Volume: 2 Issues: 6 [December, 2017] pp.73-83]
Journal of Information System and Technology Management
eISSN: 0128-1666
Journal website: www.jistm.com

MEASURING THE IMPORTANT ELEMENT OF DEFECTS IN THE HERITAGE BUILDING

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Accepted date: 2 December 2017 **Published date**: 15 January 2018

To cite this document:
Zuraidi, S.N.F., Abdul Rahman, M.A., & Akasah, Z.A. (2017). Measuring The Important Element Of Defects In The Heritage Building. *Journal of Information System and Technology Management*, *2*(6), 73-83.

Abstract: *This study is conducted to measure the importance element of building defects in the heritage building. A survey was conducted to the occupiers in three country of museum areas. The museum area has been identified through the Department of Museum Malaysia and because of the big number of museum, all staff in the museum areas were required to participate in the study to enable the researcher to collect the data concerning defects. Questionnaire has been employed as the data collection instrument and was distributed to the respondents to this study. The result has shown that the important element of defects in the museum areas is high, as the rate of defects for all elements are severe. Such high important element of defects has apparently only affected the aesthetic value of the museum.*

Keywords: *Measuring, Building Defects, Museum Area*

Introduction

According Kaur (2015), defect is a building flaw or design mistake that reduces the value of the building, and causes a dangerous condition. A construction defect can arise due to many factors, such as poor workmanship or the use of inferior materials.

In the broadest sense, acceptable buildings are where they are being required, in accordance with its environment, and provides adequate space and facilities, protected from bad weather and unwanted external conditions. Given this protection cannot be achieved with short-term structures, building naturally far outweighs many other modern products, and, if built so that they can be adapted to the changing needs and only repaired, can providing adequate service for a long time. There is much to learn from the situation the stock of existing buildings on what is mostly caused discontent after completion.

Defects are non-compliance with sections or components with standards or special features. Disability is sometimes used as a synonym for 'failure', but the meaning of the option is to show only the deviations of some possible standards, but not necessarily, resulting in failure (Kasim, 2009).

Strictness of building defects and associated damage levels, deterioration or damage or is expected to affect its buildings and buildings Occupancy is also associated with perceptions and expectations of owners and occupants. Defects or actions required to reduce or eliminate the effects the building will usually be arranged on a pre-determined priority for repairs. Build defects occur either new or old buildings. Disability in new building may not comply with Building Code and issue acceptable tolerances and standards. Meanwhile the old building, or building from the warranty period, may not comply this standard but should be judged by the standard at the time of construction or modifications (David, 1988).

Defects and deterioration are common problems in any structure constructed. However, various more common defects in old structures (Ransom, 1981). As in BS 3811 (Practice Code, British Standard 1984) defects are defined as the deterioration of building features and services quality level that users are not satisfied with.

According to California Civil Code 896, types of common building defects include: structural defects resulting in cracking or collapse; damaged or damaged electrical wiring or lighting, damaged or damaged pipes, inadequate drainage systems, faulty ventilation, cooling or heating systems, insufficient insulation or noise checks, as well as insufficient fire protection system suppression. Plus, dry rot, rotten wood, mildew, fungus, or termite or lice attacks may also be the result of building defects.

The understanding of building defects and their causes is essential for better performance of any building. Broadly speaking, building defects fall into two categories which is defects that affect the performance of structure and defects that affect the appearance of structure.

This paper intended to identify the important of condition element in heritage building. More specifically, the study is to identify and rank the element of defect by selected respondents which includes of industry players. The Pedro's method as a quantitative approach will be applied to give more significant and reliable data in developing priority for important element of heritage building in Malaysia.

Literature Review

The literature review has found that there are heritage buildings are dilapidated, lost the characteristics of authenticity in design, architecture and building materials caused no heritage management and poorly maintained and renovated on a scale which enables (Kamal, 2007; Idris, 2009). This kind of situation will indirectly accelerate the process of building damage occurred on a heritage building in addition to destroying the original identity (Rahman, 2013). There are also a few heritage buildings that are abandoned with no known owner and left empty and unattended (Rashid and Ahmad, 2008). Weakness in managing heritage building maintenance has resulted in serious damage to the structure and fabric of the building (Sodangi et. al., 2014). The impact of these vulnerabilities has resulted in buildings that are unsafe for occupation as well as the potential to be demolished as it did to the Rumah Agam Bok in Kuala Lumpur (Harun, 2005).

