ORGANIZATIONAL COST OPTIMIZATION THROUGH EFFECTIVE MAINTENANCE AND REPLACEMENT PRACTICES: REVIEWS

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Abstract

Organisations within a similar field of operations across the globe are faced with stiff competition creating dwindling return on investment. This study reviewed recent articles to discuss different ways in which strategic maintenance and replacement practices can stimulate cost optimisation. The importance of total productive maintenance (TPM) and total quality management (TQM) theories was considered as tools to address challenges across staff levels, and their effect on the organisation cost optimisation, other theories discussed were replacement theory and reliability theory that when properly applied can assist organisations to achieve cost optimisation.

Keywords: *Maintenance, Replacement, Cost Optimization, Total Productive Maintenance, Total Quality Management*.

Introduction

Globalisation and free trade have caused stiff competition in the global market space, thereby triggering sales reduction and the return on investment. Therefore, organisations have to make concerted efforts to remain competitive, and active players in the challenging situation (Haroun & Duffuaa, 2009). To achieve position of relevance and addition of values to investors and other stakeholders, cost optimisation is central to increasing return on investment (ROI) for stakeholders' satisfaction. There are several ways to achieve cost optimisation, and one of the ways is through proper assets management (Dadashnejad & Valmohammadi, 2019).

Asset management is a way of consolidating proper administration, monitoring and controlling of organisation business resources; both tangible and intangible assets (Zambon, 2017). The discovery is, when properly carried out, it brings efficiency in the system through maximum productivity, and reasonable cost savings (Sowerby, 2021). Corporate finance institute in Too, 2012 described asset management as the process of developing, operating, maintaining, and selling assets in a cost-effective way. These will favourably impact on the organisation's ROI. For managed assets, effective maintenance and replacement strategy will play significant roles.

A lot of new and improved technologies have been introduced into organisations in this area so as to achieve lower cost of producing superior products through information gathering and processing, skills, supply chains, and procedures in other to give them competitive advantage. Maintenance can influence products quality, cost of; investment, labour, and inventory which may negatively affect efficiency in the organisation and customers' service. Maintenance handling in organisations can determine the difference between making good profit and recording decline in sales leading to losses (Thomas & Thomas, 2018).

Statement of the Problem

Organisations globally are faced with escalated costs and profit shrinking due to challenges posed by the approach to assets maintenance and replacement. Several organisations are severely affected due to management's ineptitude to see timely asset maintenance and replacement as part of daily business operations. While the lower and middle managers are at variance with the management causing high operational expenses, and leading to the closure of many industries thereby increasing unemployment globally.

The study attempts to accomplish the following objectives;

1. To discuss the importance of good maintenance and replacement policies in an organisation, and the implication of management concerns to create an enabling environment for business operations
2. Discuss how the application of appropriate maintenance and replacement strategy can enhance cost optimisation in organisations.
3. The place of human capital development to achieve effective maintenance and replacement practice in organisations

A traditional or narrative literature review approach has been adopted in carrying out this research. It has enabled us to look at some studies done previously but recently on a similar subject of discussion by different scholars.

Theoretical Frameworks

There are theories that explain the place of good maintenance and replacement strategies as tools for better operating business environment. Some are discussed below;

Total Productive Management

Total productive management (TPM) is a maintenance strategy which began lately as a paradigm shift in the approach of personnel towards their job responsibilities as it relates to plant and equipment. It calls for commitment from the top-level management staffs and by extension allowing employees to take actions when necessary, regarding process within their purview. Total performance management is a combination of application performance management (APM) and operations performance management (OPM). Due to

increase in business environment agility and changes in customers' demands, organisation has to re-strategize to improve productivity which can only be achieved through efficient employee performance so as to meet up with the dynamic's nature of the business environment and customers' demands. (Toire, 2017).

