Factors affecting housing maintenance cost in Malaysia
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Abstract
Purpose – It has been found that the cost for housing maintenance is relatively high due to poor maintenance practices. This paper aims to determine and identify the factors contributing to rising maintenance costs.

Design/methodology/approach – A quantitative approach was adopted that sought to gather factual data using the approach taken by El-Haram and Horner. The research first identified the critical factors through a literature review. A total of Eighty questionnaires were then distributed to relevant respondents such as building managers or supervisors, maintenance management staff and others. In total, 31 completed questionnaires formed a database for descriptive and ranking analysis.

Findings – The research concluded that five of the most dominant factors were expectation of tenants, building materials, building services, building age and failure to execute maintenance at the right time. Meanwhile, it was found that two of the most influential impacts were outstanding maintenance charges and over-budget.

Originality/value – Measures to minimise the housing maintenance cost were obtained, such as participation of tenants and residents in housing management works and allows their acceptance of a lower standard expectation.

Keywords Housing, Maintenance programmes, Costs, Malaysia

Paper type Research paper

Introduction – building maintenance and maintenance cost
Building maintenance is the combination of technical and administrative actions to ensure the items and elements of a building in an acceptable standard to perform its required function. In order to implement building maintenance tasks efficiently, a proper building maintenance plan and monitoring system is necessary. According to Francis et al. (2001), building maintenance management is an operation involving the interaction or combination of technical, social, legal and fiscal determinants that govern and manage the use of buildings.

It can be argued that many people do not understand the importance or significance of building maintenance and its management, in particular the realisation that the efficiency of a building maintenance system contributes to the income of the company’s owning or renting the building (Emma and Syahrul, 2009). It has become a part of a total performance approach, together with several factors such as productivity, quality, safety and environment (Groote, 1995). However, in terms of residential or housing buildings, the building occupants and maintenance team are more focused on the quality, safety and environmental factors. For instance, the best quality and safety
performance of building services such as power supply, water supply and fire fighting systems, are expected in residential or housing buildings.

Total construction workload of repair and maintenance work, including house improvements, increased its proportion from approximately 25 per cent in the 1950s to over 50 per cent in the mid-1980s (Seeley, 1987). Meanwhile, previous Department of Trade and Industry statistics indicated that housing maintenance represents about 50 per cent of repair and maintenance expenditure over all sectors of building maintenance such as commercial, institutional, educational and others (Chanter and Swallow, 2007). The building maintenance was so significant to the economy not only because of the scale of expenditure involved, but also to ensure the nation’s stock of buildings (Seeley, 1987). From a Malaysian context, awareness on repair and maintenance works became more important as the development plan allocation for repair and maintenance works increased from RM 296 million during the Eighth Malaysian Plan to RM 1,079 millions in the Ninth Malaysian Plan (Ali, 2009).

Seeley (1987) noted that building maintenance is very important with the prime aim, to preserve a building in its initial state. Furthermore, implementation of building maintenance allows the building to serve its purpose effectively. There are several main purposes in order to maintain buildings as stated below:

- retaining investment value;
- maintaining building in an acceptable condition and required standard;
- presenting a good appearance of building;
- generating income for building owner and surrounding activities; and
- conserving historical and architectural values of building.

Maintenance costs cover the overall cost or budget, which is allocated to keep the building to its best performance, or to retain the building in good condition. Lee and Wordsworth (2001) noted that the main objective of maintenance management organisation is to ensure the required or acceptable standards and level of services provided in the building continuously at the minimum cost. However, Chanter and Swallow (2007) found that the cost of maintenance work is usually higher than the cost of new construction work because of several factors as stated below:

- maintenance work is always carried out on small scale, leading to diseconomies of scale;
- before the repair or replacement work is carried out; there is a need to striping out the existing work;
- maintenance work has to be carried out in confined or occupied spaces, areas of places;
- the cost of making good and general clearing away is disproportionately high; and
- it incurs substantial disturbance costs on the operation of the building and perhaps lost of production.

From a Malaysian context, the maintenance cost for housing schemes is called the building maintenance fund or management fund (Act 663, 2007 and Act 318, 2008). The fund is administered and controlled by the Joint Management Body or Management Corporation from each of the housing schemes. The Joint Management Body comprises of the
developer and purchasers. The main objective of the Joint Management Body or Management Corporation is to maintain the common property or building to keep it in an acceptable standard or in good condition.