Since there is no standard for assessing the condition of the heritage building, various methods were used in making the assessment (Amir, 2010). Each method has a different criterion. Each criterion would have a different important level. Given the various inspection methods related to the building condition, a new assessment method should be established specifically to assess the condition of heritage buildings. This will ensure that the assessment of the situation is clearly distinguishable from the other building audit and building inspection.

Over the past decades, study on building condition assessment has draws the attention from many professionals including industry experts and academic researcher (Khalil, 2016). There are many criteria and attributes were established all over the world to assess the building condition. With some modification, the criteria and evaluation approach can be adopted for the practice of heritage building management in Malaysia. Based on the previous study (Zuraidi et. al., 2016; Ramli, 2014), 23 attributes that relevant for assessing condition of heritage building have been identified.

Evaluating the defects

According to Djebarni et al. (1998), there are quite a few methods in evaluating the defects such as the Defects Index Method, Northern Ireland House Condition Method, Priority Ranking Method, Housing and Environmental Defects Index, Listing Defects Method and Standardize Subjective Rating Method (Pedro, 2008; Che Ani, 2009; Rindfuss et al., 2007; Liu, 2003). Considering the importance of the severity of the defects' measurement in Georgiou et al. (1999) study, this study has been determined to utilize the Defects Index Method as proposed by (Pedro, 2008). The method is deemed appropriate to be used in this study as it is considered appropriate cases of defects' severity, which is important in measuring the level of these defects (Georgiou et al., 1999). It is also more accurate and gives detailed explanation in measuring defects. Moreover, it was developed with consideration given to the occupiers as the respondents. The method works by using score points based on the defects 'severity. Pedro (2008) recommends a five-point scale each labeled as minor (5 points), slight (4 points), medium (3 points), severe (2 points) and critical (1 point) to rate the defects' level to each selected building element. The explanation for each defect scale is stated in table I.

Table 1: Explanation for each defects scale

Scale	Symbol	Description
Minor Defects	MI	No defects or defects without noteworthy
Slight Defects	SL	Defects that affect the aesthetic value
Medium Defects	ME	Defects that affect the aesthetic value and use or comfort
Severe Defects	SE	Defects that affect the use or comfort and endanger health or safety and may cause minor accidents
Critical Defects	CR	Defects that endanger health or safety and may cause major accidents

According to Pedro (2008) the defects index method suggests 37 elements to be assessed, where some elements might be entirely cultural based. The element which is used in Portugal, as an example, might be inapplicable to be implemented in Malaysia. Thus, for this study, the building element review has been done to select the important building element that will be utilized in this study. In total, 23 building elements have been identified from the previous studies. All 23 buildings element was divide in to 3 group such as building fabric, building structure and building service. The building element namely the ceiling; floors; roof; windows; doors; internal and external walls; the arch; ornament, apron, foundation, column, beam, truss, staircase, electricity system; air condition and mechanical ventilation system

(ACMV), fire protection, plumbing facilities; lift; gas system; sewerage and drainage. Apart from building elements identified by Pedro (2008), 13 building elements have been added in this study. These elements are important in the context of museum building. The 23 elements are regrouped into the three main criteria as listed and explained in Table 2.

Table 2: Important element for assessing condition of heritage building

Criteria	Building Fabric	Building Structure	Building Services
Element	Ceiling Floor Roof Window Door Internal wall External wall Arch Ornamentation Apron	Foundation Column Beam Truss Staircase	Electricity Mechanical Ventilation Fire safety Plumbing and sanitary Lift Gas system Sewerage Drainage

Research Methodology

This study has employed the survey research method. The quantitative data collection technique that consists of closed ended and open-ended questions was used to gather the data concerning the defects.

The total numbers of museum in the three country areas are 45 building units. Nevertheless, one museum must be excluded from this study because the museum was either under renovation or still unoccupied. This left the population for the study to be only 44 museums. The 44 responses received from the staff have constituted the response rate, which is read as 100%.

The descriptions of museum areas that have been found from the Department of Museum Malaysia are as below:

i) Museum area at Melaka
   Melaka is a state known for its history. Melaka is located on the west coast of Peninsular Malaysia and is bordered by the State of Johor and Negeri Sembilan. Melaka also listed in UNESCO World Heritage attractions on July 7, 2008. There are about 6 museums for exhibitions unique materials under the supervision of Melaka Museum Corporation.
ii) Museum area at Kelantan
   Kelantan is known as the 'cradle of Malay culture' for having an overwhelming population of Malays (93%) and the rest made up of Chinese, Indians and Thai. The Kelantanese have preserved their customs, traditions and cultures well over the years. There are about 10 museums for exhibitions unique materials under the supervision of Kelantan Museum Corporation.
iii) Museum area at Pahang
   Pahang is the third largest state in Malaysia. Located in the vast basin of Pahang River, it is bordered by Kelantan in the north, Perak, Selangor and Negeri Sembilan on the west, Johor and Terengganu in the south and the South China Sea in the east. There are about 5 museums for exhibitions unique materials under the supervision of Pahang Museum Corporation.

