



Heriot-Watt University
Research Gateway

Best practice criteria for sustainable maintenance management of heritage buildings in Malaysia

Citation for published version:

Sodangi, M, Khamidi, MF, Idrus, A, Hammad, DB & Ahmedumar, A 2014, 'Best practice criteria for sustainable maintenance management of heritage buildings in Malaysia', *Procedia Engineering*, vol. 77, pp. 11-19. <https://doi.org/10.1016/j.proeng.2014.07.017>

Digital Object Identifier (DOI):

[10.1016/j.proeng.2014.07.017](https://doi.org/10.1016/j.proeng.2014.07.017)

Link:

[Link to publication record in Heriot-Watt Research Portal](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Procedia Engineering

General rights

Copyright for the publications made accessible via Heriot-Watt Research Portal is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

Heriot-Watt University has made every reasonable effort to ensure that the content in Heriot-Watt Research Portal complies with UK legislation. If you believe that the public display of this file breaches copyright please contact open.access@hw.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Fourth International Symposium on Infrastructure Engineering in Developing Countries, IEDC
2013

Best Practice Criteria for Sustainable Maintenance Management of Heritage Buildings in Malaysia

Mahmoud Sodangi^{a,*}, Mohd Faris Khamdi^b, Arazi Idrus^c, Dabo B. Hammad^d,
Abdullahi AhmedUmar^d

^aUniversity of Dammam, Dammam, Eastern Province, Kingdom of Saudi Arabia

^bHeriot-Watt University Malaysia, Precinct 2, 62100 Putrajaya, Malaysia

^cNational Defence University of Malaysia, Sungai Besi Camp, 57000 Kuala Lumpur, Malaysia

^dUniversiti Teknologi PETRONAS, Bandar Seri Iskandar, 31750 Tronoh, Perak, Malaysia

Abstract

Sustainable development and heritage conservation have become guiding principles for our modern industrial society. In order to achieve a sustainable management of heritage building conservation in Malaysia, it is vital that maintenance takes a leading role in conserving the heritage values of the buildings. However, there has been no published work on assessment of the relative importance of each best practice criteria for sustainable maintenance management of heritage buildings in Malaysia. Thus, this paper is aimed at identifying and ranking the criteria that support sustainable best practice. Data collected through questionnaire which covered a selected sample of experts in the field of heritage building conservation. Data were analyzed using Relative Importance Index (RII), Kendall's concordance test, and Pearson's Chi-Square test. The results show that maintenance staff training and expertise was the most important criterion considered crucial by the respondents in supporting sustainable best practice. The paper is a pioneering attempt at establishing the criteria that support sustainable best practice in the maintenance management of heritage buildings in developing countries like Malaysia.

© 2014 Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

Peer-review under responsibility of the Accounting Research Institute, Universiti Teknologi MARA.

Keywords : Conservation; heritage building, maintenance management, Malaysia; sustainability

* Corresponding author. Tel.: +2348035965317

E-mail address: sodangimahmoud@gmail.com

1. Introduction

It is mainly through sustainable heritage conservation that we can pass onto future generations what is currently identified as being of cultural significance today. This would be difficult to achieve if sustainable best practice approach to the maintenance management of heritage buildings is not fully adopted. This paper shall assess the relative importance of each best practice criteria for sustainable maintenance management of national heritage buildings in Malaysia. The paper shall serve as a pioneering attempt at establishing the criteria that support sustainable best practice in the maintenance management of heritage buildings in developing countries like Malaysia. Moreover, the paper shall provide supportive practical solution for decision makers in heritage building conservation to enhance and improve their sustainable practices in managing the maintenance of heritage buildings.

