Enhancing Maintenance Services Quality: A Study of Student Satisfaction and Maintenance Strategies in Student's Residential College

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ABSTRACT

Maintenance services play a pivotal role in maintaining existing facilities, structures, buildings, and real property, encompassing routine maintenance, repairs, and replacement. In the contemporary landscape, the quality of maintenance has emerged as a critical factor in ensuring the optimal function of buildings and their components. This research endeavors to ascertain the perceived levels of students' satisfaction and expectation towards the quality of maintenance services at the residential college of Universiti Tun Hussein Onn Malaysia Pagoh Campus. This study also aimed to delineate maintenance strategies that leverage several technologies to enhance maintenance service quality. Through questionnaires, this study collected responses from a sample of participants and employed SERVQUAL approach, comprising five distinct elements, for analysis. Findings indicated that students' expectation and satisfaction levels, particularly in the realms of reliability, tangibles, and assurance, yielded high scores. However, responsiveness and empathy recorded comparatively lower scores. Additionally, the Importance Index (I) analysis measured the significance of maintenance strategies and revealed that all identified strategies were not only essential but also of paramount importance. The primary contribution of this study lies in the implementation of SERVQUAL model, which explained the relationship between maintenance service quality and various strategies employed. Recognizing the pivotal role of maintenance service quality in influencing student productivity, this study provides valuable insights for public institutions to enhance their maintenance services. The institutions can effectively elevate maintenance service quality towards advanced technology by emphasizing strategies that align with the five SERVQUAL elements.

1. Introduction

Maintenance service quality can be understood as a comprehensive customer evaluation of particular services and the extent to which it meets user expectations and provides satisfaction [1]. Efficient and effective building maintenance is mandatory. At the initial stage, the objectives, strategies, and maintenance policies will be achieved if proper maintenance is implemented effectively [2].

University buildings are the crucial part of the maintenance service quality. Failure in the supply of services required by the university will result in the loss of the value of university buildings [3]. According to Agbor [4], the interconnection between user satisfaction and expectations is intrinsically linked to the quality of services provided. In the context of a university residential college, various maintenance requisitions arise, including but not limited to electrical system maintenance, cleaning endeavors, plumbing system maintenance, and facility provision (e.g., assets, furniture, and landscaping). In addition, the time taken to respond to complaints and maintenance work carried out at the residential college is often an issue. It is one of the factors that affect the quality of maintenance services. Maintenance can be described as the act of sustaining an asset's capacity to produce something safely and cheaply throughout its entire life cycle by implementing an organized management of the following elements [5]:

i. Assets: Assets can be described as maintained equipment.
ii. Process and strategies: Maintenance processes and strategies are described as business processes associated with maintenance, maintenance strategies employed to reduce maintenance costs, maintenance engineering, and analysis techniques.
iii. People: People can be described as a group of persons in an organizational structure who are active in maintenance either directly or indirectly.

According to the British Standards Institution (BS 3811:1964), building maintenance means any work done to preserve or maintain and restore each facility. Based on the definition, it indicates that building maintenance is the work required to improve any facility covering every part of the building and its services as well as the surrounding area to reusable facilities and services. Therefore, the selection of the most appropriate maintenance strategy is crucial to enable the effective implementation of building maintenance [6]. Furthermore, maintenance and operation costs represent almost 75 to 80% of building maintenance during the design stage, including material and labor costs as well as other related costs incurred to maintain the building so that it can perform its required functions [7]. This demonstrates the importance of building maintenance management which greatly impacts on the economy [8]. Moreover, building maintenance problems can be seen when the period of use reaches 50 to 100 years compared to the construction period, which only takes 2 to 3 years. As time progresses, buildings that have many amenities undergo extreme changes, both in terms of physical and economic value of the buildings. According to the intended structural requirements, the average age of a building ranges from 20 to 50 years, but a building does not always conform to the standards that were first set forth [9]. Building structures that utilize concrete incorporating alternative materials, such as palm oil fuel ash, can be included in maintenance endeavors due to their distinct properties compared to conventional buildings [10]. Therefore, the aim of this study was to identify and analyze the perceived level of students' satisfaction and expectation towards the quality of maintenance services implemented and to identify the maintenance strategies required for quality maintenance services.

