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Key Performance Indicator of Building Maintenance and Its Effect on the Building Life Cycle

Building maintenance is considered as one of the national agenda. Multitude barriers received by the services providers have undergone various difficulties in satisfying public interest have been progressively resolved as a sign towards becoming a more developed country. In real practice, building maintenance is the thing which we mostly tolerate. If the building is able to weather the elements, we may with delay taking action on it. Most buildings are always treated with 'ad-hoc' maintenance. In some instances, the building disrepair will wait until complaints are made before any repair work is done. It shows that the situation is not considered critical as it may. Maintenance is still being practiced in improper procedure by the maintenance managers which subsequently caused bad impacts to the facilities and the services provided. It can be seen that the managers prefer carrying out reactive maintenance works rather than proactive works and at times do not consider the clients satisfaction and also the performance of services. This paper will focus on some important elements of building maintenance and its relation to building performance holistically.

Keywords: *building maintenance, building performance, disrepair, building defects, failure, asset management*

1. Introduction

There is an increasing concern that the maintenance management has been unprofessionally applied by the maintenance managers and no research has so far outlined the critical factors and deliberation on such improper practices. Readiness towards providing the best building operation is one of the ultimate aims of a maintenance manager. A maintenance manager should instill full responsibility and plan all work beforehand as it will enhance the capability and competency in solving problems. By knowing what, when and how to respond to the relevant issues,

it will prepare the building to be more reliable for the customer and keep the building status in good condition [1].

An excellent practice of maintenance management is greatly needed to increase the life cycle of the property and to minimize unexpected breakdowns or deterioration effects. In this respect, the modern maintenance manager will have to rely as much as possible on knowledge of the managerial and social sciences as on the traditional knowledge of building construction and deterioration. Improper conduct and application of maintenance management procedure and systems may result in deteriorating the property itself. Therefore, the performance of the maintenance management operations have to be continuously reviewed and analyzed in order to ascertain a high quality service [2]. A building services and facilities require maintenance to ensure its optimal performance over its life cycle. Figure 1 shows the life cycle stages of building.

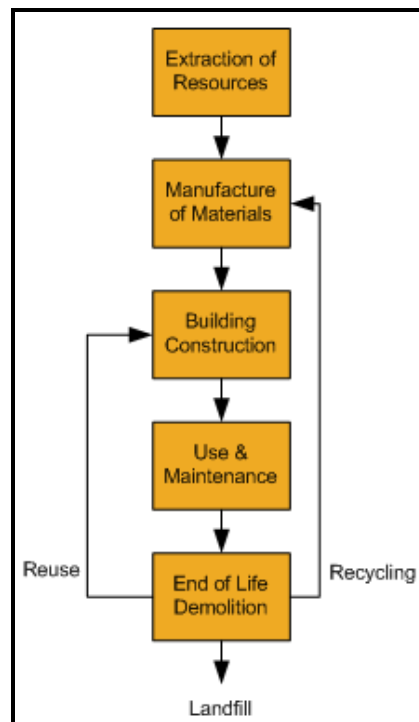


Figure 1. Life cycle stages of building

In concept of maintenance, which it defined as an action that prevent or restore a condition to its original condition. British Standard [4] defined maintenance as “the combination of all technical and administrative action intended to retain an item in, or restore it to a state in which it can perform its required function”. Maintenance has been defined differently by authors. Maintenance is defined as the

mean of processes, activities, procedures and services applied to a building. It is undertaken in order to preserve, repair, enhance and care the building fabric and facilities at all time. While carrying out maintenance, the strategy must take into account current advancement in building regulations, standards and technologies [3]. Figure 2 demonstrates the impacts incurred by a building throughout its life cycle.