1.1. Background of the Study

The most fascinating aspects of Malaysia's history and its evolving culture are demonstrated through its heritage buildings. The country is blessed with a rich legacy of heritage buildings with unique architectural and historical values [1]. The buildings serve as the cultural identity of the country and its people. Malaysia enjoys distinctive multicultural architectural heritage with strong Islamic, Chinese and Western influences; all of which have been portrayed in the heritage buildings. The over three centuries of colonial rule in Malaysia is still evident today by the presence of the unique colonial architectural styles left behind by colonial powers of the Portuguese, Dutch and British. These unique heritage buildings can be seen in all major cities and were fundamental to the establishment of heritage cities in the country [2]. Cities like George Town, Ipoh, Kuala Lumpur, Kuching, Malacca and Taiping have many historical buildings built during the colonial era (1511 -1957) with different architectural styles and influences.

Moreover, Malaysia inherited hundreds of heritage buildings from the Indians, Chinese and the indigenous traditional buildings. To date, the heritage buildings in these cities have become one of the urban identities for these cities [3]. Common examples of these buildings include railway stations, mosques, prisons, schools, palaces, traditional Malay houses, Indian temples, Chinese shop houses, churches, clock towers, institutional buildings, monuments etc. On the aesthetic nature of these buildings, Reference [3] pointed out that the buildings are essentially heterogeneous in origin. He categorized them into four major architectural styles namely Moorish (Old general post office built in 1894), Tudor (Royal Selangor club built in 1884), Neo-classical (Municipal council building in George town built in 1879) and Neo-gothic (Carcosa mansion built in 1897). Heritage buildings are commonly found in many historic cities throughout Malaysia.

An inventory study undertaken in 1992 and 1993 at the government's request by the Heritage Trust of Malaysia in conjunction with the National Museum, the Housing and Local Government Ministry and Faculty of Built Environment, Malaysia University of Technology (UTM) reveals that there are near 39,000 historic buildings built between 1800 and 1948 throughout the country which are worthy for preservation and conservation. Buildings built within these periods are classified as 'pre-war buildings' due to their year of build, ranging from 1800 to 1948. These buildings are commonly found in many historic cities throughout Malaysia. The unique colonial architectural styles of these buildings have played major role in the creation of historic cities such as George Town, Ipoh, Malacca, Taiping, Kuala Lumpur and Kuching.

The identity of a people and nation is largely defined by their heritage [4]. Heritage is something which is passed down from one generation to another. Reference [5] affirmed that in order to pass on to future generations what is currently identified as being of cultural significance today, we must imbibe good conservation practices especially for heritage buildings in order to prevent them from deterioration and extend the life and basic functions of these buildings. This would be difficult to achieve if the best practice approach to the sustainable maintenance management of heritage buildings is not fully adopted. As pointed out by Reference [5], heritage buildings differ from modern buildings in the sense that that they are anticipated to last for as long as possible.

In Malaysia today, heritage buildings are regarded as highly valuable assets due to their historical values and tourism potentials. These buildings are regarded as assets to the tourism industry because of their strong influence in motivating foreign tourists to visit the country. The industry generates significant tourism revenue - Gross

National Income of RM56.5 billion in 2010 to the Malaysian economy [2]. This makes the tourism industry one of the most important sources of economic growth. Foreign tourists are attracted to these buildings due to their cultural uniqueness, high historical and architectural values, and the strong desire to see something different [2]. Therefore, it is paramount to conserve these buildings by continuously caring and protecting them from being destroyed so as to prolong their life span and functions.

Sustainable development and heritage conservation have become guiding principles for our modern industrial society. Conservation of heritage buildings has environmental sustainability benefits. Heritage building conservation reduces energy usage associated with demolition, waste disposal and new construction, and promotes sustainable development by conserving the embodied energy in the existing buildings. In order to achieve a sustainable management of heritage building conservation in Malaysia, it is vital that maintenance takes a leading role in conserving the heritage values of the buildings[6].