Respondents and Sampling Technique

The respondents for this study are the staff in area museum. The reason for selecting staff as respondents is because they are the end user of the 'product', in this case the museum. According Fernandes (2007), they have more experience about the museum condition which lies at the post-occupancy stage. Professionals will focus more on the technical aspects whereas the user would have their own personal perceptions towards the quality of their museum.

In most studies, typically the entire population of the target respondents is wide. It is impossible to approach them all as it will take time and it will be costly. In the case, therefore, it is necessary that the sampling is done. In this study however, the staff at the museum cannot be determined because the Department of Museum Malaysian also does not have a list of the names of staff working in the museum. With the circumstances, researcher decides to approach the whole staff to gather the defect data. Islam (2008), Neuman (2000) and Babbie (1998) refer to this as a census.

Data Collection

The questionnaires were employed to gain generalization about the severity of defects occurring in museum building. In all museum areas, questionnaires were administered directly to the staff during the door-to-door visits requesting if the questionnaire can be completed on the spot (Neuman, 2000). Otherwise, the respondents would be told that the questionnaires would be left for a while as suggested by Islam (2008) and Babbie (2002) to give room to the respondents to answer the questionnaire and it will be collected later.

Hence, after the respondents had completed the questionnaires, taking advantage from the face-to-face survey where the researcher has asked an open-ended question to the respondents. It was done as an expansion to the questionnaire. The questionnaire was first evaluated to know the elements that were rated as severe or critical by the respondents.

Method of Analysis

Since there are one types of data collected, the method used to analyze them is different. The quantitative data from the questionnaires were analyzed using descriptive statistics namely the frequency test in the Statistical Package for Social Science (SPSS) software, while the qualitative data from the close-ended question was analyzed manually.

To suit with the Malaysian situation, slight amendment was done to Pedro's method. Thus, the present study will use the mean score to rate the defects. Because of that, defects score in Pedro's study also changes from minor to critical at the score range of one (1) to five (5) that are; 1 = minor, 2 = slight, 3 = medium, 4 = severe and 5 = critical. Twenty-three (23) important building elements that have previously been decided were computed using the mean score. The mean score was then interpreted according to Alston and Miller (2001) and Boone et al. (2007) study. The close-ended responses about the causes of defects' occurrences were analyzed manually. The description below shows the extent to which this study rates the defects based on the mean score:

i) If the defects mean score is between 1 and 1.49, then the defects are considered minor
ii) If the defects mean score is between 1.50 and 2.49, then the defects are considered slight
iii) If the defects mean score is between 2.50 and 3.49, then the defects are considered medium
iv) If the defects mean score is between 3.50 and 4.49, then the defects are considered severe
v) If the defects mean score is between 4.50 and 5.00, then the defects are considered critical

The open-ended responses about the causes of defects' occurrences were analyzed manually.

Result and Discussion

Evaluation of Defects in Each of Museum Areas

The results reveal that in museum Melaka the defects are slight with the overall mean of 2.3. one elements were rated as minor and 13 elements were rated as slight. Nine other elements were rated as medium. There were one respondents in museum Melaka, who rated the apron as not critical. Three elements that were good in performance are foundation, column and beams. All three elements, there was only one case of minor defects (which affect the aesthetic value) making the mean of the elements 1.40. The result obtained is shown in table 3.

Table 3: Frequency of defects severity for Museum at Melaka

Criteria	Attribute	Defects Severity (Frequency)					MD	ROD
		MI	SL	ME	SE	CR		
Building Fabric	Ceiling	-	4	4	7	3	2.5	ME
	Floor	-	1	5	6	6	2.1	SL
	Roof	-	1	4	5	8	1.9	SL
	Window	-	2	5	5	6	2.2	SL
	Door	-	4	4	7	3	2.5	ME
	Internal wall	-	3	4	6	5	2.3	SL
	External wall	-	2	5	6	5	2.2	SL
	Arch	1	3	5	7	2	2.7	ME
	Ornament	1	4	5	6	2	2.8	ME
	Apron	3	4	6	5	-	3.3	ME
Building Structure	Foundation	-	-	2	5	11	1.5	SL
	Column	-	-	1	6	11	1.4	MI
	Beam	-	-	2	5	11	1.5	SL
	Truss	-	1	5	5	7	2.0	SL
	Staircase	-	2	4	7	5	2.2	SL
Building Service	Electricity system	-	2	4	7	5	2.2	SL
	ACMV system	-	2	4	7	5	2.2	SL
	Fire protection	-	2	4	7	5	2.2	SL
	Plumbing facilities	-	2	4	7	5	2.2	SL
	Lift	1	3	6	6	2	2.7	ME
	Gas system	3	6	5	3	1	3.4	ME
	Sewerage	2	3	5	5	3	2.8	ME
	Drainage	2	3	5	6	2	2.8	ME
	Overall Mean						2.3	SL

