

Factors Influencing the Cost for Effective Heritage Building Maintenance Programme: Case Study in Ipoh, Perak

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Abstract: The abandoned buildings continue to be used and given new breath in terms of appearance, functionality and historical value. Maintenance costs are the most critical factor in order to conduct the best approach in heritage building maintenance. Shortage of annual maintenance budget will reduce the building services capacity and system effectiveness. The objectives of this study are to identify the factors influencing the cost of effective program maintenance for building heritage, to determine the significant factors influencing the cost of effective program maintenance for building heritage, and to suggest the best approaches in preparing effective maintenance programs for heritage buildings. The building becomes a subject for this case study is Dewan Bandaraya Ipoh. The method used in this study is conducting by using a structured interviews. The selected respondents were been asking a question with the help of a Likert Scale to ease them in answering the questions. Most of respondents are those who were involved directly with heritage building maintenance. The factors of building age and existing building condition become the most influencing factors for the cost of each effective maintenance program for Dewan Bandaraya Ipoh buildings in Ipoh, Perak. In conclusion, one of the workflow diagram have been suggested and modified as the best approach of an effective maintenance programme for a heritage building. The workflow eliminates unnecessary decisions, and it could reduce the time taken to decide on a maintenance programme.

Keywords: Cost of Maintenance, Heritage Building, Building Maintenance

1. Introduction

The United Nations Educational, Scientific and Cultural Organization or UNESCO stated that the World Heritage is classified into several heritage classes. The heritage classes are Natural, Cultural, and Underwater Heritage. For Cultural Heritage, it is separated into two categories – tangible and

intangible cultural heritage [1]. UNESCO adopted Convention Concerning the Protection of the World Cultural and Natural Heritage or known as World Heritage Convention or the Convention in November 1972.

The word "heritage" was described as "concrete or intangible type of cultural property, structure or artefact and may include a heritage matter, object, item, artefact, structure of creation, performance, dance, song, music relevant to Malaysians 'historical or modern manner of life' [3]. Heritage buildings can also be categorised as "pre-war buildings" as their year of construction was between 1800 and 1948 [4].

1.1 Building Maintenance

Cultural identities for heritage buildings are essential to be known by the younger generation. A new function is needed to be considered when a heritage building can no longer function its original use. This is to preserve the significant and vital of the heritage buildings [2]. In order to keep the heritage building in optimum condition and shape, it needs to have an effective heritage building maintenance programme. This case study focuses on factors influencing the cost of an effective heritage building maintenance programme at Dewan Bandaraya Ipoh, Perak.

Building maintenance is the system of technological and administrative acts to maintain a building's facilities and elements in an acceptable standard to serve its essential purpose within a cycle of operation starting from building handover to demolition [11],[16]. The objectives of building maintenance are to ensure that the buildings and their related services were in a safe condition, to ensure that the buildings were fitted to use, to ensure that the condition of the building meets all standard requirements and to carry out the required maintenance work to maintain the value of the physical assets and quality of the building. The common types of maintenance approach are as follows [7]:

i. Proactive maintenance

Proactive maintenance detects failure from its origin, and its primary purpose was to prolong the component's life to the extent possible by adopting a high level of mastery without losing operational accuracy.

ii. Preventive maintenance

This approached type was further divided into two forms scheduled for preventive maintenance and condition-based preventive maintenance. Scheduled preventive maintenance was performed at item or component, based on use or time, on a scheduled time. Although condition-based preventive maintenance was conducted based on the actual condition of the item or part as reported from continuous monitoring.

iii. Corrective maintenance

This type of maintenance was performed to restore a failed part. It intended to return the part to a state of the regular performance of its necessary feature. It was the purest form of maintenance but could be costly due to the tendency of a component to fail and lead to a large amount of consequential to other building elements. Furthermore, this type of maintenance approach was only appropriate if the cost of preventive measures was not justified by the impact of a failure, meaning that the consequences of failure were ignored or not significant.

iv. Predictive maintenance

Usually, predictive maintenance used statistical modelling based on component information to predict when and how an incident could occur. This applies to condition-based maintenance and uses condition-based maintenance calculation and control methods such as

vibration analysis, infrared thermography, and ultrasonic detection. It also involves equipment inspections during both running and stoppage periods.

v. Emergency maintenance

This approach was used to rectify issues that could lead to errors and severe cases of consequences. For example, a gas and other utilities.

