

GREEN MAINTENANCE MANAGEMENT INITIATIVE FOR UNIVERSITY BUILDINGS

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ABSTRACT

This paper has two objectives. The first objective is to provide an overview of the sustainability issues and building maintenance through literature. The second objective is to illustrate through primary data how university maintenance organizations approach green initiatives. Sustainable development is a holistic concept that integrates various criteria including energy efficiency, durability, waste minimization, social impacts, good indoor environment, pollution control, life cost, users friendly, user comfort and others. Maintenance contributes to sustainability in many ways. For instance, it holds toxic emissions to the barest minimum level, reduction of energy and resources emission by ensuring the durability and availability of the building parts and provides information to the designers on the features of already installed components. The needs for maintenance works are growing because, it is not always cost effective to demolish, reconstruct or to rebuild new facilities to replace the existing ones. Therefore, it is becoming imperative that the buildings and infrastructures are well maintained so that they could serve their useful purpose. University approaches towards sustainability is determined through interview with those concerned with the building management. The study discovered that university organisations in Malaysia are yet to come to term with the issue of green initiatives. Currently, it remains an academic issue without practical significance to those concerned with building management. In order to move the sustainability drive into the main stream university administration, there is a need for collaborative works among researchers in the universities and their maintenance organisations.

Keywords: University buildings, maintenance management, green initiatives

1. INTRODUCTION AND BACKGROUND

To go green or greening is a principle, philosophy and mindset. The term means different things to different people, however. In another respect, the word *green* has been prefixed with numerous words like, economy, tourism, building, banking, education, technology and information. It is common today to hear or see expressions like green economy, eco-tourism, sustainable education and green technology. However, irrespective of the words or terms used, the fundamental intent is the same. Green or to be greening are a blend of energy optimization, durability, waste minimization, social impacts, good indoor environment, pollution control, life cycle-cost, user-friendliness, user comfort and satisfaction. Strictly speaking, the greening concept is about tackling change in world's climate. Climate change is a product of increase in world temperature. Meaning to say, the temperatures close or around the Earth surface are warmer than normal. However, from the other hand, it has been shown that the major force behind the change in temperature is human activities.

The built environment which the building forms part, is the largest consumer of natural resource, consuming about 50% of the global energy use and produce most of the world wastes and is at the same time responsible for the production of about half of the world carbon dioxide (Kallaios, 2010). From the one hand, a lot of energies are required to plan, build, operate, maintain and dispose buildings. From the other hand, a lot of wastes are generated in the planning, construction, operation, maintenance, and disposal of buildings. However, the need for building will only intensify because we need buildings to carry out much of our activities, obligations and tasks. A building is more than just shelter; it is a factor of production. The interpretation of this statement is that the buildings are not

wanted for their own sake, rather for the services they provide or offers to the users, owner occupiers and other that have stake in the operations of the buildings. All buildings serve certain purposes, such as accommodation, inspiration or otherwise. Buildings are also source of wealth creations.

The concept of green building has no much to do with planting of trees and floras in or around the building as it is sometime thought; rather it is about the optimal energy utilization in the buildings and radical reduction of waste in building operations. It is about saving the mother earth; reducing the carbon foot-print. Reduction and minimization of the Green House gases sit at the heart of any greening initiatives. While new construction could be designed to take into account the green initiatives, it is the maintenance aspect that plays the dominant roles; this is the case, as the building cannot remains new throughout their entire life. Relatively, it is only a little fraction of the building life span that is used for design and construction.

Thus maintenance holds strategic position towards the green building initiatives. Exceptionally large amounts of carbon dioxide can be reduced through proper building maintenance. Buttressing this point further, authors like Wood (2006) contended that sustainability could not be achieved if adequate maintenance is not expended to the existing building stocks. The maintenance of buildings constantly affects everyone's life because people depend on the condition and performance of the buildings (e.g. home, offices, schools and markets) for their social happiness and economic growth (Seeley, 1987). According to Sherwin, maintenance contributes to the sustainability drives in three basic ways: it holds noxious to the bare minimum level, reduction of energy and resources emission by ensuring the durability and availability of the building facilities (Sherwin, 2000). Finally, it provides information to the designers on the features of already installed components. Therefore, if the building is operate optimally, it could help in meeting the desire carbon dioxide reduction, methane and waste reduction, reduction in energy and promote healthy living.

