

The Relationship between the Maintenance Management Problems and the Maintenance Performance of High-Rise Residential Buildings

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Abstract

Building maintenance is the practice to retain the property habitable and functioning as it is designed for. However, the effectiveness of maintenance management appears to be the issue in housing context. Many maintenance management problems still exist up to date. They are likely to influence the service quality and resident satisfaction. Therefore, the objective of this research is to establish the relationship between the maintenance management problems and the maintenance performance. The research adopted quantitative approach to achieve the research aim. The approach comprised of literature review, questionnaire survey using google form that included both close-ended and open-ended questions. Based on the literature review, fourteen (14) maintenance management problems of high-rise residential buildings are identified. From the correlation analysis result, two (2) significance correlations are determined. The maintenance budget overrun is significantly correlated with the ratio of actual maintenance spent to planned maintenance cost (cost variance) of high-rise residential building, and a significant correlation occurs between unavailability of spare parts and ratio of actual to planned maintenance downtime (equipment effectiveness) of high-rise residential building. Besides, the opinions and strategies on solving the maintenance management problems were provided, including educating the residents about the Strata Management Act 2013, selecting qualified maintenance contractor, outsourcing the maintenance services, implementation of preventive maintenance (PM), hiring specialist to perform special maintenance work, providing training for maintenance staffs, formulating the building maintenance regulation, ensuring transparency of financial account, and setting up maintenance policy.

Keywords: Building maintenance, high-rise residential building, maintenance management problem, maintenance performance

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1.0 INTRODUCTION

High-rise residential building consists of multi-family dwellings that constructed on the same land. This type of building is commonly found in urban areas as the land cost is getting expensive and limited for housing projects (Abd Wahab, Ani, Sairi, Tawil, & Abd Razak, 2016). Facilities of the high-rise residential building become the factor that attracts the people to purchase this type of housing. The shared basic amenities such as 24/7 security system, covered parking lots, swimming pool, playground, lift, and so on are provided for the high-rise housing residents. Those facilities are anticipated to be maintained in good condition (Abd-Wahab, Sairi, Ani, & Tawil, 2015).

Building maintenance is known as any practice that could help prolong the building's lifespan to perform its designed function (Chanter & Swallow, 2008). The main purpose of the maintenance work is to keep the property habitable and functionable (Abdullah, Zubedy, & Najib, 2012). The efficiency maintenance aims to minimise the frequency of disruption during the facilities' operation (Lai & Yik, 2011). Malaysia began to emphasise on tackling the building maintenance issues in 1971 by including it in the Second Malaysian Plan, 1971-1975. Nevertheless, the issues kept untreated until the year 1991, where the government allocated more maintenance budget for the government building (Zakiyudin, Fathi, Rambat, Tobi, & Rejab, 2014).

The housing project is recognised as one of the main factors to encourage the growth of economic Malaysia because of the increase of the population (Shafawi et al., 2019). Unfortunately, more maintenance issues arise when the housing stocks increase (Au-Yong, Ali, & Chua, 2019). In Malaysia, maintenance practice is not implemented efficiently due to lack of standard guidelines and improper maintenance management (Sarhini, Ibrahim, Abidin, Yahaya, & Azizan, 2021). In fact, maintenance management performance is closely connected to the maintenance department's structure (Yasin, Abdullah, Mustakim, Singh, & Abd Hamid, 2015). Nonetheless, the importance of building maintenance is often ignored by the maintenance management team, specifically the implementation of preventive maintenance (PM) (Abdullah et al., 2012). The maintenance issues of high-rise housings resulted from the inappropriate planning, lack of proactive maintenance strategy, and weak implementation of maintenance works lead to poor properties condition (Hsieh, 2009). Hence, the occupants frequently express their dissatisfaction with the state of residential properties and utilities (Karim, 2012).

Based on the review of Wellbeing, Housing and Local Government Ministry, high-rise residential buildings in Malaysia were graded below par in the assessment of the building management standards, and the residents were unsatisfactory with the service quality (Abd-Wahab et al., 2015). The late response of the maintenance team that results in the delay of maintenance work is the most common complaint made by residents. It is clear that delay of maintenance work greatly reduces the building's maintenance performance due to the low customer satisfaction and efficiency of the management team (Azian, Yusof, & Kamal, 2020). Besides, the unprofessional and inexperienced property managers fail to perform their jobs responsibility professionally. In many cases, they only notice the problem after the complaint has been made by residents because they lack of knowledge on maintenance strategy planning (Che-Ghani, Myeda, & Ali, 2018; Tiun, 2009). Furthermore, the management does not take the issues seriously, even the complaint has been made by the residents (Abd-Wahab et al., 2015). The residents' unsatisfaction arise due to the delay of maintenance work and poor services delivered such as garbage collection is then resulting the difficulty in collecting maintenance fee (Azian et al., 2020). Lacking of the maintenance fund causes the significant maintenance work such as lift repair hard to be operated (Yuen, 2016). In the end, more and more maintenance issues will be accumulated as a result of poor maintenance management.

