

ASSESSMENT OF FACILITIES MANAGEMENT PERFORMANCE ON OPERATION AND MAINTENANCE ASPECTS IN MALAYSIAN TECHNICAL UNIVERSITIES NETWORK

Nor Hapira Nadia Nafrizon¹, Mariah Awang^{*1}, Alia Abdullah Saleh², M.A.A. Rahman¹,
Nuramidah Hamidon¹, Shahril Abdul Rahman³

¹Faculty of Engineering Technology, University Tun Hussein Onn, 84600 Pagoh, Muar, Johor, Malaysia

²Faculty of Architecture, Planning & Surveying, UiTM Perak Campus, Seri Iskandar Branch, Perak, Malaysia

³Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia

E-mail: *mariah@uthm.edu.my

Received: 20.05.2020

Revised: 17.06.2020

Accepted: 06.07.2020

Abstract

This paper recommends discourse feeling acknowledgment from discourse signal dependent on highlights examination and PNN-classifier. The arrangement of acknowledgment incorporates discovery of discourse feelings, extraction and determination of highlights, lastly characterization. These highlights are valued to segregate the greatest number of tests precisely and the PNN classifier dependent on discriminant investigation is utilized to characterize the six distinctive articulations. The reproduced outcomes will be indicated that the channel occupied component extortion with utilized distribution presents much better exactness with less algorithmic unpredictability than other discourse feeling articulation acknowledgment draws near.

Keywords--- Facility Management; Operation and Maintenance; Framework; Performance Measurement

© 2020 by Advance Scientific Research. This is an open-access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)
DOI: <http://dx.doi.org/10.31838/jcr.07.08.285>

INTRODUCTION

Facilities management (FM) is based on the premise that any organizational efficiency is related to the physical environment in which it operates and that the environment in which it operates can be improved to increase efficiency (Kurdi et al., 2011). FM involves several aspects such as communication, emergency preparedness, and business continuity, environmental stewardship and sustainability, finance and business, human factor, leadership and strategy, operation and maintenance, project management, quality, real estate, and property management and technology. The key to facilities management aspects is to ensure the longevity of asset lifespan in providing a better return on investment through reduced budget and resources.

In this matter, operations and maintenance is the main aspect to be focused on in facilities management because it is the major activity in sustaining the buildings and to keep it as a valuable asset and functioning building. The only way to achieve this is by properly operating and maintaining the facilities. Customer satisfaction can be achieved through the quality, service, and value of the service provided (Zeithaml and Bitner, 2000). Customer satisfaction is important for the assessment of features or uniqueness of product or service, which is provided to achieve the level of comfort among customers and meet the client's needs.

Institution of higher learning (IPT) is a place to produce graduates that will become human capital that are believed to be the next generation who will inherit the leadership legacy to drive the country towards a better country. Based on this vision, the Ministry of Higher Education is developed by Malaysian government to ensure that the commitment on IPT will be the main focus. As education is regarded as the national key results area, the aim of IPT is to ensure that every children of the nation have access to a quality education besides being affordable, creative, innovative, characterized by high moral values and are able to compete international ranking universities through challenges and educational facilities provided. Therefore, in order for a higher education institution to achieve its occupants'

satisfaction, maintenance activities play the main role where it has to be affirmed with educational output at the most effective level.

The globalization era currently impacts various areas including education (Rahman M.S. et al., 2015; Nuramidah et al., 2019; Hussain et al., 2015). Higher education is undergoing a period of uncommon change. Changes in higher education due to high public expectations on what universities are supposed to deliver have increased parental concern about the quality of education, improved the emphasis on college ratings, demographic changes in the student population and higher costs. In order to meet educational needs, a good, clean, well-lit classroom with comfortable chairs, good audio-visual, comfortable temperatures, and ventilation is fully satisfactory. University should build a building with the latest equipment that can easily be maintained and operate well and efficient.

Implementation of management and maintenance of physical facilities to some extent can help an organization to minimize the operating costs in the institutions. Good maintenance management is also important to control issues regarding customers' satisfaction on the services provided. This is often the case, especially when it involves the maintenance process, and has to deal with number of users. Therefore, it is important that the facilities provided are maintained properly to meet the prescribed standards (Zanariah Kadir, 2007). According to Noorliza Karia et al. (2014), although several institutions have no maintenance planning, maintenance management is the basic process in enhancing the existing assets to support service operations. The top management should have maintenance planning if they realize the importance of effective maintenance management.

