (2006); Olawale and Sun (2010); Kasimu and Abubakar (2012)
2	Hire an independent supervising engineer to monitor the project	Abdul Rahman et al. (2006)
3	Multidisciplinary/competent project team	Abdul Rahman et al. (2006); Olawale and Sun (2010); Smart Market Report (2011)
4	Accurate initial time estimates	Ng (2007); Abdul Rahman et al. (2006); Love et al. (2000)
5	Use up to date technology	Abdul Rahman et al. (2006); Olawale and Sun (2010)
6	Accurate initial cost estimates	Abdul Rahman et al. (2006); Olawale and Sun (2010); Kasimu and Abubakar (2012); Love et at. (2000); Smart Market Report (2011)
7	Perform a preconstruction planning of project tasks and resource needs	Ng (2007); Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010)

(*continue on next page*)

Table 2: (*continued*)

No.	Mitigation Measures	Sources
8	Allocation of sufficient time and money at the design phase	Ng (2007); Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Kasimu and Abubakar (2012); Smart Market Report (2011)
9	Effective strategic planning	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010); Kasimu and Abubakar (2012)
10	Clear information and communication channels	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010)
11	Developing professional and skilful human resources in the construction industry through proper training and classification of craftsmen	Ng (2007); Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010)
12	Systematic control mechanism	Ng (2007); Abdul Rahman et al. (2006); Olawale and Sun (2010)
13	Acceleration of site activities	Abdul Rahman et al. (2006); Smart Market Report (2011)
14	Ensuring timely delivery of materials	Abdul Rahman et al. (2006)
15	Enforcing liquidated damage clauses	Abdul Rahman et al. (2006); Smart Market Report (2011)
16	Availability of resources	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011)
17	Ensuring adequate and available sources of financing for the entire project	Abdul Rahman et al. (2006)
18	Adopting a new approach to the contract award procedure by giving more weight to the capabilities and past performance of contractors	Abdul Rahman et al. (2006); Olawale and Sun (2010)
19	Selection of a competent consultant and a reliable contractor	Abdul Rahman et al. (2006); Kasimu and Abubakar (2012)
20	Commitment to projects	Abdul Rahman et al. (2006); Olawale and Sun (2010)
21	Competent project manager	Abdul Rahman et al. (2006); Olawale and Sun (2010)
22	Frequent progress meetings	Ng (2007); Abdul Rahman et al. (2006); Olawale and Sun (2010)

(*continue on next page*)

Table 2: (*continued*)

No.	Mitigation Measures	Sources
23	Offering incentives for early completion	Abdul Rahman et al. (2006)
24	Absence of bureaucracy	Abdul Rahman et al. (2006)
25	Adopting new procurement	Abdul Rahman et al. (2006)
26	Awarding bids to the right/experienced consultant and contractor	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010); Kasimu and Abubakar (2012)
27	Proper emphasis on past experience	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Olawale and Sun (2010); Smart Market Report (2011)
28	Community involvement	Abdul Rahman et al. (2006)
29	Contingency allowance	Abdul Rahman et al. (2006); Abedi, Fathi and Mohammad (2011); Smart Market Report (2011)

Predictive Measures

Prediction is defined as estimating whether something will happen in the future, making something known in advance by using tactical knowledge or declaring a situation in advance through basic observation and experience (Oxford Dictionary and Merriam-Webster dictionary). The predictive measures are then defined as proposals, plans, steps and suggestions taken into consideration proactively before the projects start. From the project management point of view, predictive measures minimise the disruption of project operation while allowing for budgeted, scheduled time for reaction (Aftab, Ismail and Ade Asmi, 2012). Project delays have become the industry norm in Malaysia, and allowances are made to capture the inevitable delays in construction projects. Predictive measures in the construction industry provide a delay allowance to prevent affecting the project completion time. Such allowances are normally allocated beyond the critical path of the project.