2. Type of Maintenance

Each element in the building structure will experience changes, including damage. The objective of maintenance is to maintain and enhance the function, design, and value of a building. Building maintenance also plays a role in ensuring that any existing damage can be repaired effectively and systematically to prevent recurring defects a short period of time. In fact, maintenance costs can also be reduced, which can guarantee the safety, health, and comfort of residents [9]. In general, maintenance work can be categorized into planned and unplanned maintenance. Planned maintenance consists of preventive and corrective maintenance. Planned maintenance is performed when the building and related services are maintained according to schedule. Typically, the scope of the maintenance schedule will be determined by the outcomes and performance of previous maintenance [11]. In addition, planned maintenance is also performed based on prior knowledge as well as control and use of records according to the plan that has been set, documented, monitored, and implemented regularly. Examples of planned maintenance are window cleaning, floor cleaning, and building and service inspections once a year. On the other hand, unplanned maintenance is generally corrective in nature. This maintenance is required if there is any unforeseen damage or failure in the building area [12]. Figure 1 illustrates classification of maintenance.
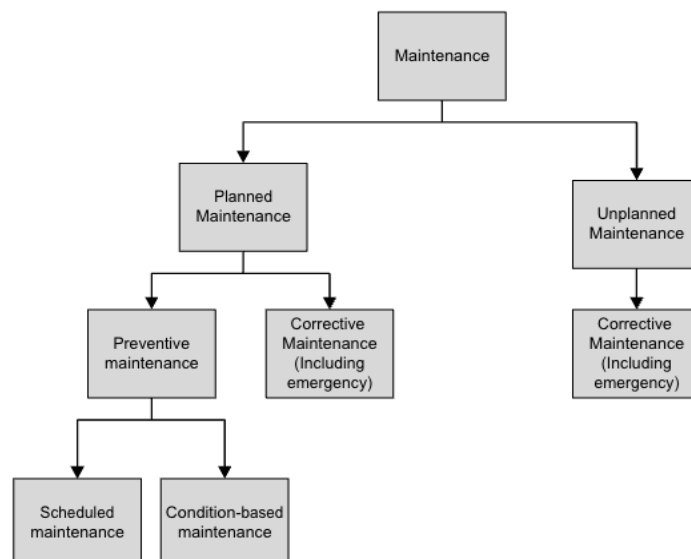

Fig. 1. Classification of maintenance [11]

In addition, planned and unplanned maintenance include corrective maintenance, preventive maintenance, scheduled maintenance, and condition-based maintenance. They also include maintenance services requested by users or occupants [13,14]. Even if these aspects are mostly not requested by the user, it is necessary to ensure that the building is always in a maintained condition [15].

2.1 Importance of Building Maintenance

Building maintenance is essential to ensure the building quality in the future by performing maintenance activities [16,17]. Among them are ordinary work, urgent work, and emergency work. All these works are performed according to appropriate time and actions for maintenance. Moreover, other maintenance activities involved are work services, work protection, replacement work, and repair work [18,19].

In building maintenance, students' expectation and satisfaction are also evidence of the effectiveness and satisfaction of an institution in managing its education system. Satisfaction is a state experienced by the student towards the performance or outcomes that meet his expectations. Satisfaction is also a function of the relative level of expectations and perceptions of performance. Students are more likely to be satisfied if their educational institution is able to provide satisfactory services and meet their expectations [20]. Ideris *et al.,* [21] stated that students' satisfaction is not only limited to learning, lectures, and notes received in class, or advice and guidance given by lecturers during learning time, it also includes students' experiences interacting with various university staff and non-academic components and the physical infrastructure offered and provided by the university as well as its maintenance services [21,22].