Lee and Wordsworth (2001) define life cycle costs (LCC) as the total cost of owning and using an asset for over its whole life span. In order to achieve the efficient and lowest long-term cost of ownership for equipment or a project, LCC analysis is an essential tool to choose the most cost-effective approach from a series of alternatives (Barringer, 2003). The alternatives might be selected from different companies or tenders. For example, the decision to select a lift system to be installed in a building can be studied and obtained from several providers such as Panasonic, Toshiba, Mitsubishi and others. Thus, LCC analysis is an economic evaluation technique that determines the total cost of owning and operating a facility or system over period of time (Mearig et al., 1999). Wu and Clement-Croome (2007) noted that the ratio of operating and maintenance costs to initial costs for buildings is an essential factor for the whole life cycle of building services system in maintenance management. The relationships between initial costs, operating and maintenance cost involve the initial investment, project management, system design, building operations and maintenance management. Barringer (2003) noted that the costs of operation, maintenance and disposal always exceed to the initial costs. Whereby, the supporting costs are two to 20 times greater than the initial procurement costs. Thus, it is very important to accurately estimate the ratio from a LCC perspective.

In order to ensure the maintenance costs for housing maintenance are minimised, it is important to determine the factors affecting housing maintenance costs. By identifying the dominant factors, it provides more information regarding the maintenance costs of residential buildings. Then, the result could assist the building managers in allocating maintenance budgets to each task during the early stage with the optimum maintenance cost. Therefore, the main objective of this research was to identify the main factors affecting cost for housing maintenance that have been described by other researchers.

Factors affecting cost for housing maintenance
According to Rydell (1970), maintenance and operating expense is one of the major components of housing cost. Basically, maintenance and operating expense contributes one-third to one-half of total cost depending on the type of housing such as condominium, apartment, flat and others.

Nowadays, an issue about the housing maintenance costs management is often discussed due to the continuous increase in housing maintenance costs. In order to reduce the maintenance costs, building managers or maintenance manager should adapt some strategies by minimising the number of maintenance tasks. According to El-Haram and Horner (2002), there are several factors that affect the housing maintenance cost. Generally, they can be divided into five main groups, which are building characteristics, tenant, maintenance factors, political and others factor. The main factors were divided into several variables that affect housing maintenance cost as shown in Figure 1.

Building characteristics
Building characteristics always have an influence on the maintenance costs (El-Haram and Horner, 2002). Basically, building characteristics include the building age, function, building or unit area, height of building, type of structure, finishes, services, building materials and others. Every building has its own characteristics and this makes the
buildings require different amount of maintenance costs distribution and allocation to be maintained in good condition. For instance, building characteristics of apartment and serviced apartment are different in terms of the building amenities provided, facilities and services available (Sonthya, 2006).

**Building age.** According to Slater (1982), Skinner (1982) and O’Neill (1974), the age of a building has a close relationship with the maintenance costs. Whereby, the maintenance costs increase while the building age is increasing. When the age of a building increases, some maintenance works such as painting work, replacement of new roof tiles and other works are required to ensure the sustainability of building. Additionally, higher maintenance cost and remedial cost are required for aged plumbing and drainage systems in buildings because of corrosion problems (Wong, 2002). Thus, the maintenance cost is likely to be increased over the aging of building.

**Figure 1.** Variables of factors affecting housing maintenance cost
Building height and building area or size. There is an impact on maintenance costs regarding the height of a building. The higher the building, additional costs would be required for the tools and equipment used to carry out the maintenance tasks (Skinner, 1982). For example, scaffolding is needed to carry out various maintenance tasks at high rise buildings such as painting work, window cleaning or repair and other external works.

Type of structure. The structure of a building is another factor that always affects maintenance costs. Owing to intensive investments in the design of civil infrastructures in the 1960s and 1970s, the number of deteriorating structures has increased considerably in the last decade. In this phenomenon, the structures require a great amount of financial resources for inspection, maintenance, repair, rehabilitation and replacement (Neves et al., 2004). The structural stability of a building must be inspected and maintained from time to time in order to ensure the occupants’ safety. Thus, periodical maintenance of steel structures is required to prevent the corrosion and maintain their strength and stability. Maintenance cost is significantly subjected to the type of structure in buildings.