TPM is a maintenance strategy with the focus on how to increase organisation production level and at the same time increase employee motivation thereby creating job satisfaction and can be referred to as the medical science of machines (Singh & Ahuja, 2015). It also brings organisation to see maintenance as part of its daily activities and integral part of manufacturing process with the intent to minimize emergency and unscheduled maintenance (Desai & Khare, 2017)

Reasons for TPM

TPM was developed and introduced in Japan between 1950 and 1970 by Seiichi Nakajima due to his experience in maintenance best practices (Soesatijono & Darsin, 2021), to help organisations to steer clear of wastage of products and services in the global dynamic economic environment, rendering of services and production of goods are of maintained quality, production of a small consignment quantity of goods and giving of services are done at the shortest credible time, to ensure that customers get value for their money by giving them non-defective products and quality services, and to bring down operational cost thereby increasing ROI (Nawanir 2016).

The eight (8) pillars of TPM (autonomous maintenance, focused improvement, planned maintenance, quality maintenance, early equipment management, education and training, administrative and office TPM, safety, and healthy operating environment) mainly concentrate on proactive and preventive maintenance strategies to improve equipment reliability and services consistency (Abed & Mutlag, 2020).

Total Quality Management

Total quality management (TQM) is a quality enhancement procedure concerned with customer satisfaction and is service-oriented. It was first developed in Japan but has spread in popularity globally. Despite its acceptability globally as a customer-based instrument that focuses on quality improvement and encourages improved processes, the practice of TQM is guided by a different set of theories (Bayighomog & Arasli, 2019), some of which are discussed below.

Deming's Theory

Deming's theory of Total Quality Management is predicated on fourteen facts of management identified by him and these are; creation of loyalty of purpose,

acceptance, and implementation of a new philosophy, resisting the habit of carrying out mass inspections, price should not be the determinant factor for a business award, focusing on uninterrupted production and service improvement, adopting innovative approaches for leadership, elimination of trepidation out of the company, departmental obstacles to be reviewed, elimination of quantity-based work goals, eliminating quotas and standards, support for the pride of expertise, make sure every team member is well trained and educated, and finally, get the top management to key into the thirteen points stated above (Worlu & Obi, 2019).

It is also based on four points profounds of knowledge, which are; **System Appreciation –** comprehend organisations' processes and systems. **Variation Knowledge** – have an understanding of the occurring disparities and the reasons for those disparities. **Knowledge Theory** - have the perception of what can be known. **Psychology Knowledge** - understanding human nature.

Deming is known for his ratio
Quality = (Result of work efforts)/ (Total costs)
Plan-Do-Check-Act (PDCA) is a laid-out sequence for ceaseless improvement. In the **planning** phase, outline both the objectives and actions. Then, **do** your actions and get the process improvements implemented. Follow up with **check** to ensure quality against the original, and in conclusion, **acting** involves accessing the areas that require changes for continuous improvement afterwards you can go back to the plan phase (Deming, 2018)

Joseph Juran's Theory
Joseph Juran is credited with what is known as the "Quality Trilogy." The quality trilogy is made up of quality planning, quality improvement, and quality control. If a quality improvement project is to be successful, then there have to be well-laid plan and control measures on all quality improvement actions. Juran considered ten steps to quality improvement. These steps are: create awareness of the opportunities and necessities for improvement, determine the improvement goals, organisation is required for goals attainment, provision for training needs, initialize projects, monitor progress, performance recognition, results must be reported, improvements achieved should be well tracked, then repeats steps (El-Daghar, 2018).

Replacement Theory and Reliability Theory
There is an increase in the organisations' effort to remain afloat in business due to reasons such as; competitiveness in the market, institutional relevance in global market space, customer satisfaction, and ability to increase profitability. Maintenance theory essentially referred to carrying out the right maintenance at the appropriate time to guide against system collapse or

downtime for an objective system (Nakagawa & Zhao, 2019), these authors went further to discuss a new research topic in maintenance theory known as Replacement Over time, a situation when replacement is carried out at the end of a working cycle instead of a scheduled time, and it was discovered that it is a tool for a new optimization procedure in reliability engineering. Comparing this method, that is replacement overtime both statistically and theoretically with the existing standard and random replacement procedures 'Maintenance Overtime Policies in Reliability Theory' revealed that the new policy when adopted, will cause organisations to experience significant enhancements on its application to their inspection policies, cumulative damage models and parallel systems.