Heritage buildings require sustainable maintenance management practices that are essential in extending the life of the buildings and avoiding the need for potentially expensive and disruptive repair works, which may damage the buildings heritage value. However, there has been no assessment of the relative importance of each best practice criteria for sustainable maintenance management of heritage buildings in Malaysia. Therefore, the main purpose of this paper is to identify and rank the criteria that support best practice for sustainable maintenance management of heritage buildings in Malaysia based on the perceptions of the in-house experts, Academics and Consultants.

2. Best practice criteria supporting sustainable maintenance management of heritage buildings in Malaysia

An extensive literature review was carried out on best practices in general building maintenance management and conservation of heritage buildings. Based on this review and interview with some experts in heritage building conservation, a combined list of 26 criteria influencing a best practice in the maintenance management of national heritage buildings was produced. A two-stage expert pilot survey was carried out and at each stage, the experts eliminated those criteria that they perceived do not considerably support best practice approach in the maintenance management of Malaysian national heritage buildings. At the end of the pilot survey, the 26 criteria obtained from literature review and interview with the experts were pruned down to 16. The list of the 16 criteria that should be given higher priority in the maintenance management of Malaysian national heritage buildings was produced and sent to the respondents using questionnaires to rate the importance of each criteria.

Although the criteria may not be exhaustive due to complexities associated with maintenance management of heritage buildings, however, the list covered the significant criteria that support best practice approach to the maintenance management of national heritage buildings in Malaysia. The criteria are listed and briefly described in Table 1.

3. Methodology

A questionnaire was used to collect factual and perceptive responses and measure attitudes regarding the best practice criteria that support effective maintenance management of heritage buildings. Reference [7] argued that the questionnaire is a widely used approach for descriptive and analytical surveys to find out the facts, opinions and views of respondents. An e-mail based questionnaire was chosen for the survey in view of its reduced response time, low cost and the fact that all the respondents have access to the internet. Reference [8] have pointed out that e-mail based questionnaires have several important advantages over paper- and-pencil surveys that make them particularly attractive to researchers. These questionnaires provide reduced response time, better response quality, lower cost, ease of data entry, flexibility of and control over format, advances in technology, recipient acceptance of the format, and the ability to obtain additional response-set information. The development of the questionnaire was done in such a way that each question would be clearly phrased to avoid ambiguity and checked for expression, objectivity and relevance to the problem being investigated.

For the purpose of this research, purposive sampling was adopted because it allows the selection of respondents whose experience permit an understanding of maintenance management for heritage buildings which will be very

valuable for this research. Also, the adoption of purposive sampling helped to eliminate respondents who did not fit the requirements [9]. The population from which samples are drawn, i.e. the sampling frame for the consultants and Conservation Personnel was formed from a recent list made available to the researcher by the National Heritage Department of Malaysia and Non-Governmental Heritage Organizations like Heritage of Malaysia Trust, Penang, Melaka and Johor Heritage Trusts. These respondents were carefully chosen because of their greater heritage building conservation consciousness as they are expected to be better informed about what constitutes good heritage building conservation practices and the relationship between maintenance management and heritage building conservation.

Table 1 Best practice criteria supporting sustainable maintenance management of heritage buildings in Malaysia