Maintenance and facility management involve a combination of technical actions between management and supervision in an institution to ensure that the existing facilities function properly. This subject is important because failure may result in negative impact to all parties. A study concerning evaluation of facility management in the operation and maintenance field was

conducted to review the effectiveness of the facility management in the Malaysian Technical Universities Network (MTUN) involving four university colleges: UniMAP (in Perlis), UTHM (in Johor), UTeM (in Melaka), and UMP (in Pahang). Facility assessment process criteria were used as the main criteria in the assessment of operation and maintenance. Based on the workbook on facility evaluation (Harvey & Kaiser, 1982), several criteria need to be identified in the evaluation of facilities. The criteria are:

- i. Determination of the maintenance need to be prioritized.
- ii. Identification of facilities that can still be used.
- iii. Identification of facilities that need to be deleted to avoid the occurrence of disaster.

FACILITY MANAGEMENT

Facility management is a new field that introduced strategies needed to be considered by an organization to achieve its core activities. It provides a strong support to the operations of one business and contributes to the achievement of its objectives and strategy by ensuring that the buildings, equipment, services, systems and workforce are effective and efficient (Hamilton & Norizan, 2001). Zuhairi (2004) supported this claimed by stating that facility management—also known as property management—provide services to support the operations of an organization.

According to the British Institute of Facilities Management (BIFM, 2009) United Kingdom, facility management is a combination of activities from various disciplines in environment and management form that can affect humans and workplaces. Hackman & Davis (2008) suggested that facility management is visible not only from the perspective of physical and environment, but also needs to discuss the aspects of effective facility management in achieving the objectives of an organization.

First, facility management focuses on facilities in the workplace by considering various work settings that are not only limited to office space but also cover various types of premises such as production, medical and educational institutions. As such, facility management may be applicable to all types of organization. In addition, facility management services can also support and enable continuous growth of one organization. In this context, facility managers play a pivotal role in coordinating human capital and premises through projection of information technology advancement for efficient operations towards the achievement of better organization.

The concept and role of facility management defined by IFMA (2006) have four core elements as shown in Figure 2.5. Payant and Lewis (1999) said that operations and maintenance facility is the core to the management facility. The functions of these activities can be achieved by having skilled and professional workforces.



Figure 1. The definition of facility management according to IFMA (Wan Zahari, 2008)

In Malaysia, facility management has been developed for more than 10 years and had faced various problems related to the practice. This is because the practice does not have a clear concept and direction which cause a lot of confusions and lack of insights in understanding the concept of real facility management. Nordiana et al. (2016) said that there are many arguments related to facility management practices in the country and some did not see the importance of implementing facility management. The question that often arises is whether facility management is an integral part of managing property or not; or whether it is just called facility management when its activities are carried out in the sourcing (in-house) (Nordian et al., 2016).

FACILITY MANAGEMENT IN INSTITUTIONS

According to Asiabaka (2008), an institution could use facility management as one of its strategic approach to produce unparalleled environment for effective teaching and learning activities. However, the main problem in facility management of an institution is due to its limited understanding and guidance in producing policies relating to institutional infrastructure. In addition, the facility management in an institution is determined by the government. It requires community involvement in the creation of an effective management so that the institution can provide a widespread service to the community.

Facility management in an institution is integrated as part of institutional management. Asiabaka (2008) and Rahman M. et al., (2019) also emphasized that facility management is important to ensure a conducive learning environment in an institution. Therefore, it adds, facility management requires concerted efforts from all stakeholders in an institution including a specialized facility to determine an appropriateness and accurate relation to the objectives of the learning institutions.

Kiffah (2001) stated that the mission of facility management process is to ensure that every classroom is clean, healthy, and safe. Uline et al. (2008) revealed that the facility is inadequate to affect the performance of teaching and learning, and health and safety of students and lectures. Lackney (1999) stated that physical environment including building institutions, cannot be disregard as part of the combined learning ecology.

Bullock (2007) also explained that a number of students are likely to be able to achieve a better performance in newer buildings or buildings that have just been modified, compared to students who studied in old buildings. Meanwhile, Payant (2007) stated that the facility should be adapted to the standards required by users. He also concluded that low attention society will influence guest energy educators, policy makers, and educational system to determine exact instructions to ensure quality institution facilities.

The role of facility management is to provide a conducive, effective and quality environment for students and lecturers in institutions to create a quality education. Facility is part of the assets in an organization that functions to support users to achieve a particular purpose especially in core processes (Wes and Danny, 1999; Alexander, 1996). In an institution, the facility is intended to provide a comfortable learning environment for students. According to Mei (2005), facility management in learning should be equipped sufficiently and made up of hard and soft facility management.

Hard facility management consists of several activities including the layout of the seating area, occupancy density, lighting, colour and decoration, furniture and ventilation. Meanwhile soft facility management includes a number of activities such as technical support, security and peace, and the need for adequate facilities.