The predictive measures are identified through a predictive analytical process based on future behaviour characteristics. They are concerned with forecasting probabilities and trends that create dummy delays to avoid delays on critical path activities. The data are collected from relevant predictors who have experienced the delays in previous construction projects.

Preventive Measures

According to the Oxford Dictionary, preventive is defined as keeping something undesirable from occurring. Webster's Dictionary additionally defines preventive as "precautionary". Preventive measures against housing delivery delays refer to precautionary measures that are prepared as a defence against inhibiting factors. These measures are active measures that are implemented during the planning stage of a project. Preventive measures are always favourably put into practice by construction parties before construction to minimise project risk. Any project risk in the project can lead to project delay, which puts pressure on the project time and cost.

In terms of project management, preventive measures are defined as scheduled maintenance action plans aimed at preventing breakdowns, delays and failures (Aftab, Ismail and Ade Asmi, 2012). Preventive measures are based on the prediction of problems to avoid their occurrence through self-initiated actions and analysis procedures. The initiative to provide better preventive measures can involve the active participation of staff through the contributions of the team, improvement of knowledge sharing, management reviews and feedback. Construction players have learned lessons to minimise project delays through experience in previous projects. Experience and project documentation play a vital role in preventive measures, as the majority of project delay factors are fundamentally similar.

Corrective Measures

Correct is defined as to counteract, rectify, alter, or adjust to bring a situation back to its required condition (Merriam Dictionary, Oxford Dictionary). Corrective measures are used to mitigate the effects of project controlling factors by acting as a remedy. Corrective measures normally take place after an event to eliminate the cause of a detected nonconformity or another undesirable situation. These measures are used to handle delays after the occurrences to stop, track, and reduce the effects of the delay (Abedi, Fathi and Mohammad, 2011). Corrective measures normally take action after the root causes are identified. Delays in construction have long been discussed, and delay causes have been tabulated to simplify their identification process. Corrective measures can be further classified as corrective predictive measures, which remedy the current situation and predict upcoming issues based on the current scenario, or corrective preventive measures, which are meant to correct the current issues and at the same time prevent the same problem from occurring in the future.

Organisational Measures

As discussed in the previous section, organisation is defined as a group of people with a particular interest who normally have collective goals in achieving the same target (Oxford Dictionary). Organisations in the construction industry are segmented due to the involvement of several construction parties with different interests. Thus, a temporary organisation itself has a high potential for causing project delays due to communication and coordination factors and decision-making by different parties. To effectively control and mitigate the delay issues resulting from the segmented construction organisation, Olawale and Sun (2010) and Abedi, Fathi and Mohammad (2011) suggested targeting the particular company organisation rather than focusing on the temporary construction team. Thus, organisational measures in delay mitigation play an important role to controlling the effects of project delay due to the company's beliefs, orientation, management style or philosophy, which normally will not affect only one project but rather can affect all projects being undertaken by the company.

RESEARCH METHOD

This review on housing and related issues in Malaysia is intended to clarify some fundamental concerns in this area of research. The background understanding of the survey and highlighted issues also significantly contributed to the development of the questionnaire.

A total of 400 sets of questionnaires were distributed to local authorities, developers, consultants and contractors in Malaysia. A total of 132 completed questionnaires were received, representing a 33% response rate. According to Fellows and Liu (1997), the normal expected usable response rate ranges from 25%–35%, so the response rate for this study is considered acceptable.

There are many techniques that can be employed to evaluate the relationship between mitigation measures and housing delivery delays, such as linear regression techniques, analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA). One of the main reasons that this study employs structural equation modelling (SEM) lies with its capability of modelling the relationships among multiple independent and dependent constructs simultaneously (Zainudin, 2012) compared to the aforementioned techniques that can analyse only one layer of linkage between independent and dependent variables at a time. As the mitigation measures involve various factors, it is the contention of this study that SEM yields a better outcome than those other techniques.