Criteria	Brief Comments
Retaining cultural significance ('retaining')	Preserving and enhancing the cultural significance and functionality of heritage building
Clear maintenance Policies ('policies')	These consist of clear statement of objectives and techniques needed to be adopted in keeping heritage buildings fit for use and conserving their values
Conservation Plan ('conservation')	A document which describes why a heritage building is important and how that importance will be retained in any future use, alteration, development or repair.
Management Plan ('management')	This serves as a tool for the implementation of conservation plan
Management processes and procedures ('processes')	These are set of processes and procedures needed for maintenance implementation.
Change in Attitude ('attitude')	Custodians of heritage buildings changing their mindset on conserving the heritage values of the buildings
Maintenance prioritization ('prioritization')	Sequence of carrying out maintenance work which depends on pre-determined priorities
Regular inspections ('inspections')	Checks carried out varying frequencies to ensure maintenance is carried out before expensive corrective maintenance has to be done
Information management ('information')	Planning, organizing, controlling and coordinating the collection, storage and retrieval of suitable information to ensure efficient and effective maintenance management of heritage buildings
Maintenance Staff Training and Expertise ('training')	Continuous training of maintenance staff to acquire appropriate skills, attitude and degree of sensitivity required of personnel dealing with maintenance and its management
Conservation consciousness ('consciousness')	Preservation awareness among individuals and organizations that have heritage buildings within their care
Financial Planning and Budgets ('financial')	Having greater financial control through adopting planned maintenance programmes and restricted maintenance budgets.
Monitoring and review systems ('monitoring')	These are methods in examining the maintenance units for the purpose of protecting the cultural significance of heritage buildings
Planned maintenance approaches ('approaches')	Programmes aimed at preventing loss of any part of the heritage buildings by maintaining them in a proper order e.g. planned preventive maintenance
Organizational culture and structure ('organizational')	Empowering the maintenance function to have greater control in making decisions that affect heritage buildings
Integration with corporate strategy ('integration')	Integrating maintenance management decisions with the corporate objectives of organizations that have heritage buildings within their care.

Eventually, the list of respondents was drawn comprising Consultants (experts working with NHD who undertake a wide range of heritage and conservation projects and provide professional consulting services in relation to buildings, structures and sites of cultural significance), Conservation personnel of the National Heritage

Department (NHD) and Conservation Personnel of the Non-Governmental Heritage Organizations in Malaysia (NGHO). In administering the questionnaires, respondents were asked to rate the level of importance of a list of best practice criteria in the maintenance management of national heritage buildings in Malaysia. The rating was based on a 5-point Likert scale where 1=Not at all important, 2=Slightly important, 3=Important, 4=Very important and 5= Extremely important.

4. Analyses and Results

Since purposive sampling was adopted in this survey to allow for the selection of respondents whose experience permit an understanding of maintenance management for heritage buildings, a minimum sample size of 30 was taken as the minimum set for the survey. Of the original sample of questionnaires, 52% were returned fully completed and the number exceeded the minimum specified above. Compared with other similar surveys in the areas of construction and facilities management, e.g. 21% by [10] and 30-40% by [11]; the response rate obtained (52%) is considered to be good.

The data collected from the survey were ordinal because the distances between any two numbers (ratings) assigned in the Likert scale are not known. The use of parametric statistics (means, standard deviations, etc.) to analyze such data would not produce meaningful results and non-parametric procedures should therefore be adopted [12]. The non-parametric procedures adopted for this study were relative importance index analyses, Kendall's concordance test and the Chi-square test.

Relative Importance Index (RII) is a non-parametric technique widely used by construction and facilities management researchers for analyzing structured questionnaire responses for data involving ordinal measurement of attitudes [13]. This method uses weighted scores to compare the relative importance of the criteria under study. It is chosen for the analysis of the data collected from this survey, within various categories classified as in-house experts, academics and consultants [14]. The five-point scale was transformed to relative importance indices for each criterion, using the above method to obtain the ranks of the different criteria [15]. These ranking enabled the researcher to cross-compare the relative importance of the criteria as perceived by the three categories of respondents [16]. However, the mean and standard deviation of each individual criterion are not appropriate statistics to evaluate the overall rankings because they do not reflect any relationship between them [17]. As such, all the numerical scores of the identified criteria were transformed to relative importance indices to determine the relative ranking of the criteria. The relative importance index (RII) was calculated using the following expression:

$$RII = \frac{\sum w}{A \times N} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1}{5 \times N} \quad (1)$$

RII ranges from zero to one ($0 \leq \text{index} \leq 1$). w is weighting given to each criteria by the respondents and ranges from 1 to 5 where 1 is not at all important and 5 is extremely important. A is highest weight (5 is the highest in this paper); N is total number of respondents; n_1 is number of respondents for not at all important; n_2 is number of respondents for slightly important; n_3 is number of respondents for important; n_4 is number of respondents for very important; and n_5 is number of respondents for extremely important.