Building services. According to John and Clements-Croome (2005), building services systems are generally installed in buildings to provide a healthy and safe living environment for the occupants or residents. The building services include ventilation, lighting and power supply, water supply, sanitation, transportation communication and other systems. Building services accommodated in buildings is one of the factors affecting housing maintenance costs. According to Lam (2001), building services is a vital aspect to be concerned in building maintenance management, especially the mechanical and electrical services, which are the active components in a building. Owing to the high maintenance cost involved and the consequences of building services’ failure, awareness on the significance of building services maintenance has increased in the building services industry.

Building materials. Building materials selected in the early design stage have an effect on maintenance costs. High maintenance cost is required to repair or replace the existing building components because of cutting cost at the initial design and construction stage, as well as wrong choices of materials. Shabha (2003) proved that the incompatible and poor quality materials used in construction and lack of regular-planned maintenance has caused the deteriorations or defects occurred in the building components. Moreover, Cheung and Kyle (1996) noted that material selections chosen over the life of a facility or building component undoubtedly influence the maintenance and operating costs of an asset and its service life.

Tenant factors
Housing maintenance cost is always influenced by the tenants or residents in numerous aspects. According to El-Haram and Horner (2002), tenant factors that have an impact on the maintenance cost include the expectation of tenants or residents, use of the property, vandalism by the tenants, delay in reporting failures, complete failure to report problems, as well as accessibility to the property. Olubodun (2001) noted that 25 per cent of total maintenance needs could be due to the tenant influence. Thus, participation of tenants and residents in housing management can be considered as a strategy of the landlord in bridging the gap between expensive maintenance management and the legitimate expectation or demand of the tenants (Yip, 2001).
**Expectation of tenants.** High expectation of tenants significantly affects housing maintenance cost. According to Yip (2001), the operating and maintenance account of estate management in Hong Kong has dramatically increased from time to time. For instance, the surplus of HK$432 million (RM 185 million) in 1988 had increased to HK$1.7 billion (RM 727 million) in 1997 based on the annual report from the Hong Kong Housing Authority because of rising demands from tenants and residents for better living environments. Therefore, it is proven that high standards of expectation from tenants and residents are likely to increase the maintenance cost.

**Use of the property.** According to the Queensland Department of Public Works (2010), one of the factors that influences the level of maintenance funding is the deterioration or wear associated with the usage and occupancy of residents and tenants. In fact, this problem can be minimised by introducing property operating manuals and rules, and educating tenants and residents (El-Haram and Horner, 2002). Otherwise, the maintenance and repair cost will increase gradually because of improper use of the property through further damage.

**Vandalism by tenants.** Vandalism by tenants is often discussed as a factor that affects housing maintenance cost. According to Olubodun and Mole (1999), vandalism is one of the factors that causes the defects on building components. In Malaysia, it is found that Kuala Lumpur City Hall (DBKL) spent RM 2.5 million solely for repairing faulty lifts and it was said that 95 per cent of the faulty lifts were caused by vandalism (Bavani, 2010). Consequently, the maintenance costs are influenced by distributing the repair costs to treat such defects, which are caused by vandalism.

**Delay and failure in reporting problems.** According to Lee and Wordsworth (2001), the rate of deterioration of the component and the corresponding increase in the cost of rectification is likely without early response to such defect. Early response to the building failure is necessary to reduce the maintenance cost. However, early response to the building defect or failure cannot be done if there is a delay and failure in reporting the problems. In fact, delay and failure in reporting problems do affect the housing maintenance cost to some extent, but the significance of this factor is not that obvious (El-Haram and Horner, 2002).

**Accessibility to the property.** El-Haram and Horner (2002) proved that inability to gain access to the property is one of the major factors that affect housing maintenance cost. Sometimes, the residents or tenants may not allow maintenance staff to access to their unit space for privacy reasons. According to Al-Arjani (1995), some tenants may not allow maintenance staff from gaining access to carry out maintenance works or tasks because of cultural issues. For instance, there are cracks found on the surface of external walls of a parcel unit in the sixth floor but is restricted to access to such unit space. Hence, maintenance staff can only access from the external building and additional equipment like scaffolding would be required to repair the affected portion.