Drawing from the above explanations, sustainable or green maintenance could be define as "maintenance system that meets the value system of the present users without compromising the ability of meeting the value system of the future users" (Olanrewaju and Kafayah, 2008). The interpretation of this is that, maintenance demand is initiated after careful considerations of environmental, social and financial aspects of the planning, organization, directing execution controlling aspects in maintenance management processes, practices and procedures. The homeostatic balance between the five points in the value chain is elemental. While the general approach to managing building maintenance is common to most types of (maintenance) organizations, each building has its definite characteristics and functional performances that should be optimized. In that regards, the maintenance objectives must be customized towards the peculiar requirements and value of the buildings to the organization.

As an illustration, the functional requirements of a police cell is utterly different from say, a room at the hospital were patient is treated. In another context, greening must be included as one of the objectives of the maintenance strategies, in those instances, in order to factors in green issues. The management of building maintenance is crucial in the green building maintenance initiatives. This is the case because; maintenance in theory and in practices is tactical, technical or engineering in nature. Thus maintenance cannot be blamed; rather it is the management of the maintenance that requires a radical step change. Many issues and objects which reside in the building maintenance management often involves investigations using theories and methodologies from varying disciplines including economic, laws, engineering, science, culture, mathematical and statistical information and knowledge.

This paper aims to examine building in the context of the green initiatives. While there are sufficient literatures on how designing new buildings can contribute to meeting the green initiatives, literature on how maintenance management could contribute to this initiative are grossly inadequate. Therefore, this paper adds to the scanty existing body of knowledge in this space. The primary data is obtained through interview and discussion with those concerns with the building management. The paper concludes by arguing that building maintenance is a strategic issue for academic institution. The failure of universities to accept maintenance as a core service is serious failure to a sector that prides itself as vehicle for scientific and technological advancement.

The remainder of the paper is structured as follows. The theoretical framework and background is discussed next. The theoretical framework and background is divided into two parts: part focuses on defining sustainability and aligning same with building maintenance. Then, reviews of how university maintenance organizations can achieve the green initiative were outlined. This is follow by data analysis. A discussion on the findings follows is intermittingly with the data results. The paper is

finally concluded by bringing together the major issue in green maintenance initiatives.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

In this paper, terms including eco-building, green building sustainable building and energy efficient building are synonymous with green building and they are sometime used interchangeably. However, the green initiative is a vogue and ambiguous term. The concept places much emphasis on striking balance between natural and the built environment, while taking into account the impact of man's activities on the environment in meeting the need of the present generation without inflicting harm to the future generation. The greening concept is akin to refrain from passing our debts to our yet unborn grandchildren. Green building can be defined as building that strives to preserve the economic, ecological, spiritual, social and cultural requirements for societal well-being, and at the same time preserve the natural environment for the future users (Olanrewaju and Kafayah, 2008). Building construction and operation involves resources such as energy, water and raw materials. It also generates wastes and emits potentially harmful atmospheric emissions. All this are contributing to the climatic changes directly and indirectly. From the conceptualization phase of a building to its disposal phase, it impacts greatly on the environments.

Buildings construction and operation account for close to half of water used globally. The building sector makes use of one-third of the world's resources, and responsible for about 40% of GHGs emission and at the same time makes use of about 15% of world's water. Furthermore, about 40% of world's solid waste is generated through building construction and operation. Building envelope is also argued to contain about 5 times more pollutants than the air outdoors. Substantial part of building is composed of concrete. However, cement is the most active component of concrete, thus, in order to reduce carbon dioxide emission; there is need for radical change in cement production techniques and application.

