Original Article

Behavioural issues in maintenance of university buildings

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ABSTRACT University buildings require maintenance to create a suitable environment that supports and stimulates learning, teaching and innovation. This article is concerned with identifying, evaluating and categorizing the criteria of the university building users' value systems. The criteria of the user value system or VALUCRITE are those that are taken into account while making decisions on maintenance management to enhance user satisfaction. For this purpose, this article reviews the related literature and presents the outcome of a questionnaire survey. Questionnaires were administered to 550 university building users in Malaysia. Twelve criteria were addressed to the respondents measured on a five-point continuum scale. With 87 per cent response rate and a cumulative mean score of 4.0516, six of the criteria have an individual mean score more than the cumulative mean score. The data were both satisfactorily reliable and valid. A multiple regression analysis performed revealed that collectively the 12 criteria can significantly explain user satisfaction ($F_{(12\,439)} = 33.576; < 0.05$) Therefore, the criteria can actually be used as screened criteria to ensure users' optimum performance with the maintenance service of university buildings.

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INTRODUCTION

Although this article is part of an ongoing research, it somehow took on a life of its own. It is the plan of the research of which this article forms part to develop a model of reference points to ensure that every time maintenance is initiated and implemented, it is consistent, systematic, proactive and holistic. The objectives of this article are: (1) to expand the theoretical framework for user value criteria in university building maintenance (2) to determine through a questionnaire survey the user value criteria in the Malaysian university buildings. This article is divided into four parts, preceded by an introduction. Building maintenance management concepts, techniques and strategies were introduced. Part II reviews various issues related to educational buildings and goes on to present the roles of maintenance in sustaining and enhancing the performance of university buildings. The part further describes the criteria in the building user value system. First, the service quality issues were presented. The need to modify and expand the 'SERVQUAL' criteria was reviewed. Next, the modified criteria suitable to building users were established. These later criteria were collectively labelled 'VALUCRITE' (derived from value criteria a similitude of the service quality criteria). Part III deals with the research design and methods used in the analysis of the research data. In part IV, the data analysis and discussion of the research findings were presented. Part V concludes this article. The research disciplines that informed this research primarily fall within three disciplines of literature and theory: building, maintenance and value-based management. The premise for this study is the move from the building and its management as the main focus for the maintenance management process towards the value chain (enhance productivity and user satisfaction) as the main focus. The value chain is the focus for more effective and efficient strategy of creating value to maintenance organization and building users. Value creation is increasingly viewed as a process of facilitating a network of relationships within which organizations are positioned (Pryke, 2009)

THEORETICAL FRAMEWORK

Recent studies (Housley, 1997; Fleming and Storr, 1999; Amaratunga and Baldry, 2000; Price *et al*, 2003; Green and Turrell, 2005; Leung and Fung, 2005; Wong *et al*, 2006; Fianchini, 2007 and Lavy and Bilbo, 2009) have affirmed the positive correlations between the performance of educational buildings and the quality of education. University buildings are factors of production. The buildings are procured to create a suitable, conducive and adequate environment that supports, stimulates and encourages learning, teaching and innovations. A failure in the supply of these essential services is a loss in value to the university institution, the community, the students, staff and other stakeholders. Constructing new buildings helps to upgrade educational facilities and provide better quality education; however, it is of utmost importance to maintain the existing buildings to acceptable performance standards that are capable of facilitating the transfer of knowledge and carrying out other academic activities effectively and efficiently.

On the other hand, since 1990, the government of Malaysia has realized that public universities were consuming a large share of the public revenue without a corresponding return for investment. As a result, government is pressuring the public universities to be self-funding. A feature that is normal with private universities, however, Government is already partnering with the private sectors so that it can maintain the control of the public universities. A PFI deal was just signed for the construction of additional six campuses of Universiti, Teknologi Mara. The deal is expected to save the government RM 500 million (Nordin, 2010 Cited in The Star, 5 May 2010). Therefore, universities have no choice but to be market driven in order to generate sufficient revenue in addition to the government interventions if they must remain operational.

However, several studies have indicated the need to balance capital costs against the subsequent maintenance costs of the buildings, as a perceived saving today could lead to high maintenance costs in future. The increase in land costs has lead to the unprecedented growth in maintenance works. This is calling for cogent need for building maintenance and its management, which must be done in an effective and efficient manner, however.