According to Hakim et al. (2006), facility plays an important role in the learning process. Good facility can help students to have good focus and be able to improve the quality and the completeness of learning. Joseph and Michael (2001) also explained that in designing the space and facilities, emphasis should be given to the space or the size of the space, the layout of the seats, doors and window, electrical, lighting, sound effects, temperature and ventilation, the brightness in the lecture room colour and board. Figure 2 depicts the learning space facility designed by Joseph and Michael.

The facility is a product or service that makes it easy for an organization to achieve a particular purpose. Generally, (Wes and Danny, 1999; Alexander, 1996) stated that the facility usually forms part of the property in an organization to support employees to achieve business objectives. In the context of educational organizations, such as universities, it is meant to create a comfortable learning environment for students, lecturers, and other users in a university.



Figure 2. Learning space facility design (Joseph and Michael, 2001)

MAINTENANCE

Maintenance is defined as the combination of technical and administrative actions, including supervision that intends to retain an item or restore it to a state in which it can perform a required function (Parida et al., 2006). Chanter and Swallow (2006) defined maintenance as a combination of any action carried out to retain an item or to restore it to an acceptable condition. Lind and Muyingo (2012) stated that maintenance can be classified into planned maintenance and corrective maintenance. On the other hand, Dennis (2009) classified maintenance into four categories according to its purpose and process as follows:

- i. Preventive maintenance is carried out by providing routine inspection, identification, and prevention of incipient failure to prevent an object from failing or wearing out. Maintenance is normally designed for prevention.
- ii. Statutory maintenance shall be carried out when plants such as lifts, fire systems, fume hoods and air conditioning systems are serviced and maintained in accordance with the legislative requirements.
- iii. Corrective maintenance is the maintenance required to return an object to working order when it fails or is worn out.
- iv. Backlog maintenance is maintenance that is required to prevent degradation of an asset or its operation but has not been performed.

The main responsibility of the maintenance unit is to maintain all facilities and infrastructures and to ensure the effectiveness of

the supporting system for activity and work process in the office (Akasah, Z.A. et. al., 2011). The main supporting system such as lift system, air conditional system, air intake and outlet, electrical system, firefighting system, plumbing and sanitary system, cleaning services, civil and structural building, landscape, safety security, pest control, and telecommunication system, should be working properly without any disturbance that could affect the entire office work process (Bin Hashem, 2006).

Maintenance can be implemented in three stages: planning and design stage, construction stage, and maintenance stage (Al-Khatam, 2003). Bin Hashem (2006) has listed some factors that can influence maintenance during the design stage, such as corrosion, future needs and defective materials of choice. Cooper and Jones (2008) reported that the key factors that contributed to high levels of dissatisfaction on the approach to maintenance programs are: poor specification of initial requirements, unclear aims and objectives and inappropriate frameworks, inability to predict long term cost requirements, variations in the levels of experience of those conducting surveys, unrealistic claims by consultants selling survey services, inappropriate or unusable data, poor links to organizational objectives, and a lack of fit of survey data. Shah Ali et al. (2010) stated that the most dominant factors affecting maintenance cost were building materials, building services, building age and failure to execute maintenance at the right time. Cobbinah (2010) showed another type of factors as being responsible for the poor maintenance of public buildings. The factors include the age of the buildings, lack of maintenance culture, inadequate funding and high maintenance costs, pressure on the number of users of the building facilities, and poor construction and maintenance work by the institution's maintenance personnel.

Maintenance is regarded as a tool to promote sustainability in buildings. However, historically, in both public and private sectors, the maintenance process and management that involve assessing performance, and maintenance management of buildings are neglected, and avoidable. These are regarded as adding little quality to the working environment and expanding the scarce resources, which would be better utilised (Olajide, 2012). Dhillon (2002) stated that the maintenance of engineering equipment in the field has become a challenge since the industrial revolution (IR 4.0). Although a significant progress has been made to efficiently maintain the equipment in the field, the maintenance is still a challenge due to factors such as scale, expenses, complexity and competition. Ahzahar et al. (2011) stated that buildings that neglect maintenance may fall into several defects which may lead to structural failures.

OPERATION AND MAINTENANCE MANAGEMENT

Maintenance management or operational management is used to turn input into outputs (goods and services), including staff, resources, energy, materials, and technology (Myeda et al., 2011). Maintenance and operating cost are one of the housing cost major components. They contribute one third to one half of the total construction cost depending on the type of housing such as condominium, apartment, flat and others (Ali et al., 2010; Rydell, 1970). It has been reported that between 70% and 85% of the building maintenance and operation costs can be influenced during the design stage. It is a significant part of the total building life cycle costs and awareness towards planning building maintenance and operation cost has been increased recently (Dhillon, 2009; Krstić & Marenjak, 2012).