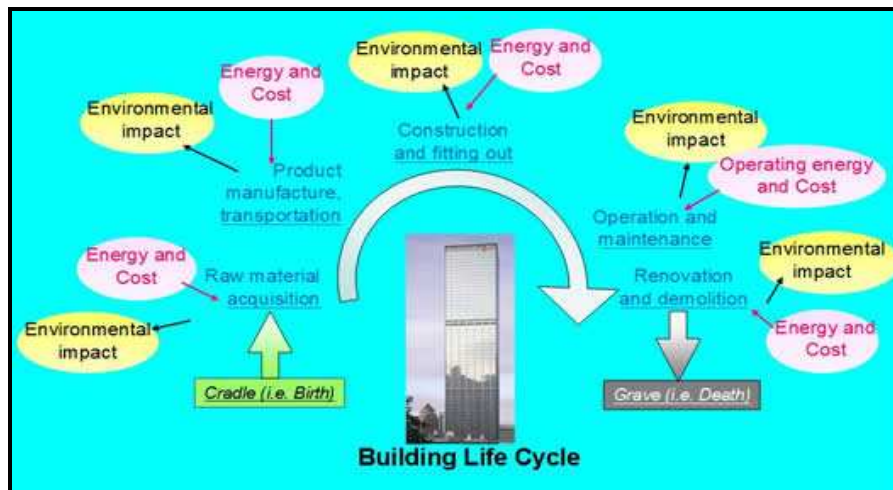


Figure 2. Impacts incurred by a building throughout its life cycle

All activities of the management that determine the maintenance objectives, strategies, and responsibilities, and implement them by means, such as maintenance planning, maintenance control and supervision, improvement of methods in the organization, including economical, environmental, and safety aspects [4]. Maintenance management involves managing the functions of maintenance. Maintaining equipment in the field has been a challenging task since the beginning of industrial revolution. Since then, a significant of progress has been made to maintain equipment effectively in the field. As the engineering equipment becomes sophisticated and expensive to produce and maintain, maintenance management has to face even more challenging situations to maintain effectively such equipments in industrial environment. Maintenance management includes maintenance strategies, functions of maintenance department, maintenance organization and elements of maintenance management [5].

2. Maintenance Strategies and Organization

A maintenance strategy means a scheme for maintenance, i.e. an elaborate and systematic plan of maintenance action. The equipment under breakdown maintenance is allowed to run until it breaks down and then repairing it and put-

ting back to operation. This strategy is suitable for equipments that are not critical and have spare capacity or redundancy available. In preventive or scheduled maintenance, maintenance actions such as inspection, lubrication, cleaning, adjustment and replacement are undertaken at fixed intervals of numbers of hours [6].

An effective Preventive Maintenance program does help in avoidance of accidents. Condition monitoring detects and diagnoses faults and it helps in planned maintenance based on equipment condition. This condition based maintenance strategy or predictive maintenance is preferred for critical systems and for such systems breakdown maintenance is to be avoided. A number of condition monitoring techniques such as vibration, temperature, oil analysis, etc. have been developed, which guide the users in planned maintenance [7].

In design out maintenance, the aim is to minimize the effect of failures and in fact eliminates the cause of maintenance. Although it is an engineering design problem, yet it is often a responsibility of maintenance department. This is opted for items of high maintenance cost that are due to poor maintenance, poor design or poor design outside design specifications. It may be mentioned that a best maintenance strategy for each item should be selected by considering its maintenance characteristics, cost and safety.

In addition to the above, new strategies concepts such as Proactive Maintenance, Reliability Centered Maintenance (RCM), Total Productive Maintenance (TPM), etc. have recently been evolved to look it from different perspectives and this has helped in developing effective maintenance. In proactive maintenance, the aim is identify what can go wrong, i.e. by monitoring of parameters that can cause failures. In Reliability Centered Maintenance (RCM), the type of maintenance is chosen with reliability of the system in consideration, i.e. system functions, failures relating to those functions and effects of the dominant functional system failures. The aim is to have overall effectiveness of the equipment with participation of all concerned using productive maintenance system.

It concerns in achieving an optimum balance between plant availability and maintenance resource utilization. The two organization structures that are common are: Centralized and Decentralized. A decentralized structure would probably experience a lower utilization than centralized one but would be able to respond quickly to breakdowns and would achieve higher plant availability. In practice, one may have a mix of these two. A maintenance organization can be considered as being made up three necessary and interdependent components.

- ✚ Resources: men, spares and tools
- ✚ Administration: a hierarchy of authority and responsibility for deciding what, when and how work should be carried out.
- ✚ Work Planning and Control System: a mechanism for planning and scheduling the work and feeding back the information that is needed for correctly directing the maintenance effort towards defined objective.

It may be mentioned that maintenance or production system is a continuously evolving in which the maintenance organization will need continuous modifications

in response to changing requirements. Moreover, it is required to match the resources to workload. Maintenance activities – be it preventive or condition monitoring, involve use of resources- men and materials including documents. This requires coordination amongst the involved personnel so that these are timely undertaken. Work planning and control system under maintenance management in the plant ensures this and provides planning and control of activities associated with maintenance. This means application of general management principles of planning, organizing, directing and controlling to the maintenance functions, e.g. to the establishment of procedures for development of maintenance strategy and to models for describing the flow of work through maintenance work planning department. Figure 3 visualizes an example of Building Information Management Formwork which is implemented as one of the strategies to smoothening the building maintenance aspects throughout the building life cycle.