There are some assumptions in replacement theory (Shiksha, 2021), which are; Assumption that an asset will continue to maintain its operational efficiency. There exists a constant technological level. The productivity level of an asset remains the same over time. The cost of maintaining or repairing and that of replacement is constant. The main objective is to bring the cost of replacement to a minimal level.

Maintenance Practices

Llamazares, (2017) defines maintenance as "the work of keeping something in proper condition, care or upkeep: taking steps to avoid something breaking down (preventive maintenance) and bringing something back to working order (corrective maintenance)", while, Sivaranjith (2019) defines it, "as efforts taken to keep the condition and performance of a machine always like the condition and performance of the machine when it is still new."

From these two definitions above, Maintenance can be described as a process(s) of ensuring that the performance level of any resources in organisations both human and equipment are kept in good condition through consistent observation and checks for anything that can impede optimum resource performance, getting it timely fixed by repairs or replacement of part or the entire resource for the smooth running to achieve set goals.

Deloitte (2015), states that inefficient fund distribution in today's maintenance management systems is limiting the costs conversion into output, and the faster rate at which equipment are becoming outdated nowadays calls for a policy change on maintenance expenses. It's been discovered also, that maintenance cost in manufacturing and transportation industries take between 2 – 10 percent and about 24 percent respectively on the organisation's yearly income. This has made management team in organisations to discovered that, for them to attain quality products and productive procedures, maintenance is a fundamental function to keep their assets at a reliable level in this "era of automation", flexible manufacturing systems (FMS)", "lean manufacturing",

and just-in-time" operations (Haroun &Duffuaa, 2009). Organisations need to define a means of optimising their maintenance cost for good returns annually.

Types of Maintenance

Different authors have looked at the types of maintenance in diver's ways. According to Khazraei & Deuse (2011), maintenance could be classified in relation to strategies in line with features of traditional maintenance and which are reactive and preventive and other strategies that has connection with thoughts in maintenance. They concluded that different approaches, expertise and procedures can be followed in applying any of these strategies.

Usually, most equipment comes with the owner's manual that specifies how often service should be carried out for optimum performance and to reduce failure. The owner should follow the manufacturer's instructions for better equipment performance, known as; compulsory continuous maintenance necessity. But, in preventive maintenance this may not hold, the reason being that buyer may choose to act otherwise. The major challenge will be on the best approach to take relating to the time and cost of carrying out such actions.

Preventive Maintenance

This involves continuous and periodic monitoring of a system looking out for signals that can impede its smooth running and getting it corrected immediately before the failure of such system or an item in a system. It can either be automated or physically observed, which enables promptness of the maintenance team in correcting the malfunction subsystem before the entire system's total breakdown. It helps to eliminate or reduce costs associated with the system's total collapse and keeps equipment ready to use every time (Maiti, 2020). It is mostly applicable in organisations that failure can be catastrophic, for example, in the airline industry where at a given flying number of hours, checks must be carried out and regular maintenance is done to guide against failure. This is also applicable to less disastrous systems like the painting of buildings and lubrication of machines periodically (Johnston, Chambers & Slack, 2004)

Corrective or Run to Breakdown Maintenance

This is a maintenance strategy with the intention to only repair or replace when the equipment or an item has rundown completely. The procedure in such organisation is to allow a complete failure of an item before any action can be taking (Maiti, 2020). This effect might not be disastrous on the system but, may result in an embarrassing circumstance, for example, a telephone or television in a hotel room. In the long run, can affect the production/service of such organisation, and negatively impact their running cost (Oladimeji, Singh, & Afolabi, 2021). Another critical example is the Nigeria roads maintenance

that are left unattended to until they become impassable or after lost to lives and properties.

Condition-Based Maintenance

A maintenance strategy that observes and check in real-time the equipment state and performance level to ascertain the type of maintenance required on such asset or resource at a given time. The strategy is based on immediately observing asset conditions promptly; like an increase in vibration, changes in the sound, decrease or increase in the output, and through data collection by the attachment of an electronic monitor on the asset. It allows for an immediate response, reducing the downtime and preventing the asset from the total rundown. (Shin & Jun, 2015).