**Maintenance factors**

Maintenance factors are likely to have great influence on housing maintenance costs (El-Haram and Horner, 2002). Generally, maintenance factors can be divided into two main factors, which are technical factors and administration factors. In terms of technical factors, some aspects that affect the maintenance cost are poor workmanship, and poor quality of spare parts and materials. While in terms of administration factors, the aspects that influence maintenance cost include poor maintenance management,
budget constraints, failure to execute maintenance at the right time and poor budgetary control. The selection of the maintenance management team and staff is closely related to the maintenance factors that affect the housing maintenance cost.

**Poor workmanship.** Poor workmanship during the implementation of maintenance tasks is greatly affecting the maintenance cost in both the short- and long-term. Khalid et al. (2006) noted that poor workmanship is the predominant cause of defects emerging on the projects or maintenance works. Owing to poor workmanship, more defects will occur immediately or after the period of time the maintenance works are done. Then, further and additional remedies might be required to treat such defects. As Love and Irani (2003) mentioned, direct cost is often quoted in evaluating quality of workmanship and represent a significant proportion of total project costs or total maintenance costs. Hence, the total maintenance costs are likely to be increased as a result of poor workmanship during the implementation of maintenance works.

**Poor quality of spare parts and materials.** Poor quality of spare parts and materials used in the building components, elements, services or facilities significantly influence the maintenance costs. Al-hammad et al. (1996) stated that the problems related to the lack or unavailability of the required spare parts, tools or materials to perform maintenance tasks. As a result, poor quality or second hand spare parts are acquired for the maintenance tasks.

**Poor maintenance management.** According to Horner et al. (1997), the main objective of maintenance management is to minimise the need of repair on building defects by enhancing planning and implementation, adopting suitable materials and tools at the appropriate time and minimising the total LCC. Maintenance management quality is always an issue that significantly affects the housing maintenance cost. Effective building or housing maintenance management can minimise the operating and maintenance costs, while the building continues to function and operate efficiently. The poor maintenance management practices are neither cost effective nor optimum, and often cause a lot of problems, such as defective building, poor building functionality and others.

**Budget constraints.** Pascual et al. (2008) stated that the asset or building failure rate increases as time passes and this produces more repair and maintenance tasks. In order to ensure the sustainability of a building, the increasing maintenance cost is needed while the building age is growing older. It is often seen that deferral or delay of some maintenance tasks occurred because the budget allocated is not sufficient to cover the need for maintenance (El-Haram and Horner, 2002). Consequently, further implications such as damage, wear and defect will be incurred.

**Failure to execute maintenance at the right time.** According to Narayan (2003), failure or delay to execute maintenance actions at the right time may cause further implications to incur such as excessive damage, wear and defect. Then, additional maintenance works are necessary to be carried out in order to treat the problems. For instance, maintenance staff may have identified a problem occurring in a lift system such as the defective lift motor, but they delay the maintenance and repair to accommodate the occupants, which may result in permanently damaging the lift motor. This results in an increase in material and labour costs while additional maintenance and repair works are required.

**Poor budgetary control.** Quality of maintenance activities often affects the housing maintenance cost. According to Ali (2009), the quality of maintenance activities is influenced by the amount of budget allocation in each task. Budget controlling in maintenance activities is essential to manage the maintenance cost expenditure.
In fact, sufficient resources especially finance is needed for maintenance work to have good maintenance actions and to sustain the required standard of building functions (Lee and Scott, 2009).

Political factors
Political factors affect the housing maintenance cost in some circumstances, especially when there are changes of political policies through government or local authority. El-Haram and Horner (2002) proved that the political factors considerably affect the housing maintenance cost in Malaysia. The variables include right to buy policy, new health and safety regulations and poor management. However, the “right to buy policy” aspect is only applicable for public housing and “poor management decision system” is not obvious in affecting the housing maintenance cost. So, only the “new health and safety regulations” aspect will be discussed in this study.

New health and safety regulations
Health and safety is a key factor influencing the planning of maintenance tasks (Lee and Scott, 2009). Thompson (1994) noted that building maintenance is so important, whereby its role is not only to ensure the facilities and services in buildings are operating at the optimal standard of functions, but to satisfy the performance to the requirements of the building’s occupants. In order to obtain the objective of building maintenance, maintenance staff must consider all aspects of requirements of occupants to be compliant to the statutory health and safety regulations. Those aspects may include environmental conditions (ventilation, lighting and sanitation), data communication and electrical power. For time being, new health and safety regulations might be created to improve the building performance. Hence, new design concepts that comply with such new regulations are required when designing or refurbishing a building. This often affects the design cost for a new building or maintenance cost for an existing building.

