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Measuring The Continuity Of Performance Of Maintenance Management In Government Facilities Focusing On The Electricity Services Sector During The Corona Pandemic Period In Oman

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Abstract

COVID-19 has turned working life upside down on the Globe. The Sultanate of Oman is no exception. Sudden, decreased working hours and rapid adjustments to working from home have created changes no one could have predicted. Working from home is becoming the new normal in the pandemic, with 30% of people now clocking on from living rooms, bedrooms and kitchen tables around the country. This figure almost doubles to 70% for office workers, who are currently conducting meetings via video link and connecting in ways previously limited to those with flexible working arrangements in place.

To some extent, working from home may be workable in many industries. Still, services industries such as the electricity distribution sector, different approach to be adopted due to the nature of works involved in these sectors. Though electricity distribution services came under the essential services category last year and even this year are challenging to all electricity distribution organizations in Oman. In this paper, the authors discussed the extent of the impact of the Corona pandemic on the maintenance department teams in government units, mainly on the Electricity service sector in Oman. The most critical changes in this sector during this pandemic period are identified by measuring the efficiency of the various systems and their performance. Difficulties in delivering spare parts and the arrival of maintenance teams to buildings due to extended lockdown. Also, the new mechanisms that have been established for buildings and facilities management teams in this sector the best practices that have been applied during the pandemic are listed in this paper.

Keywords: - Maintenance Management, Electricity service sector, Facilities Management.

Introduction

From remote monitoring and handling more remote employees, maintenance management managers have new challenges during the coronavirus pandemic measuring the continuity of performance of maintenance activities . Facility managers responsible for operating the equipment's and other critical facilities face challenges throughout the coronavirus pandemic. Most operations and maintenance tasks have renovated more challenging. As an example, if necessary equipment works regular onboard status reporting but limited remote capability, the facility manager, could ordinarily depend on physical rounds, expressive that onsite personnel will hear or see alarms, unfamiliar smells, or sounds or readily experience the result of issues (such as a power bump). But with less than an entire onsite staff, there is a greater risk of problems being missed.
Past and current maintenance practises in both the private and Government sectors would infer that maintenance is linked with equipment repair after it is broken.

The dictionary defines maintenance as "the work of keeping something in proper condition, upkeep." That would imply that maintenance should be taken to prevent a device or component from failing or repair expected equipment degradation experienced with the device's operation to keep it in proper working order. Data attained in numerous studies over the previous decade shows that utmost private and Government facilities do not consume the necessary resources to maintain equipment in proper working order. They wait for equipment failure to happen and then take whatever actions are required to repair or replace the equipment. Nothing lasts forever, and all equipment has related with it some predefined life expectancy or operational life. (Alkaabi et al., 2020; Outline and Maintenance, 2018)

Reliability-centred maintenance (RCM) history Originated in the civil aircraft industry in the 1960s with Boeing 747 series. US Department of Defence defined RCM with the first complete description in 1978(Course and Tjernberg, 2014). They were introduced for the Nuclear power industry 1980s by EPRI and introduced for Hydro Power Plants in the 1990s, e.g. Norway and Sweden(Josefsson, 2005) . Today attempts to implement RCM to plan transmission- and distribution systems and wind power parks Maintenance.

Types of equipment are an essential resource, which is constantly used for adding value to products. So, maintenance teams must keep equipment in the best operating condition. Otherwise, there will be excessive downtime and interruption of production if used in a mass production line. On the other hand, poor working of pieces of equipment will lead to correlated quality problems. Hence, it is a complete necessity to maintain the equipment in

perfect operating conditions with cost-effectiveness (Alshamsi, et al., 2019). Accordingly, we need an integrated tactic to curtail the cost of maintenance.

In certain circumstances, the equipment will be obsolete over a while. Suppose a firm wants to be in the same business competitively. In that case, it has to decide whether to replace the equipment or retain the old equipment by taking the cost of maintenance and operation into account.