The main target of Condition-Based Maintenance (CBM) is to make sure that an asset is well observed and checked continuously so as to notice any failure before the occurrence, which is a proactive way of attending to an imminent asset failure, thereby allowing for optimum performance and output. (Cousineau, 2020)

The use of CBM also has more acceptability in big corporations than smaller ones, that prefer to carry out preventive or predetermined practices than apply CBM; (Ahuja & Khamba, 2008). The main reason is due to the failure of most organisations to take advantage of the technicalities of the tools involved or by not selecting the right tools, and wrong application of technology as well. (Walker, 2005)

Reliability Centred Maintenance

Reliability centred maintenance (RCM) focuses on the required maintenance of items based on performance level and functions in their operational setting and continuously gathering of experience and frequent evaluation of the process. RCM thoughts and methods are applicable in any system. (Lima & Castilho, 2006). It harmonises corrective maintenance high cost with preventive or predictive maintenance cost and optimises preventive maintenance tactics taking into consideration the useful life of the considered equipment (Azizi, & Fathi, 2014RCM has also integrated the most consistent and effective cost-saving mix ideas of (Preventive, Predictive, Real-Time Monitoring, Run-to-Failure, and proactive) maintenance methods for the improvement of efficient equipment performance with minimal maintenance cost incurred throughout its design useful life (Mobley, 2002).

Aerospace industry of recent has brought about the reliability centred maintenance (RCM) with innovative procedures connected with reliability, availability, and it's now being modified for industrial systems use. (Trojan & Marcal, 2017).

Reasons for Maintenance

In this contemporary age, Organisations now treat the issue of maintenance and replacement as a matter relating to its economy and profitability as against taking them as technical issues. This has made them realise the need to focus on maintenance and replacement costs elements because they can easily be cut in the short run (Lokothwayo, 2017).

The maintenance process should be seen as a business process, and the main reason for it is to reduce production cost thereby increasing profitability and not reliability. Although, for improved utilization of the resources that are currently available, there is a need for industries to employ reliability activities to guarantee a better profit (Ahuja & Khamba, 2008).

Shamayleh, Awad, & Abdulla, (2019) defines 'Service Industries' as those organizations which specialized in the provision of goods that are intangible and characterised by immediate consumption at the point of purchased because they cannot be warehoused, this explains maintenance as a 'Business Process'. By implication, we can classify maintenance as 'Service Business' that involves taking steps on stakeholders' behalf with nonphysical results, only be on record. Every business required effective cost management and control systems which is a complex one, especially in the service industries due to the intangibility of its outcome. There is connectivity between profitability and maintenance service in organisations, therefore, it is imperative for organisations to view cost on asset maintenance as economic value because this will assist in higher dependability, better duties disposition to stakeholders, and a higher and better quality of their products and services (Shamayleh, Awad, & Abdulla, 2019). Furthermore, Konjaang, & Xu (2021) impressed the inseparability of the cost element of maintenance and the profitability of any organisation and call for a good understanding of the modern maintenance process by operators because, any arbitrary effort to cut or remove things that the management might term waste (spare parts, people, and others) will affect negatively the maintenance process thereby posing a great danger to the overall organisational goals despite the presence of reliability tools and its practices. There are other reasons why maintenance is carried out in organisations. The focus will be on some of the basic ones.

Maintenance is being done to elongate the productive life of an asset. (If an asset undergoes regular checks and required action is promptly taken, it keeps running at an optimal level and reduces sudden breakdown). Also, to maintain the installed capacity of an asset, reduce running cost, comply with government policies, safety reasons, and for a good relationship between the organisation, and other stakeholders (Fiorino & Bhan, 2016).

Furthermore, failure to meet the expected level of product quality will lead to unnecessary costs being incurred by the organisation and this can have a devastating impact both internally and externally. The associated costs are, but not exhaustive; Scraping of low-quality products, reworking for products that can be reworked or recycled, getting issues rectified to meet the standard, processing customers' complaints, and handling returned products. There can also be loss of motivation internally, and loss of goodwill externally (Galloway, Rowbotham, & Azhashemi, 2012).