In museum Kelantan, defects data as presented in table 4 exhibits that there are reported two elements that have one critical defects namely the apron, and gas system. Only one critical case is reported to be the foundation, simultaneously being rated the worst condition in museum

area Kelantan. The mean for this element however is still slight that affects only the aesthetic view. All respondents from this museum agreed that their internal wall did not have any defect. The highest mean score is shown to be at the gas system with the important defects' mean score of 3.4. This score however is still in the range of medium defects. In this museum vicinity, most of the elements however were rated as slight. Only eight elements were rated as medium. Table 4 presents the results obtained for museum area Kelantan.

Table 4: Frequency of defects severity for Museum at Kelantan

Criteria	Attribute	Defects Severity (Frequency)					MD	ROD
		MI	SL	ME	SE	CR		
Building Fabric	Ceiling	-	3	4	6	3	2.4	SL
	Floor	-	1	4	6	5	2.1	SL
	Roof	-	1	3	5	7	1.9	SL
	Window	-	1	6	4	5	2.2	SL
	Door	-	2	4	7	3	2.3	SL
	Internal wall	-	1	4	6	5	2.1	SL
	External wall	-	1	4	6	5	2.1	SL
	Arch	-	3	4	6	3	2.4	SL
	Ornament	1	3	5	5	2	2.8	ME
	Apron	3	3	5	4	1	3.2	ME
Building Structure	Foundation	-	-	2	4	10	1.5	SL
	Column	-	1	2	4	9	1.7	SL
	Beam	-	1	2	4	9	1.7	SL
	Truss	-	1	3	5	7	1.9	SL
	Staircase	-	2	4	6	4	2.3	SL
Building Service	Electricity system	-	2	4	6	4	2.3	SL
	ACMV system	2	2	4	7	1	2.8	ME
	Fire protection	-	3	4	7	2	2.5	ME
	Plumbing facilities	-	2	4	7	3	2.3	SL
	Lift	2	3	5	4	2	2.9	ME
	Gas system	3	5	4	3	1	3.4	ME
	Sewerage	2	3	5	4	2	2.9	ME
	Drainage	2	3	4	5	2	2.9	ME
	Overall Mean						2.4	SL

In museum area Pahang, the highest mean score lies on the foundation with the mean score read 3.5. The rate of defects however is severe. The mean for each building element is in the range of slight defects except for the foundation, column and beam which defects are labeled minor. There are three elements that are in the worse condition in museum area Pahang. From 10 respondents who gave their feedback in museum area Pahang, 3 of them rated both elements as minor. Most of the respondents agreed that they did not have any problem with the gas system in their museum. Overall, the rate of defects for all elements in museum area Pahang is slight with the mean score of 2.2. The results for the frequency of defects' severity in museum area Pahang are presented in table 5.

Table 5: Frequency of defects severity for Museum at Pahang

Criteria	Attribute	Defects Severity (Frequency)					MD	ROD
		MI	SL	ME	SE	CR		
Building Fabric	Ceiling	-	1	2	5	2	2.2	SL
	Floor	-	1	2	3	4	2.0	SL
	Roof	-	-	2	4	4	1.8	SL
	Window	-	-	4	3	3	2.1	SL
	Door	-	1	2	5	2	2.2	SL

	Internal wall	-	-	2	4	4	1.8	SL
	External wall	-	1	2	4	3	2.1	SL
	Arch	-	1	2	5	2	2.2	SL
	Ornament	1	1	3	3	2	2.6	ME
	Apron	1	2	3	3	1	2.9	ME
Building Structure	Foundation	-	-	-	2	8	1.2	MI
	Column	-	-	1	2	7	1.4	MI
	Beam	-	-	1	2	7	1.4	MI
	Truss	-	-	3	3	4	1.9	SL
	Staircase	-	1	2	4	3	2.1	SL
Building Service	Electricity system	-	1	2	5	2	2.2	SL
	ACMV system	-	2	2	5	1	2.5	ME
	Fire protection	-	2	2	5	1	2.5	ME
	Plumbing facilities	-	1	2	5	2	2.2	SL
	Lift	1	3	2	2	2	2.9	ME
	Gas system	2	3	3	2	-	3.5	SE
	Sewerage	1	3	3	3	-	3.2	ME
	Drainage	-	1	3	4	2	2.3	SL
	Overall Mean						2.2	SL