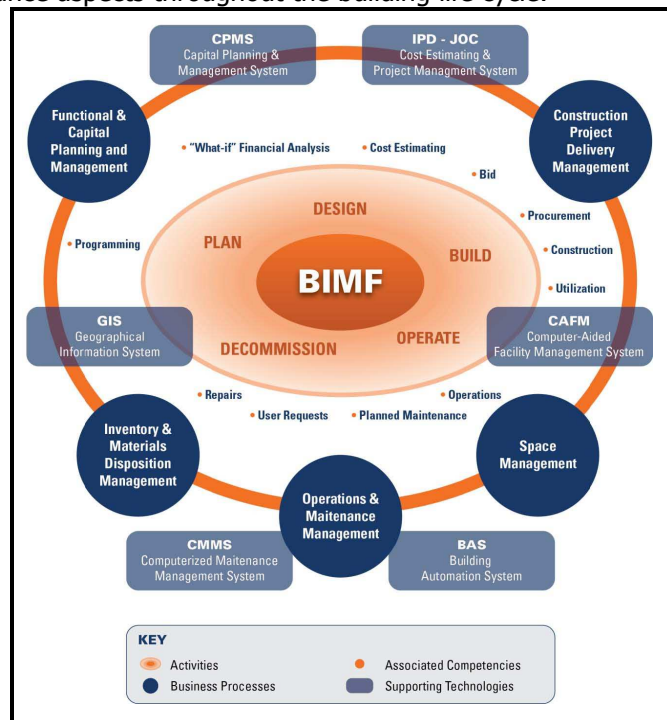


Figure 3. Building Information Management Formwork (BIMF)

3. Building Maintenance Performance

Maintenance performance indicators are utilized to evaluate the effectiveness of maintenance carried out. Maintenance performance indicators could be used for financial reports, for monitoring the performance of employees, customer satisfaction, the health safety environment rating and overall equipment effectiveness as

well as many other applications. If maintenance performance indicators are identified properly then maintenance performance can provide or identify resource allocation and control, problem areas, the maintenance contribution, benchmarking, personnel performance and the contribution to maintenance and overall business objectives [8].

Service quality framework differently proposes three different aspect on the property quality and also image aspect also from property quality. The indicator for performance comprises of the performance of aspects which are related to equipment task, cost, immediate customer impact and also learning and growth [9].

The dimensions or parameters set the limit of scope that to be measured in maintenance management system, for instance has used the building evaluation concept in her post-occupation to public office buildings in Malaysia which focuses on the building elements, building services and also noise pollution and vibration [9]. Figure 4 shows effect of adequate and timely maintenance and repairs on the service life chart

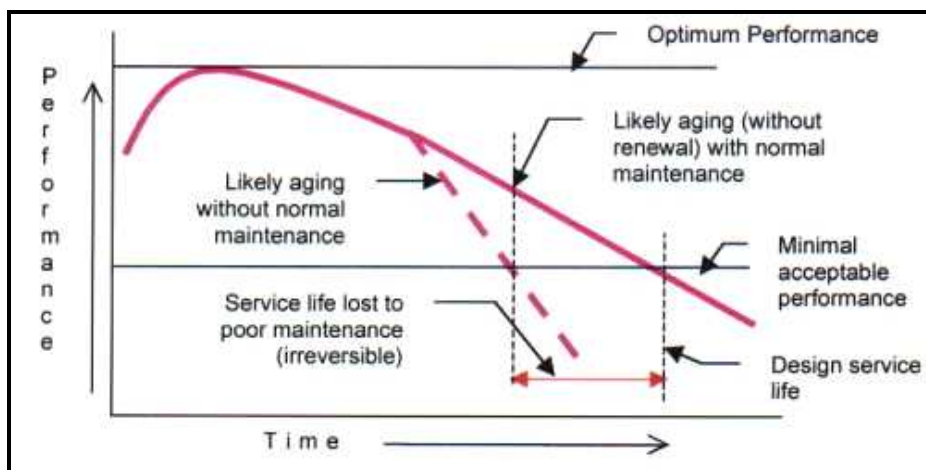


Figure 4. Effect of adequate and timely maintenance and repairs on the service life chart

A more detailed list of dimensions on building maintenance management aspect that are significant for the performance measurement which encompasses a wide range of services as mechanical and electrical, fire fighting system, cleaning and housekeeping, civil and structural monitoring, security and safety management, parking system, landscaping and ground care services, environment and air quality control, energy and utilities computerized maintenance management system, vertical transportation and building maintenance [10].