In order to make sure the maintenance performances are always meet the occupants' satisfaction, the maintenance management problems should be identified and given the proper treat. Therefore, this research objective is formulated to investigate the relationship between the maintenance management problems and the maintenance performance of high-rise residential buildings.

■2.0 MAINTENANCE MANAGEMENT PROBLEMS

Maintenance management is defined as the systematic approach to managing, outlining, supervising, and assessing the maintenance task and expenditure (Omar & Mustafa, 2019). The efficiency of the maintenance management is able to influence the occupant's satisfaction (Abd-Wahab et al., 2015). Generally, it is meant to reduce or eliminate the building defects and minimise the life cycle cost by implementing the proper maintenance and utilising appropriate material and tools at the right time (Horner, El-Haram, & Munns, 1997). Unfortunately, a lot of maintenance issues still occur, specifically in the stratified residential building properties (Che-Ghani, Myeda, & Ali, 2023). From the previous research on the scope of residential buildings, many building tenants claimed that the main reason of the poor maintenance performance is due to the inefficient maintenance management, lack of standard in maintenance management, lack of PM, abuse the public property, and the service quality of the maintenance management (Abd-Wahab et al., 2015). Thus, the following section will elaborate the maintenance problems accordingly.

2.1 Lack of Awareness or Cooperation of the Residents

Au-Yong, Azmi, and Myeda (2022) highlighted that it is crucial for the building users or residents to aware about the importance of their involvement in the maintenance management activities. Cooperation of the residents with the maintenance management team in solving the maintenance problems is highly recommended to practice in every high-rise residential building. It helps to increase the maintenance management efficiency (Daniel & Wei, 2013). Nonetheless, it is found that the residents do not play their role in the maintenance management, such as refuse to settle the outstanding maintenance fee, poor involvement in organisation activities, and the poor attitude towards the facilities provided (Abd-Wahab et al., 2015). Poor involvement of the residents in the organisation is one of the elements that affect the efficiency of the maintenance management. For example, the residents make the report lately after meeting the failure and defects that result in the increasing of the maintenance cost. In some occasions, the residents refuse the request of maintenance staff to permit access of the unit for the maintenance purpose due to the cultural issues (El-Haram & Horner, 2002). Moreover, problems related to facilities abuse are also common in high-rise housing contexts. This statement is supported by Yau, Ho, and Chau (2008), who state that the residents tend to use the hose reel facilities to wash the car. It is clear that the poor maintenance of the facilities is not only caused by the inefficient of the maintenance planning but also the residents' degree of care.

2.2 Unqualified Maintenance Contractor

The involvement of maintenance contractor in maintenance management is inevitable for some maintenance tasks due to unavailable in-house resources or regulation compliance (Au-Yong, Ali, Ahmad, & Chua, 2017). However, the maintenance management tends to select the maintenance contractors with the lowest tender prices as instructed by the owner representatives, leading to hiring the unqualified and incompetent contractors (Ali, Chua, & Ag Ali, 2016). The maintenance conducted by those unqualified contractors often pose the workmanship issues because they usually do not obtain or pass the professional training recognised by the relevant authority. In worst case scenario, the maintenance contractor who is lacking the experience conducts the maintenance works that implicating poor maintenance outcomes (Suffian, 2013). This becomes a norm as a result of lack of consideration towards the qualification of the contractors during the selection process. By right, selection of maintenance contractor is a complex process and requires detailed reviews, efforts and time in choosing the right sourcing approach and provider (Moktar & Myeda, 2023).

2.3 Amendment of Regulation

Regulation provides guidelines to standardise the maintenance practices in the country. Typically, the maintenance management only focuses on the compliancy of the health and safety regulation in high-rise housing to ensure the residents free from the life-threatening scenario. From time to time, the health and safety regulation is amended to suit the current environment and enhance the building

performance (Ali, Kamaruzzaman, Sulaiman, & Cheong Peng, 2010). Therefore, the management team is required to adjust the building by considering the current regulation in the designing stage of the refurbishment project.

2.4 Training and Motivation

In general, maintenance staff's training and motivation can significantly improve their work quality (Zawawi & Kamaruzzaman, 2009). Lack of the maintenance personnel training is recognised as one factor contributing to weak maintenance management. The performance of the maintenance is majorly based on the maintenance personnel's skill. Low maintenance performance often due to the human mistake that causes by the poor maintenance practices. Poor maintenance skill can lead to the increasing rate of failure and further implications. Therefore, additional maintenance work needs to be done on the failure of the system to correct it to the original or standard state (Ali et al., 2010). Indeed, the management team must be willing to invest on the training and motivation programmes in order to improve the maintenance staff's knowledge and skill (Au-Yong et al., 2022).

