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Significance of Building Maintenance Management Systems towards Sustainable Development

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Abstract. Building maintenance management is an organized and effective system of maintenance operations which is set up to deal with problems related to the upkeep of a building. Its goal, aside from locating and remedying a building's deficiencies, is to effectively minimize the overall costs of maintenance and is also an effort to maximize the gain and benefits from the savings. There are a few factors that influence decisions to undertake maintenance work. The principal goal of maintenance is to protect a building in the early stage of issues as they arise. Some major reasons for maintaining a building include retaining its reputation and value of investments, maintaining the building in a condition which allows it to accomplish its purpose, and presenting a good outer shell. This paper will review and discuss some of the major elements of building maintenance towards achieving sustainable buildings.

Keywords: building maintenance; maintenance management; maintenance technology; sustainable building.

Introduction.

Building owners consider planned maintenance to be a matter that calls for serious apprehension, yet they can't afford to allow their properties to perish over time [1]. As it is undoubtedly not feasible, and even detrimental, to restore all older buildings, everybody is concerned about the condition of older buildings. Whether the owners, builders, or the end users, all involved ought to devote serious attention to this infinite dilemma of building maintenance [2]. Now and then, a certain amount of budget is available to handle or cover problems, but maintenance is instead held off while waiting for the liable party to deal with the issue. In such a situation, progress in building maintenance is waylaid and commotion over the restoration commonly arises [3]. Building maintenance encompasses every aspect of a building, for example, rooms, toilets, windows, walls and furniture. Building maintenance is a worldwide issue and is especially used as a timely corrective measure for damages and structural concerns; which, if not properly taken care of, could undermine the reputation and safety of the structure [4].

The following are specific maintenance objectives: to execute daily housekeeping and cleaning to sustain an appropriately aesthetically pleasing facility, to swiftly react and repair minor discrepancies in the facility, to expand and frequently perform systematically scheduled maintenance checks to avoid untimely failure of the facility and its systems as well as its components, to complete major repairs based on the lowest possible life-cycle cost [5], to

recognize, design and undertake enhancement projects to diminish and curtail the entire building's operating and maintenance costs, to operate the facility's utilities in the most cost-effective way while providing required dependability, to offer a trouble-free and comprehensive system for the reporting and recognition of essential repairs and maintenance work, to perform precise cost estimations to guarantee the most cost effective maintenance problem solutions possible, to keep an appropriate amount of materials and spare parts on reserve for unforeseen repairs, and to accurately track the costs of all maintenance work done [6].

Types of maintenance.

Corrective maintenance is maintenance carried out subsequent to breakdown having occurred and is meant to reinstate an item to a state in which it can execute its intended purpose. Whereas preventive maintenance is maintenance that is carried out at a prearranged period of time and is anticipated to diminish the probability of malfunction or diminished performance for any particular item. Condition-based maintenance is defined as preventive maintenance that is carried out as a result of knowledge of the issue thanks to scheduled or incessant monitoring [7].

It should be pointed out that corrective maintenance is the simplest type of maintenance approach, where building components are utilized until they break down. It covers all actions including repair of an element that has failed to a point at which it can no longer execute its intended purpose. Hence, corrective maintenance can be tremendously costly because the breakdown or failure of particular items can cause significant damage to other elements in the building. For example, failure of the roof might cause harm to the ceiling as well as the interior part of the building. Furthermore, the failure of an item can take place at a time that is equally inconvenient for the user and the maintenance personnel. This could make arrangements for manpower and spare parts exceptionally complicated [7]. Figure 1 outlines the maintenance system life cycle.