The main function of building maintenance is not only to ensure that the building always meets the occupant's satisfaction and expectation but also to ensure that the building, system, or equipment operates at maximum efficiency. To minimize building maintenance issues and their impact, maintenance strategies are indispensable with appropriate solutions. Planning and maintenance strategies of a building should be enhanced [23,24].

2.2 SERVQUAL Model

To measure the quality of building maintenance services. SERVQUAL model is appropriate for use. This model states that service quality may be determined by detecting the gaps between customers' satisfaction with the service to be delivered and their expectation of the actual performance of the service. Parasuraman *et al.,* [25] established and categorized five elements of service quality, which are tangibility, reliability, responsiveness, assurance, and empathy. Based on these elements, there were 22 items for assessing satisfaction and 22 items for assessing service quality expectations.

i. Tangibles refers to physical facilities, equipment, and materials.
ii. Reliability refers to the ability of the firm to perform services effectively and accurately
iii. Responsiveness refers to the firm and its ability and willingness to aid customers and provide services as promised
iv. Assurance refers to the employees of the firm. It is their skill to produce trust and credibility
v. Empathy refers to the attention and priority given by the organization to the needs and requests of customers.

The SERVQUAL model is an excellent scale to use when measuring service quality in specific industries [26]. Through this model, the university can determine the extent of students' satisfaction with the quality of services provided. Concurrently, it can assist university to improve the quality of services and maintenance offered in the future. This study aimed to identify and analyse the perceived level of students' satisfaction and expectation towards the maintenance service quality at students' residential college, UTHM Pagoh Campus, using the SERVQUAL model. This study also identified strategies for quality maintenance services. The results of this study are expected to improve the quality of maintenance services by dealing the maintenance issues of students' residential college buildings.

3. Methodology

This study used two different questionnaires and different respondents. The first questionnaire was constructed based on the SERVQUAL model, which has five elements: tangibles, reliability, assurance, empathy, and responsiveness. Each item in the questionnaire was adopted from SERVQUAL model as prescribed by previous study [26]. The first questionnaire collected data from students residing at residential college, UTHM Pagoh Campus. There were 44 items in the first questionnaire focusing on identifying and analysing the perceived level of students' satisfaction and expectation towards the maintenance service quality at students' residential college, UTHM Pagoh Campus. The items were separated into 22 items for satisfaction and 22 items for expectation. All items in questionnaire were adopted from previous study [27]. In addition, 5-point Likert scale was included in the questionnaire for respondents to give their feedback for each question of the two items. Table 1 shows the Likert scale used for measuring students' satisfaction from very dissatisfied to very satisfied. Meanwhile, students' expectation was measured from very low expectation to very high expectation, as shown in Table 2. The reliability of the first questionnaire was greater than 0.70, as shown in Table 3. Generally, good reliability should be more than 0.70 [28,29]. Eq. (1) expresses the calculation of SERVQUAL score, whereas its interpretation is summarized in Table 4.

Table 1
Likert scale used to level of students' satisfaction

Scale	1	2	3	4	5
Description	Very Dissatisfied	Somewhat Dissatisfied	Satisfied	Somewhat Satisfied	Very Satisfied

Table 2
Likert scale used to level of students' expectation

Scale	1	2	3	4	5
Description	Very Low Expectation	Moderately Low Expectation	As Expected,	Moderately High Expectation	Very High Expectation

Table 3
Reliability test

Questionnaire	Cronbach's Alpha	N of Item	Internal Consistency
1	0.985	44	Excellent

SERVQUAL score = (Expectation score – Satisfaction score) (1)

Table 4
SERVQUAL score interpretation

SERVQUAL score = (Expectation score - Satisfaction score)	
Expectation = Satisfaction	Quality services
Expectation < Satisfaction	Excellent or extraordinary level of quality
Expectation > Satisfaction	Shortfall or lack of quality (deficient quality)

The second questionnaire collected data from maintenance management. The criteria required by maintenance management to answer the questionnaire were to have at least 5 years of experience in the field of maintenance and have experience in maintenance work. There were 22 items included in the second questionnaire focusing on identifying the maintenance strategies for quality maintenance services. All items in this questionnaire were adopted from previous study