Apart from the human resource, which is the repository of knowledge, the building is the largest asset of the university institution. The cost of the property function in comparison with the turnover of university institution ranged from 8 per cent to 11 per cent (Housley, 1997). Currently, universities use the nature, design and condition of their buildings to woo students. In Malaysia, universities that in the past relied on the applications sent to them through the Ministry of Education now use their buildings as a variable to attract students (Rohaizat, 2002; Yosuf *et al*, 2008). It would not be difficult to argue that this is also the case elsewhere. To provide quality education, university buildings have to be well maintained to ensure optimum operable performance.

Maintenance includes the required processes and services carried out to preserve, repair, protect and care for the building's fabric and engineering services after completion, repair, refurbishment or replacement to current standards to enable it to serve its intended functions throughout its entire lifespan without drastically upsetting its basic features and use (Olanrewaju, 2010). Maintenance is required to delay decay, deterioration and failure in order for buildings to perform optimally throughout their design life. All buildings must be maintained throughout their lifespan. A maintenance-free building would have to compromise its durability and reliability considerations, which are very critical characteristics of a building. However, once a building has been completed, it is expected to be durable, reliable and available. It is probably very unlikely that a building that is expected to remain in continuous operable performance/use for more than 5 years will not require maintenance. Nevertheless, buildings are expected to last for, say, more than 60 years at best.

From the above definition, it is obvious that maintenance is not really about the building itself *per se* but the building users. User care rather than building care is the prime purpose of maintenance. The maintenance objective stems from user needs and wants or value system. Buildings are

procured for the sake of the service they provide to their occupants. To do this, however, it requires resources (material, workforce, money, capital and technology). Thus, maintenance management must stem from user performance requirements. The traditional approaches to maintenance are inadequate to attain the satisfaction of the modern forward-thinking building users. Traditionally, the management is fixated on cost reductions and only on the clients' interests. The satisfaction of the users is given inadequate consideration. The classical approach is fragmented, dispersed and biased. Current building users are sophisticated compared to how they used to be, more so for university building users who are 'enlightened' and always in 'transition'. There is a need for changes in the way building maintenance is initiated and implemented.

On the basis of the conclusion drawn from analysis of over 40 companies, Treacy and Wiersema (1995) suggest that organization could achieve success through customer intimacy. Customer intimacy demands, this discipline demands that companies must have sufficient and adequate knowledge of their customers' needs and wants. While the customer need is the must have in a product or service, the want is the quality that the customer wishes to have in a service or product. If the need is provided, the customer can slightly compromise on the wishes. In other words, the customer might still buy the product even if the wants are provided. The service provider must look far beyond the immediate objectives of the products or services to the users. The providers must provide service that has wider ends than the customers realized was possible (Bartholomew, 2008)

There are two main stakeholders in the maintenance management value chain. They are: maintenance organizations as the service providers and building users as the consumers of the services. Usually, a perceived 'gap' exists between what the users want and need and what the service providers provide. Consumers and service providers always have different perceptions with regard to the value of service delivery. In other words, 'perceived' gaps exist between the services that organizations provide compared with the services that end users want and need. Service outputs are labour intensive, customized and provided at the convenience of the users. Thus, human contact and its consequences are a crucial part of the process of producing services (Russell and Taylor (2006). They also found that service outputs are not easy to measure because that cannot be readily stored, felt, held and used again.

However, improving user satisfaction and improving productivity can be achieved through the value management principle and philosophy. Value-based management places emphasis on the collaborative approach towards the creation of value to the stakeholders (Knight, 1997; Martin and Petty 2000; and Ashworth and James, 2001). Value maintenance management involves the attainment of maintenance needs effectively (sustains user satisfaction) and efficiently (with optimum materials, labour and costs). In this context, both the provider and users are considered systemically by considering the user value system, on the one hand, and the productivity and profitability of the maintenance organization, on the other. Therefore, in this study, the VM philosophy is used to develop a model (methodology) of maintenance management
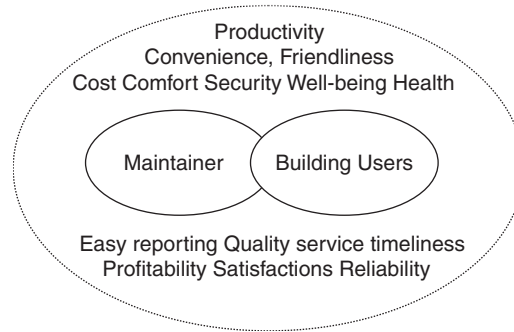
Figure 1: Relationships and criteria in maintenance service delivery.

for university buildings. Unlike the traditional management principle that is fixated on cost and on investors' interests only, value-based management contains both financial and non-financial measures to measure/assess systemic performance.