More than 90% of the building life cycle requires active maintenance and the full-service life of building cannot be attained without maintenance (Olanrewaju, Idrus, & Khamidi, 2011). The easiest way to cut maintenance costs is to stop servicing but the long-term results are usually very expensive.

Therefore, the goal of the new approach is to conduct as little maintenance as possible while at the same time ensuring the availability of facilities for utilities, building elements and the entire building. In other words, maintenance should only be carried out when necessary to ensure the building can be used continually, efficiently and profitably at acceptable levels of efficiency or when there is a potential of extending the useful life of the building elements (Horner et al., 1997).

A maintenance strategy is adopted to extend the buildings life cycle and its fitting services. Maintenance personnel choose different maintenance strategies depending on allocation maintenance resources (Lee & Scott, 2008). Typical management has several strategic options involved in maintaining a house, and there are many alternative decisions to make. For example, there is a possibility of rising the maintenance demand by addressing the actual cause of the failure and defining its impacts. Another example, it may be necessary to decide whether to repair or replace an item, and whether to perform regular maintenance at fixed intervals or simply to respond to users' requests (Horner et al., 1997).

Normally, each activity of maintenance repair performed will involve replacement of spare parts. Changing of original and quality parts is the responsibility of the building maintenance management. However, most of the new buildings in Malaysia were built and fitted using high-tech and sophisticated equipment or systems imported from abroad such as from the United State (US), the United Kingdom (UK), Germany, Finland, and Japan. This has resulted in an increase in the cost of replacement parts which involve transportation and foreign exchange. To make it worse, most of the imported parts requires a long period of time to get in Malaysia. This cause the management of building maintenance take a shortcut by using artificial parts which are cheaper and easily available in Malaysia or neighbouring countries like Thailand and Indonesia. More alarming if the parts do not have quality and durability as appropriate. This would reduce the efficiency of the systems or the equipment. Consequently, the equipment or system is risky when used by building occupants.

Side effects often faced by a high-tech and sophisticated building maintenance. This creates difficulty in getting a skilled and experienced person in a given field. For example, only a small number of experts are capable of performing periodic inspections and comprehensive reports to explain the current state of a building and to detect any sign of damage in the future. Lack of expertise in building maintenance will affect the quality of the services provided by an organization

SATISFACTION OF OCCUPANTS

Although there are various definitions that can define occupant satisfaction, the most popular definition for occupant satisfaction is the comparison between occupant's expectations with their impression on the actual quality of service (Effaziela, 2008). This can be seen in the expectancy disconfirmation model (EDM)

where expectations are compared with the notion of them. This means that if the perception of the occupant's expectations is right, then what is expected to be right by them is accurate. So, they will be satisfied. Zeithaml et al. (2006) stated that the term satisfaction is the response given in meeting the needs of a client through consideration of products or services or both.

The term occupant satisfaction can provide a subjective overview of what an occupant wants and whether the occupant's wish is achieved through satisfaction with themselves. According to Harris (1996), occupant satisfaction is an overall requirement for occupant perceptions or in other terms, occupant's overall feeling. The satisfaction can be shaped quickly or can be nurtured over a certain period of time. Therefore, an organization must aware that occupant satisfaction involves:

- i. Strategic approach that will increase profitability and sales.
- ii. It starts with the commitment and influence of the superior.
- iii. It involves the whole organization.
- iv. It can be measured, detected and calculated.

ISO 9000 defines occupant satisfaction as an occupant perception at a stage where the requirement or expectation of the occupant—either expressed or implied—has been fulfilled. Occupant satisfaction here refers to overall occupant satisfaction with occupant interaction by identifying the difference between occupant expectations and occupant perceptions.

PERFORMANCE MEASUREMENT

Gopikrishnan & Paul (2016) stated that for any building built, it is necessary to take care of user requirements related to architectural, functional and financial aspects. Physical aspects are related to the building structure and properties, the relationship between functional aspects of the building with tenants and the financial aspects (capital cost/life-cycle costs) of the building. These aspects aim at meeting users' needs, expectations and aspirations. A building can be deemed as performing if the occupant is satisfied and vice versa. According to Loosemore and Hsin (2001), it is highly difficult to measure the effectiveness of the facility over the feelings, attitudes and behaviour of occupants or users. Satisfaction as a person's feeling of pleasure or disappointment results from the comparison of a product's performance/outcome perceived in relation to his or her expectations (Kotler, 1997). Several researchers find satisfaction as an overall variable, while others suggest that satisfaction is best described by a combination of facets or attributes. Gopikrishnan and Paul (2016) also believe that customer satisfaction can be thought of as a single overall evaluation result; a review of subjective responses to many different facets.

For this research purpose, the search for several literature pertaining to performance measurement variables were conducted. Table 1 shows the literature search and variables that they used to measure.