[30,31]. The items were mapped to the SERVQUAL model, and Cohen's kappa was evaluated by two experts in maintenance and education, respectively. Inter-rater agreement showed that the elements of tangibles, responsiveness and empathy were under moderate agreement (range of 0.41-0.60). Reliability and assurance elements were under substantial agreement (range of 0.61-0.8). All the agreed items in the second questionnaire needed to be answered by respondents based on five scales from strongly disagree to strongly agree, as shown in Table 5. The validity and reliability of this questionnaire was greater than 0.70, as shown in Table 6. Generally, good reliability should be more than 0.70. The importance index was computed using Eq. (2).

Table 5
Likert scale used to identify the maintenance strategies for quality maintenance services

Scale	1	2	3	4	5
Description	Strongly Disagree	Disagree	Intermediate	Agree	Strongly Agree

Table 6
Reliability test

Questionnaire	Cronbach's Alpha	N of Item	Internal Consistency
Two	0.729	22	Good

$$\text{Importance Index (I)} = \frac{\sum (W\,n)\,x\,100\,\%}{A\,x\,N} \tag{2}$$

Responses for the importance index are categorized as follows:

 i. 0% to 20%: not important.
 ii. 20% to 40%: less important.
 iii. 40% to 60%: moderately important.
 iv. 60% to 80%: important.
 v. 80% to 100%: very important.

4. Results and Analysis

Table 7 shows the results and analysis of the data collected by gender, age, race, faculty, and year of study. Samples from the first questionnaire was distributed to students at UTHM Pagoh, and the distribution showed that men represented 48.6%, and females were 51.4%. It was found that most of the respondents (37.1%) were in the age range of 25 to 26 years old. The distribution by race showed that most of the respondents were Malay (64.8%), and the majority of respondents were students from Faculty Engineering Technology (55.2%). Samples of second questionnaire were distributed to maintenance management. The distribution revealed that males represented 62%, while females were 38%. The result indicated that most of the respondents (62.5%) aged from 31–40 years old.

Table 7
Demographic profile of respondents

Characteristic	Frequency (n)	Percentage (%)
1st Questionnaire		
Gender		
Male	51	48.6
Female	54	51.4
Age		
18 - 21	28	26.7
22 - 24	37	35.2
25 – 26	39	37.1
27 above	1	1.0
Race		
Malay	68	64.8
Chinese	21	20.0
Indian	16	15.2
Faculty		
Engineering Technology	58	55.2
Applied Science Technology	25	23.8
Centre for Diploma Studies	22	21.0
2nd Questionnaire		
Gender		
Male	5	62.5
Female	3	37.5
Age		
21 – 30	3	37.5
31 – 40	5	62.5

4.1 Level of Students' Expectation and Satisfaction towards Maintenance Service Quality

The SERVQUAL questionnaire was conducted to assess the maintenance service quality. The results were averaged and summarized in Table 8. The mean of students' expectation for each SERVQUAL element was also calculated. The results exhibited that the mean scores of students' expectation level ranged from 4.19 to 2.73 based on a five-point scale. Meanwhile, the mean score of students' satisfaction level ranged between 3.83 and 2.59. Quality is a comparison between expectation and satisfaction. Each SERVQUAL score was calculated based on the interpretation of the SERVQUAL score. Table 9 shows the overall SERVQUAL score for each element. Reliability ranked first for the highest priority of SERVQUAL score. This element reflected the ability of maintenance management to perform the promised services reliably and accurately in terms of time, cost, and quality, which are directly influenced by the organization's resource base, namely budget and system. In addition, the tangible element indicated the second highest priority of SERVQUAL score. This element was associated with physical convenience and equipment provided to the user, and the assurance element indicated the third highest priority of SERVQUAL score. This element was related to human factors.