Buildings, once completed are expected to perform certain function for a certain period. However, "Even before a building is completed, Nature begins to destroy it systematically, and gravity, wind and seismic movement constantly test the stability of the structure. The ultraviolet wavelengths of sunlight fade and decompose organic building materials through molecular breakdown" (Allen, 1995 and 2005). Accordingly, birth, growth, maturity, decline, decay, death, and rebirth are fundamental stages in all natural cycles and so too with buildings, although humans like to keep the cycle under control through maintenance until its death suits human purposes (Allen, 1995 and 2005) buildings are also destroyed through human activities, through use, misuse / or abuse. However, buildings may not perform satisfactorily as a result of inadequate design, poor workmanship, defective materials and components, wrong installations and applications and the failure to provide the required maintenance.

But, assuming the initial design was adequate for the intended use, the quality of workmanship was high, the materials and components selected were of high quality and installed properly, any inconsistencies from the predicted service life can be attributed to maintenance. New buildings are often beautiful, meet the required energy standards and are functional for the occupants, are of state-of-the-art and stakeholders are happy, but for it to achieve its design performance it must be well maintained (Schrag, Smith and Stollenwerk, 2007). Maintenance, therefore, is essentially required to delay defects to ensure that buildings perform optimally throughout their life cycle so that they represent value to the users. If defects are allowed to occur, the performance of the building is undermined. In other words, the essence of building maintenance is to increase the life expectancy of a building and to conserve energy. Building requires maintenance in order to attain its design life. Thus, the need for maintenance in buildings will only intensify as the value of the building and the associated engineering services must be preserved and sustained for the building to be meaningful.

The value of building decreases unless maintenance is administered. Maintenance costs account for a significant part of the building operation. For instance, about 75% of the total expenditure on the life cycle cost of a building is attributed to maintenance (Booty, 2006). More than 90% of the life cycle of building projects requires maintenance (Zavadskas and Vilutiene, 2006). A number of definitions are available for the term "maintenance". To some, maintenance is the actions that are required to restore a defective building to its original condition (Tapsir, 2005) many disagreed with such definition, however (Wood, 2003 and Jones and Sharp, 2007). Most of the definitions are not comprehensive enough to provide the accurate definition for the concept in practice. Maintenance is more than mere corrective approaches to building management.

However, one of a comprehensive definition that represents what maintenance means is that offer

by Olanrewaju (2009): “the processes and services taken to preserve, repair, protect and care for a 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 life span without drastically upsetting its basic features and use. From this definition, maintenance is not necessarily about the building itself *per se* rather is about the occupants of the buildings. “User care” is the focus of maintenance! This definition is based on the understanding that building is procured for the sake of the services (i.e. comfort, protection, accommodation, security and esteem) they offer to their users. It is the correct functioning of the building that the users desire not the physical condition of the building. To the extent that the building is capable of allowing the users to perform their functions, the building is a source of value creation to the functional service of accommodating, learning, teaching and doing research-with specific reference to the university buildings.

Buildings maintenance can range from minor works that cost few dollars to major works that can cost billions of dollars. Building maintenance is a big investment in most countries and in most developed countries it accounts for almost 50% of the turnover in the construction industry (Wood, 2005 and Vanier 2001). However, expenditure on maintenance in other countries is also showing parallel patterns. The increase in land costs has also led to the unprecedented growth in maintenance works. Since the 1960s several studies have indicated the need to balance capital costs against the subsequent maintenance costs of the buildings. Because a perceived saving today could lead to high maintenance costs in the future. The example of this can be cited. Costs of servicing a hospital building may be six times greater than the building costs (Seeley, 1996).

While new buildings should be designed and operated to incorporate green initiatives. The maintenance of existing buildings must be made to address green criteria, if saving and protecting the mother earth is critical. Designing and constructing green buildings is not enough, the maintenance objectives must include green criteria, otherwise a long lasting solution will not be achieved. To underscore this, internationally recognized systems for assessing buildings environmental performance including LEED (Leadership in Energy and Environmental Design), GBC (Green Building Challenge) and BREEAM (Building Research Establishment Environmental Assessment Method), HQE (High Environmental Quality), CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) and VERDE include, buildings and services maintenance in their assessment criteria (Sinou and Kyvelou, 2006). See also (Seeley, 1987). Nationally, in Malaysia, the Green Building Index, also clearly articulates maintenance as a critical component towards meeting the sustainable development goal. Apparently to provide a holistic framework for sustainable construction, maintenance consideration is significant. A sustainable building must be easy to maintain any way! Building maintenance constantly affects everyone’s life because people’s comfort and productivity is relative to the performance of the building they live, learn, conduct research and work in (e.g. home, offices, schools, university and markets), not to mention the impact it has on social fabric and economic growth (Rendeau, Brown and Lapides, 2006).