Table 2 shows the general background of the respondents; Consultants have the highest proportion (37.21%). This adds validity to the responses. Remarkably, over 85% of the respondents have their academic background in built environment courses and about 79% of them have more than 20 years of professional working experience. These could be considered very relevant in prioritizing the best practice criteria in the maintenance management of national heritage buildings in Malaysia. Interestingly, about 95% of the respondents have been involved in more than 10 conservation projects mostly conservation of colonial heritage buildings in the form of rehabilitation projects. These justify their selection as respondents for the survey.

Table 2 General Background of Respondents

Background	NHD Experts (%)	NGHO Experts (%)	Consultants (%)	Total (%)
Designation	30.23	32.56	37.21	100.00
Academic Background				
Architecture	9.30	13.95	13.95	37.20
Bldg Conservation	6.98	6.98	4.65	18.61
Bldg Surveying	13.95	11.63	6.98	32.56
Civil/Structural Eng	0.00	0.00	11.63	11.63
Total	30.23	32.56	37.21	100.00
Years of working experience in present profession				
Less than 5	0.00	0.00	0.00	0.00
5 to 10	4.65	0.00	0.00	4.65
11 to 20	9.30	6.98	0.00	16.28
More than 20	16.28	25.58	37.21	79.07
Total	30.23	32.56	37.21	100.00
No of Previous heritage building conservation projects				
Less than 5	0.00	0.00	0.00	0.00
5 to 10	4.65	0.00	0.00	4.65
More than 10	25.58	32.56	37.21	95.35
Total	30.23	32.56	37.21	100.00
Type of Heritage building conserved				
Colonial	18.60	16.28	11.63	46.51
Traditional Malay	6.98	4.65	16.28	27.91
Traditional Chinese	2.33	9.30	4.65	16.28
Traditional Indian	2.33	2.33	4.65	9.31
Total	30.23	32.56	37.21	100.00
Nature of previous conservation project				
Major Repairs	4.65	6.98	9.30	20.93
Restoration	11.63	13.95	11.63	37.21
Rehabilitation	13.95	11.63	16.28	41.86
Total	30.23	32.56	37.21	100.00

Table 3 on the other hand shows the summary of the relative importance indices (RII) and ranks (R) for the criteria that support best practice in the maintenance management of national heritage buildings in Malaysia. Similarly, Figure 2 shows the profiles of the best practice criteria as perceived by the respondents as well as their weighted averages. It was observed in Table 3 that that the three most important criteria as perceived by the respondents were ‘maintenance staff training and expertise’, ‘financial planning and budgets’ and ‘conservation plan’. NHD and NGHO both ranked maintenance staff training and expertise (RII of 0.954 and 0.943 respectively) as the most important criteria that support best practice in the maintenance management of national heritage buildings in Malaysia while Consultants ranked it as 8.5th criteria. This shows that there is dissimilarity of the orderings of the data when ranked by each of the three categories. This could be that the ranks of both NHD and NGHO increase while that of Consultants decreases. As such, it can be asserted that there is a negative correlation between the rankings of these respondents for this particular criterion.