Table 8
SERVQUAL score for all items

No	Item	Expectation of a service	Satisfaction of a service	SERVQUAL Score Mean	Rank
Tangibles					
1	Furniture equipment for students.	3.78	3.79	-0.01	10
2	Leisure spot facility.	3.57	3.65	-0.08	16
3	Learning rooms.	3.72	3.38	0.34	5
4	The electricity and water system.	3.34	3.40	-0.06	14
Reliability					
5	The time to answer students' questions related to services is will be done on time and quickly.	3.11	3.15	-0.04	13
6	Maintenance work is done at the right time.	3.20	2.59	0.61	2
7	Information related to maintenance is provided to students promptly.	3.26	2.70	0.56	3
8	The maintenance performed immediately.	3.30	2.62	0.68	1
9	Keeps and records accurately about the activity's services.	3.32	3.39	-0.07	15
Responsiveness					
10	Queries dealt with efficiently and promptly.	3.32	2.73	-0.59	22
11	Channels provided for student complaints.	3.83	4.19	0.36	4
12	The staff working, managing, and serving well.	3.79	4.12	0.33	6
13	Repair and maintenance are always arranged.	3.24	3.10	-0.14	20
Assurance					
14	Period of maintenance works performed.	3.26	3.24	-0.02	12
15	Friendly and courteous service staff.	3.30	3.37	0.07	7
16	The service staff always do their job right.	3.37	3.36	-0.01	9
17	Student questions related to maintenance services are answered with by service personnel.	3.30	3.37	0.07	8
Empathy					
18	Quality of maintenance services provided.	3.27	3.38	-0.11	17
19	Collection of student opinions on the evaluation of the quality of maintenance services.	3.18	3.30	-0.12	18
20	Students' questions and feedback listened to, responded to, and handled quickly and adequately by the management.	3.22	3.23	-0.01	11
21	Renovates and modernizes maintenance services for the living and studying of students.	3.18	3.32	-0.14	19
22	Study rooms are available and convenient.	3.37	3.78	-0.41	21

Table 9
SERVQUAL score for five elements

Element	Expectation mean (S)	Satisfaction mean (E)	Service quality score (G) G = E - S	Classification	Priority
Tangibles	3.60	3.56	0.04	Deficient quality	2
Reliability	3.24	2.89	0.35	Deficient quality	1
Responsiveness	3.54	3.55	-0.01	Excellent level of quality	4
Assurance	3.34	3.31	0.03	Deficient quality	3
Empathy	3.24	3.40	-0.16	Excellent level of quality	5

The results of this study indicated that the higher the SERVQUAL score, the greater the improvement required as the satisfaction level was below the expected level. The highest SERVQUAL score for the three elements signified students' dissatisfaction. The elements of tangibles (0.04), reliability (0.35), and assurance (0.03) exhibited deficient quality. Conversely, the elements of responsiveness (-0.01) and empathy (-0.16) indicated excellent quality level. One aspect of SERVQUAL model was responsiveness, which has a positive and substantial influence on customer's satisfaction. In other words, customers were satisfied with the response of the personnel. According to Gajewska and Piskrzyńska [32], personnel are willing to assist consumers, respond to requests and have the confidence to notify customers when the services will be completed. Several researchers define responsiveness as the willingness to assist customers and provide prompt service.

4.2 Maintenance Strategies Required for Quality Maintenance Services

Based on Table 10, the mean of maintenance strategies required for maintenance service quality of each element ranged from 4.75 to 4.13 on five-point scale. The overall mean value of each element exceeded 4, meaning that, based on how the mean value was interpreted, all the maintenance strategies were rated as "very high".

The importance index was calculated to reflect the importance of maintenance strategies for maintenance service quality for each element according to the identified priorities. Table 11 shows that the importance index of each element exceeded 80% to 100% and categorised as very important. This study identified 22 maintenance strategies required for quality maintenance services. The identified strategies were then classified into five elements: tangibles, reliability, responsiveness, assurance, and empathy.