Other factors
Besides, the factors that have been stated, there are other factors that affect the housing maintenance cost such as third-party vandalism and poor or lack of training (El-Haram and Horner, 2002). These factors can have an impact on the housing maintenance cost, which are often neglected by maintenance management staff.

Third party vandalism
Third-party vandalism is one of the factors that affect housing maintenance cost. According to Tiuin (2003), vandalism is one of the serious problems observed in many high-rise residential buildings. Although the security guards are assigned to protect the property of the buildings, such vandalism activities are still occurring. This factor has been proven by El-Haram and Horner (2002) as highly affecting the housing maintenance cost with the rank of 8 among 24 factors in their study. This factor is commonly caused by third-parties that have no relationship or interest to a building.

Poor or lack of training
Poor or lack of training is likely to have an impact on the housing maintenance cost. Narayan (2003) stated that lack of maintenance personnel training is one of the reasons for poor operating practices in maintenance management. Maintenance personnel or operator’s skill is an essential factor that influences the maintenance performance (Pascual et al., 2008). Poor operating and maintenance practices often lead to human error and consequently the occurrence of poor quality of maintenance outcomes. The poor maintenance outcome is then increasing the failure rate,
which leads to the avoidable failures or further implications and subsequent repairs or additional maintenance works that are required in order to ensure the building performance standard.

**Research methodology**

This research was conducted using a quantitative approach, based on the work undertaken by El-Haram and Horner (2002), to which a survey was recognised as the most suitable method for data collection. According to Ali (2009), the questionnaire should be short and simple in order to get a high response rate, meanwhile not taking much time for the respondents to answer. Simple random sampling was adopted to determine potential and relevant respondents who have been or are currently involved in housing maintenance management in the Klang Valley, Malaysia. Furthermore, the respondents were required to answer questions based on their experience or involvement in maintenance management for medium or high cost (property unit value more than RM 100,000) residential buildings, which are managed by an official management body or committee. Also, the buildings needed have a minimum of four storeys and completed between 1990 and 2009.

Gillham (2000) stated that a typical survey requires a minimum response rate of 30 per cent to produce reliable and convincing results. In this research, a total of 80 questionnaires were distributed to the building or resident manager, building supervisor, maintenance management officer and other relevant individuals within Klang Valley. Out of 34 responses, 31 were found to be useful and valid for the analysis, as shown in Table I. The remaining three questionnaires were incomplete or invalid for some reason. Hence, a response rate of 39 per cent was achieved.

**Data analysis and discussion**

Ranking analysis was used by ranking the key variables shown in Table II. The mean score (with 1 – not impacting at all to 5 – impacting a great deal) was used to rank the variables of factors affecting cost for housing maintenance in the research. The main purpose of ranking analysis is to indicate the differences in the level of impacts or influences on housing maintenance cost among the variables. Table II shows the ranking of the variables of factors affecting housing maintenance cost.

In Table II, the expectation of tenants proved to have the highest rank. This means that the expectation of tenants has become the most influential factor that affects housing maintenance cost. In fact, the demand of tenants towards better life styles or living environments is rapidly increasing. This phenomenon has led to the need of maintenance and hence rising of maintenance cost. The result of analysis has proven the work by Yip (2001), describing the dramatic increase of maintenance accounts of estate management because of the rising demand from tenants and residents for better living environments.

<table>
<thead>
<tr>
<th>Job title</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building manager</td>
<td>18</td>
</tr>
<tr>
<td>Building supervisor</td>
<td>10</td>
</tr>
<tr>
<td>Maintenance management officer</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
</tr>
<tr>
<td>Total (n)</td>
<td>31</td>
</tr>
</tbody>
</table>

**Table I.**

Number of respondents according to job title
Building materials was ranked second for factors affecting housing maintenance cost. According to Hanim (2008), building materials have been increasing because of the escalating raw material and operational costs. Thus, the maintenance cost is rapidly increased due to the rising building material cost, especially when the deteriorations or defects occur. This finding has confirmed the statement of Nor Haniza et al. (2007) and Cheung and Kyle (1996), whereby the improper material selection over the life of a facility or building component is one of the dominant factors affecting housing maintenance cost.