Table 1. The performance measurement variables

	Financial	Human Resources	Planning & Scheduling	Work Execution	System Operation
Maintenance Performance: A case study of Hospitality Engineering System (Chan et al., 2001)	√			√	√

Development of Maintenance Function Performance Measurement Framework and Indicators (Peter Muchiri et al., 2011)			√	√	√
Exploring Maintenance in Services Sector (Noorliza et al., 2014)	√	√	√		√
A Performance Management Framework for Healthcare Facilities Management (Champika Liyanage, 2017)		√		√	√

RESEARCH THEORETICAL FRAMEWORK

Theoretical framework refers to a study of relationship between a number of elements or dimensions or factors that have been identified as important in a study (Dickson et al., 2018). The theory and model serve as a tool to explain, predict and become a guide to a study conducted (Littlejohn, 1996). The construction of this theoretical framework will help a study to build its hypothesis and test on a relationship that has been hypothesised.

The hypothesis test could prove whether a theory is right or not according to the context of the study (Sekaran and Bougie, 2010). The model of an effective work performance is a major management goal in producing optimum working performance (Boyatzis, 1982). This model states that effective work performance can be achieved when there is uniformity between three elements: individual competencies, organization and task requirement. The model is shown in Figure 3.



Figure 3. The effective working performance model. Source: Boyatzis (1982)

There are various definitions that can reflect the word 'performance'. The Robert French Dictionary defines performance as the results that were acquired (accomplished) or achievements. Rue (1999) on the other hand, defines

performance as the degree of achievement of assignments which refers to work for each individual.

Philip Ricciardi (1996) defined performance as productivity multiplied with quality. It refers to the amount of work that can be completed and the value of work made against customers. In addition, performance also means the ability to provide a correct release of the right way and time in an appropriate effort. Based on the definitions, it can be concluded that performance is a milestone in the assignments given by individuals and organizations.

RESEARCH DESIGN IN DEVELOPING A FRAMEWORK TO MEASURE INSTITUTIONAL FACILITY PERFORMANCE

Stages from literature review to the formation of conceptual study framework are compulsorily conducted to facilitate the achievement of the research purposes. This study involves a mixed method design approach, which is a combination of two qualitative approaches, namely, scientific research and quantitative. The mixed-method approach strategy was chosen because it realised that all methods have limitations. Researchers agree that the use of a single method can be offset by other methods. In addition, the use of different source of data types is believed to be able to provide clarification of the data analysis conducted.

The function of a research design is to ensure that the evidences obtained can allow a researcher to answer the research question and objectives as unambiguously as possible. According to Coolican (2004), quantitative methods aim to measure, quantify or find the extent of a phenomenon whereas qualitative methodology is usually associated with describing the experience, emphasizing meaning and exploring the nature of an issue.

The methodological choice used is the mono method quantitative. This method was used by most researchers in similar study and they yield a result (Kelly et al., 2005; Hussain et al., 2017; Kanning et al., 2008 and Penny & Wan, 2007). According to Kaplan and Duchan (1992), the combination of research methods improves the quality of research. The methodology of this study is based on five stages. The first stage is to identify problems in facility management. The problem must be a reliable and systematic problem that will give a negative impact on the management of institution facilities if not working

on settlement. Early surveys were carried out determining the scope of studies and limitations to be taken into account. For example, the background of the problem and impact to the affected parties, organization, and functions of the department; the characteristics of the respondent and the importance of revenue expected in the research. The implementation of a pilot study at this phase involved survey at the initial stages. It helps to increase the understanding of what exactly had been done in practice from this research.

The second phase covers data collection on the efficiency of facilities management and satisfaction of occupant over the existing facilities. Questionnaire was used as the main method for data collection in this research. The use of closed item questionnaires and the selected answer is very good because it does not require the respondents to think or produce new ideas on a question (Kerlinger, 1986). There are several strengths in implementing questionnaire method such as the identity of the respondent can be kept confidential, low cost to implement, can be distributed to many people, and can acquire a lot of data (Rozand Nor Sheereen 2006). The finding from the pilot study is used in this stage to further strengthen the important information over a set of question. At this stage, the respondents' answers were reviewed and findings from questionnaires by the management of campus were discussed.

The fourth stage involves analysing the data collected. This stage includes descriptions of relationship between the efficiency in operation and maintenance aspect and satisfaction of occupants using the facilities. Findings from the third level are used in this stage to further strengthen the information on the performance of facilities management in the campus. The selection of data analysis techniques is determined based on several factors such as sample types, data types or variables volume involved in analysis; data that will be tested and the desired measurement stage (Mohd. Saidin, 2007).