All elements exhibited very important index value for the identified maintenance strategies. Referring to Table 11, the element of assurance was ranked as the highest based on the important index average of 90.00%, followed by the responsiveness element (86.88%). Meanwhile, the empathy and reliability elements recorded the same important index average value of 86.50%. The tangibles element had the lowest average index value of 83.75%. These results are in agreement with the other studies. Zakaria *et al.,* [33] stated that the maintenance organisation must also implement a systematic procedure to determine the maintenance budget, taking into account the factors that can influence maintenance allocation. In addition, sustainability concepts must first be approached in the maintenance strategies to promote a balance between economic, environmental, and social dimensions [34].

Table 10
Items of maintenance strategies

Codes	Items	Mean	Standard Deviation
MS1	Budget estimates must be based on the current building condition, building age, and the attitude of building users.	4.38	0.518
MS2	Development of building maintenance procedures.	4.13	0.354
MS3	Building design must meet specific criteria and quality.	4.38	0.518
MS4	Providing a design of building that considers maintenance work, for example, the route to access during maintenance work.	4.25	0.463
Overall mean of tangibles		4.29	
MS5	Systematic management planning includes financial control, a clear maintenance policy.	4.63	0.518
MS6	Financial control guidelines must be established since financial control greatly influences the effective maintenance services, specifically in the current situation.	4.25	0.463
MS7	Planning for future resources requirement.	4.13	0.354
MS8	The financial allocation in the maintenance of the building should be balanced with the annual work schedule as well as the maintenance planning that has been set.	4.38	0.518
MS9	Provision of adequate human resources or manpower to carry out tasks related to building maintenance.	4.25	0.463
Overall mean of reliability		4.33	
MS10	Technologies in the market can aid in the efficiency of maintenance. The CMMS stores data about the equipment, machinery, and other assets.	4.50	0.535
MS11	Providing various reporting methods will add value to the organization and user satisfaction as an essential value in delivering the best maintenance service.	4.50	0.535
MS12	Maintenance policy should support it by providing high-quality services to the students by providing perfect assets, responsive to complaints, accountable to the assets' performance, and continuous quality improvement.	4.25	0.463
MS13	Management should develop an effective communication platform such as meeting and online feedback system, involving all key participants with commitment and contribution towards the maintenance activities.	4.13	0.354
Overall mean of responsiveness		4.35	
MS14	Staff training and expertise are rated as the most important in maintenance management.	4.75	0.463
MS15	Management must organize the required training or workshop sessions for staff to develop their knowledge.	4.38	0.518
MS16	Determining the personnel that fulfils the requirement.	4.50	0.535
MS17	Ensuring that the workers have the required competence periodically.	4.38	0.518
Overall mean of assurance		4.50	
MS18	Implement regulations and standards to provide quality services to building maintenance for the comfort, safety and health of all occupants.	4.38	0.518
MS19	Increase awareness and sensitivity to the importance of building maintenance to all occupants.	4.25	0.463
MS20	Prioritize the maintenance of buildings related to safety and health.	4.25	0.463
MS21	Plan long-term comprehensive maintenance of five years or more to facilitate the preparation of budget, manpower, spare parts.	4.25	0.463
MS22	Mandating a comprehensive inspection of the building to ensure that the building is in good condition and importantly to ensure the safety of the occupants of the building.	4.50	0.535
Overall mean of empathy		4.33	

Table 11
Importance index of each element

Elements	Importance Index Average (%)	Categorized	Priority
Tangibles	83.75		5
Reliability	86.50		4
Responsiveness	86.88	Very Important	2
Assurance	90.00		1
Empathy	86.50		3