MCB UP Ltd (1987) reported that the maintenance of building services accounts is relatively high, as it covers 20-45 per cent of total building running costs, even at the lowest estimate. The statement is verified by this finding, whereby the building services are one of the highest ranked factors (third) that affect housing maintenance cost with a mean score of 4.03. Hence, the planned maintenance of building services is necessary in order to prevent the poor implications of building services failure (Lam, 2001).

Building age was the fourth-ranked factor that affect housing maintenance cost. Lateef (2008) described that one of the essential elements that needs to be measured in the allocation of maintenance budgets is the building age. This is probably due to the need of additional maintenance works to be carried out in the older building. For example, major refurbishment and retrofitting of building equipment or elements need to be implemented when the building has reached its economic life span (Ali, 2009).

It is determined that failure to execute maintenance at the right time is another prominent factor (fifth) that affect housing maintenance cost. The finding is in line with the work of Narayan (2003), stating that failure or delay to execute maintenance tasks at the right time may cause further impacts and then burden the financial maintenance. This is due to the additional maintenance works required to be done to treat the problems. In addition, the finding proved the statement of Suttell (2006), who said that maintenance is not expensive compared to what might need to spent if the system degrades and ultimately fails.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Variables</th>
<th>Mean ((n = 31))</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Expectation of tenants</td>
<td>4.35</td>
<td>0.755</td>
</tr>
<tr>
<td>2</td>
<td>Building materials</td>
<td>4.19</td>
<td>0.749</td>
</tr>
<tr>
<td>3</td>
<td>Building services</td>
<td>4.03</td>
<td>0.912</td>
</tr>
<tr>
<td>4</td>
<td>Building age</td>
<td>4.00</td>
<td>1.238</td>
</tr>
<tr>
<td>5</td>
<td>Failure to execute maintenance at the right time</td>
<td>3.71</td>
<td>1.270</td>
</tr>
<tr>
<td>6</td>
<td>Accessibility to the property</td>
<td>3.39</td>
<td>0.761</td>
</tr>
<tr>
<td>7</td>
<td>Use of the property</td>
<td>3.39</td>
<td>0.558</td>
</tr>
<tr>
<td>8</td>
<td>Type of structure</td>
<td>3.23</td>
<td>0.845</td>
</tr>
<tr>
<td>9</td>
<td>New health and safety regulations</td>
<td>3.03</td>
<td>0.983</td>
</tr>
<tr>
<td>10</td>
<td>Budget constraints</td>
<td>3.00</td>
<td>0.931</td>
</tr>
<tr>
<td>11</td>
<td>Poor workmanship</td>
<td>2.87</td>
<td>0.991</td>
</tr>
<tr>
<td>12</td>
<td>Building height and building area or size</td>
<td>2.55</td>
<td>1.060</td>
</tr>
<tr>
<td>13</td>
<td>Vandalism by tenants</td>
<td>2.23</td>
<td>1.055</td>
</tr>
<tr>
<td>14</td>
<td>Poor or lack of training</td>
<td>2.19</td>
<td>0.833</td>
</tr>
<tr>
<td>15</td>
<td>Poor quality of spare parts and materials</td>
<td>2.16</td>
<td>0.934</td>
</tr>
<tr>
<td>16</td>
<td>Poor budgetary control</td>
<td>2.13</td>
<td>0.806</td>
</tr>
<tr>
<td>17</td>
<td>Delay and failure in reporting problems</td>
<td>2.06</td>
<td>0.964</td>
</tr>
<tr>
<td>18</td>
<td>Third-party vandalism</td>
<td>2.00</td>
<td>1.095</td>
</tr>
<tr>
<td>19</td>
<td>Poor maintenance management</td>
<td>1.68</td>
<td>0.909</td>
</tr>
</tbody>
</table>

Table II. Ranking of variables of factors affecting housing maintenance cost

Building materials was ranked second for factors affecting housing maintenance cost. According to Hanim (2008), building materials have been increasing because of the escalating raw material and operational costs. Thus, the maintenance cost is rapidly increased due to the rising building material cost, especially when the deteriorations or defects occur. This finding has confirmed the statement of Nor Haniza et al. (2007) and Cheung and Kyle (1996), whereby the improper material selection over the life of a facility or building component is one of the dominant factors affecting housing maintenance cost.