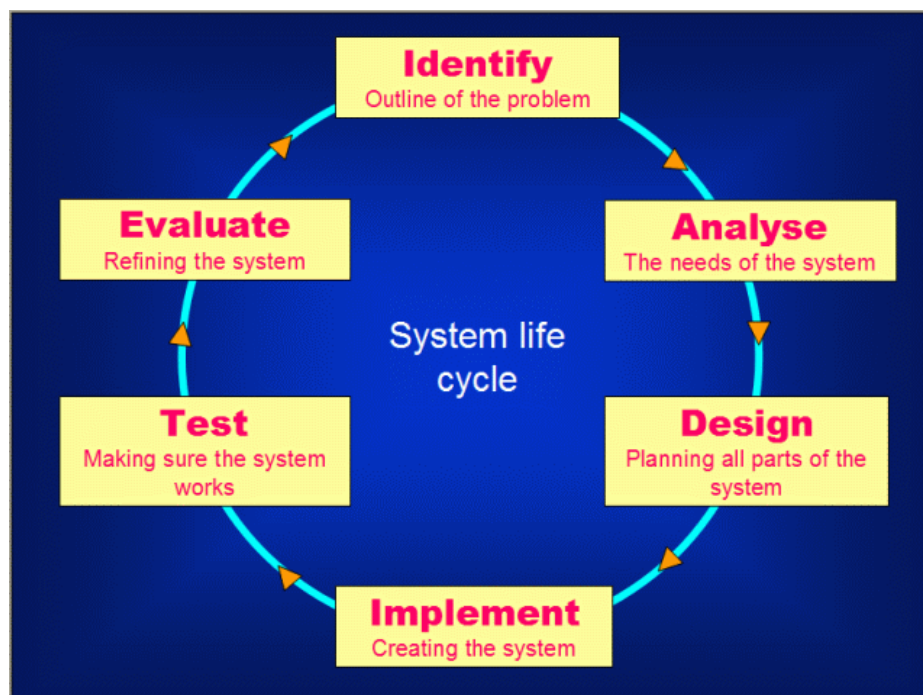


Figure 1. System life cycle [7]

Preventive Maintenance.

On the other hand, preventive maintenance is established to surmount the disadvantages of corrective maintenance by reducing the likelihood of malfunction and avoiding unexpected failure. Preventive maintenance checks are done in agreement with a prearranged plan at regular, fixed intervals, which may be based, for example, on an operating time. There are some additional advantages of preventive maintenance compared to corrective maintenance such as the ability to conduct the maintenance advance and to be executed when it is expedient to the building's users, the expenditure could be lowered by avoiding higher costs of significant damages, the point in time

when a component of the building or the entire building itself becomes out of service can be offset, the health and safety of the users can be improved, and they are less challenging in terms of spare parts and labour costs [8].

The category of preventive maintenance includes checks or upgrades that are programmed or predefined and standard time intervals to ensure continual proper functioning of the components. This type of maintenance can reduce unplanned work and is allotted for in overall costs [9]. Additionally, professional property managers are trained to comprehend that breakdowns of principal components must be prohibited. Preventive maintenance keeps a building operating at peak performance during regular inspection and repair.

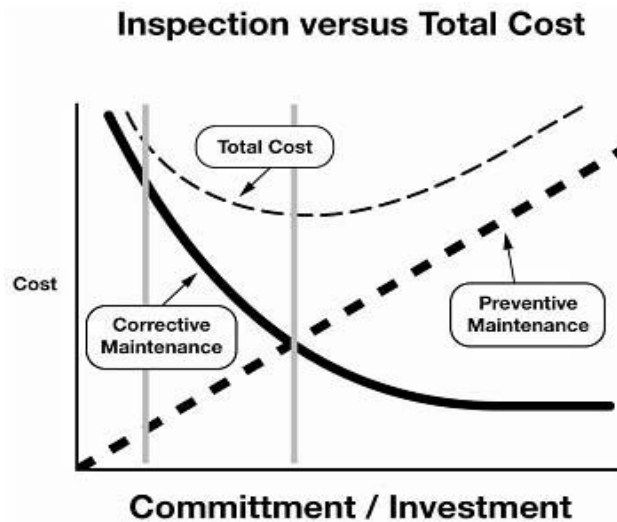


Figure 2. Total Cost broadens with the meeting point of Corrective and Preventative costs, indicating the low point for total cost desired [8]

The intention is to determine minute problems before they turn big and costly according to their cost of maintenance. Preventive maintenance's approach is most suitable for components that are subject to expected damage because they are fragile or easily worn out, their breakdown patterns can be recognized and can be modelled effectively, components that are meticulously synchronized for health and safety reasons, and also components that could be liabilities under the service contract. Figure 2 shows how the total cost broadens with the meeting point of corrective and the preventative costs which indicates the low point for total cost required.

Condition-Based Maintenance.

For condition-based maintenance, maintenance is carried out in reaction to the worsening of a unit as designated by a change in its condition or performance [9]. This notion dictates that an alteration in condition and functioning of an item is the primary grounds for carrying out the maintenance. As a result, an optimal time is required in order to execute the maintenance so that the real state of each component in any particular building can be diagnosed.

It should be pointed out that, for the purpose of gaining the full benefit of using this type of maintenance, the condition of an item needs to be observed carefully in order to spot whether there is any proof of alteration from a normal state to an abnormal one [9]. Figure 3 represents the 'typical' degradation process experienced by any type of equipment. In a certain period of normal operation time, where the item has been running smoothly, a change might occur which will affect overall performance.