Table 3 Summary of the relative importance indices (RII) and ranks (R) for the criteria that support best practice in the maintenance management of national heritage buildings in Malaysia

Criteria	General		NHD Experts		NGHO Experts		Consultants	
	RII	R	RII	R	RII	R	RII	R
Training	0.935	1	0.954	1	0.943	1	0.913	8.5
Financial	0.930	2	0.938	3	0.914	2	0.938	5.5
Conservation	0.930	3	0.938	4	0.900	5	0.950	1
Management	0.926	4	0.923	5	0.914	3	0.938	5.5
Retaining	0.921	5	0.938	2	0.886	6	0.938	2.5
Inspections	0.902	6	0.923	7	0.871	8	0.913	10
Policies	0.893	7	0.862	12	0.9	4	0.913	8.5
Information	0.893	8	0.923	6	0.857	10	0.900	11.5
Consciousness	0.893	9	0.892	9	0.857	11	0.925	7
Processes	0.879	10	0.877	11	0.857	9	0.900	11.5
Prioritization	0.879	11	0.846	14	0.843	13	0.938	2.5
Approaches	0.874	12	0.862	13	0.814	16	0.938	2.5
Monitoring	0.865	13	0.908	8	0.843	12	0.850	15
Attitude	0.865	14	0.892	10	0.814	15	0.888	13
Organizational	0.837	15	0.769	16	0.871	7	0.863	14
Integration	0.823	16	0.785	15	0.829	14	0.850	16

However, from the perspective of the consultants, they ranked conservation plan as the most important criteria because it is a vital document which describes why a heritage building is important and how that importance will be retained in any future use, alteration, development or repair. Notwithstanding these differences, maintenance staff training and expertise is being regarded as fundamental pillar of heritage building conservation. Reference [18] emphasized that maintenance management for historic buildings is very skilled and requires responsible and competent personnel. For maintenance management to be effective, managers should have the requisite specialist qualification as well as appropriate experience [19]. Reference [20] further pointed out that maintenance works involves the management of wide range of different skills and professional input. Also, the role of maintenance management needs good strategic management skills, as well as being able to deal with a wide range of tactical processes and related issues [21].

Financial planning and budgets was ranked 3rd (RII = 0.938), 2nd (RII = 0.914) and 5.5th (RII = 0.938) by the NHD, NGHO and Consultants respectively. Irrespective of the slight disagreement in the rankings, this criterion is considered equally paramount in maintenance management of heritage buildings. For clear and comprehensive heritage building maintenance management systems to be implemented successfully; there should be a long term financial planning and ring-fenced budgets for maintenance [22]. This long term financial planning for maintenance enables the maintenance managers to tactically take into account the implications of managing the maintenance workload over time [20]. More so, a periodic review of maintenance budgets provides an opportunity for a reconsideration of maintenance priorities previously established, and this is considered a good practice in the maintenance management of heritage buildings. Therefore, for efficient maintenance management of heritage buildings, a greater consistency between business strategy, maintenance policy, financial management and maintenance implementation is required.

The next most important criteria is Conservation Plan which ranked 3rd (RII=0.930) in the general ranking but ranked 1st (RII=0.950), 4th (RII=0.938) and 5th (RII=0.900) by the Consultants, NHD and NGHO respectively. The ranking (1st position) of this criterion by the consultants is not surprising at all, after all, these are experts who undertake a wide range of heritage and conservation projects and provide professional consulting services in relation to buildings, structures and sites of cultural significance. Above all, they know the high significance of conservation plan in the maintenance management of heritage buildings. Conservation plan is a document which describes why a heritage building is important and how that importance will be retained in any future use,

alteration, development or repair. It is a primary document used in ascertaining a clear picture of the building in its present condition and in informing any decisions about its future. It therefore seeks to provide a thorough and accurate examination of the building's historical development, recording important features in an accessible and clear way, allowing informed decisions to be made about future programmes of repair and restoration. Most significantly, it identifies the sensitivity of parts of the building to possible change and will help to guide proposals for future uses. Although each conservation plan is tailored to the needs of each building, yet a typical plan would include a summary of historic research, architectural description, inventory, condition assessment, statement of significance and recommendations for conservation and repair.