MCB UP Ltd (1987) reported that the maintenance of building services accounts is relatively high, as it covers 20-45 per cent of total building running costs, even at the lowest estimate. The statement is verified by this finding, whereby the building services are one of the highest ranked factors (third) that affect housing maintenance cost with a mean score of 4.03. Hence, the planned maintenance of building services is necessary in order to prevent the poor implications of building services failure (Lam, 2001).

Building age was the fourth-ranked factor that affect housing maintenance cost. Lateef (2008) described that one of the essential elements that needs to be measured in the allocation of maintenance budgets is the building age. This is probably due to the need of additional maintenance works to be carried out in the older building. For example, major refurbishment and retrofitting of building equipment or elements need to be implemented when the building has reached its economic life span (Ali, 2009).

It is determined that failure to execute maintenance at the right time is another prominent factor (fifth) that affect housing maintenance cost. The finding is in line with the work of Narayan (2003), stating that failure or delay to execute maintenance tasks at the right time may cause further impacts and then burden the financial maintenance. This is due to the additional maintenance works required to be done to treat the problems. In addition, the finding proved the statement of Suttell (2006), who said that maintenance is not expensive compared to what might need to spent if the system degrades and ultimately fails.
Based on the ranking analysis results, the authors found the first-ranked variable is expectation of tenants that affect housing maintenance cost. However, another three of the highest-ranked variables are factors on building characteristics. While the fifth-ranked variable is the failure or delay to execute maintenance at the right time. As a result, the important factors to be considered in residential building maintenance management are building characteristics, expectation of tenants and failure or delay to execute maintenance at the right time.

In order to study the impacts or influences of those factors on maintenance performance, various impacts were identified and ranking analysis was done to determine the occurrence of those impacts in the maintenance management of residential buildings. In this case, the frequency of each impact was computed. Then, the ranking was determined from highest to lowest frequency. Table III shows the ranking of the impacts or influences of factors affecting housing maintenance cost on maintenance performance.

It was found that the highest-ranked impact was outstanding maintenance charges. This is confirmed by a report from the National House Buyers Association of Malaysia (2009), where all 42 state housing projects in Penang are being managed on deficit funds. This problem is due to the residents that have outstanding maintenance charges. The residents or tenants are not likely or even not able to clear the outstanding maintenance charges, especially when the maintenance cost is rapidly increased. Furthermore, one of the questionnaires respondents suggested that all residents should pay maintenance fees on time. This statement implied that there are outstanding maintenance charges owed by the residents.

Over-budget ranked second, with the total frequency of nine. Over-budget is often an issue when the maintenance cost is dramatically increased. In fact, over-budget in maintenance management can be caused by most of the factors that affect housing maintenance cost. For example, failure to execute maintenance is often due to the insufficient budget allocation (El-Haram and Horner, 2002). As a result, further implications occurred such as excessive damage, wear and tear and defects (Narayan, 2003). An additional cost or expense that is not allocated within budget is then required for such maintenance and repair works.

Based on the ranking analysis results, the authors found that both of the higher impacts on maintenance performance are related to monetary matters. Hence, it is summarised that the most apparent impact to be concerned in maintenance management include outstanding maintenance charges and over-budgeting in residential building maintenance management.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Impacts or influences</th>
<th>Frequency (n = 43)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Outstanding maintenance charges</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Over-budget</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Untreated defects/delayed in repair works</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Building services and facilities</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Property value</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Legal offence</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Building performance and functionality</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Health and safety issues</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Others</td>
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Table III. Ranking of impacts or influences on maintenance performance
Conclusions
The literature review identified 19 variables of factors affecting housing maintenance cost. After the data was analysed, it was found that five of the most influential variables were expectation of tenants, building materials, building services, building age and failure to execute maintenance at the right time. It was also found that two of the most dominant impacts were outstanding maintenance charges and over-budgeting. In summary, various measures to minimise the housing maintenance cost were outlined as follows:

- participation of tenants and residents in housing management works;
- introducing property operating manuals and rules, including educating tenants and residents;
- effective maintenance management (appropriate maintenance policy);
- allocating balance budgets in every maintenance task;
- maintain and repair on urgent and on time tasks before further implication or defect occurs;
- adapting preventive maintenance;
- ensuring and enforcing all residents or tenants to pay the maintenance fee on time; and
- employing minimum but optimum labour and staff with acceptable qualification standards.

References
Factors affecting maintenance cost


**Further reading**


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