Types of Maintenance

The life design of most equipment needs time base maintenance. For example, belts need alignment and adjustment to be maintained, good lubrication on rotating equipment is mandatory, and so forth. In some cases, specific types of machinery need replacement, e.g., a wheel bearing on a motor vehicle, to ensure the main piece of equipment (in this case, a car) last for its design life. Different approaches have been developed to know how maintenance can be performed to ensure equipment reaches or exceeds its design life. In addition to waiting for equipment to fail (reactive maintenance), the other approaches are preventive maintenance, predictive maintenance, or reliability centered maintenance.

Breakdown Maintenance (Reactive)

Breakdown(Reactive) maintenance is essentially the 'run to fail' maintenance style. No actions or efforts are taken to maintain the equipment as the manufacturer initially intended to certify design life is reached. Studies as recent indicate that this is still the primary style of maintenance.

Table 1: Breakdown (Reactive) maintenance

Advantages	Disadvantages
• Low cost. • Minimal planning is required. • The process is straightforward, so it is easy to understand. • Rarer staff are required as less work is done day-to-day.	• Increased cost due to unplanned downtime of equipment. • Increased labour cost, especially if overtime is needed. • Cost involved with repair or replacement of equipment. • Possible secondary equipment or process damage from equipment failure. • Inefficient use of staff resources.

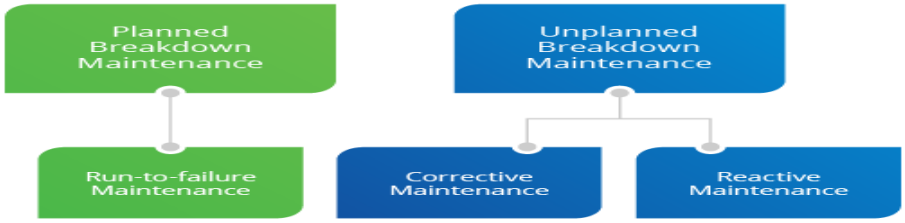

Figure1 Types of Breakdown maintenance source
(https://www.fiixsoftware.com/breakdown-maintenance/, 2021)

Preventive Maintenance

Preventive maintenance can be defined as follows: Actions performed on time- or machine-run-based schedule that detects, preclude, or mitigate degradation of a component or system to sustain or extend its useful life through controlling degradation to an acceptable level. preventive maintenance workflow figure 2

Table 2: Breakdown (Reactive) maintenance

Advantages	Disadvantages
• Cost-effective • Flexibility allows for the alteration of maintenance periodicity. • Increased equipment life cycle. • Energy savings. • Reduced equipment or process failure.	• Catastrophic failures were still likely to occur. • Labor concentrated. • Includes extreme maintenance performance. • Possible for subsidiary harm to components

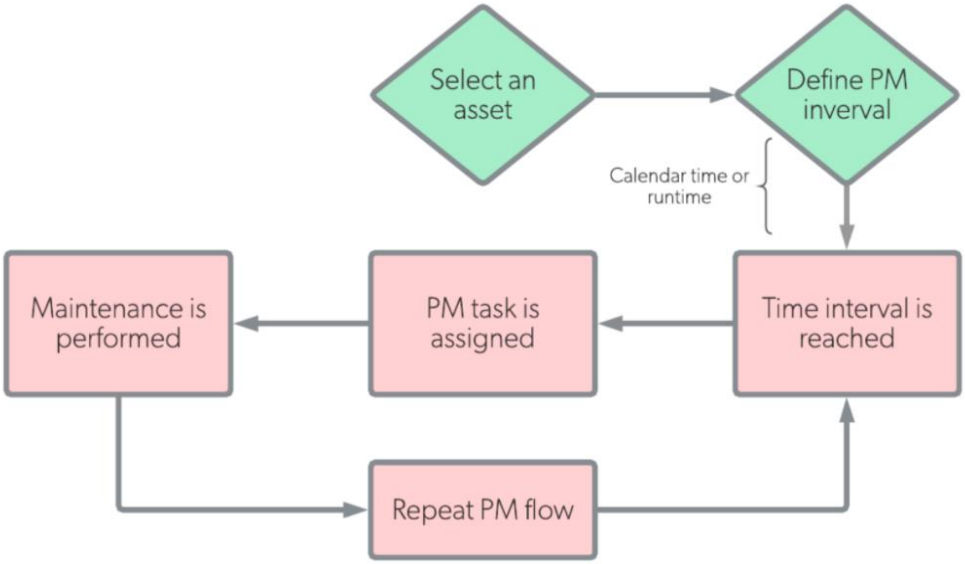

Figure 2 Preventive Maintenance Workflow source

(Https://www.onupkeep.com/preventive-maintenance/, 2021)