The fifth stage involves the development of the structural framework on the performance of facility management in operation and maintenance aspects. Fundamental principles of this performance structure explain that the efficiency of service will increase in line with the satisfaction of occupants using the facility. This stage will also summarise the finding of the study. The overall flow of the study design is shown in Figure 3.1. Hence, the framework for the performance of facility management in MTUN is to be deemed to have the potential to be applied in the campus facility management system in particular and other IPT as well.

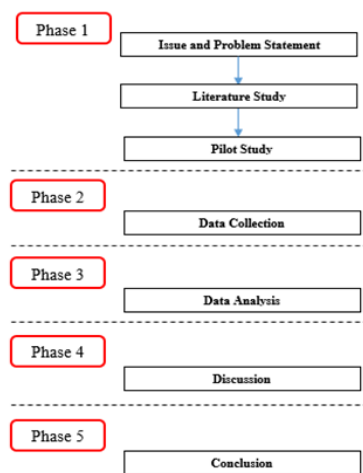


Figure 4. The flowchart of the research design

CONCLUSION

This study is beneficial and contributes to a better understanding on the property and facilities managers regarding the operation and maintenance aspects in the provision of quality teaching and learning in educational institutions. Assessment in operation and maintenance over the aspect developed can be used as a basis and guidance for the development of the facility management profession, particularly in identifying the problems related to the operation of a building. In this way, facility management can meet the criteria as a strategic management tool that acts manage multiple disciplines.

IPT as a centre for the development of ideas and innovation undoubtedly requires a conducive environment in the activities carried out. A good environment can reduce the negative impact of the teaching and learning activities carried out in the IPT. Approximately 90% of daily human activities occur in a building. Operation and maintenance management quality is very important in IPT because it affects the productivity and performance of buildings' users in the IPT. IPT is certainly in need of facility management to maximize its activities performed by users in the internal environment. This can reduce risks and impact the performance of academic users positively.

Overall, this study can provide more information and systematic data towards the increasing in the efficiency of the facilities management in operation and maintenance aspects at MTUN's universities. Therefore, it is expected that the effectiveness in satisfying customer can be enhanced through facilities management.

ACKNOWLEDGEMENTS

This work would not have been possible without the financial support of the "Geran Penyelidikan Pascasiswazah" (Vot. H595) and grant project Vot. H251 by Universiti Tun Hussein Onn Malaysia (UTHM). We are grateful to all of those with whom we have had the pleasure to work during this and other related projects.

REFERENCES

1. Ahzahar, N., Karim, N., Hassan, S. and Eman, J. (2011) A study of contribution factors to building failures and defects in construction industry, *Procedia Engineering*, Vol. 20, pp. 249 - 255.
2. Akasah, Z. A., Abdul, R. M. A., & Zuraidi, S. N. F. (2011). Maintenance management success factors for heritage building: A framework. In *WIT Transactions on the Built Environment* (Vol. 118, pp. 653-658). <https://doi.org/10.2495/STR110541>
3. Alexander, K. (1996). *Facilities Management: Theory and Practice*. London: E & FN Spon.
4. Asiabaka, I, P. (2008). *The Need for Effective Facility Management in Schools in Nigeria*. New York Science Journal, Vol.1 (2), pp 10-21.
5. BIFM (2009) *Facilities Management Introduction*, from: <http://www.bifm.org.uk/bifm/about/facilities>.
6. Bin Hashem, A., (2006). *Maintenance management and services case study Perkeso building's in Peninsular of Malaysia*, Unpublished MSc. thesis, University Technology of Malaysia
7. Boyatzis, R.E. (1982). *The competent manager: a model for effective performance*. London: Wiley.
8. Bullock, C.C. (2007). *The Relationship Between School Building Conditions and Student Achievement at The Middle School Level In the Commonwealth of Virginia*, Virginia Polytechnic Institute and State University, Blacksburg, VA. Tesis Phd.
9. Cobbinah, P. (2010). *Maintenance of buildings of public institutions in Ghana case study of selected institutions in*