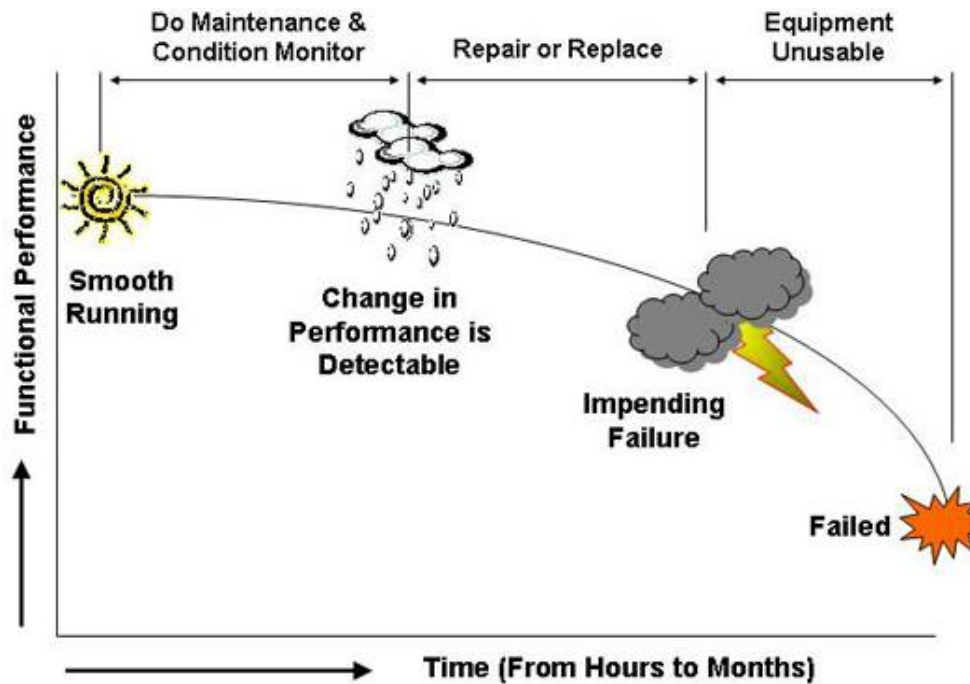


Figure 3. Typical process of degradation that any type of equipment may undergo [9]

Relationship between Preventive and Corrective Maintenance.

As previously outlined, there are two types of maintenance which are preventive maintenance and corrective maintenance. Preventive maintenance is the routine, regularly scheduled maintenance of a piece of equipment that ensures its continuous use and maximizes its life expectancy. Meanwhile, corrective maintenance is an emergency measure which is carried out after damages or problems have already occurred.

Preventive maintenance is suggested as a means to diminish equipment breakdowns. It is a method that requires a set maintenance programme, but the cost aspect connected with this type of scheduled equipment servicing is small in comparison to the cost of coping with unforeseen and disastrous breakdowns which entail not only main repairs but even the replacement of expensive components or even the entire system [2]. Figure 4 shows the difference between preventive and corrective maintenance.

According to Figure 4, preventive maintenance is better in comparison with corrective maintenance because the advantages of taking precautions towards a building to prevent it from becoming worse outweigh those of doing renovations or repairs after damages have already occurred. The cost of corrective maintenance is also more expensive compared to the cost of preventive maintenance. This is because preventative maintenance allows for low cost ways of preventing problems before they become exponentially more expensive, serious damages.

Preventive maintenance notably more advantages over those of a corrective maintenance program. The advantages of preventive maintenance are that it can increase a component's lifecycle and can reduce component failure. Additionally, it allows for possible energy savings estimated at 12-18 % cost savings in contrast to corrective maintenance. On the other hand, corrective maintenance incurs less short-term costs and requires fewer staff since less work is being done [10].

In terms of the disadvantages of corrective maintenance, it could increase long-term costs due to unplanned equipment downtime and probable derivative equipment or procedure damage. Though superior, preventive maintenance also has some disadvantages. It can be labour intensive and some breakdowns are still likely to occur despite carrying out preventive measures. It may also lead to the execution of needless routine maintenance because of the predetermined maintenance schedule [10].