Predictive Maintenance

Predictive maintenance can be defined as follows: Measurements that detect the onset of system degradation (lower functional state), thereby allowing causal stressors to be eliminated or controlled before any significant deterioration in the component physical condition. Results indicate current and future operational capability. Predictive Maintenance Workflow Figure 3

Table 3: Predictive maintenance maintenance

Advantages	Disadvantages
• Increased component operational life/availability. • Allows for preemptive corrective actions. • Decrease in equipment or process downtime. • Decrease in costs for parts and labour. • Better product quality. • Improved worker and environmental safety. • Improved worker morale. • Energy savings.	• Increased investment in diagnostic equipment. • Increased investment in staff training. • Savings potential not readily seen by management.

• Estimated cost savings over preventive maintenance schedule period.	

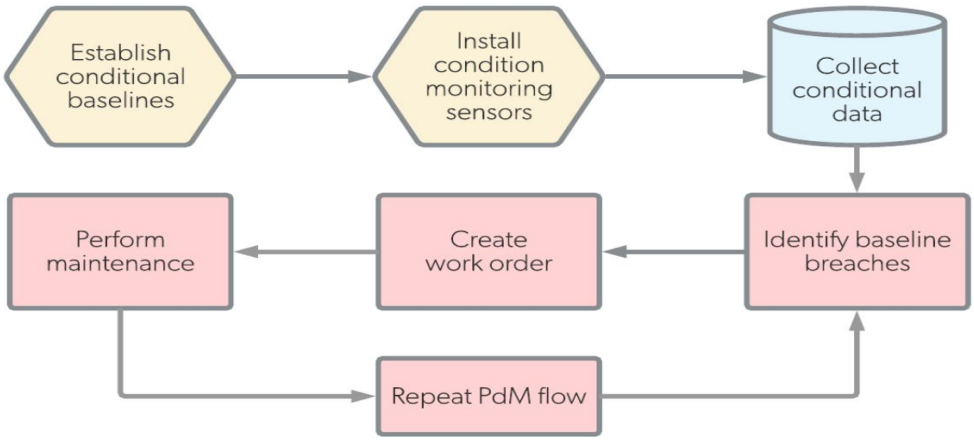

Figure 3: Predictive Maintenance Workflow source

(Https://research.aimultiple.com/predictive-maintenance/, 2021)

Reliability Centered Maintenance(RCM)

Reliability-centred maintenance (RCM) is the optimum mix of reactive, time or interval-based, condition-based, and proactive maintenance practices. Rather than being applied independently, these principal maintenance strategies are integrated to take advantage of their respective strengths to maximize facility and equipment reliability while minimizing life-cycle costs. (Outline and Maintenance, 2018) RCM is so heavily weighted in predictive maintenance technologies that its program advantages and disadvantages mirror those of predictive maintenance. In addition to these advantages, RCM will allow a facility to match resources to needs more closely while improving reliability and decreasing cost. (Outline and Maintenance, 2018)

Table 4: **Reliability-centered maintenance (RCM)**

Advantages	Disadvantages
• Maximum effectual maintenance style. • Minimum costs maintenance style • Minimize frequency of repairs. • Minimize the probability of failures. • Particular critical equipment maintenance • Maximum machinery reliability. •Easy for root cause analysis	•Maximum investment in the analytical device. • Maximum investment in training. •Savings not readily seen by management.

•Cost savings.	