3. THE POSITION OF EXISTING BUILDING AND GREEN MAINTENANCE INITIATIVES

In this section, our aim is to represent the complexity of the body of literature capturing the range of conflicting assumptions and understandings about what theories and practice of maintenance of existing and other initiatives like refurbishment, reconstruction and retro-fitting. Before proceeding further however, it is important to acknowledge what although we attempt to offer a balanced portrait of opposing views, our opinions and biases will come through whether we want them to or not. This kind of investigation is particularly important in maintenance issues, in which so many divergent assumptions are often left unsaid or asserted as truth. While some could argue that some issues are better left unsaid, it is felt, it will not be at any one’s interest to continue to pretend as everything is right and thus failed to present our side of the case. At least, this could as well serve as impetus to some writers and commentators.

Published literature revealed a wide range of opinion which tends to polarize either towards new buildings, maintenance or other initiatives. However, maintenance is only justifiable to reconstruction or refurbishment if the building remains fit functionally since the object of maintenance is much related to the use value as compared to other criteria like the physical condition. While initiatives including refurbishment, alteration, conversion and reconstruction are one off, maintenance is a must in the building life cycle. Client may decide not to alter, refurbish, convert their building, but this is

not possible in the case of maintenance. Almost certainly, building that will stand for more than five years or even less require maintenance to remain useful. A building that would not require maintenance throughout its life span will compromise for its life span and the functional requirements. In another respect, building last more than says 100 years. However, authors including Killip (2006) were of the view that building maintenance alone is inadequate to address the targeted 60% reduction of carbon dioxide emission by 2050.

Admittedly, green building requires a holistic approach since it is a multi-faceted agenda. However, through proper maintenance a building can be efficient and remain desirable. The recent amendments in the UK to the building regulations that compel sustainability issues be considered during building maintenance (Wood, 2006) is a clear example that maintenance seeks to contribute to the sustainability agenda. The amendments stipulate that all repairs and replacements must meet the requirements of the sustainability agenda. If a building is not well maintained, certainly it will affect quality and productivity of the users and the society at large. Buildings that fail in their efficiency standing or do not receive the required maintenance will certainly produce more waste (i.e. carbon dioxide emission), affect users' wellbeing, as well as consume more energy, water and other resources. These will definitely affect the sustainable agenda. The strategies and initiatives in green construction drive is green maintenance, which refers to adopting a green mindset in our maintenance processes, methods and materials, in order to minimize pollution to our environment, sound financial prudence and community and social integration and the meeting the overall objective of green environment.

If building deterioration continues then the future generations would, among others, face very serious financial burden (Seeley, 1987). In fact, failure to act would also lead to major social and environmental problems. Even if all buildings are to be refurbished, converted or improved, they still require some considerable amount of maintenance to avoid deterioration and unnecessary wastage of the investment. Too often during maintenance works, the contractors (and consultants) are faced with problems from shortages of specific materials and components due to incompatibility or outdated items. Naturally, such materials and components should be repaired or replaced with new and improved ones that are designed to meet existing standards, codes and regulations, as well as helpful to the sustainability agenda. Strictly speaking, there is no way all existing buildings can comply with the sustainable agenda without going through the painstaking of maintenance processes. It is practically impossible to replace or rebuilt all organization or nation buildings at one time. Even a nation, no matter how endowed it is cannot embark on such unachievable mission. This is an illustration. The replacement cost of the 1960s buildings in English universities alone is estimated to cost £11 bn (Rawlinson & Brett, 2009). Thus, through efficient maintenance management, energy usage can be minimized, toxic materials will not be used, and safe and durable materials will be preferred living condition will be improved.