2.5 Budget Constraint

Maintenance work cannot be carried out effectively without a suitable budget in place (Che-Ghani et al., 2023). Budget constraint always leads to the postponement of the maintenance job until the fund is available. The organisation has poor understanding of the maintenance work tends to allocate insufficient maintenance budget. Besides, lack of information or improper data handling system are among the major factors contributing to poor financial planning. The previous maintenance expenditure data should be recorded properly as it is the primary reference in deciding on the maintenance budget and maintenance planning (Mazlan & Mohammed, 2008). According to Ali et al. (2010), the outstanding balance charge of the residents is also the root cause of the insufficient budget allocation. In the situation where the maintenance cost keeps increasing, most of the residents are unlikely or unable to pay outstanding balance. They argued that the fees are not reasonable, and the allocation of the collected maintenance fees is questionable and not clear (Yusoff et al., 2011).

2.6 Over-Budget

Lee and Scott (2009) stated that maintenance standards depend on the available maintenance resources. However, over-budget is one of the factors that influenced the maintenance cost of housing. In many cases, inadequate maintenance financial planning causes the limitation of the maintenance work that leads to defects, damage, etc. Subsequently, an additional charge that is out of the budget is needed to fix the defects and restore the building component to the original condition (Ali et al., 2010). In other words, inappropriate maintenance implementation leads to additional cost expenditures and over-budget, leading to unhealthy cash flow and ineffective maintenance management practices (Au-Yong et al., 2022). As a result, more maintenance backlog will be accumulated due to poor budget control and unavailable to perform the maintenance tasks on time.

2.7 Absence of Building Maintenance Regulation

The quality of maintenance management in Malaysia is inconsistent due to the absence of standard operating procedures and monitoring of maintenance (Che-Ghani et al., 2023). Generally, there is no standard or guideline established in Malaysia regarding the building maintenance. To make the matters worse, it is difficult to determine the exact maintenance cost, because the estimated cost often differs significantly from the actual cost (Mohd-Noor, Hamid, Abdul-Ghani, & Haron, 2011). Besides, there is no regulation regarding the maintenance fee. Occasionally, it provides the management team the chance to gain pocket money by increasing the maintenance fee (Mohd Tawil, Che-Ani, Ismar, Zain, & Daud, 2010). Thus, maintenance management regulation should be developed in to standardise the practices in the field of maintenance management (Che-Ghani et al., 2023).

2.8 Lack of Knowledge and Skill

Maintenance personnel's experience and understanding of the maintenance work can significantly influence the maintenance performance (Au-Yong et al., 2022). Lack of the knowledge and skill of the maintenance staff will result in inefficient maintenance management. Failure to assess the quality of work performed by the maintenance workers themselves could lead to adverse effects, such as incompetence to detect unnecessary errors and errors made by them (Kangwa & Olubodun, 2003). It is found that most of the maintenance personnel over-rely on the technology, but in fact, they unclear about the principle of the maintenance operation. In most common cases, the maintenance supervisors only performs the role to supervise and approve the maintenance report. Still, they do not know the technical knowledge regarding the maintenance work (Alshehri, Motawa, & Ogunlana, 2015).

2.9 Lack of Staff and Specialist

A competent maintenance manager should identify the appropriate number of maintenance staff to be employed to avoid understaffing or overstaffing. Lack of the staff means that the workload of the existing staff increase that may affect the quality of the work even all the staffs able to perform the maintenance work (Zawawi & Kamaruzzaman, 2009). Besides, the specialist is needed for the specified maintenance work like lift and firefighting system maintenance. Sometimes, the specialist is not available locally and it takes time to hire the specialist from overseas that leads to the delay of maintenance work (Alshehri et al., 2015). According to Suffian (2013), building maintenance usually covers the services system and facilities only. Therefore, the hired maintenance personnel are qualified with technical

knowledge such as mechanical and electrical knowledge, resulting in the ignorance of architectural defect because they lack the knowledge of civil and structure.

2.10 Unclear Job Description and Department Structure

The maintenance manager must be able to bridge the needs of building owners with organisation of the maintenance structure to set agreed-upon performance goals, allocate and prioritise sufficient resources or budgets, inform the management of policy and direction changes to meet these goals, and report the performance of meeting these goals (Au-Yong et al., 2017). Otherwise, there will be an issue where the maintenance staff confuse their responsibility in the department and do not know who can refer and report when they meet the problem. As a result, there have been many unanswered applications and grievances stored. Maintenance manager is advised to make sure all the maintenance staffs are clear about their position and responsibility before implementing any maintenance work by providing a documented description of the job responsibility (Zawawi & Kamaruzzaman, 2009).

2.11 Lack of Maintenance Software Tool

Wang, Ali, and Au-Yong (2022) highlighted the potential of application of Building Information Modelling (BIM) technology in maintenance management scenarios. The effective maintenance software provides the information on operation, maintenance and renovation of the building for the maintenance department in deciding on the budget allocation. It assists the building manager in designing the maintenance work by distributing the budget appropriately. On the other hand, the existing management system is outdated and will entail maintenance inefficiency (Alshehri et al., 2015). The maintenance team argues that the existing management system is obsolete, and they deem this system as inefficient to the department. Therefore, there is a need to investigate the feasibility of applying maintenance software tool to improve the maintenance management practices.