The results for all three museum areas show that in each museum area surveyed, the most defective element is the not same from one area to another. Museum area Melaka has a problem with the column whereby in museum area Kelantan, the most problematic element is the foundation. The defect of gas system is so severe at museum area Pahang, in comparison with that element in other areas. Overall, the mean score for the most defective element in each museum area is slight. In these two museum areas, the open-ended response inhibits that the high level of defects is foundation function failure.

Evaluation of Defects in all Museum

Table 6 presents the overall result from all museum areas. The highest defects' mean score is the foundation with the mean score 1.4 with 29 of 44 respondents rating the defects as critical which suggests that there is have defect. The lowest mean score is the gas system with 3.4 with most of critical cases occurring on the gas system with 2 cases. Overall results suggest that the mean for all elements in all three museum areas surveyed was rated as slight (2.3) which fell in the range of 1.50 and 2.49. It can be concluded that the level of defects in the museum area is slight. This further makes an indication that the defect only affects the aesthetic value of the museum (overall).

Table 6: Frequency of defects severity for all Museum

Criteria	Attribute	Defects Severity (Frequency)					MD	ROD	Ranking
		MI	SL	ME	SE	CR			
Building Fabric	Ceiling	-	8	10	18	8	2.4	SL	15
	Floor	-	3	11	15	15	2.0	SL	6
	Roof	-	2	9	14	19	1.9	SL	4
	Window	-	3	11	16	14	2.1	SL	7
	Door	-	7	10	19	8	2.4	SL	13
	Internal wall	-	4	10	16	14	2.1	SL	8
	External wall	-	4	11	16	13	2.1	SL	9
	Arch	1	7	11	18	7	2.5	ME	16
	Ornament	3	8	13	14	6	2.7	ME	18
	Apron	7	9	14	12	2	3.2	ME	22
Building Structure	Foundation	-	0	4	11	29	1.4	MI	1
	Column	-	1	4	12	27	1.5	SL	2
	Beam	-	1	5	11	27	1.5	SL	3
	Truss	-	2	11	13	18	1.9	SL	5
	Staircase	-	5	10	17	12	2.2	SL	10
Building Service	Electricity system	-	5	10	18	11	2.2	SL	11
	ACMV system	2	6	10	19	7	2.5	ME	17
	Fire protection	-	7	10	19	8	2.4	SL	14
	Plumbing facilities	-	5	10	19	10	2.2	SL	12
	Lift	4	9	13	12	6	2.8	ME	20
	Gas system	8	14	12	8	2	3.4	ME	23
	Sewerage	5	9	13	12	5	2.9	ME	21
	Drainage	4	7	12	15	6	2.7	ME	19
	Overall Mean						2.3	SL	

These results show the overall mean for all element of defects in the museum are slight. Based on the scale in Pedro's (2008) study, it can be concluded that most of the defects in museums have defects that only impact on the aesthetic value of the museum and no to serious. According to Yusof and Shafiei (2011) and Sufian and Rahman (2008) who note that the practice of build first and maintains later may provide less defective museums. In other words, the practice of the museum has been proven to be successful in providing museum with low defects. As for the causes of defects' occurrences, most of respondents agreed that the defects happen because maintenance not follow the work schedule assigned.

Conclusion

The findings have justified the reason why maintenance for the museum building should be implemented in Malaysia. Although the museum defects are slight, the results from the close-ended responses imply that there are cases where the workmanship and the material used by certain owner museum are unsatisfactory. The result shows that museum areas Melaka, Kelantan and Pahang have relatively higher level of defects in terms of the technical aspects of defects (defects that occur when the efficiency of an element is reduced, reasoned by the poor workmanship and materials of inferior quality). It seems to suggest at this point, there is a problem with the maintenance practice and as for the users, when they inspect the museum before making the decision to repair, the surface knowledge that they have is proven to be insufficient for them to be able to detect such defects. In this case, the government should be stricter in implementing the law and acts in such a way to continuously monitor the maintenance phase for the maintain museum. Alternatively, it may be better if owner museum appoints building surveyors for expert advice before they make the decision to repair.

Acknowledgment
This paper was partly sponsored by the Centre for Graduate Studies Universiti Tun Hussein Onn Malaysia, for making this publication possible.

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