4. GREEN MAINTENANCE OF UNIVERSITY BUILDINGS

Higher education is a major catalyst in generating and sustaining knowledge, skilled and competent human capital to meet the need and strategic vision of a nation. University education is created to contribute to the sustainable development of the society as a whole. It aims to educate highly qualified graduates who are able to meet the needs of all sectors of human activities. The developments in all sectors of the economy are indeed outcomes of universities and research centers across the globe. Universities are now operating under high competitive and turbulent environments, due to increase in government expenditure and reduction and revenues. The times governments are cutting down budgets to the public universities are coinciding with the time the buildings are ageing. This is again happening, when students and their parents are becoming more demanding and concern about the building performance. Thus, the only way, today's university can survive and progress it to be more effective and efficient in the face of these pressures. These requirements impinge on all aspects of the university operations and notably among the aspects is the management of the constructed facilities.

Recent studies (Housley, 1997; Fleming and Storr, 1999; Amaratunga and Baldry, 2000; Price, Matzdorf, Smith and Agahi, 2003; Green and Turrell, 2005; Leung and Fung, 2005; Wong, Fellows and Liu, 2007; Fianchini, 2007 and Lavy and Bilbo, 2009) have affirmed the positive correlations between performance of educational buildings and quality of education. University buildings (and services) are procured to create suitable, conducive, and adequate environment to support, stimulate and encourage learning, teaching, innovation and research. University buildings constitute the most difficult collection of largely buildings to maintain because of their complex engineering services and

their heterogeneous nature. Building in this context includes the building's fabrics, structures and the engineering services.

A building provides values not only to the university organization, but also to the students, faculty members, parents and other users and stakeholders. Although, there is no available comparable numerical data on the state of disrepair, decay, deterioration and unfitness of the Malaysian university buildings, it is possible that they suffer from a similar degree of care and neglect like other institutional buildings.

University buildings in Malaysia are characterized by ceramic sanitary appliances and fittings. The administrative and academic buildings are with split air conditions while hostels fitted with three bladed fans. The walls are plastered and rendered in cement and sand prepares to emulsion paints. The maintenance managers of universities managed extensive array of buildings such as office, lounges, reception areas, conference rooms, storage, treatment rooms, workrooms for equipment (photocopiers, fax machines, printers, and mailbox) classrooms, teaching and research laboratories, libraries, residence halls, cafeteria, Mosque, tea rooms and sport facilities.

In the maintenance of university buildings, the roles of the maintenance organization are prominent in order to achieve the greenery or green scorecard. Following are some of the obvious strategies or initiatives that are applicable or can be taken by the maintenance organizations towards the green initiatives:

- Plants and equipments should be maintained at optimum standards.
- Defect should be avoided or minimized to barest minimum with sound maintenance strategy. Because defect leads to deficiency and which will account for increase in energy consumption and release of green house gases to the earth surface.
- Repair maintenance should be carried out with local materials, components, instruments and labour.
- Maintenance management should be systemic so that it innovative, and competitive.
- As far as practicable maintenance should be preferred to refurbishment and reconstruction. Because refurbishment or reconstruction consumed more energy and water generate more waster as compared to maintenance.
- The criteria of the user value system should be a major determinate for maintenance demand. If this is done, often, the building will have to be maintained again, even where, the environmental, social and economic issues are taken into account. In other words, poor user satisfaction will lead to maintenance.
- Repair maintenance should ensure the applications of natural or green materials and other resources. In other words, when the need for maintenance arises, materials and components that it productions and operation require complex high-technology should be discourage and at same time, durable materials and components and should be given high preference.

5. APPROACHES TAKEN BY UNIVERSITY IN MALAYSIA TO SUSTAINABLE BUILDING MANAGEMENT

As part of an ongoing research on the validation of the systemic building maintenance management model that was developed for Malaysian university organizations, a question was addressed to the participants concerning measure taken towards green maintenance management. The model was validated through face to face interview technique. The participants were from both the public or private universities. The participants have between 10 and 27 years of experience with the asset, facilities or maintenance organizations of their respective university. Their positions in the organization includes, Maintenance Executive; Head of Facilities and Maintenance Division; Senior Manager, Department Of Maintenance, Timbalan Pengarah (Penyelenggaraan); Timbalan Pengarah (Architecture and Civil Engineering); Director Of Development Division; Ketua, Bahagian Penyelenggaraan; Pengarah, Jabatan Pembangunan; Facilities Engineer and Head of Electrical and Electronic Division. The entire participants except one are male.