5. Discussions

Based on Figure 2, the element of reliability indicated the highest priority of SERVQUAL score for students' expectation, while the element of assurance showed the highest priority for the maintenance strategies required for quality maintenance services. The element of tangibles was the second highest priority of the SERVQUAL score for the expectations of students, while the element of responsiveness was the second highest priority for the maintenance strategies required for quality maintenance services. For students' expectation, the element of assurance was the third highest priority of SERVQUAL score, while the element of empathy was the third highest priority for the maintenance strategies required for quality maintenance services. Responsiveness was the fourth highest priority of SERVQUAL score for expectations of students, while reliability was the fourth highest priority for the maintenance strategies required for quality maintenance services. The final priority of SERVQUAL score was indicated by empathy element for students' expectation, while tangible element was the final priority for the maintenance strategies required for quality maintenance services.
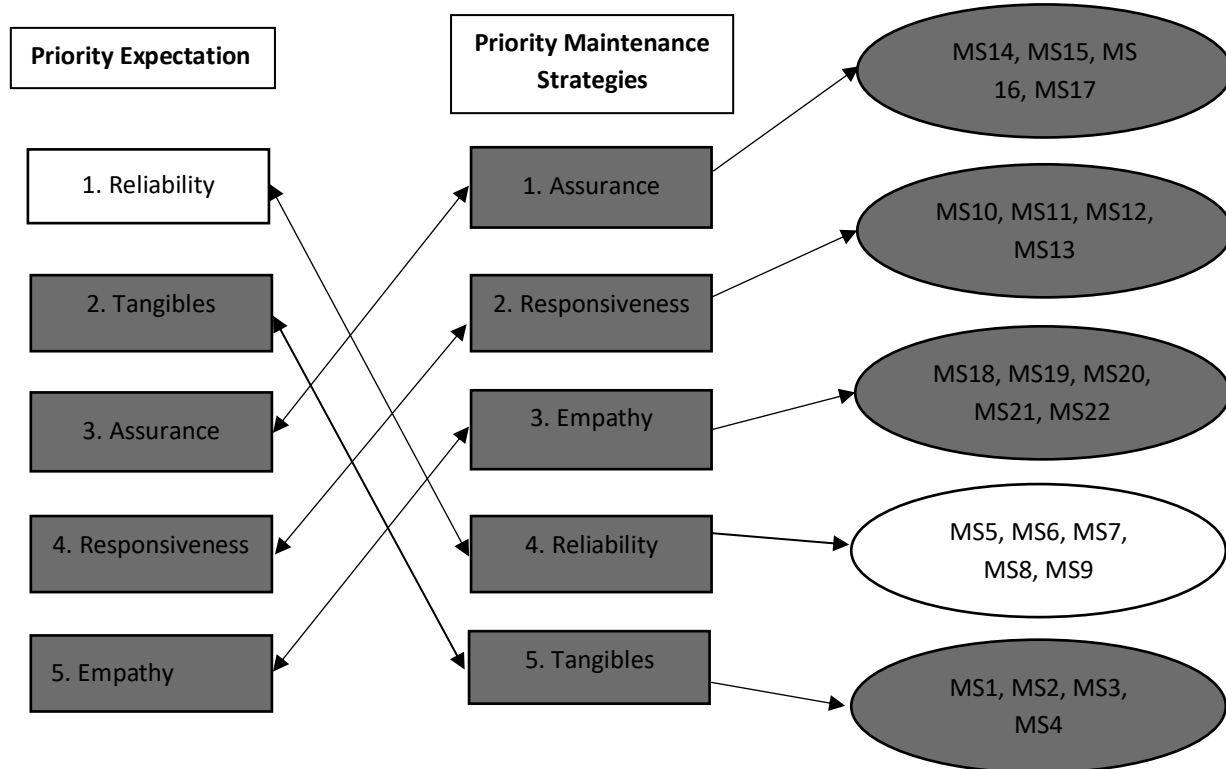

Fig. 2. Comparison between priority of expectation and maintenance strategies

In this study, it was argued that priority of expectation selected by the students for the maintenance service quality was reliability as it reflected the ability of maintenance management to perform the promised services reliable and accurately in terms of time, cost and quality, which are directly influenced by the organization's budget and system. For example, "maintenance work is done at the right time", "information related to maintenance is provided to students promptly", and "the maintenance is performed immediately" are factors that need to be considered to ensure the quality of maintenance services. These results are consistent with a previous study that there are a large number of users in university buildings, including lecturers, students and employees; thus, the priority for comfort and quality of building maintenance becomes a necessity and a must for all occupants in the building [35].