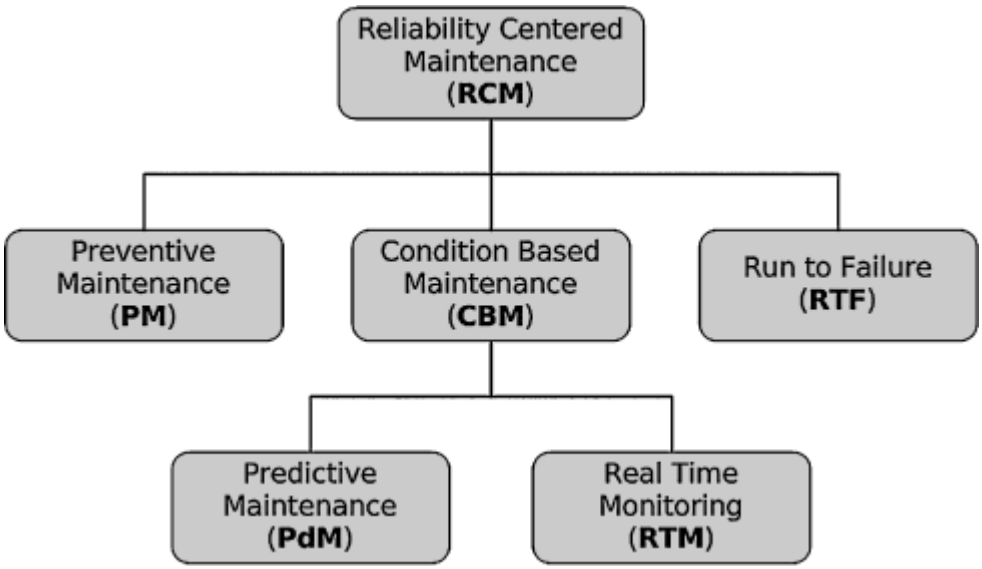

Figure 4 : (RCM) Workflow source (https://www.accessengineeringlibrary.com2021)

Maintenance Management in Power Systems

The reliability of the power plants and transmission lines in the electricity industry is crucial for meeting mandate. Consequently, timely maintenance plays a significant role in reducing breakdowns and avoiding expensive production shutdowns. The literature contains a sound body of work attentive on improving the generation unit and transmission line maintenance schedule.

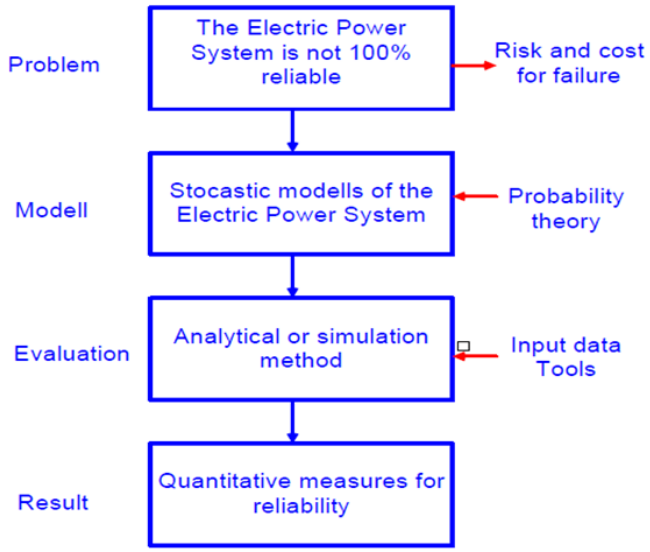

Figure 5 failure identifying in electric power system source: (Course and Tjernberg, 2014)

"The reliability of power plants and wind and solar farms is vital. In this context, equipment maintenance management is a major economic issue" (Gendreau et al., 2016). Equipment maintenance management in electric power systems is concerned with decisions such as when to stop a generation unit for maintenance, re-start it again. How many resources (e.g., technicians) are to be assigned to a given period's care. These decisions are taken under complex environments and constraints such as resource availability, demand satisfaction, and reliability thresholds.