Replacement Practices and Cost

For business continuity, there's need to design a replacement policy to assist in determining replacement age and time for asset i.e., when it's economical to do away with old resources. A replacement procedure is an administrative instruction that is put in place to guide the organization on the age and nature of replacement to be carried out in order to optimize its objective (Popova & Popova, 2014). These include; Setting standards determining the most economic period for replacement. Determining appropriate time for resource replacement. Aligning replacement with set objectives, randomly setting likely time a failure might occur. Determine whether the replacement should be done individually or as a group.

According to Twin, 2021; Replacement cost is the money required by organization to replace an asset due to any of the conditions stated above. Management must see this cost as an investment. Also, operators and maintenance officers are synergised to achieve optimal cost level.

Reasons for Replacement

Replacement is the act of introducing new asset to substitute the existing deteriorating or failed one, and this can be due to a decrease in performance rate or production level; meaning that there is inefficiency problem, because system is performing below its installed capacity, an increase in failure rate, introduction of more efficient alternative in the market, skyrocketed cost of maintenance, and/or total collapse of the asset (Christodoulou, Lev, & Ma, 2018). Human asset can be replaced because of old age, regular sickness/breakdown. Change in operational system that cannot be met, and/or as a result of death or permanent disability. Organizations set replacement period, based on usage.

Discussions

To achieve an optimum reliability level whenever there is component wear-out of a system, the issue of preventive maintenance is ruled out. What obtains in a situation of such system maintenance when optimization of total cost is considered, and discovered that repair cost of a component is less than replacement cost when failure occurs, preventive maintenance of that

component looks sensible; but considering achieving an optimum reliability level in optimization, this has been a complex issue (Gupta & Gupta , 2013).

The process of resolving the optimal cost level, stimulated loss level, to achieve profit maximization is the main focus of optimization, and to achieve this, positive decisions must be taken (Li, Mai, Zhang, & Tian, 2019, & Lokothwayo, 2017) through the reduction of less important preventive maintenance, rather focus on worthwhile maintenance. Items scheduled for replacement should be replaced than repairs, and Condition-based replacement to be well guided. Organisation should take training and retraining of employees on system operations and when acquiring new equipment seriously. Standard fault tracking and data collection system to be developed. Build in every employee sense of belonging. Synergy between teams will allow for proper understanding that will positively impact on the operational costs as it. Adoption of appropriate maintenance and replacement strategy suitable for their operations. Customer's relation and robust feedback system is key.

Conclusion and Recommendations

Looking at different maintenance and replacement strategies and the theories discussed in this study, management has a critical role to play in adopting the best strategies and application of these theories as tools to optimise their operational cost based on the type of equipment and business requirement.

Organisations must undertake regular research on latest and better available plant/equipment to enhance quality of products and services, and timely deliveries to customers. Development of prompt maintenance and replacement culture. Good understanding of equipment by the operators with regular checks and quick response to faults.

Human resources are key asset needed to achieve cost optimization, employees are to carry out necessary maintenance and replacement strategies to meet organisational set goals of cost optimisation (Parida & Kumar, 2009). Management should develop adequate and regular trainings to acquit employees with its goal and create enabling operating environment. Healthy feedback system, for prompt detection of challenging areas, and quick intervention when required (Watson, Boudreau, & Chen, 2010).

Accountability should be considered as the hallmark to achieving cost optimization. A superior officer must develop a robust system of communication between himself and his subordinates, to enhance efficient team building and effective interpersonal relationship. Motivation can come in different ways, these includes but not limited to; removal of barriers between management and other staffs, and freedom to act independently (Strese,

Meuer, Flatten, & Brettel, 2016). Availability of freedom of expression by staff without fear of intimidation creates efficiency leading to higher productivity. A decent reward system for displaying excellent skills and ingenuity will build the spirit of excellence in employees. It is important for all employees to observe annual leave (time for rejuvenation) to avoid mistakes due to fatigue, and equipment should have rest time where necessary.

Limitations and Suggestion for Further Research

This paper limits itself to literature reviews. We hope to look at effective maintenance and replacement strategy as a tool for business continuity in industries.

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