2.12 Poor Workmanship

Besides, poor workmanship is known as the root cause of the defects in maintenance works. The symptom of the deficiency usually visible once the maintenance works are done. Subsequently, additional remedial works need to be given to rectify the defect. Thus, the maintenance cost increase is unavoidable (Karim, Marosszeky, & Davis, 2006). For the successful and efficient execution of maintenance work, maintenance standards are a vital indicator of performance. It forms a basis for control, which is the rule for running a productive organisation, and it helps keep maintenance costs down (Che-Ghani et al., 2023).

2.13 Failure of Preventive Maintenance (PM)

Improper maintenance planning, missing of proactive maintenance, and weak implementation of the maintenance work are believed as the main bugbear of the maintenance management in high-rise residential building (Hsieh, 2009). It is noted that lack of PM would result in many maintenance problems in the building. However, corrective maintenance (CM) is the primary approach executed by most of the maintenance team in Malaysia. The current measure of reactive maintenance is said not to meet the needs of the building user and building performance (Chua, Zubbir, Ali, & Au-Yong, 2018). CM is deemed as the inefficient maintenance strategy because of the high cost consumed due to the high breakdown frequency (Au-Yong, Ali, & Ahmad, 2014). Ideally, PM is the best choice from CM in terms of the maintenance cost saving because it is designed to minimise the downtime of the asset, prevent the occurrence of major defects and at the same time improve the reliability and sustainability of the asset (Chua et al., 2018). Therefore, it is clear that the high occupants' satisfaction level and the overall building performance can be achieved by selecting the correct maintenance strategy.

2.14 Unavailability of Spare Parts

In selecting the system to be adapted in the building, the maintenance team is necessary to consider the availability of the spare part. The component replacement is needed when it reaches its maximum limit to enable the system back to the original state and make sure it can operate safely. It is suggested to use the spare part that available locally. In general, the spare part of the outdated system is challenging to find because it is out of the market. The only solution in getting this spare part is by ordering from oversea, which results in the delayed maintenance work and even worse the building operation forced to stop (Alshehri et al., 2015). Additionally, it increases the unnecessary cost such as taxing and shipping fees, which added the price on the particular spare parts. Therefore, some of the organisation choose to purchase the second-hand spare part or materials due to the new is unavailable locally (Al-Hammad, Al-Mubaiyadh, & Mahmoud, 1996). The poor quality of spare parts to some extent, higher the maintenance cost, because the failure is likely to occur in high frequency during its operation if the PM is not performed well (Yeh, Lo, & Yu, 2011). Therefore, it is clear that the quality of the spare part able to affect the maintenance performance. An experienced and excellent building manager can allocate the budget properly in purchasing the spare parts and materials at the least possible cost without affecting the quality of the system (Chua et al., 2018).

■3.0 MAINTENANCE PERFORMANCE

The success and viability of the organisation can be reflected by the effectiveness and efficiency of the maintenance scheme. Hence, the maintenance performance should be measured by using the appropriate method (Che-Ghani et al., 2023). The performance of management is interpreted as the process of measuring the effectiveness and efficiency of the action (Neely, Gregory, & Platts, 1995). Maintenance performance measurement is important to evaluate the occupants' satisfaction on the completed works. The benefit of the execution of maintenance strategy is enjoyed by organisation and the quality performance is reflected by the occupants' satisfaction (Abd Rani, Baharum, Akbar, & Nawawi, 2015).

Besides, cost, quality and time are the common parameters to measure maintenance performance parameters (Lam, Chan, & Chan, 2010; Zuashkiani, Rahmandad, & Jardine, 2011). Instead of concentrating solely on tangible aspects, the quality of management work should also be taken into account as the maintenance performance parameter. According to Parida (2007), the following indicators can be used as maintenance performance measurement.

- Customer satisfaction
- Equipment effectiveness
- Cost variance
- Health, safety and environment issues

3.1 Customer Satisfaction

Customer satisfaction enables the organisation to understand the root cause of the poor maintenance performance and allow them to do the evaluation and figure out the best solution. Besides, customer satisfaction enables the organisation to notice the demand of the customers (Kärnä, Sorvala, & Junnonen, 2009). Customer satisfaction survey can be done by measuring the customer perception and experience on service quality, uninterrupted delivery time, health, safety and environmental issues (Kumar, 2006). The amount of helpdesk requires and complaint forms received can be used to measure occupants' satisfaction (Chua et al., 2018). These factors can determine how the maintenance work's success because the effective practice would result in the excellent performance of the facilities or services system.