A sample size of 132 for SEM is considered acceptable, as the minimum sample size suggested in the literature is not less than 100 (refer to Table 3). Moreover, a review of construction-related SEM studies (refer to Table 4) suggests a size less than 200. Some studies use even fewer than 100 samples. Based on this, the collected sample size is adequate to proceed with SEM to evaluate the relationship between mitigation measures and housing delivery delay.

Table 3. Recommended Sample Sizes

No.	Author	Recommended Sample Size
1	Gorsuch (1983)	At least five responses per construct, no fewer than 100 individuals per analysis
2	Anderson and Gerbing (1984)	Between 100 and 150
3	Hatcher and Stepanski (1994)	At least five times the latent variables or a minimum of 100
4	Hutcheson and Sofroniou (1999)	Between 150 and 300
5	Bagozzi and Yi (2012)	Above 100, preferably above 200
6	Zainudin (2012)	Minimum of 100 for fewer than five latent variables, minimum of 300 for fewer than seven latent variables

Table 4. Construction Management Related Studies using SEM

No.	Title	Author	Sample Size	Software
1	Impact of project performance	Zulu (2007)	63	Amos
2	Project planning effectiveness	Mainul Islam and Faniran (2007)	52	Amos 4.0
3	Factors influencing architect trust	Ding, Ng and Wang (2009)	130	Amos 6.0
4	Organisation and project performance	Wong, Cheung and Fan (2009)	83	Amos 5.0
5	Risk in international construction projects	Eybpoosh, Dikmen and Birgonul (2011)	166	EQS 6.1
6	Factors affecting delay	Doloi, Sawhney and Iyer (2012)	77	Amos 19
7	Cost overrun	Aftab, Ismail and Ade Asmi (2012)	157	PLS 2.0

Table 5. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO)		0.822
Bartlett's test of sphericity	Approx. chi-square	1.570 E3
	df	406
	Sig.	0.000

Table 6. Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of items
0.936	29

The Kaiser-Meyer-Olkin measure of sampling adequacy varies from 0 to 1. A value close to 1 indicates that the patterns of correlation are compact, so the factor analysis will yield a reliable factor. Values between 0.8 and 0.9 are considered great, as they indicate that an appropriate factor analysis can be performed.

Bartlett's test of sphericity is used to determine whether factor analysis is appropriate to be carried out on data through its significance. A significant value of less than 0.05 indicates that the test is significant and factor analysis could be performed. Both KMO and Barlett's test in this study meet the minimum requirements, as it has been proven that the factor analyses performed are appropriate and significant (refer to Table 5 and Table 6).

ANALYSIS AND DISCUSSION

A survey of four parties was carried out via structured questionnaire. Principal Component Analysis (PCA) was selected to analyse the criticality of the delay factors to the delay mitigation measures. PCA was conducted with 29 mitigation measures identified from the literature, and a Likert Scale (1 to 5) was used to collect relevant opinions from the respondents.

By referring to Table 2, there are 29 mitigation measures identified from the literature. Seventeen mitigation measures were extracted from PCA and classified into four components, preventive, predictive, organisational and corrective measures, as shown in Table 7.

Table 7. PCA Mitigation Measures

Rotated Component Matrix					
		Component			
Code		**Prevent.**	**Predict.**	**Org.**	**Correct.**
M1	Comprehensive contract document	0.782			
M2	Hire an independent supervising engineer to monitor the project			0.712	
M3	Multidisciplinary/competent project team	0.710			
M4	Accurate initial time estimates		0.695		
M9	Effective strategic planning	0.603			
M10	Clear information and communication channels	0.635			
M12	Systematic control mechanism		0.711		
M13	Acceleration of site activities			0.611	
M14	Ensure timely delivery of materials	0.724			
M15	Enforcing liquidated damage clauses				0.658
M16	Availability of resources	0.616			
M18	New procurement by giving more weight to the capabilities and past performance of contractors			0.680	
M19	Selection of a competent consultant and a reliable contractor	0.656			
M20	Commitment to projects		0.746		
M25	Adopting new procurement			0.619	
M27	Proper emphasis on past experience		0.638		
M29	Contingency allowance				0.633

PCA is also known as confirmatory factor analysis (CFA) in SEM. Seventeen extracted mitigation measures were grouped into four categories, presented in SEM format in Figure 3. The figure explains the relationship among the preventive measures, predictive measures, organisational measures and corrective measures that are directly inter-related to housing delay.