The maintenance index of about half of the universities are between 1% and 2%. However, in many of the universities it is between 4% and 8%. Maintenance index is the fraction of annual maintenance expenditure with the total building value of a university. From the outcomes, the total number of buildings in the portfolio of the nine respondents is 1,050 while the size of the floor area totaled 3, 900, 000 square meters. Out of the ten participants interviewed, only two of the participants have some good ideas about what it actually represents.

However, most of the participants say their universities have plan to inculcate sustainable in their design and construction in future. A participant says, to them in the maintenance department issue of greening is confusing and complicated. He also argued that, the agenda is actually a class room or academic issue rather than practical issues. To them in the maintenance department they are unable to even understanding what it actually mean in practical. While he was making reference with a building constructed on the campus that was dubbed “green building” He says he could not see anything sustainable or green about the building.

However, among the two participants that have some *good* idea about the concept, they have put some initiative in place. For instance, the university has as a matter of principles to replace all defective parts and components with those that is certified sustainable. Also measures were put in place to reduce energy usage. For example, previously all chillers were in full operation throughout the year, but now the operations of chillers were ration. Also the quantities of water supply to all the hostels have been reduced and users provided with tips on water usage. In another note, the efficiency of plants and equipments has been improved and constantly monitor with the Building Automation Systems. This university has since last year, gradually replacing major mechanical and electrical installations with those that meet with the sustainable status. The other university, though does not have laudable programme towards greening, but also has some encouraging initiatives.

For instance, it has invested into water harvesting. This is whereby, rain water are collected and stored for use. Water recycling is also another measure that the university is currently embarking on. With respect to the third university, the only measure it has towards green is with regards to the building operation but not with the building maintenance. In this university, the buildings are fitted with mechanical device. The device work based on the temperature in the buildings. The device allows all the lighting installations in the building to switch off automatically at 7 pm on the working days. But if the devices, detect the presence of a person or people in the building, the light will switch on automatically. However, the installations are only in the new buildings in the campus. In another words, half of the university’s buildings do not have such devices.

In many of the cases however, the approaches is mainly related with switching off the lighting and air conditioning system when not use. Since most of the lighting and air conditioning systems are central controlled a lot of energy could be save. However, all the university survey have serious campaign on recycle on used item like paper, plastic, glass. In fact, three category of bins each for paper, plastic and glass were placed in a strategic location for this purpose.

However, there is the need for the maintenance unit of the university to work together with the academic unit, so that the lighting and air conditioning system in the classes, workshops and laboratories that will not be used could be identified to be switch off. The working together would also enable the maintenance organization could advice the academic unit on alternative class. The example of this may be cited. The lecturers may never think on the need to swift class to a smaller class that could comfortably serves the require purpose yet save energy used for air the conditioning system. Often, you find less than 10 students in room that is met to accommodate 50 or more students. Certainly, this class will consume more energy as compared to a small class. Furthermore, maintenance management should be introduced into engineering disciplines in order to produce engineering that some knowledge and skills in maintenance management functions.

6. CONCLUSION

Green initiatives for university organization have alighted. While there are no hard or fast rules towards meeting the greening initiatives, a number of positive principles can facilitate meeting waste reduction, energy maximization, water reduction and other aspects of the greening agenda. However, there are not concrete steps towards the greening initiatives among the universities in Malaysia. Unfortunately, many researches on the benefits and applications of the sustainability is coming the universities. It is recommended that, synergies be formed among the researchers in the sustainability disciplines with the maintenance organizations of universities so that those concerning with the building management will appreciate the benefits of the approaches. In this way, practical problems and other application issues can be addressed and jointly work on the researchers and practitioners.

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