3.2 Equipment Effectiveness

Performance in maintenance can be measured by the downtime of the building system (Shohet, 2006). Coetzee (1999) stated that the machine effectiveness can reflect the maintenance performance because the equipment is directly influenced by the maintenance work. The frequency of downtime is the indicator to determine the equipment effectiveness during its operation. The actual downtime rate is used to compare with the planned downtime rate to define the effectiveness of the equipment. It is said that the equipment has the low performance rate when then actual downtime rate higher than planned downtime rate and vice versa (Au-Yong, Ali, & Ahmad, 2015). The data on the frequency of system breakdown and its duration can be sourced on its performance history. These data can also reflect the availability of the system in building during the operation hours. Maintenance downtime is used as the maintenance team's reference to improve the maintenance performance (Pascual, Meruane, & Rey, 2008).

3.3 Cost Variance

Maintenance expenditure is deemed as a necessary expense rather than profit generator. This statement is proved from the research of Jonsson (1997) who stated that the management team neglects the need for maintenance due to the absence of profitability. Maintenance efficiency for maintenance tasks is calculated based on savings or expenditure (Samat, Kamaruddin, & Azid, 2011). According to Shah Ali (2009), the difference of the actual expenditure from the expected cost for maintenance activities is used to evaluate the maintenance performance. In the case where the actual spent of the maintenance cost is lower than the planned cost, it indicated the high maintenance performance is accomplished and vice versa.

3.4 Health, Safety and Environment Issues

Inadequate maintenance may lead to the occurrence of incidents and accidents. Past incidents provide the idea to the maintenance team on the elements that need the attention to reduce the risk of health and safety of the users (Holmgren, 2006). During the implementation of the maintenance, the maintenance personnel and users are exposed to the risk of health and safety because if the maintenance failure occurs, this leads to the accident (Grusenmeyer, 2014). Thus, measuring the maintenance performance via the health, safety and environment issues is appropriate as individualised attention is given to every single occupants of the building (Che-Ghani et al., 2023).

■4.0 RESEARCH METHODOLOGY

The research began with literature review to determine the maintenance management problems that affecting the maintenance performance of high-rise residential buildings. Since this research applied quantitative approach, the data collection method adopted was online questionnaire survey. The data was the collected via close-ended questions (to assess the relationship between the maintenance management problems and the maintenance performance) and open-ended questions (to obtain recommendations for solving the maintenance management problems) in the questionnaire. The questionnaire consisted of 4 sections. Section A was about the background

of the respondents (nominal scale, multiple choice questions); Section B was the occurrence of the maintenance management problem (ordinal scale, 5-point Likert scale); Section C was the maintenance performance (ordinal scale, multiple choice questions); and Section D was the open-ended question to obtain the opinions and strategies of the respondents in solving the maintenance management problems of high-rise residential buildings. The targeted high-rise residential buildings were condominiums that shared the similar characteristic such as more than 7-storey, completion year more than 2 years and located in Klang Valley. The questionnaire was sent to 221 condominiums located in Klang Valley via JMB or MC emails to reach out the building manager/property managers, building executive/supervisors, or facilities managers. However, only 36 responses were gained and the details of the respondents were shown in Table 1. Based on the theory of the Central Limit Theorem (CLT), minimum 30 samples were sufficient to represent the population with a defined level of variance and it was suitable for most of the research to get the valid result (Bougie & Sekaran, 2019; Ganti, 2023). Upon completion of data collection, the quantitative data was analysed with ranking analysis and Spearman correlation analysis. While the data from the open-ended question was tabulated according to the related maintenance management problems.

Table 1 Social demographic information of respondents

Profile	Description	Number of Respondents, n=36	Percentage, %
Job Title	Building manager / Property manager	19	52.8
	Building executive / supervisor	13	36.1
	Facilities manager	4	11.1
Working Experience in BM field	0-5 years	20	55.6
	6-10 years	11	30.6
	11-15 years	4	11.1
	16-20 years	0	0.0
	21 years and above	1	2.8
Educational Background	SPM / STPM / A-Level / Pre-U certificate or equivalent	4	11.1
	Diploma in relevant field	9	25
	Degree in relevant field	16	44.4
	Master in relevant field	5	13.9
	Other	2	5.6

■ 5.0 FINDINGS AND DISCUSSION

5.1 Maintenance Management Problems of High-rise Residential Buildings

Table 2 shows the ranking of the maintenance management problem of high-rise residential buildings. From the Table 2, the highest ranking of the maintenance management problem in the high-rise residential building is the shortage of the maintenance staff and specialist with the mean value of 3.33. Dahlan and Zainuddin (2018) explained that the shortage of maintenance staff causes the reduction of the management's efficiency, and it might lead to the indirect impact on the building components in the case of failure. Therefore, more expenditure is needed to recover the significant defects. Moreover, the progress of the maintenance work is slowed down due to the limited maintenance staff which causing the planned maintenance schedule to be disrupted (Nashruddin, 2021). Besides, the young generation tend to no choose the training course in pursuing degree level because the technical job is deemed unstable and low-paid jobs. Other than that, many seniors reach to the retirement age and leaving the industry with a shortage of qualified replacements (Short, 2020).