As for the property quality on functional aspect, he outlines cleanliness, building services, signage, security and parking as the dimensions to be assessed while for the image aspect the building aesthetic aspect of property quality is delineated. Timeless and reliability are two important factors that must be considered in

measuring the performance of service quality [11]. It should be pointed out that over 30 years, the cost of operation and maintenance for buildings is more than the initial construction cost; how much more depends on the building type and location as been shown in Figure 5.

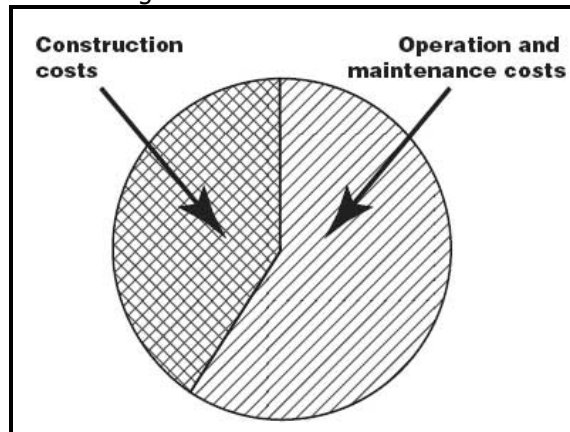


Figure 5. Cost of operation vs maintenance cost for buildings

4. Building Maintenance Practices Performance in Office Building

Government office building has a variety of facilities available to government employees where they are an end customer as well as the public who deal in government offices. Through building maintenance management undertaking maintenance of government office buildings so that they can function as usual and end users who use the facility or office space in government buildings will always be in a conducive environment in their daily activities.

Therefore, government facilities and office space needs to be maintained in good condition at all times and enhanced customer satisfaction. It is an important asset for all businesses and organizations. This applies to all organizations including buildings.

There are certain goals common to most building maintenance organizations and this evidence suggests a need for a balanced scorecard approach, which adequately reflects the characteristics, goals and critical success factors of the building maintenance organizations. In providing an effective service is the vision and objectives of the organization to carry out the maintenance works combined with value for money, to respond quickly to changes in customer needs, to achieve continued improvement services, to develop the skills of all staff and ultimately to recognize their performance means opportunities for advancement. . An effective and useful critical success factor for use by building maintenance organizations has to reflect aims [12].

It is the main point for identifying customer satisfaction, service quality, customer complaints, and the range of services offered in response to customer needs in carrying out its maintenance building. Among all the factors, satisfaction is the main thing. "The customer is always right" is a common phrase that translates in customer complaints made to the maintenance management. Thus, responding to complaints is very subjective depending on how the delivery quality and the services have been performed. But there are some constraints on this situation to provide an effective service. This happens where we can not satisfy everyone in all aspects but try to keep it at maximum.

The growth of facilities management in Malaysia is very slow and the field is still in its infancy. The definition of facilities management is poorly understood and here it is not being practiced in an appropriate way. The automated computerized system as an integrated approach, is the closest examples to the adoption of facilities management. The traditional management methods are dominantly applied compared to integrated facilities management system although the new approach has proven to be positive in strategic operations. Maintenance practices were not guided and most often its importance is neglected in business strategies. The non-existence of a specific organization to provide guidelines and control on the quality level as well as to assess the performance of facilities management practice is one reason why evaluation is difficult [13].

Having an effective management process in a building or an infrastructure is a key factor to maintaining the performance right through its service life [14]. It is a well-known fact that whole life cost can be significantly lower if the management process is efficient. 32 per cent of cost could be saved with an increased level of maintenance activity programs compared with a minimum level of maintenance activity programs based on a water distribution network project of over 50 years in operation [15].

The frequency of inspections may be clearly prescribed. For example, in the case of different type of mechanical equipments, some items of machinery may require different process of inspections from the others. Therefore, there will be a number of different in sections required at a variety of intervals for different components.

Repair and replacement decisions tend to divide into two categories. First, there are replacement decisions based on the known cost of continuing to repair an item. The problem is to determine when the time for replacement has come, or better still, to predict when it will occur. For simple items, the decision may be an easy one, requiring the inspector to judge against a simple criterion.

There is a lot of work required to set up a successful maintenance management system. However, once it is in place, most of the data is an addition or deletion to the inventory or when cost increases and estimates need to be corrected. There is numerous computerized maintenance management system of on-reserve assets [15].

The maintenance supervisor or manager must also monitor the work progress daily, weekly or monthly depending on the nature of the situation and the potential impact of a service breakdown to the community. Any significant variance in labor hours, work order costs or total maintenance cost for a particular asset should be identified through exception reporting. The supervisor should determine the cause of the variance and, where possible, develop alternative solutions or actions to reduce time and costs. Taking these steps as will help improve the efficiency and effectiveness of the maintenance program [15].