1.2 Factors Influencing the Cost of Building Maintenance

Many factors that can affect the cost of building maintenance programs have been identified based on previous studies. The factors listed below are the most significant in determining the cost of building maintenance according to previous studies.

i. Limited or insufficient maintenance budget factor

The amount of maintenance performed decreased proportionally when the budget was insufficient or limited. In the future, this can cause the postponement of needed maintenance and could cause significant repairs [8]. Second, building owners needed to allocate enough budget for maintenance work during the preparation of the annual budget. If maintenance activities were not carried out based on actual need, there might have been an over-budget problem in operation and maintenance phase due to the postponement of certain maintenance activities [9]. Lastly, a sufficient budget must support the building maintenance activity. The allocation of the budget was one of the obstacles in building maintenance planning [10].

ii. Building age factor

Generally speaking, when the building age is older, more specific maintenance work needs to be performed, and more attention and focus needs to be given. The age of a building has a close relationship with maintenance costs. When the age of building increase, then the maintenance cost also increase. This happens because old building required some maintenance works such as painting work, replacement of new roof tiles and other works are required to ensure the sustainability of the building. Thus, the maintenance cost is likely to be increased over the aging of the building [11].

iii. Selection of material factor

The building defects and deteriorations were the common issues occurred in heritage buildings. The maintenance work needed to improve quality and safety for Town Hall Building and the Georgetown Heritage Centre Building. It involves the heritage value which the maintenance officer need to preserve the value of history for each building, so the technician maintenance must use the same material to replace the damage inside or outside both of building [12]. For housing maintenance, selection of building materials in the early design stage can influence on maintenance costs. High maintenance cost was required to repair or replace the existing building components because of cost were cut off at the initial design and construction stage, followed by wrong choices of materials [11].

iv. Technical factor

Another challenge was the shortage of material and labour to recreate structural materials and duplicate crafts under the technical factor. Because of the lack of conservation skills for repairing and maintaining heritage architecture, it has been discovered that inexpert and inexperienced workers do about 60% of heritage building conservation and maintenance. This resulted in 50% of the problems that arose after the repair and maintenance activities [13]. Development issues were one of the technical faults. The system concerned specification and construction methods under the design problem [9]. Lastly, the technical factor also can

directly influencing the maintenance cost. For building indicators under technical factors, maintenance planning used assessments on the building age, building condition, life span, energy rating and complexity. Early signs of breakdowns and maintenance patterns can be retrieved from the information on historical maintenance [14].

v. Maintenance factor

Poor quality of spare parts and materials used in building components, elements, services, and facilities have significantly influenced maintenance costs [11]. Meanwhile, maintenance performance indicators can be used for financial reports, for monitoring the performance of employees, customer satisfaction, the health safety environment rating and overall equipment effectiveness as well as many other applications in building maintenance [15]. Last but not least, the proper management of spare parts was one of the critical techniques to boost maintenance quality. Therefore, proper management of spare parts was essential to improve maintenance performance [16].

2. Materials and Methods

The method used for this case study was conducted through mixed method approach by interviews and structured survey. The process of interviewing the respondent was done by giving them a question with the help of a Likert scale during the interview process to get the needed data. The data collection process were involved five (5) selected staff from Building Works Division, Ipoh Municipal Council. The pilot survey was conducted by contacting the office to know the potential respondents, know the boundary of the interview process, such as how many staff involved and the organisation and their department. The interview was conducted, and the respondent was asked several questions with the help of a Likert scale to achieve the first and second objectives while the third objective, the flow of work of heritage building maintenance programme were compared to determine the effective heritage building maintenance programme. The methodology flow chart as follows.