Table 2 Ranking of the maintenance management problem of high-rise residential buildings

Rank	Variables	Mean (n=36)	Standard Deviation
1	Lack of staff and specialist	3.33	1.195
2	Over-Budget	3.19	1.238
3	Amendment of Regulation	3.17	0.845
4	Poor workmanship	3.11	1.304
5	Lack of knowledge and skill	3.06	1.145
6	Lack of training and motivation	3.06	1.013
7	Lack of awareness of the residents	3.03	0.971
8	Unavailability of spare parts	2.97	1.055
9	Failure of Preventive Maintenance (PM)	2.86	1.073
10	Budget constraint	2.75	1.180
11	Absent of regulation	2.72	1.085
12	Lack of Maintenance Software Tool	2.67	1.146
13	Unclear Job Description and Department structure	2.61	1.022
14	Unqualified maintenance contractor	2.58	0.906

Next, the high-rise residential management team faces the problem of over-budget, which is ranking second with the mean of 3.19. Over-budget might be caused by the maintenance team too rely on the historical data without doing market survey and taking reasonable consideration on the location factor, current building condition, material prices, etc. (Mong, Mohamed, & Misnan, 2018).

Then, it is followed by the amendment of regulation which ranked third, with mean score of 3.17. Building maintenance is crucial not only to ensure the facilities and services in buildings are running at desired levels, but also that the performance meets the needs of the building's user (Thompson, 1994). The aim of the building maintenance can be achieved by complying with the current building regulation that cover the aspect of the environmental conditions, power supply requirement, telecommunication requirement, etc. which could meet the requirement of the building occupants. The health and safety regulations keep updated to meet the current situation and it aims to increase the performance of the building. It generally increases the burden and disturb the maintenance planning of the maintenance team in order to comply to the requirement. For example, from the Fire Services (Fire Certificate) (Amendment) Regulations 2020, the building owner have to hire a Fire Safety Officer who responsible to maintain the fire protection system at optimum level (SKRINE, 2020). In this scenario, the maintenance cost would increase because of the increasing of the fire protection system maintenance.

The problem of poor workmanship is ranked fourth with the mean of 3.11. In Malaysia, one of the results of poor workmanship can be revealed by the wavy surface of plaster on the wall (Suffian, 2013). Abdul-Rahman, Thompson, and Whyte (1996) pointed out a few factors which leads to the poor workmanship.

- Communication barrier
- Improper construction material
- Poor weather condition
- Insufficient experience of worker
- Poor project management
- Time and cost limitation

During the construction period, some of the contractor tends to employed short term unskilled worker which cause the low-quality project. The construction workers are commonly the foreigner who cannot understand or unfamiliar with the local language. Thus, the workers always unclear and misunderstanding their job scope which leads to the poor workmanship. Besides, the contractor tends to cut down the labour cost due to improper planning of the budget that cause the lack of worker to complete the task within the planned time. Therefore, the defect of the building is appeared because of lacking of workers to complete the task within the agreed time (Ali & Wen, 2011).

5.2 Correlation between Maintenance Management Problems and Maintenance Performance

In this survey, hypotheses are developed and then tested using correlation test. The hypotheses are as follows:

H_0 : There is no significant correlation between the maintenance management problems and maintenance performance of high-rise residential buildings.

H_1 : There is a significant correlation between the maintenance management problems and maintenance performance of high-rise residential buildings.

In correlation analysis, the $p < 0.05$ indicates statistically significant relationship between two (2) variables. It is a strong evidence to reject the null hypothesis at the significance level of 0.05. The correlation result is shown in the Table 3. Overall, there are two (2) significant results.

Table 3 Correlation between maintenance management problems and maintenance performance of the high-rise residential buildings

Variables		Average number of complaints received per year	Ratio of actual to planned maintenance downtime	Ratio of actual to planned maintenance cost	Average number of accident or incident happened
Lack of awareness of the residents	Correlation	-0.120	0.086	0.107	0.104
	Coefficient Sig. (2-tailed)	0.484	0.618	0.534	0.545
Unqualified maintenance contractor	Correlation	-0.022	-0.008	0.073	0.021
	Coefficient Sig. (2-tailed)	0.896	0.965	0.673	0.905
Amendment of Regulation	Correlation	-0.101	0.007	0.151	0.150
	Coefficient Sig. (2-tailed)	0.556	0.966	0.38	0.382
Lack of training and motivation	Correlation	-0.328	0.125	0.171	0.161
	Coefficient Sig. (2-tailed)	0.051	0.466	0.319	0.347
Budget constraint	Correlation	-0.157	-0.111	0.092	-0.207
	Coefficient Sig. (2-tailed)	0.361	0.517	0.593	0.227
Over-Budget	Correlation	-0.058	0.276	0.740**	-0.186
	Coefficient				