'Attitude', 'Organizational culture & structure' and 'Integration with corporate strategy' were ranked in the last three positions with RII of 0.865, 0.837 and 0.823 respectively. However, NHD ranked attitude in 10th position (RII=0.892), NGHO in 15th (RII=0.814) and Consultants in 13th (RII=0.888) positions. This illustrates that NHD conservation personnel perceive change in attitude to be more important in managing the maintenance of heritage buildings in the country. This could be attributed to the fact that the NHD conservation team members are more aware on the urgent needs to have a change in attitude by showing much greater awareness and good understanding of the cultural significance of the buildings under the care of the National Heritage Department.

Interestingly, NGHO ranked organizational culture & structure in 7th position (RII of 0.871) while NHD and Consultants ranked it in 16th (RII=0.769) and 14th (RII=0.863) respectively. This negative correlation between the rankings of these respondents for this particular criterion is an indication that the NHD and Consultants are more realistic and pragmatic in the sense that they are aware that maintenance function does not have greater centrality and input into the strategic decision making process affecting heritage buildings [22]-[23]. This could be attributed to the fact that a large number of personnel responsible for the routine care of heritage buildings lack special managerial and professional expertise in the maintenance management of heritage buildings [24]. As a result, the maintenance function has a low status. With this deficiency, empowering them might be considered detrimental to successful management of heritage building maintenance.

Integration with corporate strategy was ranked 15th (0.785), 14th (0.829) and 16th (0.850) by the NHD, NGHO and Consultants respectively. This result indicates that the respondents are convinced that criteria like conservation plan, management plan, management processes and procedures and planned maintenance approaches overshadow this criterion when it comes to maintenance management of heritage buildings as such it has an aggregated ranking of 16th (RII=0.823).

5. Conclusion

Conservation of heritage buildings has environmental sustainability benefits. Heritage building conservation promotes sustainable development by conserving the embodied energy in the existing buildings. In order to achieve a sustainable management of heritage building conservation in Malaysia, it is vital that maintenance takes a leading role in conserving the heritage values of the buildings. Malaysian heritage buildings are regarded as valuable assets to the tourism industry due to their strong influence in motivating foreign tourists to visit the country. Therefore, it is paramount to conserve these buildings by continuously caring and protecting them from being destroyed so as to prolong their life span and functions. It is mainly through heritage conservation that we can pass onto future generations what is currently identified as being of cultural significance today, and this would be difficult to achieve if the best practice approach to the sustainable maintenance management of heritage buildings is not fully adopted. This paper assessed the relative importance of each best practice criteria for sustainable maintenance management of national heritage buildings in Malaysia. It was found out that "maintenance staff training & expertise"; was the most important criteria that support sustainable best practice in the maintenance management of heritage buildings in Malaysia as agreed by the respondents. This paper is a pioneering attempt at establishing the criteria that support sustainable best practice in the maintenance management of heritage buildings in developing countries like Malaysia. The paper provides supportive practical solution for decision makers in heritage building conservation to enhance and improve their sustainable practices in managing the maintenance of heritage buildings.

