

## THE ROLE OF MAINTENANCE IN MANUFACTURING SECTOR: AN EXCERPT FROM REVIEW OF LITURATURE

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### ABSTRACT

*The purpose of this study is to reveal the role of maintenance which is integrated to various levels of the manufacturing sector. Maintenance is a very popular concept in the manufacturing world as well as in some countries in the developing world. The study explores the degree of maintenance implementation in manufacturing plants and its impact on manufacturing organization. This study was designed based on the maintenance approach from various authors, to provide detailed explanation to readers on the role of maintenance practices in reducing manufacturing costs and in providing more economical, quality services compared to the in-house workforce.*

**Keywords:** *Maintenance, Manufacturing organization, Preventive maintenance*

### INTRODUCTION

Maintenance can have positive impacts on business performance, including increasing productivity and profitability. On the other hand, the lack of maintenance can result in an unplanned stoppage that causes unrecoverable damages where companies have to pay additional costs, such as paying overtime charges for the employees. Therefore, the importance of maintenance function has increased due to its role in keeping and improving availability, performance efficiency, products' quality, on-time deliveries, environment and safety requirements, and total plant cost effectiveness at high levels. In this regard, International Electro technical Commission, (2006) defined maintenance as the practices of retaining and restoring equipment to its original state so that machines and equipment's can function for a longer period of time. Al-Sultan and Duffuaa, (1995) stated that, maintenance is a key function for an organization that can provide long-term profitability give critical support for heavy and capital-intensive industry by sustaining machinery and equipment in a safe operating condition. Parida and Kumar (2006) found that success and survivability of an organisation depends on the efficiency and effectiveness of the maintenance system. It is also stated that an organisation's main tasks in maintenance are to repair, replace, make adjustments, lubricate, modify and inspect. These roles are derived from the stakeholders' expectations, vision, goal and objectives.

As a result, the question of how maintenance could improve the company productivity and profitability need to be investigated further. It is stated that effective maintenance policies, can maintain failures at a minimum level and this could result in great savings. According to Ireland and Dale (2001) all maintenance strategies adopted in an organization share the same objectives namely, zero defects, zero accidents, employee safety assurance, zero breakdowns contribution to productivity, quality costs, delivery, process safety and morale for all

investors. However, Campbell and Jarden (2001) stated that maintenance is the process of reducing the total operating cost and at the same time, creating good manufacturing atmospheres in the production plants.

Meanwhile, Mobley (2002) found that in an organization, the maintenance process only represent 15 per cent of the total production cost, depending on the specific industry while Fredendall et al.,(1997) highlighted that the optimal level of maintenance strategy application can lead to a lower cost in the long run. Kumar, Jennifer and Granholm (1998) mentioned that effective maintenance strategy reduces system failures in production plant and increase the availability of units. Therefore, maintenance is gaining more and more significant role in corporate long-term profitability. Consequently, it affects production and its operational aspects including capacity, quality, costs, environment and safety.

In the meantime, a previous study by Cheng and Taumala (2015) found that employee involvement in maintenance strategy can prevent any divergences from occurring. Fogarty and Shaw (2010) studied the violation behaviours among aircraft maintenance workers and found that attitudes and group norms directly affect the factors behind incidents and accidents. Hence, this paper illustrates how an effective maintenance policy could influence productivity and profitability of the manufacturing process.

### **IMPORTANCE OF MAINTENANCE PRACTICES IN ORGANIZATION**

Even though maintenance is considered as a support function in production that has indirect effects on other functions, it is difficult to trace its impacts. In this light, the perceived maintenance performance depends on the perspective adopted by the organisation. Many organisations believe that the implementation of preventive maintenance will reduce an organisations' large maintenance budget and ensure the safety of the equipment and employees (Oke, 2004). In the meantime, Burke and Smith (1999); Sriskandarajah et al., (1998); and Percy et al., (1997) asserted that maintenance activities which focus on three priorities, namely cost, quality and cycle time can help world-class companies to get ahead in the competitive market. Furthermore, preventive maintenance practices are very useful in dealing with mechanical problems and unexpected stoppages which will affect production performance, particularly the equipment, availability and support responsiveness.

A maintenance strategy involves identifying researching and executing repairs, replacements as well as inspecting the stakeholders' decisions. Bradley (2002) conducted a study to identify the best maintenance practice that could reduce an organisation's cost and concluded that in the manufacturing environment, maintenance cost could consume 2–10% of the company's revenue, and this could reach up to 24% in the transport industry. In the meantime, maintenance practices in an organisation are subjected to frequent changes due to global competition which lead to undertaking complex technologies, competition, and product characteristics evolved (Bonde, and Fulzele, 2013).