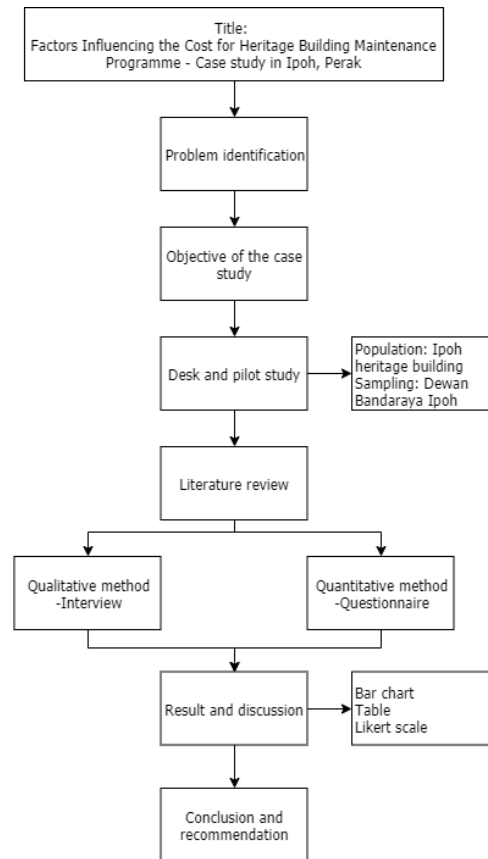


Figure 1: Research Methodology Flow Chart

3. Results and Discussion

The significant factors listed were sorted and filtered to ensure the factors were relevant to this case study and relevant for heritage building maintenance.

Table 1: The listed factor that can influence the cost of effective heritage building maintenance programme

Factor	Sub-factors
Financial	i. Sufficient amount of budget for overall maintenance work ii. Specific budget allocation on unexpected maintenance works iii. Payment period to appointed contractor
Building characteristic	i. Building age ii. Existing building condition iii. Building services
Material	i. Availability of original materials ii. Compatibility of materials iii. Cost of materials
Technical	i. The workmanship of labour to reproduce composite materials and replicate crafts of the heritage building ii. Design criteria iii. Identify the cause of the defect in the heritage building
Maintenance	i. Execute maintenance at the right time ii. Availability of operation and maintenance manuals iii. Poor communication between professionals, craftsmen, and general labourers

From interview findings, it shows that the most influencing factor of cost for effective heritage building maintenance is financial factor. This factor will give a reflection to the Ipoh Municipal Hall building which have been built more than 100 years ago. Existing building conditions also could contribute significant impact to the cost of heritage building maintenance. If the situation was worst, much work needed to settle during maintenance work to achieve the perfect condition of the building. Thus, the building age factor existed and can influence the cost of its building maintenance programme at Ipoh Municipal Hall building.

The existing building services system also can give a cost constraint of this building maintenance. Recently, Ipoh Municipal have been conducting an upgrading works to the air conditioning system. The total cost for the upgrading process was around RM2.0million. The compatibility of specific building materials with the original building items or elements are need to be considered. In other words, the more the originality part can be saved, the more authentic the heritage building condition. This matter important because for heritage building, the originality and authenticity of the building were crucial to keeping its identity same as from the condition when it was built. Lastly, the availability of original materials also plays a significant role in maintenance works. By having the original materials, the heritage building could be restored into the original condition.

3.1 Work Flow of Effective Heritage Building Maintenance

In order to make the determined influencing factors are important to the building maintenance programme, The proposed work flow have been prepared to ensure the understanding of work procedure can be simplify and ease to follow. Figure 2 shows the effective procedure for heritage building maintenance programme which can reduce the overall maintenance costs. The proposed workflow eliminate unnecessary decisions, and it can reduce the time taken to decide on a maintenance programme.