References

- [1] Sodangi, M., Khamidi, M.F., Idrus, A. 2013a. Maintenance Management Challenges For Heritage Buildings Used As Royal Museums in Malaysia. *Journal of Applied Sciences and Environmental Sustainability*, 1 (1), 23-28.
- [2] Idrus, A., Khamidi, F., and Sodangi, M. 2010. Maintenance Management Framework for conservation of Heritage Buildings in Malaysia. *Journal of Modern Applied Science*, Vol. 4, No. 11 pp 66-77.
- [3] Ahamd, G.A. 2002. "Challenges of Colonial Heritage Buildings in Malaysia". *Proceedings of the International Conference on the Politics of World Heritage*, The University of North London, UK 2-4 September.
- [4] Prentice, R. 1994. Perceptual deterrents to visiting museums and other heritage attractions. *Journal of Museum Management and Curatorship*, Vol 13, Issue 3. pp 264 – 279.
- [5] Sodangi, M., Idrus, A., Khamidi, F., Adam, Dahiru. 2011a. Environmental Factors Threatening the Survival of Heritage Buildings in Nigeria. *South Asian Journal of Tourism and Heritage*, Vol. 4, No. 2, pp 38-53.
- [6] Sodangi, M., Khamidi, M.F., Idrus, A. 2013b. Towards Sustainable Heritage Building Conservation in Malaysia. *Journal of Applied Sciences and Environmental Sustainability*, 1 (1), 54-61.
- [7] Fellows, R. and Liu, A. 1997. *Research Methods for Construction*. 3rd ed., Blackwell Science, Oxford.
- [8] Granello, D. H., & Wheaton, J. E. 2004. Online data collection: Strategies for research. *Journal of Counselling & Development*, 82, 387-393.
- [9] Idrus, A. B. 2001. *Development of Procedure and Tool for Evaluating and Selecting Concrete Floor Systems for Concrete Frame Buildings*, PhD Thesis, Imperial College of Science Technology and Medicine, London.
- [10] Proverbs, D.G., Holt, G.D. and Olomo;aiye, P.O. 1999. European construction contractors: a productivity appraisal of in-situ concrete operations. *Journal of Construction Management and Economics*, 17(1), 221-230.
- [11] Aibinu, A. A. and Jagboro, G. O. 2002. The effects of Construction Delays on Project Delivery in Nigerian Construction Industry. *International Journal of Project Management*, Elsevier, 20, 593-599.
- [12] Johnson, R. A. and Bhattacharyya, G. K. 1996. *Statistics: Principles and Methods*. Wiley, New York.
- [13] Chan, D.W.M. and Kumaraswamy, M.M. 1997. A Comparative Study of Causes of Time Overruns in Hong Kong Construction Projects. *International Journal of Project Management*, Vol. 15, No. 1, pp. 55-63.
- [14] Sodangi, M., Idrus, A., and Khamidi, M.F. 2011b. "Examining the Maintenance Management Practices for Conservation of Heritage Buildings in Malaysia". In: *National Postgraduate Conference 2011 (NPC 2011)*, 19-20 Sept 2011, UniversitiTeknologi PETRONAS, Tronoh, Perak, Malaysia.
- [15] Naoum, S.G. 1998. *Dissertation Research and Writing for Construction Student*. Reed Educational and Professional, Oxford.
- [16] Odusami, K.T. 2002. Perception of Construction Professionals Concerning Important Skills of Effective Project Leaders. *Journal of Management in Engineering*, Vol. 18, No. 2. Pp. 61-67.
- [17] Enshassi, A., Mohamed, S. and El Karriri, A. 2010. Factors Affecting the Bid/No Bid Decision in the Palestinian Construction Industry. *Journal of Financial Management of Property and Construction*, Vol. 15, No. 2
- [18] Feilden, B. 1982. *Conservation of Historic Buildings*. Oxford: Butterworth.
- [19] Wordsworth, P. 2001. *Lee's Building Maintenance Management*. 4th Ed, London: Blackwell Science.
- [20] Chartered Institute of Building, 1990. *Maintenance Management: A Guide to Good Practice*. Ascot: CIOB.
- [21] Barrett, P. 1995. *Facilities Management: Towards Best Practice*. Oxford: Blackwell Science.
- [22] *Maintain our Heritage 2003*. Best Practice Maintenance Management for Listed Buildings. Final Report Submitted to Maintain our Heritage by the University of the West of England, Bristol, September.
- [23] Feilden, B.M. and Jokilehto, J. 1993. *Management and Guidelines for World Cultural Heritage Sites*. International Centre for the Study of the Preservation and Restoration of Cultural Property, Rome, P.3.
- [24] Sodangi, M., 2012. *Development of Maintenance Management Frmaework for the conservation of Heritage Buildings in Malaysia*. Unpublished PhD thesis, UniversitiTeknologi PETRONAS, Perak, Malaysia.