	Sig. (2-tailed)	0.735	0.103	0.000	0.277
Absent of regulation	Correlation	0.041	-0.242	-0.082	-0.030
	Coefficient				
	Sig. (2-tailed)	0.815	0.141	0.635	0.861
Lack of knowledge and skill	Correlation	0.109	0.016	0.159	0.135
	Coefficient				
	Sig. (2-tailed)	0.528	0.928	0.353	0.432
Lack of staff and specialist	Correlation	0.065	0.167	0.319	0.066
	Coefficient				
	Sig. (2-tailed)	0.705	0.329	0.058	0.704
Unclear Job Description and Department structure	Correlation	0.114	-0.100	0.011	-0.081
	Coefficient				
	Sig. (2-tailed)	0.508	0.560	0.950	0.637
Lack of Maintenance Software Tool	Correlation	-0.039	0.057	0.109	0.100
	Coefficient				
	Sig. (2-tailed)	0.821	0.743	0.527	0.562
Poor workmanship	Correlation	0.044	0.212	0.037	0.124
	Coefficient				
	Sig. (2-tailed)	0.798	0.214	0.832	0.470
Failure of Preventive Maintenance (PM)	Correlation	-0.055	0.054	0.064	-0.131
	Coefficient				
	Sig. (2-tailed)	0.750	0.754	0.711	0.446
Unavailability of spare parts	Correlation	0.101	0.357*	0.244	0.285
	Coefficient				
	Sig. (2-tailed)	0.558	0.033	0.152	0.093

The maintenance budget overrun is significantly correlated with the ratio of actual maintenance spent to planned maintenance cost (cost variance) of high-rise residential building with a coefficient, r of 0.740 ($p < 0.05$). The r value indicates a strong relationship ($r > 0.50$) between the maintenance budget overrun and the maintenance cost variance. The precision of building performance that can be estimated could affect maintenance planning to a large degree. The degree of accuracy, on the other hand, should be in line with the predictions' time-scale goals. Some highly detailed approaches can result in unnecessary costs and can cause capacities of maintenance resources to become distracted (Chanter & Swallow, 2008). The following are the factors that needed to be taken into consideration in figuring out the maintenance budget (Chanter & Swallow, 2008; Gupta, Gupta, & Gandhi, 2014).

- Current condition of the buildings
- Labour cost
- Maintenance strategies
- Material and spare parts price
- Available funds

Insufficient knowledge of maintenance managers and unskilled staffs are also the element that leads to over budget because they are unable to execute their tasks effectively (Sani, Mohammed, Misnan, & Awang, 2012). Unprofessional maintenance staff tends to increase the burdens to the organisation by increasing the building or equipment failures due to lack of training and knowledge (Mong et al., 2018). Thus, the maintenance budget overruns because extra cost is needed to repair or replace the failure part.

Next, the correlation coefficient of 0.357 ($p < 0.05$) indicates a significant correlation between unavailability of spare parts and ratio of actual to planned maintenance downtime (equipment effectiveness) of high-rise residential building. Spare parts are needed for the replacement of faulty parts. The r value indicates a moderate relationship ($0.30 \leq r < 0.50$) between the unavailability of spare parts and the equipment effectiveness. The spare parts are needed to be imported from abroad such as Japan, German because most of the current building design and equipment used is too advanced. It takes time to be transported to Malaysia and hence longer the maintenance downtime of the particular equipment (Mong et al., 2018). This statement can be proved by Van Horenbeek, Scarf, Cavalcante, and Pintelon (2013) who concluded that the late of the arrival of spare parts would give rise to the downtime cost because of the delay of replacement.

The lead time of the equipment is the factor consideration in deciding the spare parts ordering. The maintenance team tends to order the spare part when it is necessary in the case of short lead time because the chance of the downtime occur is very small. The inventory is used to deal with the impact of the corrective replacement and it is reviewed periodically to avoid the spare part from out of stock. In the condition where both PM and CM must execute for different equipment at the same time, the available and limited spare parts are given priority to CM. The PM is performed until the new spare part is available (Van Horenbeek et al., 2013).

5.3 Suggestions in Solving the Maintenance Management Problem

A management body's function in managing a residential property is critical in ensuring that every problem is dealt with a definitive resolution. From the Section D of google form questionnaire, the respondents are given the space to give their opinions and strategies on

solving the maintenance management problems of high-rise residential buildings. Table 4 shows the opinion and strategies on solving the maintenance management problem of high-rise residential buildings given by respondents.