One of the most successful contributions of operations research to improve decision making in equipment maintenance management is the application of optimization techniques to solve maintenance planning and scheduling problems. In electric power systems, these problems range from simple technician-equipment assignments to complex problems considering interactions between different stakeholders and uncertainty in the problem parameters.
(Gendreau et al., 2016) In this paper, the researcher demonstrates the alternatives of power continuity in government buildings that do have redundancy, such as diesel generators DG or alternative power supply UPS or to have two lines supplying the building.
Figure 6 showing a typical government building having two power supply line 1 and line 2. If line 1 fails the automatic transfer switch, ATS can transfer to line 2 to have a potential flow.

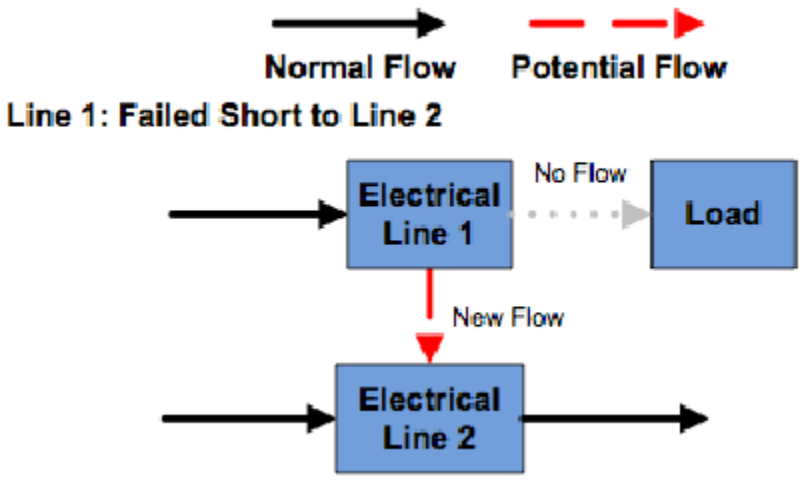

Figure 6: An example failure in an Electrical Power System source (Jensen, Tumer and Kurtoglu, 2009)

Discussion

This paper presents the type of maintenance strategies for Electrical Power System using best practices during the coronavirus pandemic. The main contribution of this paper was to study the best practices utilizing the methods to expand the scope of the failure scenarios of the government building systems. The benefit to ensure the development of alternative approaches. However, the concept which is in use primarily breakdown maintenance management (BM), and preventive maintenance (PM) management method, that to have Reliability-centered maintenance RCM that can exist and capture in most of the government building; the advantage of implementing of Reliability-centered maintenance RCM during the pandemic COVID-19 is to maximum effectual maintenance style.

Minimum costs maintenance style minimizes the frequency of repairs. Minimize the probability of failures. Particular critical equipment maintenance maximum machinery reliability. Easy root cause analysis and cost savings provide insight into using Reliability-centered maintenance RCM approaches. To simulate the impact of unanticipated Reliability-centered maintenance RCM flows, this method generates a system that can be used to build maintenance management. Additionally, the approach of Reliability-centered maintenance RCM a restricted to some of the disadvantages of maximum investment in analytical devices, top investment in training, and Savings not readily seen by management. Besides, a set of potential maintenance managements flows expands the system failure protection used by the existing approaches. For RCM development, the results indicate future contributions in two areas. First, this method applied to the central electrical systems can perform a function-based failure propagation behaviour and impact results. Because the BM Breakdown(Reactive) maintenance is essentially the 'run to fail' maintenance style, which is Increased cost due to unplanned downtime of equipment.

Also, Increased labour cost is due to more time for restoration of the breakdown equipment. Secondly, comparing these breakdowns to RCM fault detectability can provide early-stage notification before the equipment failure to a maximum of machinery reliability. A significant limitation of this current methodology is the lack of engineers/technicians due to the lockdown and limitation of staff to be on board. The remote monitoring and handling of more remote employees in electricity distribution services come under essential services providing continuity of performance as usual.

Recommendation

This paper summaries the process and type of maintenance to ensure the continuity of performance of maintenance management in government facilities focusing on the Electricity services sector during the Corona pandemic period in Oman (the course of action and the series of stages or steps to follow) and the framework (the essential supporting structure and the basic system) needed to continue manage maintenance activities with a very limited manpower safeguarding reliability of the power plants and transmission lines in the electricity industry.

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