The establishment and subsequent consideration and inclusion of the user value criteria into the maintenance management system cannot be stressed enough. It precedes maintenance organization making decisions on maintenance strategy. This forms the basis of the maintenance budget and control (Kelly, 2006). Therefore, formulating maintenance objectives involves active participation of the users who signify their expectations and perception of the buildings. According to Parasuraman, Zeithaml and Berry (1990), the determinants of service criteria include reliability, responsiveness, competence, access, courtesy, communication, credibility, security and understanding the user (Heizer and Render, 2008). Although these determinants are suitable for classical and general service consumers, they can be adapted for building users. Many researchers in the different industries or sectors have modified Parasuraman's SERVQUAL model (Kumar, Kee and Manshor, 2009).

However, Russell and Taylor (2006) also identified the dimensions of service quality to include timeliness, courtesy, consistency, accuracy, convenience, responsiveness and completeness. However, there is a need to modify the dimension to suit the particular requirements of the service consumers. The modifications are necessary because the traditional dimensions in the service quality were inadequate to cater to the needs of various consumers. Figure 1 illustrates the relationships and criteria of the stakeholders in maintenance service delivery.

Building users are critical of reliable maintenance organization and services and prefer easy access to maintenance service providers. Furthermore, users want an easy means of communication with the maintenance organization and also want to be treated with courtesy. It is also imperative that building users want to be attended to by competent operatives and that places used for living, learning, studying and doing other activities within the university are safe and secure. Therefore, maintenance organization should be cognizant of the building user concern. The performance of the building is likely to be enhanced if the maintenance organizations are aware of these 'gaps' and take them into consideration in the maintenance process in response to the user value

systems. Users' 'satisfaction and providers' productivity are significant in the maintenance management system. These two perspectives of service providers and consumers must be combined for meaningful analysis. When the two perspectives are separated, improvement in one will lead to deterioration in the other. Value maintenance management, therefore, is management that centres on enhancing building users' satisfaction and increasing maintenance service providers' productivity. In this article, the value criteria or VALUCRITE is addressed.

RESEARCH DESIGN AND METHOD OF DATA ANALYSIS

There are about 1.5 million (approximate population of staff and students throughout the universities in Malaysia in an academic session) university building users in Malaysia. The sample size for this research was 500. This sample is chosen because of the guidelines on the determination of sample size. Sekeran (2004) outlines that for up to a population of 2 million, 500 samples are adequate and sufficient. Moreover, 10 times the number of variables is statistically significant for sample size. Inferential statistics also begin to lose their values if the sample size exceeds 500. In fact, many writers have argued for a sample size of 400 for any population if inferential statistics are required. Research involving all bank users or customers in Malaysia (which undoubtedly far exceeds the total university building users in Malaysia) drew valid conclusions based on 308 samples (Kumar, Kee and Manshor, 2009).

A questionnaire survey approach was used to collect primary data. The questionnaire was divided into three parts. The first part focuses on the respondents' profiles and the second part focuses on background information. The third section provides feedback on the criteria within the user value system. University building users are individuals or groups that use the building and its services to perform a specific function or the person or group that specifies functional requirements. They specifically refer to students and staff (academic and non-academic). The questionnaires were administered to university students. The students were conveniently selected as it is not possible to administer the questionnaire to all the universities in Malaysia, owing to location and time factors.

The questionnaire was modified after Arditi and Nawakorawit (1999), Chanter and Swallow (2007), Kumar, Kee and Manshor (2009) and a series of discussions was held with those concerned with the university building management. The questionnaires were predominantly (more than 95 per cent) administered in class, before the day's lectures commenced. The essence of the survey was initially introduced to the students. They were told that the questionnaire would take about 10 min to complete. The survey involves students from five universities, three of which are public and two privately owned. All the universities were well known in Malaysia. Everybody in the classes, irrespective of whether they live on or off campus, was asked to participate in the survey.