Meanwhile, according to Duffuaa et al., (1999) every organisation has the following objectives; first - they need to keep their assets and equipment in good conditions, well configured and safe to use, second - profit maximization, and third - maintaining specific quality level of service or products. In this regard, all maintenance activities including preventive, predictive; corrective, overhauls, design modification and emergency maintenance should be performed in an efficient and effective manner to minimise costs, ensuring safe and clean environment, and increasing human resource development. In this

light, it is clear that all of these objectives are heavily impacted by maintenance. Consequently, these objectives will create frequent challenges and responsibilities in establishing continuous improvement in an organisation in order to fulfil the organisation's maintenance policy (Bonde, and Fulzele, 2013).

However, Francastel (2009) stated that maintaining the equipment and applying some maintenance techniques in a manufacturing plant would help the organization to face the current challenges, instead, in order to achieve a central coordination and a cooperation control, the organization must execute and establish task maintenance policy. These statements were agreed to by Schermerhorn and Delaney, (2013) and Daft and Lewin, (1993). Concurrently, it was stated that the creation of a task maintenance policy can assist a person to control, choose, negotiate, and estimate organisational operation. In addition, Niebel (1994) stated that the applicability of maintenance practice in an organization is specifically focused on area that needs specific considerations to overcome the challenges.

### **MAINTENANCE IN A MANAGEMENT SYSTEM VIEW**

Consequently, many organisations have evolved to improve the management method of stakeholders' requirements response time. In this light, there are two examples of system view; quality management and maintenance management. However, based on the description of various studies it can be found that there are differences between quality management and maintenance management methods (Garvin, 1988; Dale, 1999; Kroslid,1999). Söderholm, Holmgren and Klefsjö (2007) stated that maintenance activity is basically a process of checking, examining or finding errors or damages, is conducted across disciplinary areas, such as logistics, engineering and asset management. They stated that various studies have used Total Productive Maintenance (TPM), Reliability Centred Maintenance (RCM) and Condition Based Maintenance (CBM). These different approaches have also been proposed by many scholars (Shiba al,1993; Dean and Bowen, 1994; Hellsten and Klefsj, 2000) as ways to improve the quality of management through systematic methods.

Meanwhile, IEC (1995) stated that a management system is considered as a combination of entities at any level of complexity, these entities include, people, processes, equipment, facilities, materials, tools and software. Moreover, the elements of this composite entity can be used for business purposes or to support in performing specific tasks or to achieve a specific goal in organisation. According to Hellsten and Klefsjo (2000), quality management can be categorised as a management system that purposely aims to improve external and internal customer satisfaction using available resources. They also mentioned that these management systems consist of three interdependent elements, which are; values, methodologies, and tools. Similar maintenance management system has been applied to management by Akersten (2002) and reliability by Akersten and Klefsj (2003).

### **SELECTED TYPE OF MAINTENANCE APPROACH**

#### **Preventive Maintenance**

Moghaddam and Usher (2010) described preventive maintenance as a general replacement activities and this process include inspection of the machine or equipment, cleaning the surface of working area in order to avoid slipping, inspect the level of the lubrication in the machine, adjustment of the equipment, proper alignment of the machine or cutting point and

finally replacement of systems that wear-out. Similar, Duffuaa and Raouf (2015) pointed that preventive maintenance includes the replacement activities such as checking and correcting the air pressure, changing the aging characteristics of the machine and replacing ailing equipment with new equipment to decrease the occurrence of failure. Thus, based on the above statement, it is clearly indicated that preventive maintenance is a replacement strategy that is widely used in organisations to maximize system operation and system reliability as well as minimise or lower cost of failure to some sort of budget limitations (Yaping and Pham, 2011). In addition, Seow and Jiying, (2006) asserted that applying a preventive maintenance and productive maintenance is a way to revolutionize the SME sector; they also stated that many organisations fail to recognise maintenance job as a right measure to ensure organisational sustainability.

Consequently, according to Chen & Liao, (2005) and Cheung et al., (2005) the burden of high maintenance costs in organization is an obvious, unbearable issue that illustrates the need for preventive maintenance. Moreover, it was stated that defence equipment and personnel have expanded the use of preventive maintenance activity as an efficient service. This has tremendous impact on the workers who work in hazardous environment and to ensure the production process runs without the breakdown problem that enables maximum plant availability with minimum delays and failure, as well as providing best gear to reduce or eliminate subcontracted works (Cheung et al., 2005). Furthermore, manufacturing plans are often based on preventive maintenance event with regular maintenance process, hence, for many organisations, this result in the reduction of the huge protection fund (Oke, 2004) where the scheduling of preventive maintenance for the operational equipment presented a stable industrial action. However, at times, the process can be highly complex. In this regard, speedy preventive scheduling would be more cost-effective than exchanging equipment. In the long term, this is a cheap protection measures that can be implemented. (Cheng and Taumala, 2015; Moghaddam and Usher, 2010).