- the Ahanti region of Ghana, Unpublished (MSc) thesis, Kwame Nkrumah University of Science and Technology, Kumasi.
10. Coolican H, (2004). Research Methods and Statistics in Psychology, 4th edition, London, Hodder Arnold
 11. Cooper, J. and Jones, K. (2008) Sustainable social housing maintenance, University of Greenwich.
 12. Dennis, G. (2009). Assesst maintenance policy, The university of Queensland
 13. Dhillon, B. (2002) Engineering maintenance: a modern approach, CRC Press LLC, United States of America.
 14. Dickson Adom, Emad Kamil Hussein and Joe Adu Agyem. (2018). Theoretical and Conceptual Framework: Mandatory Ingredients of a Quality Research. International Journal of Scientific Research.
 15. Effaziela Mohd Tahar (2008). Expectation and Perception of Postgraduate Students for service Quality. Universiti Teknologi Malaysia. Master Thesis.
 16. Elyna Myeda, N., Nizam Kamaruzzaman, S., & Pitt, M. (2011). Measuring the performance of office buildings maintenance management in Malaysia. Journal of Facilities Management.
 17. Gopikrishnan Seshadhri and Paul, V.K., (2016). "User requirement related performance attributes for government residential buildings." Journal of Facilities Management, Vol. 15 (4), pp. 409-422
 18. Hackman Hon Yin Lee and David Scott. (2008). Strategic and operational factors' influence on the management of building maintenance operation processes in sports and leisure facilities, Hong Kong. Journal of Retail & Leisure Property February 2009, Volume 8, Issue 1, pp 25-37
 19. Hamilton, B. dan Norizan Ahmad. (2001). Facilities management development. In: Facilities Management Seminar.
 20. Hussain, A., Abubakar, H.I., Hashim, N.B. (2015). Evaluating mobile banking application: Usability dimensions and measurements. Conference Proceedings - 6th International Conference on Information Technology and Multimedia at UNITEN: Cultivating Creativity and Enabling Technology Through the Internet of Things, ICIMU 2014, art. no. 7066618, pp. 136-140
 21. Hussain, A., Razak, H.A., Mkpjojiogu, E.O.C. (2017). The Perceived Usability Of Automated Testing Tools For Mobile Applications. Journal of Engineering Science and Technology, 12 (Special Issue 4), pp. 89-97.
 22. Horner, R., El-Haram, M. and Munns, A. (1997) Building maintenance strategy: a new management approach, Journal of Quality in Maintenance Engineering, Vol. 3 No. 4, pp. 273-280.
 23. IFMA (2006). Definition of Facilities Management. International Facility Management association,
 24. From URL: http://www.ifma.org/what_is_fm/index.cfm
 25. Joseph. D.C. dan J.C. Michael. (2001) Time Saver Standards For Building Types. New York: McGraw-Hill.
 26. Kanning, U., Vogler, S., Bernhold, T., Gellenbeck, K., and Schlockermann, B., (2008). Determinants of the implementation of facility management in German communes, Facilities, Vol. 26 no: 9 pp. 418 - 425
 27. Kaplan, R. S., and Norton, D. P., (1992), The balanced score card-measure that drive performance, Harvard Business Review Jan.-Feb pp.71-79.
 28. Kelly, J., Hunter, K., Shen, G., and Yu, A., (2005), Briefing from a facilities management perspective, Facilities vol. 23 Iss: 7 pp.356-367.
 29. Kiffah, J.W. (2001). Development and Implementation of a Service Quality Rating System for Facilities Management in Urban Public School District. Wayne State University: of Michigan: Tesis Phd.
 30. Kotler, P. (1997). "Marketing management: Analysis, planning, implementation and controls." 9th edition, Prentice Hall, New Jersey
 31. Krstić, H., & Marenjak, S. (2012). Analysis of buildings operation and maintenance costs. Građevinar.
 32. Kurdi M. K., A. H. Abdul Tharim, N. Jaffar, M. S. Azli, M. N. Shuib and A.B. Waheed. (2011). Out-sourcing in facilities management- A Literature Review. 2nd International Building Control Conferences pp.445-457
 33. Lackney, J.A. (1999). Assessing school facilities for learning/assessing the impact of the physical environment of educational process: integrating theoretical issues with practical concerns. Proceeding on UEF21 New Jersey Institute of Technology Newark, NJ.
 34. Lee, H. H. Y., & Scott, D. (2008). Overview of maintenance strategy, acceptable maintenance standard and resources from a building maintenance operation perspective. Journal of Building Appraisal.
 35. Lind, H. and Muyingo, H. (2012) Building maintenance strategies: planning under uncertainty, Property Management, Vol. 30 No. 1, pp. 14-28.
 36. Loosemore, M. and Hsin, Y.Y. (2001), "Customer based benchmarking for facilities management." Facilities, Vol. 19(13/14), pp. 464-476 Mbach, J. and Nkado, R. (2007), "Conceptual framework for assessment of client needs and satisfaction in the building development process", Journal of Construction Management and Economics, Vol. 24(1), pp. 31-44
 37. Md Yusof Hamid, Mr David Baldry and Prof. Keith Alexander (2007). Strategic Facilities Management in Higher Education Institution. The Research Institute of the Built and Human Environment, University of Salford.
 38. Mei, Y.L. (2005). Enhancement of classroom facilities of primary schools and its impact on learning behaviours of student. Journal of Facilities, Vol. 23, No.13/14. pp. 585-594.
 39. Mohd Shahril Abdul Rahman, Hishamuddin Mohd Ali, Ibrahim Sipan, Mariah Awang, Abdul Hakim Mohammed (2015). Space Utilization Model For Higher Education Institutions. Jurnal Teknologi, Vol. 75 (10).
 40. Noorliza Karia, Muhammad Hasmi Abu Hassan Asaari, and Hayati Saleh (2014). Exploring Maintenance Management in Service Sector: a Case Study. Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management Bali, Indonesia, January 7 - 9, 2014
 41. Nordiana Mohd Isa, Syahrul Nizam Kamaruzzaman, Othman Mohamed, Aini Jaapar, and Asra Zaliza Asbollah. (2016). Facilities Management Practices in Malaysia: A Literature Review. MATEC Web of Conferences 66, 00054 (2016).
 42. Nuramidah Hamidon, Khalid Salleh, Mariah Awang, Mimi Suliza Muhamad (2019). Study of The Amount of The Domestic Energy Consumption At Kolej Kediaman Pelajar Uthm Pagoh By Relating With Carbon Dioxide Emission And Its Implication To The Environment, International Journal Of Recent Technology And Engineering (IJRTE), Blue Eyes Intelligence Engineering & Sciences Publication, 5, 1683, ISSN:22773878
 43. Olajide, F. and Afolarin, A. (2012). Evaluation of maintenance management practice in banking industry in Lagos state Nigeria, International Journal of Sustainable Construction Engineering and Technology, Vol.3, No. 1, pp.45-53.
 44. Olanrewaju, A. L., Idrus, A., & Khamidi, M. F. (2011). Investigating building maintenance practices in Malaysia: a case study. Structural Survey, 29(5), 397-410.
 45. Parida, A. and Kumar, U. (2006). Maintenance performance measurement (MPM) issues and challenges, Journal of