The model validity is tested through the model fitness indexes. A model should at least meet one of the fitness requirements in each category of absolute fit, incremental fit and parsimonious fit (Zainudin, 2012). By referring to Table 7, the model has successfully met the requirements except for the Tucker Lewis Index (TLI). However, the model remains fit because comparative fit index (CFI) and TLI fall in the same category of incremental fit. As mentioned, the model is considered fit as long as one of the requirements in each category is achieved.

The next step is to examine the regression weight of the housing delay mitigation measure model. In most cases, the primary developed model is unstandardised due to the unconstrained model estimation. Therefore, a comparison between an unstandardised model and a standardised model is needed to verify the changes. In addition, the model shown in Figure 3 is a standardised model, in which the standardised regression weight summary is shown in Table 9.

Table 9 shows the unstandardised regression weight of the housing delay mitigation measures model. All of the critical ratios in Table 8 are above +1.96, which indicates that the weights are statistically significant at the 0.05 level of statistical significance (at alpha = 0.05, critical ratios that fall between –1.96 and +1.96 are not statistically significant). Due to the unconstrained model estimation, the unstandardised path coefficients are not directly comparable to each other within the same model, so standardisation is needed. Table 9 shows the standardised regression weight representing the change in the dependent variable given a standard deviation unit change of the predictor variable.

Table 8. Index Category and Level of Acceptance for Fitness Indexes

Category	**Index**	**Zainudin (2012)**	**Bagozzi and Yi (2012)**	**Singh (2009)**
Absolute fit	Chi-square	> 0.05		
	Root mean square of error approximation	< 0.08	≤ 0.05 to ≤ 0.08	≤ 0.10
Incremental fit	Comparative fit Index	> 0.90	≥ 0.93	0 to 1
	Tucker Lewis Index	> 0.90	≥ 0.92	≥ 0.95
Parsimonious fit	Chi-square/Degree of freedom	< 5.0	0–2	1–2