In addition, there was a different view from maintenance management towards the quality of maintenance services. The assurance element was the priority for the maintenance service quality as it implied the human factors. For example, "staff training and expertise are rated as the most important in maintenance management," "management must organise the required training or workshop sessions for staff to develop their knowledge", "determining the personnel that fulfils the requirement" and "ensuring that the workers have the required competence periodically". These statements manifested the need for better control over maintenance costs, products and service quality, environmental impacts resulting from maintenance actions, and economic well-being, health, safety, and education of employees [36,37].

These results are consistent with the study by previous study, and suggest that companies need to take into consideration four crucial criteria to build a sustainable maintenance plan for facilities and maintenance services as follows [38]:

i. Selection of maintenance strategies.
ii. Training of employees involved in maintenance.
iii. Control of production equipment to generate less waste.
iv. Optimization of materials used during maintenance actions.

To improve the maintenance service quality in the future, it is necessary to take into consideration the specific objectives for the defined methods. It should be notably driven by the integration of the Internet of Things, coupled with the real-time processing of Big Data through the utilization of cloud computing. The confluence of technological advancements is emblematic of the evolving landscape in contemporary industry and underscores the transformative potential of Industry Revolution 4.0. Computerized Maintenance Management Systems (CMMS) or Building Maintenance Management System (BMMS) has the potential to be used for managing maintenance activities and supporting equipment management, inspection planning, supervisory protocols, and service documentation [39]. CMMS plays a role in standardizing maintenance data and optimizing maintenance operations by facilitating the management of maintenance staff and recording of events related to the maintenance of production and measurement equipment, including failures, repairs, and inspections [40]. Furthermore, the utilization of a digital data approach holds the potential for enhancing and optimizing maintenance management processes. In the context of implementing Industry Revolution 4.0, a substantial metamorphosis is evident in working environments, marked by heightened automation and enhanced interoperability. This evolution is made possible through the integration of the Internet of Things, combined with the real-time processing of substantial volumes of data via cloud computing [41]. The digital data and information management tools and software, such as Computer Aided Facilities Management System, Radio Frequency Identification, Intelligent Building Management System, Building Automation System,

Intelligent Facilities Management System, Building Information Model, Wireless Sensor Technology, and Mobile Intelligent Terminal, provide the efficiency of management, increase the speed of information flow, help practitioners to make judgments, reduce staffs' workload and reduce operation costs [42]. These software applications and tools offer substantial support to space management to conduct life cycle analysis, provide professional training, and oversee system integration platforms which can collectively meet the goals of enhancing operational efficiency, alleviating workloads, enhancing precision, and curtailing costs during the operational and facility management stages.

6. Conclusions

This study successfully determined the levels of satisfaction and expectation of students regarding the maintenance service quality at residential college of UTHM Pagoh Campus. The core of this investigation lies the quintessential components encapsulated in the SERVQUAL model. The findings of this study highlighted the elevated priority of SERVQUAL scores attributed to three pivotal elements of reliability, tangibles, and assurance. However, there were two elements with the lowest priority scores, namely responsiveness and assurance. Moreover, meticulous exploration of SERVQUAL elements and identification of 22 maintenance strategies were indispensable for ensuring quality maintenance services. All these 22 strategies were considered imperative and highly consequential based on the Importance Index values, which spanned in the range of 80 to 90%. All items of maintenance strategies were also indispensable and very important. The outcomes of this study provide meaningful contributions to multiple stakeholders and existing body of knowledge. This study also adeptly evaluated satisfaction and expectation levels of students regarding maintenance service quality by leveraging the SERVQUAL model. It offers an insightful overview to students regarding the essential strategies underpinning maintenance service quality at residential college premises. This study has the potential to profoundly impact and enhance university maintenance service quality in the future. By integrating the identified maintenance strategies and aligning them with the five SERVQUAL elements, universities can proficiently catalyze and orchestrate substantial advancements in their maintenance services utilizing a technological-enhanced approach for the future.

Acknowledgement

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