Twelve criteria were identified and addressed to the respondents. The data collection and collation commenced in December 2009 and lasted through to January 2010. The questionnaire was prepared in English and extended over two pages of A4. The questionnaire was adjusted through the margins and font size to fit the page. The respondents were asked to

grade each of the criteria in order of the importance a criterion has on their satisfaction with maintenance services. The criteria were major maintenance issues with the organization. Although the list may not be exhaustive because of the complexities associated with maintenance services, it covers the significant criteria. It was hypothesized that the criteria addressed to the respondents can significantly explain (or are important to) building users in maintenance services. In order to measure the degree of importance, a scale of importance was used:

Not at all important – if the respondent agrees that the criterion has any influence at all. This was measured on a scale of 1.

Not very important – if the respondent agreed that particular criterion is not very influential. This was measured on a scale of 2.

Important – if the respondent agrees that the particular criterion is only just influential. This was measured on scale of 3.

Very important – if the respondent agrees that the particular criterion is very influential. This was measured on a scale of 4.

Extremely important – if the respondent agrees that the particular criterion exerts extreme influence. This was measured on a scale of 5.

The degree of importance of each of the criteria is determined by the mean score test of each of the criteria. The mode technique was also used to determine the weightage of each of the measurement scales. From the individual mean score tests, the average mean score was computed. Mean is the average or mid-score of a distribution. It is determined to explain the varying opinions of respondents. It is used to calculate the average of observations. The mean is the most stable of the three measures of average of scores (Steinberg, 2008). The Standard Deviation is also calculated to determine the level of variability of each of the individual values from the mean score. Therefore, if the mean score falls between 1.0 and 1.5, the criterion is considered as not important at all. See Table 1 for other distributions. This cut-off point is used because the lowest possible mean score is one. This also applies to the 'extremely important' scale. The maximum possible score is five. However, it was understood that natural scale originates from zero (0), which in this case is not required. Criteria that do not exert any (zero) importance were not included in the list. During the piloting and subsequent discussions with

Table 1: Distribution of index evaluation metric

Item	Scale	Evaluation (interpretation)
1	1.00–1.50	Not at all important
2	1.51–2.50	Not very important
3	2.51–3.50	Important
4	3.51–4.50	Very important
5	4.51–5.00	Extremely important

those managing university buildings, it was emphasized that only the criteria that improve user satisfaction to building users should be addressed to the respondents.

Data analysis was performed using SPSS to produce descriptive and inferential statistics. Descriptive Statistics provide information regarding the distributions of data sets or variables. Missing data (that is, where the respondent refused to tick where applicable or there is multiple entry), could have a negative impact on the outcome of the findings. However, such an effect could be improved during data analysis by either replacing the missing data with the mode or mean of the data. However, in this article, the missing data will not be treated as such; instead, the authors prefer to leave the data raw, as it were, so that the outcomes will not in any way be influenced by the authors.

RESULTS AND DISCUSSION

This part presents the results of the survey and goes on to discuss the results. A total of 550 questionnaires were administered to the students. Fifty-eight questionnaires were not returned. Fifteen were not usable because they were not properly completed by the respondents. This leaves a total of 477 usable questionnaires for this research to analyse, with a response rate of 81 per cent, which is considered satisfactory for this research. Figure 2 contains the distribution of the respondents in terms of gender. Fifty-four per cent of the respondents were female, whereas the remaining (46 per cent) were male. The analysis in Table 2 further suggests that about 74 per cent of the respondents were from publicly owned universities, whereas 26 per cent of the students were from private universities.

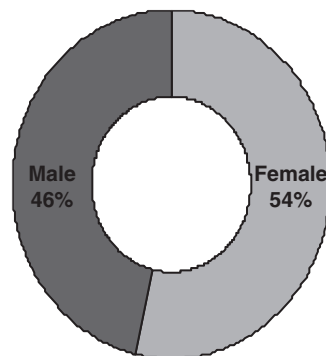**Figure 2:** Distribution of respondents' gender.

Table 2: Distribution of respondent's type of university

Category	Frequency	Per cent
Public university	348	73.70
Private university	124	26.30
Total	472	100.0

Table 3: Distribution of respondent's level

Level	Per cent
First year	19.1
Second year	32.9
Third year	40.0
Fourth year	6.3
Fifth year	0.2
Postgraduate	1.5
Total	100.0

Table 4: Distribution of respondent residence

Residence	Frequency	Per cent
Off campus	121	26.7
On campus	332	73.3
Total	453	100.0

The results of the survey indicate that the majority (40 per cent) of the students were in their third year (Table 3). This group was followed closely by those in their second year. Many (19.1 per cent) of the responding students were in their first year of university. Only 6.3 per cent were in fourth year, whereas less than 1 per cent were in their fifth year. The results further revealed that 15 per cent ($n = 7$) of the students were doing either Master's or PhD degrees.