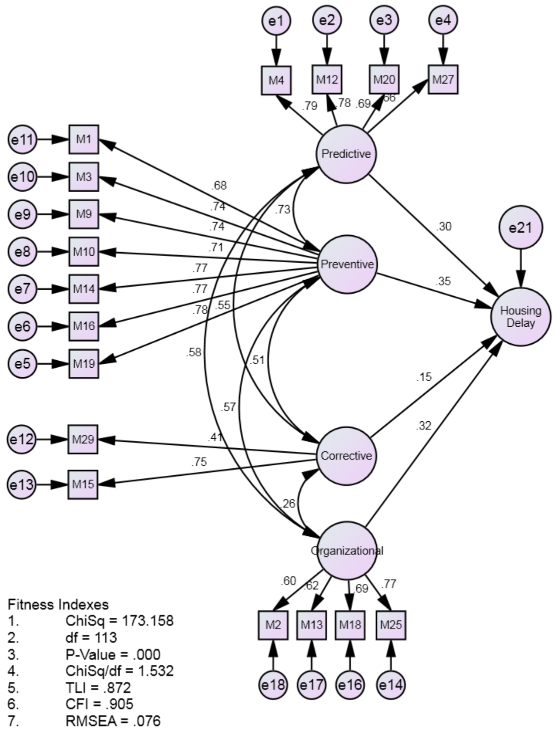

Figure 3. Structural Equation Model of Housing Delay Mitigation Measures

Table 9. Unstandardised Regression Weights

			Est.	S.E	C.R.	P
Delay	<---	Predictive	1.000			
Delay	<---	Preventive	1.000			
Delay	<---	Corrective	1.000			
Delay	<---	Organisational	1.000			
M04	<---	Predictive	1.000			
M12	<---	Predictive	1.101	.149	7.399	***
M20	<---	Predictive	.917	.142	6.446	***
M27	<---	Predictive	.796	.129	6.151	***
M19	<---	Preventive	1.000			
M16	<---	Preventive	.803	.104	7.709	***
M14	<---	Preventive	.913	.119	7.700	***
M10	<---	Preventive	.883	.126	6.996	***
M09	<---	Preventive	.816	.112	7.319	***

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Table 9: (*continued*)

			Est.	**S.E**	**C.R.**	**P**
M03	<---	Preventive	.811	.110	7.381	***
M01	<---	Preventive	.715	.107	6.672	***
M29	<---	Corrective	1.000			
M25	<---	Organisational	1.043			
M18	<---	Organisational	.760			
M013	<---	Organisational	.816			
M02	<---	Organisational	.792			
M15	<---	Corrective	2.207	1.015	2.175	.030

Notes: Est. = Estimation; S.E = Standard Error; C.R = Critical Ratio; P = z/t hypothesis

The purpose of a standardised weight (Table 10) is to assess the relative contribution between a predictor variable and an outcome variable. A standardised weight with an absolute value greater than 0.10 indicates a small effect, values of more than 0.30, a medium effect, and those greater than 0.50, a large effect (Kline, 1998).

From the above discussion, it is shown that the predictive, preventive and organisational measures moderately contribute to the mitigation of housing delay, while corrective measures have slightly less influence. This might be due to the nature of the corrective measures that are implemented after a delay incident, while the best mitigation measures avoid delay.

Table 10. Standardised Regression Weights

			Estimate
Delay	<---	Predictive	.298
Delay	<---	Preventive	.351
Delay	<---	Corrective	.149
Delay	<---	Organizational	.322
M04	<---	Predictive	.794
M12	<---	Predictive	.782
M20	<---	Predictive	.687
M27	<---	Predictive	.658
M19	<---	Preventive	.781
M16	<---	Preventive	.771
M14	<---	Preventive	.771
M10	<---	Preventive	.711
M09	<---	Preventive	.739
M03	<---	Preventive	.744
M01	<---	Preventive	.683
M29	<---	Corrective	.410
M25	<---	Organizational	.766
M18	<---	Organizational	.686

(*continue on next page*)

Table 10: (*continued*)

			Estimate
M13	<---	Organizational	.615
M02	<---	Organizational	.602
M15	<---	Corrective	.748

CONCLUSION

This paper has made a contribution to the body of knowledge by examining the relationship between mitigation measures and housing delivery delay. Preventive measures, predictive measures, organisational measures and corrective measures are well known among construction players. However, the majority of them blindly implement mitigation measures without knowing what, when, where and how. This paper plays an important role in categorising the existing mitigation measures in the industry and justifying the most effective measures to mitigate housing delay.

It is discovered that preventive measures are the most effective mitigation measures practiced in Malaysia, as they recorded the highest index coefficient in the SEM model. There are seven mitigation methods classified as preventive measures, namely a comprehensive contract document, competent project team, effective strategic planning, clear information and communication channels, ensuring timely delivery of materials, availability of resources and lastly, selection of a competent consultant and a reliable contractor. As preventive measures are predictions of problems to avoid the occurrence of delays through systematic precautions and past experience, construction players should emphasise evaluating past projects and strategic planning to enhance housing delivery performance.

The limitation of the study lies with its small sample size. Although the sample size is sufficient for the purpose of SEM, it does not represent the real scenario of the housing industry in Malaysia. However, the contribution of this paper should not be ignored, as it is provides a general outlook of the current housing industry where mitigation is concerned.

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