5. Conclusions

Maintenance management in private and public sectors has been rapidly changing throughout the years. This is due to several factors such as enhancement of sophisticated technology, globalization and change of economy are some of the main causes. Despite the realization of the importance of the management and maintenance of the buildings and facilities, it has not been emphasized clearly and systematically, which results in over budget costing for maintenance and remedial works.

Good practice of maintenance management is greatly needed to increase the life cycle of the property and to minimize unexpected breakdowns or deterioration effects. In this respect, the modern maintenance manager will have to rely as much as possible on knowledge of the managerial and social sciences as on the traditional knowledge of building construction and deterioration. Improper conduct and application of maintenance management procedure and systems may result in deteriorating the property itself.

Therefore, the performance of the maintenance management operations have to be continuously reviewed and analyzed in order to ascertain a high quality service. An excellent practice of maintenance management is greatly needed to increase the life cycle of the property and to minimize unexpected breakdowns or deterioration effects. While carrying out maintenance, the strategy must take into account current advancement in building regulations, standards and technologies.

References

- [1] Horner R.M.W., El-Haram M.A., A.K. Munns A.K., *Building maintenance strategy: a new management approach*, Journal of Quality in Maintenance Engineering, Vol. 3 Iss. 4, 1997, pp.273 – 280.
- [2] Olanrewaju Abdul Lateef, *Building maintenance management*, Malaysia, Journal of Building Appraisal, Vol. 4, 2009, pp. 207 – 214.
- [3] Hackman Hon Yin Lee, Scott D., *Overview of Maintenance Strategy, Acceptable Maintenance Standard and Resources from a Building Maintenance Operation Perspective*, Journal of Building Appraisal Vol. 4, 2009, pp. 269-278.

- [4] Khalil N., Abdul Hadi Nawawi, *Performance Analysis of Government and Public Buildings via Post Occupancy Evaluation*, Asian Social Science, Vol. 4, No. 9, 2008, pp. 103 – 112.
- [5] Bertolini M., Bevilacqua M., Braglia M., Frosolini M., *An Analytical Method For Maintenance Outsourcing Service Selection*, International Journal of Quality & Reliability Management, Vol. 21 No. 7, 2004, pp. 772 – 788.
- [6] Crespo Márquez A., Moreu de León P., Gómez Fernández J.F., Parra Márquez C., López Campos M., *The Maintenance Management Framework: A Practical View To Maintenance Management*, Journal of Quality in Maintenance Engineering, Vol. 15 No. 2, 2009, pp. 167 – 178.
- [7] Lateef O A, Khamidi M.F., Idrus A., *Building Maintenance Management In A Malaysian University Campuses: A Case Study*, Australasian Journal of Construction Economics and Building, Vol. 10, No.1/2, 2010, pp. 76-89.
- [8] Igal M. Shohet, *Key Performance Indicators for Maintenance of Health-Care, Facilities*, Vol: 21, No. 1/2, 2003, pp. 5 – 12.
- [9] Joseph H.K. Lai, Francis W.H. Yik, *Monitoring Building Operation And Maintenance Contracts, Facilities*, Vol: 25, No. 5/6, 2007, pp. 238 – 251.
- [10] Nik Elyna Myeda, *The Sphere of Performance Measurement In Strategic Facilities Management*, Journal of Facilities Management, Vol. 10, Iss.3, 2012, pp. 32-38.
- [11] Nik-Mat N.E.M., Kamaruzzaman S.N., Pitt M., *Assessing the Maintenance Aspect of Facilities Management through a Performance Measurement System: A Malaysian Case Study*, The 2nd International Building Control Conference 2011, Vol. 20, 2011, pp. 329 – 338.
- [12] Arditi D., Nawakorawit M., *Issues In Building Maintenance: Property Managers' Perspective*, Journal of Architectural Engineering, Vol. 5, No. 4, 1999.
- [13] Nik Elyna Myeda, Kamaruzzaman S.N., Pitt M., *Measuring the performance of office buildings maintenance management in Malaysia*, Journal of Facilities Management, Vol. 9, Iss. 3, 2011, pp.181 – 199.
- [14] Wu S., Neale K., Williamson M., Hornby M., *Research Opportunities In Maintenance Of Office Building Services Systems*, Journal of Quality in Maintenance Engineering, Vol. 16, Iss.1, 2010, pp.23 – 33.
- [15] Azlan Shah Ali, *Cost Decision Making In Building Maintenance Practice in Malaysia*, Journal of Facilities Management, Vol. 7 No. 4, 2009, pp. 298 – 306.

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