The above results indicate that on an average the respondents have spent more than 1 year on the campus. In fact, students have to spend a year or three semesters for the foundation programmes before moving to the first year. This is the case in most of the universities in Malaysia. A majority (73 per cent) of the students live on campus, whereas only 27 per cent of them live off campus. See the distribution in Table 4. As such, the majority of students have adequate information on both academic and administrative, as well as residential buildings. In fact, it is even possible that many of those who live off the campus once lived on campus.

Gender and residence were crossed, the results of which are displayed in Table 5. The results indicate that 29 per cent of the female students resided at home, whereas the remaining 71 per cent lived on campus. Out of the 158 male students who completed the questionnaire, 76 per cent of them resided in hostels, whereas only 24 per cent of them lived outside the university's hostels.

The reliability test for the 12 VALUECRITE was considered satisfactory (Table 6). In fact, these results were excellent, as the closer the values were to 1 the better. Individually, the value ranges from 0.0919 to 0.923. Therefore, these data are reliable. A convergent validity test was conducted. The correlation values for the validity scores range from 0.356 to 0.628 (the results of this analysis cannot be displayed in this article because of space constraint). If correlations were higher than

Table 5: Distribution of cross-tabulation of gender with residence

Category	Respondent residence		Total
	Off campus	On-campus	
Female			
Count	70.0	174	244
% within respondent's gender	28.7%	71.3%	100.0%
% within respondent residence	57.9%	52.4%	53.9%
Male			
Count	51.0	158	209
% within respondent's gender	24.4%	75.6%	100.0%
% within respondent residence	42.1%	47.6%	46.1%
Total			
Count	121	332	453
% within respondent's gender	26.7%	73.3%	100.0%
% within respondent residence	100.0%	100.0%	100.0%

Table 6: Reliability statistics

Cronbach's Alpha	N of Items
0.926	12

0.75, the criteria might have to be examined to ascertain whether they were actually the same criterion split into two. The conclusions that are drawn from both the validity and reliability tests are that the 'goodness of measures' was very satisfactory.

It was hypothesized that the 12 criteria together can significantly explain user satisfaction in maintenance service delivery. In other words, it is possible to use the criteria as screened criteria in order to enhance user satisfactions. In order to substantiate this hypothesis, a multiple regression analysis was performed. The 12 criteria were regressed against meeting user expectations with building performance. The outcomes of the analysis are contained in Tables 7 and 8. The results show that the criteria can significantly explain about 70 per cent of meeting user expectations.

The results further indicate that the regression findings of $F(12\,439) = 33.576; < 0.05$ are significant. Therefore, there is conclusive statistical evidence to conclude that the criteria are capable of predicting user satisfaction. The criteria can actually be used as screened criteria to ensure user optimum performance.

Table 9 lists the frequency, mean scores and ranking of the criteria in the user value system. The average mean score was 4.0516. Specifically, seven of the 12 criteria have individual mean scores higher than the average mean score. The interpretation of this is that the building users were more critical of the sixth criteria. Quality of maintenance service is the most highly ranked criterion, followed by users' health and safety and then security of the user properties. The least considered criterion was the building's aesthetic appeal. Surprisingly, optimum building performance and dependable maintenance organizations were also poorly

Table 7: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
I	0.692(a)	0.479	0.464	0.64924

Table 8: ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
I	Regression	169.832	12	14.153	33.576	0.000(a)
	Residual	185.042	439	0.422	—	—
	Total	354.874	451	—	—	—