- Quality in Maintenance Engineering, Vol. 12, No. 3 pp. 239 – 251.
46. Payant, R.P. dan Lewis, B.T. (1999). Operations plans. In: Lewis, B.T. (Pnyt.). Facility Manager's Operation and Maintenance Handbook, New York: McGraw-Hill. pp. 3.3-3.61.
 47. Payant, R.P. & Lewis, B.T. (2007). Facility Manager's Maintenance Handbook, Hill New York: McGraw NY.
 48. Penny, Wan Yim King, (2007). The use of environmental management as a facilities management tool in the Macao hotel sector, Facilities, Vol. 25 no: 7 pp. 286 – 295.
 49. Rahman, M. A. A., Musa, M. K., Awang, M., Ahmad, F. H., & Hamidon, N. (2019). Exploring issues and problems perceived by occupants of malaysian affordable housing. International Journal of Innovative Technology and Exploring Engineering, 8(8 S), 398–401.
 50. Rahman, M. S. A., Ali, H. M., Sipan, I., Awang, M., & Mohammed, A. H. (2015). Space Utilization Model For Higher Education Institutions. *Jurnal Teknologi*, 75(10).
 51. Rydell C. P., (1970). Factors affecting maintenance and operating costs in federal public housing projects. *Rand*, 634
 52. Shah Ali, A., Kamaruzzaman, S., Sulaiman, R. and Peng, Y. (2010) Factors affecting housing maintenance cost in Malaysia, *Journal of Facilities Management*, Vol. 8 No. 4, pp. 285-298.
 53. Sekaran, U., & Bougie, R. (2010). *Research Methods for Business: A Skill Building Approach* (5th edition). New Jersey: John Wiley and Sons.
 54. Uline, C. and Tschannen-Moran, M. (2008). The walls speak: the interplay of quality facilities, school climate, and student achievement. *Journal of Educational Administration*, Vol. 46, No.1, pp.55-73.
 55. Wan Zahari, W.Y., (2008). *Menilai Kualiti Perkhidmatan Pihak Berkuasa Tempatan Menggunakan FM-SERVQUAL*. UTHM: Tesis Ph.D.
 56. Wes, M., and Danny, S.T. (1999). *Facilities Management and the Business of Space*. South America: John Wiley & Sons.
 57. Zanariah Kadir. (2007). *Persepsi Pelanggan Terhadap Aplikasi Perjanjian Tahap Perkhidmatan Dalam Pengurusan Penyelenggaraan Fasiliti di Institusi Pengajian Tinggi*. Universiti Teknologi Malaysia: Tesis Sarjana.
 58. Zeithaml V.A., Bitner M.J. (2000). *Services Marketing*. New York: McGraw-Hill.
 59. Zuhairi Abd. Hamid. (2004). Role of information technology in facility management. *Buletin Ingenieur*, Vol. 24. pp. 25-31.