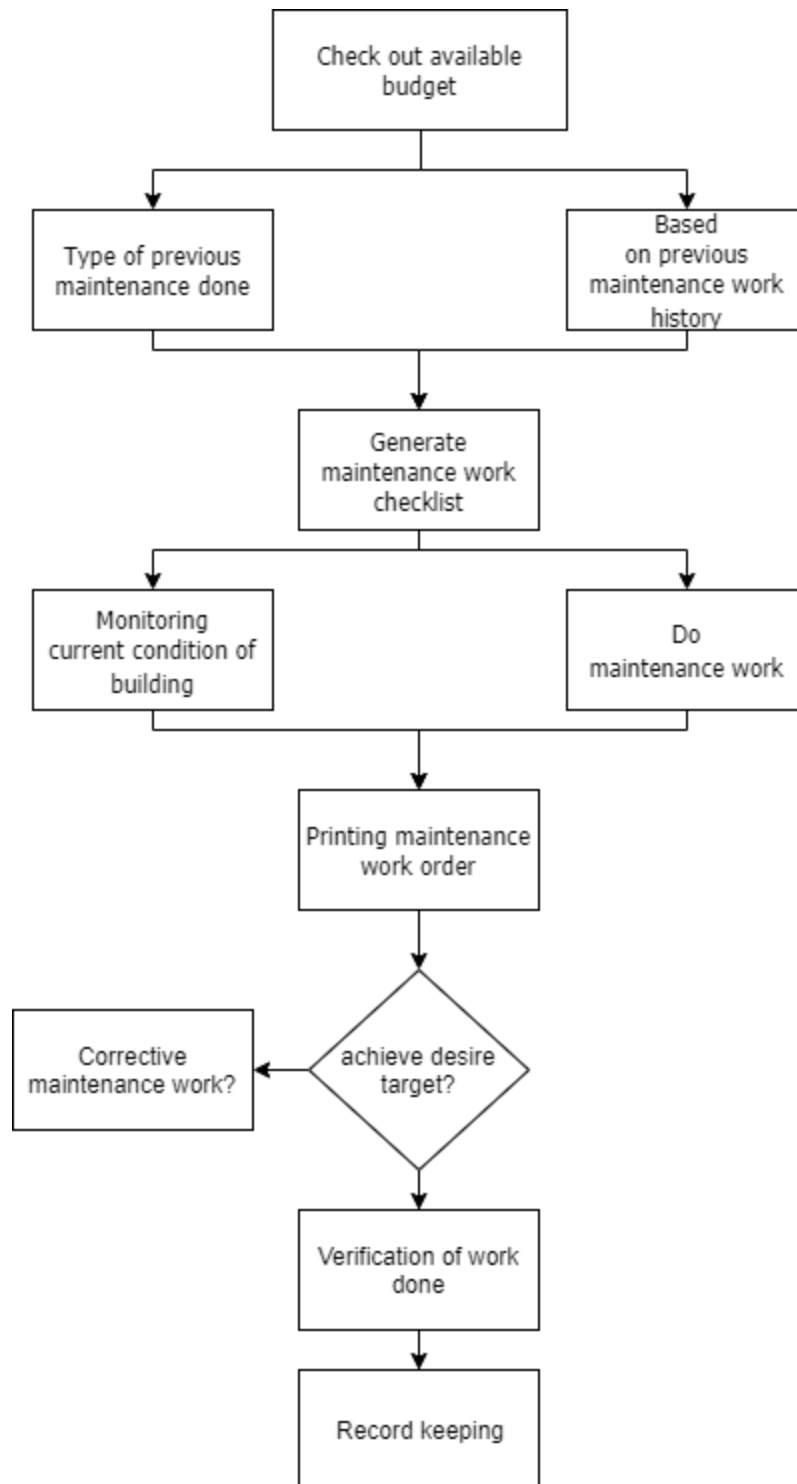


Figure 2: Proposed Work Flow of Effective Procedure for Heritage Building Maintenance Programme

4. Conclusion

The most critical factors which influencing the cost for effective heritage building maintenance were the building age and existing building conditions. The building age is the significant matter in determining the cost needed in building maintenance. The older the building, the more money need to spend to do maintenance work. For the existing building condition, there is a statement stated when the conditions of the building are worst, the more money need to be spent in order to fix the condition up to a proper standard condition. The worst condition could make maintenance work

becomes delay as it needs to focus on building condition first, then go directly to the needed parts of the building that need to be maintained.

Lastly, the best approach for preparing effective maintenance programme for heritage building have been proposed according to the modified Public Work Department workflow as a potential guideline which could eliminate unnecessary decision, and reduce the time taken to decide on a maintenance programme.

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