### **Total Productive Maintenance (TPM)**

Ljungberg (1998) defined TPM as overall equipment effectiveness (OEE); overall equipment effectiveness (OEE) helps an organisation to increase profits and reduce costs using a method of calculation (OEE) (Kwon Lee, 2004). Moreover, Nakajima, (1988) highlighted that TPM generally focuses on eliminating the in use equipment in process line that lead to losses; these losses can be classified into three main categories i.e. downtime of productivity, speed losses and product defects.

According to Mad Lazim, Ramayah and Ahmad (2008) , all available resources at levels in an organization could achieve its desired goals of zero breakdowns through the implementation of TPM. Inherently, Nakajima (1988) stated that TPM helps achieve zero breakdowns in an organization, increasing availability and reliability, as well as integrates preventive maintenance, based on the state of maintenance and preventive maintenance activities. In fact, in TPM, the periodic maintenance is basically known as an opposite of preventive maintenance, which has an ability to detect any deterioration or possible defect of equipment in the production site in order to reduce or prevent the permanent failure of machine more effectively, using new integrated technology and inspection of condition-based technology, including vibration analysis, fluorescence Spectroscopy, Infrared thermography, Tribology and oil analysis and other (Parida and Kumar 2006). In this regard, TPM helps an organisation to adequately identify current problem that occur in manufacturing organisation which in return, will ensure smooth daily operation with zero

accidents and breakdowns as well efficient administration, training and education (Lixin, Shicheng, Yunqi and Guiwen, 2011; Ochieng et al., 2004). On the other hand, Ochieng stated that strong support and commitment in terms of technology aspect from top management are crucial factor that need to be concern by every management in order to ensure successful implementation of TPM. In addition, Hansson, Backlund and Lycke (2003) presented the importance of top management leadership 's focus on strategic planning and training, monitoring and evaluation, strengthening, information and communications to increase the successful implementation of not only TQM, but also TPM and RCM (reliability centred maintenance). More importantly, Tsang and Chan (2000); Lee Cooke (2000) revealed that the management also need to conduct routine activity in order to identify and increase the employee participation, education and training, strategic planning and communication through TPM in an organisation.

### **Condition Based Maintenance (CBM)**

Moubray (1997) and Nowlan & Heap (1978) stated that condition based maintenance is basically linked to condition tasks and particularly, involves condition monitoring. Such activities are introduced as the solutions for some potential failures. Moreover, they asserted that CBM is a preventive form of maintenance used to effectively plan maintenance activities. In this regard, Mobley (2002) mentioned that the condition based maintenance is performed to serve the following purposes; to determine the existence and seriousness of the problem in the watched item, and how long the item can be run before failure, as well as to identify specific pieces in the items that happen to be degrading and diagnose the condition. This can be done through a system that uses condition based maintenance to determine and schedule predictive maintenance actions autonomously or perhaps through the interaction with additional systems or humans (Bengtsson, 2004). In this light, Thurston (2001) and Lebold et al., (2003) stated that the condition based maintenance system contains seven modules/activities, data acquisition (sensors), signal processing, condition monitoring, health assessment (diagnosis), prognostics, decision support, and presentation, while according to Yam Ainsl et al., (2001), diagnoses in condition based maintenance can be divided into three classes: (1) rule-based diagnostics, (2) case-based diagnostics, and (3) model-based diagnostics.

## **CONCLUSION**

Maintenance is the golden standard for success in any manufacturing organization. This study attempts to find the implementation of maintenance in manufacturing organization and how these practices embraced in other manufacturing plants to an advanced level to achieve superior operational performance. The findings of this study indicate that the implementation of maintenance improved manufacturing operations, similar to the findings of other scholars (White et al., 1999; Detty and Yingling, 2000; Cua et al., 2001; Shah and Ward, 2003). In all, this study found that maintenance activity was a key strategy to maintain the livelihood of the plant's assets which can reduce manufacturing time and costs without decreasing the operational efficiency of the processing facility. This was supported by Smith and Hawkins (2004) who mentioned that the applicability of maintenance practices in an organisation reduces machine failure and cuts the cost of operational breakdown in an organization. Moreover, it was stated that these activities decrease the labour costs, reduced parts purchase, increase the efficiency and overall uptime of system productivity. All of these are found to be the main key drivers for the maintenance implementation in manufacturing firm.

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