Table 9: Distribution of frequency, mean and ranking of the criteria

Criteria	Level of importance (Model values)					Mean	Ranking
	Not at all important	Not very important	Important	Very important	Extremely important		
Optimum functional performance	1.5	3.8	35.0	35.6	24.1	3.7715	11
User health and safety	0.6	1.3	16.6	33.3	48.2	4.2725	2
Time to respond to complaint	1.3	2.3	23.9	37.9	34.6	4.0231	8
Aesthetic appeal	0.06	4.3	37.9	36.0	21.3	3.7298	12
Security user property	0.8	1.7	21.4	29.1	46.9	4.1953	3
User comfort and well-being	0.4	2.1	22.0	35.7	39.7	4.1226	4
Time to complete maintenance work	0.6	2.1	24.2	35.8	37.3	4.0695	6
Efficient reporting system	0.8	3.4	22.2	38.6	35.0	4.0339	7
Reliable maintenance organization	1.1	1.5	30.0	36.6	30.9	3.9471	10
Convenience of appointment to make repair	1.0	3.6	21.8	40.5	32.9	4.0084	9
Friendly maintenance staff	1.5	2.9	20.1	33.5	41.9	4.1153	5
Quality of maintenance service	0.4	1.9	15.5	28.5	53.5	4.3298	1
Cumulative Average Score	**0.84**	**2.58**	**24.24**	**35.12**	**37.22**	**4.0516**	**VI***

*VI denotes very important.

ranked. Less than 1 per cent of the respondents actually agreed that the criteria were not important at all. Close to 3 per cent do not believe that the criteria are very important. On the other hand, 24 per cent measured those criteria as important. Although 35 per cent of them believed the criteria were very important, the majority (37 per cent) of the respondents considered the criteria extremely important to them.

The level of importance with the quality of maintenance service spread across the five categories of measurement. Only a negligible number (0.4 per cent) of the respondents concurred that the quality of maintenance service was not important at all. And 2 per cent of them also argued that it was not very important. However, 16 per cent of the respondents believed it was important. Concurrently, although 29 per cent measured quality of maintenance service as very important, the majority (54 per cent) of the respondents actually adjudged it extremely important. These outcomes were not surprising, however. It is only natural that the quality of works is significant.

The respondents also ranked user health and safety as important. Less than 1 per cent of the respondents believed that user health and safety is not important at all. About 1 per cent also believed that user health and safety was not very important. The majority (48.2 per cent) of the responding building users, however, regarded user health and safety as extremely important. Similarly, although only 17 per cent of building users agreed that user health and safety were important, 33 per cent opted for very important. On the one hand, although about 3 per cent of the respondents believed that security of properties was either not important at all or not very important, 21 per cent outlined that it was important. Forth-seven per cent of the survey respondents viewed security of property as extremely important, and at the same time 29 per cent considered it very important. It is not surprising that the building users ranked user comfort and well-being next. Nearly 3 per cent of the respondents considered user comfort and well-being either not at all or not very important. Forty per cent of them considered this factor extremely important, however. Close to 60 per cent of the respondents further believed it was either important or very important. It is only natural that building users will want to be attended to by friendly maintenance staff. A significant proportion (4.4 per cent) of the respondents either agreed that friendly maintenance staff was not at all or not very important. The majority (42 per cent) of the respondents considered it extremely important. More than 50 per cent of the responding building users considered friendly maintenance staff important or very important.

Time to complete maintenance works was ranked high. Twenty-four per cent of the respondents considered this important. Furthermore, more than 70 per cent of the university building users considered it very important or extremely important. It was expected that the procedures of the reporting system are rated high. Although about 4.2 per cent believed it was not at all or very important, 22.2 per cent considered this important. Furthermore, more than 70 per cent of them think it is very important or extremely important. The majority (38 per cent) of survey respondents believed that the time taken to respond to maintenance complaints is very important to them. This is followed closely by many (35 per cent) who regarded it as extremely important. Although 24 per cent of the respondents also believed it was important, 3.6 per cent considered it not at all or not very important.

Less than 5 per cent of the respondents do not agree that convenience of making appointments to make repairs is important. Twenty-two per cent of the respondents considered this important. Sixty-four per cent of the building users further measured the convenience of making appointments for maintenance as very important or extremely important. Surprisingly, optimum functional performance was poorly rated. However, 71 per cent of the respondents considered it important or very important. Although 5 per cent believed it was not at all or not very important, 24 per cent considered it extremely important. These outcomes were, indeed, unexpected.

CONCLUDING COMMENTS

This article challenged the classical maintenance management system. The traditional approach is fragmented, dispersed and biased. A systemic building maintenance management model improves a building's functional performance by integrating perspective and activities that are traditionally separated. Traditionally, the criteria of user's value systems are not incorporated into maintenance management systems. However, buildings only have value if they continue to provide the intended services adequately to the users. A failure of this will render the existence of the building insignificant, if not even useless. The article only reports the opinions of the building users, and there is a need to collect the opinion of the university maintenance organizations for meaningful comparison. However, it is highly likely that differences in their opinions will be found.

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