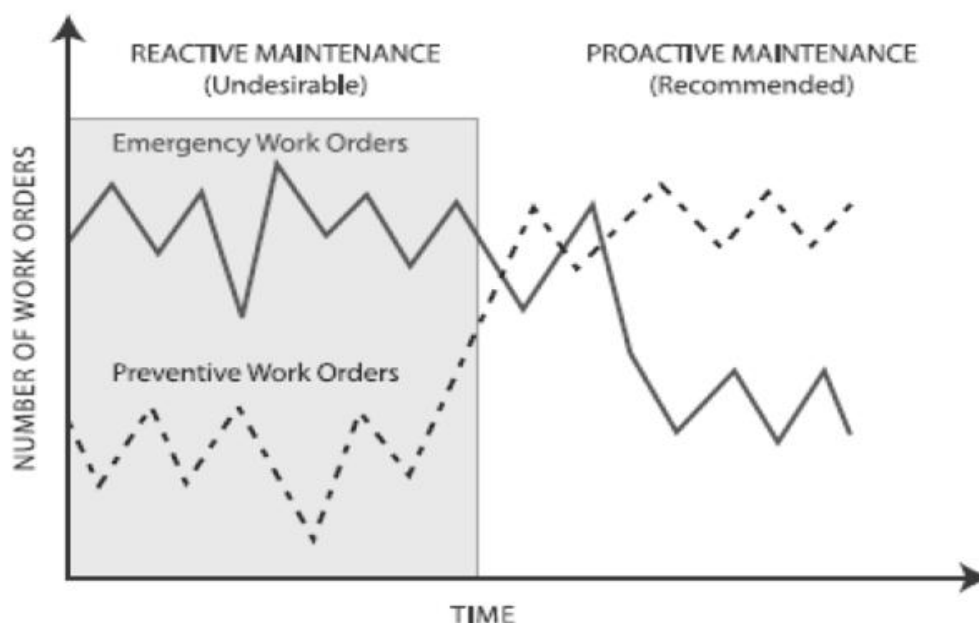


Figure 4. The difference between preventive and corrective maintenance [11]

Building maintenance performance.

Maintenance performance indicators are utilized to assess the efficiency of undertaken upkeep. Maintenance performance indicators could be used for financial reports, monitoring the performance of employees, customer contentment, environmental health and safety ratings, overall equipment efficiency, as well as many other applications. If maintenance performance indicators are recognized correctly, then maintenance performance can offer or recognize resource allocation and control, problem areas, maintenance contribution, benchmarking, personnel performance, as well as the contribution to maintenance and overall business objectives [11].

It should be noted that all these parameters set the limitations to which the maintenance management system should be contained. For example, a building evaluation system is utilized for the pre-occupation of public office buildings in Malaysia which focuses on particular building components, services and also noise contamination and shuddering [7, 8, 9].

Maintenance work.

Generally, the three types of maintenance work are normal work, urgent work and emergency work. These types of work are applied according to the type of failure and the action time. One to three weeks are taken for ordinary work, whilst for jobs requiring fast attention, the action taken is less than one week. Immediate action for emergency work must be taken in one to two days. The categories of maintenance for various types of work are described as follows:

Work Service.

Cleaning services fall into the category of work service for their facilities and equipment. These services require scheduling and should be conducted in accordance with priorities as well as with the routine of the equipment or facilities that need to be maintained. Quantity of services is dependent on size range and number of units or tasks in a building. The larger the size and coverage of the equipment, the more service jobs required, and vice-versa. Examples of such types of this work include machines, windows, floors and others [12].

Repair Work.

Repairs carried out to address failures and defects of the facility and equipment building covering incompatibility methods and materials used in construction. Thus, appropriate services focus on the early stages after construction is completed. Urgent repairs can reduce more frequent maintenance requirements in the future. Repair work implemented based on complaints and

consumer reports or by the owner about damaged building components, pumps, tiles, lighting damage, air conditioning and so on affect the comfort of many [13].

Replacement Work.

All materials, components and equipment for a building face differing levels and rates of damage influenced by their quality, the environment, and frequency of use [14]. Thus, replacements can be used to ensure that each item is replaced at the proper time if a corrective action cannot be made. Scheduled inspection should be done routinely for each recorded items with the intent of identifying failures and damage. Replacements can prevent adverse effects on performance and the overall function of the building. Among the items that are considered to be the main lifeline of a building and which, therefore, must be observed are structural components, mechanical components, electrical and water systems [15].

Work Protection.

Protection involves work aimed at controlling functions, including the appearance of a building's performance. Protection should be given throughout the life of the building as the building is vulnerable to damage and defects caused by factors such as weather, frequency of use, and others. Protection can avoid defects and more serious damage in the future. It can also guarantee the resistance of each component during use. For example, exterior surfaces of buildings can be painted to control the effects of weather and fungal attack [15].

Conclusion.

This paper has comprehensively examined dominant theories on maintenance and it will help future researchers become acquainted with relevant maintenance issues. It should be pointed out that building maintenance management is an organized and effective system of maintenance operations which is set up to deal with problems related to the upkeep of a building. Its primary purpose, apart from identifying and remedying damages in a way that minimizes maintenance costs, is to enhance the overall value of the investment. There are many factors that influence the decision to perform maintenance on a building, but the major intention of maintenance is to protect a building in its preliminary stage and to retain the value of investments in the property. Keeping the building in a condition in which it continues to fulfil its purpose and making sure it presents an attractive exterior are also important factors made possible through proper building maintenance.

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