Table 1 Suggestions on solving the maintenance management problem of high-rise residential buildings given by respondents

Maintenance Management Problem	Opinion and Strategies on Solving It
Lack of awareness of the residents	<ul style="list-style-type: none"> • The residents have to be well educated about strata living first before moving in from the landed property as they bring their old ways into a strata living and sometimes cannot adapt to the new rules set by government as well as management team. For example, the residents do not pay the management fees on time and follow the rules set by the management. • Residents should understand the maintenance of a strata building instead of thinking that all the problems are liable by the management office. The residents should also have a better understanding on the Strata Management Act 2013 on the roles and responsibility of the residents in the strata buildings. Residents should play their role in maintaining the building in good condition and save the maintenance cost by avoiding vandalism.
Unqualified maintenance contractor	<ul style="list-style-type: none"> • Review the performance and achievement of the targeted contractor during the procurement stage and choose the qualified maintenance contractor. The qualified contractor means the contractor is certified and registered with Construction Industry Development Board (CIDB). The contractor is competent and well training which enable him to execute the maintenance job professionally.
Budget constraint and over-budget	<ul style="list-style-type: none"> • Adoption of outsourcing services to the professional third party. The maintenance expenditure is within the control by periodically assess the third party's services, compare and negotiate prices for their offerings. The costs of recruiting, training, uniforms and employee benefits can be saved by outsourcing service because it is bear by the service provider. This also can be applied for inventory items by restocking the spare parts in large quantities with cheaper prices. • Due to the cost of delay maintenance can be rather expensive, implementing a planned maintenance approach rather than reactive maintenance can save a lot of money in the long run.
Lack of knowledge and skill, poor workmanship, and lack of training and motivation	<ul style="list-style-type: none"> • Hired specialist to perform the special maintenance work such as maintenance electrician, plumber, etc. • Giving sufficient training to the maintenance staffs. The maintenance staffs should be sent for the training program to sharpen the maintenance skill and knowledge on the building systems. • Before hiring the maintenance staff, it is necessary to make sure the applicant is qualified and certified in relevant field. • The supervisor or building manager needs to play their role in monitoring and supervising the maintenance staffs' work in order to ensure that the outcome is meet the requirement.
Lack of staff and specialist	<ul style="list-style-type: none"> • Outsourcing the maintenance services to service provider that provide comprehensive maintenance. Therefore, the action can be taken immediately when the problem or the failure of the equipment arise because the service provider's technician is around on site.
Failure of preventive maintenance (PM)	<ul style="list-style-type: none"> • Extra precaution needs to be taken for water tank, pump, genset each building, elevator and piping because these are the main services provided for the residents. • Having the schedule maintenance planning of all the system in the building to reduce the downtime of the system. It can be achieved by making sure the consistency on the checklists for the PM and periodic inspection are performed consistently.

Besides, there are some measures on solving the maintenance management problem found from the previous papers. The relevant authority such as local authority, professional bodies, and management team itself play important role in solving the maintenance management problems by the following methods (Ali et al., 2010; Tiun, 2009).

- The guideline or regulation regarding to the qualification, role and responsibilities of a building manager or property manager should be provided to ensure the person equipped with necessary knowledge and skill before managing and starting the maintenance work. This way can prevent the owner from hiring the unqualified and unprofessional maintenance staffs. The action taken or penalty for the residents' default such as refusing to pay maintenance fees, did vandalism, abuse the fire-hose to wash car, etc. should be stated and mentioned clearly in the regulation.
- Make the financial account and funds transparent and use it effectively. The cash inflow and outflow should be calculated properly and shows to the residents to increase the awareness of the residents regarding to importance of maintenance fees in upgrading the building facilities.
- Set up the maintenance policy as the guideline for the maintenance personnel to plan the maintenance strategies. The contents of maintenance policy including maintenance aim and objective, scope of maintenance work, maintenance standard, maintenance strategies, key performance index of maintenance performance, etc., which ensure the maintenance staff clear their roles and the management structure in maintenance department. Besides, maintenance policy can ensure the budget is allocated fairly and properly and make sure the building condition always in optimum level.

6.0 CONCLUSION

This research identifies the significant maintenance management problems that require attention. From the ranking analysis of the maintenance management problems, the top four (4) maintenance management problems of high-rise residential building are lack of staff and specialist, maintenance budget overrun, followed by amendment of regulation, then poor workmanship. Then, two (2) significant correlations are determined. The maintenance budget overrun is significantly correlated with the ratio of actual maintenance spent to planned maintenance cost (cost variance) of high-rise residential building. This finding indicates that proper maintenance planning and budgeting are crucial to ensure the healthy maintenance cash flow. Moreover, the unavailability of spare parts is found to be significantly correlated with the ratio of actual to planned maintenance downtime (equipment effectiveness). An efficient spare part management is essential to ensure the maintenance works being done on time. Some additional opinions and strategies on solving the maintenance management problems are provided too, including educating the residents about the Strata Management Act 2013, selecting qualified maintenance contractor, outsourcing the maintenance services, implementation of preventive maintenance (PM), hiring specialist to perform special maintenance work, providing training for maintenance staffs, formulating the building maintenance regulation, ensuring transparency of financial account, and setting up maintenance policy. Anyway, these opinions are subjected to verification where it is not being done in this research (the research limitation). Therefore, it is recommended to further examine the effectiveness of these opinions in the future research.

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