Plant Key Success Factor through Spare Parts Inventory Management

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***Abstract*: The relationships between a plant operational reliability and its key success factors are discussed in this paper. Several critical factors including effective spare parts management, maintenance approach and continuous improvement is explore along with plant operation reliability. Subsequently, the plant spare parts plays a vital role in many of the global industries and the inventory management of spare parts can be a strategic importance in it as costs and capital are tied together with it in many areas. The key success factors could be applied accordingly for the optimization of the plant that will benefit the stakeholders involved.**

Keywords*: spare parts management, inventory management, maintenance, plant operation, key success factor.*

1.0 INTRODUCTION

Maintenance in plant operation becomes the prime challenges in plant operation environment. Plant maintenance has become increasingly more important as the plants, machine and technology involved in the modern era has evolved into something much more complex and intricate to handle and maintain. According to [1], maintenance is the activity that preserves the equipment in appropriate condition such as repairing it after it is broken. It defined as action of sustaining the equipment or restoring it to a given condition [2]. The maintenance covers a collection of activities such as inspections, overhauls, repairs, preservation of parts, and replacement of equipment in order to restore its function and avoid consequence failure. The actions taken will prevent the plant operation facing the consequences of plant failure. It involves a collection of skills, tools, and material to retain the equipment at good working condition. According to [3], the maintenance cost represents 15% to 60% of the total operating cost. In other words, [3] stressed that for every 33 cents out of every dollar spend, it will became the cost of ineffective maintenance. Hence, there is a need to improve the maintenance effectiveness as it can significantly increase profits and competitive age [4]. Since spare parts are an integral part of plant maintenance, the effective inventory management of spare parts is critical in ensuring the safe and reliable operations of the plant and the company.

Many industries such as aerospace and defense, transportation, telecommunications and information technology, utilities and durable goods suppliers depends on the effective spare parts management. The spare parts requirement arises when the equipment breakdown and need to be replaced. The failure rate is uncertain and has a relationship with the quality of the maintenance. Eventually this occasion causes unpredictable demands for spare parts. The

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intermittent or uncertain demand [5], the large numbers of spare parts [6] and the risk of spare parts obsolescence [5] may cause the spare parts not meeting the supply chain points. At the same time, being out of stock when a spare part is required leads to downtime of capital goods, which is very expensive due to loss of operational continuity.

The demand uncertainty is further highlights as the supply chain is getting global with various parties involved. As more parties are involved, more reducing demand uncertainty while optimizing spare part inventory levels. Obviously, most of the time the spare parts inventory to prevent lengthy breakdown time are tied up with high capital cost. The productivity of a firm is directly linked to the reliability and operational ability of the plants and machines, thus plant operation reliability is a key problem here. It has been highlighted that spare parts utilization consume about $700 billion annual expenditure that created about 8% of the US gross domestic. Given the very high level of inventory investments, the issues of spare parts breakdown is a critical one for all stakeholders involved. The failure of plants, machines and alike due to spare parts breakdown or lack of spare parts for maintenance in this particular area will create a disastrous event to the whole industry.

2.0 LITERATURE REVIEW

Reliability can be defined as the ability of the entire system to perform its intended function according to specific period and within the operating environment. The process of reliability study is an Operations Management discipline, as it become the fundamental of efficiency evaluation of many process systems. For instance, [7] created Overall Equipment Effectiveness (OEE) to estimate a crucial parameter in reliability maintenance. Four components that are

information is transmit along the web of supply chain communication. Independent operating parties in the supply chain potentially creates a barrier that can disrupt the information flow during the information transmission. The lack of information transparency can hinder a supply chain management. As demand uncertainty is highly critical in the supply chain, a reliable supply chain management is also of critical value in

related to reliability issues which are technical, operational, management and commercial.

Table 1: Issues in Reliability

Technical issues	• Understanding deterioration and failure • The effect of design on product reliability • The effect of manufacturing on product reliability • Testing to obtain data for estimating part and component reliability • The estimation and prediction of reliability
Operational issues	• Operational strategies for low-reliability/unreliable systems • Effective maintenance
Commercial issues	• Cost and pricing issues • Marketing implications
Management issues	• The impact of reliability decisions on business • The risk to individuals and society resulting from product unreliability • The effective management of risks from a business point of view

2.1 PLANT KEY SUCCESS FACTOR

It is important for the organizations to respond to the global competitive advantage by looking forward increase their productivity, maximizing the overall equipment effectiveness and pursing an effective and efficient maintenance

program. [8] formulated nine key success factors in order to pursue an effective maintenance management.

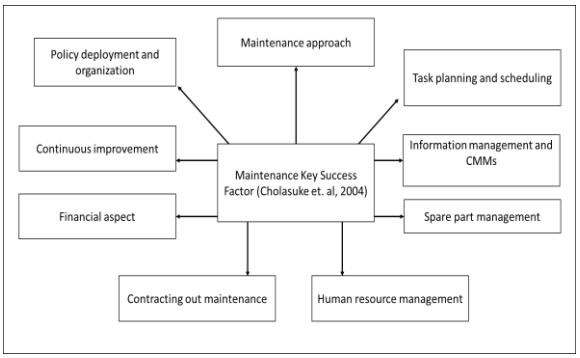

Figure 1: Key Success Factor in Measuring Maintenance Effectiveness

2.2 MAINTENANCE APPROACH

Maintenance effectiveness has a significant impact in terms of increasing profits and competitive age [4]. There are many approaches that has been established to improve the quality of maintenance in the organization. One of the approach is to establish Preventive Maintenance (PrevM) in plant operation. Besides, [9] stated that PrevM is conducted to prevent failure and sometime it was planned earlier within the operation timeline. [9] also stressed that the delays of maintenance reduces the operational availability of the equipment. [10], stated that PrevM involved routine inspection, servicing and keeping the maintaining the facilities in proper condition in order to prevent the failure. On the other hand, Predictive Maintenance (PredM) approach is used to identify the degradation mechanism and provide correction for the equipment [1]. [11] suggested PredM as a tool to define cause symptom in order to predict the problem and tackle the corrective action. Another type of the maintenance approach that similar with predictive maintenance is Condition Based Maintenance (CBM). Anyway, [11] claimed CBM is better than PredM as it use online as well as offline data.

2.3 MAINTENANCE TASK PLANNING AND SCHEDULING

Maintenance planning and scheduling has a strong impact in successful maintenance implementation. Improper planning can create disastrous consequences to the organizations [12]. By having appropriate planning the management can benefit the level of productivity satisfaction and reduce cost [13][12].

2.4 INFORMATION MANAGEMENT AND CMMs

With the advancement of today's technology, IT has been deeply embedded in information management. Information management and computerized maintenance management (CMM) is about the management of all maintenance related data, which includes collecting, analyzing and transforming data into relevant information for the use of the maintenance [8][14]. Computerized maintenance management systems (CMMs) can bring about an effective and efficient management of maintenance information [15]. Maintenance of the key performance measurements is also a necessary component of information management system that provides the link between the current statuses of maintenance function in relation with the maintenance objective. This will provide the means to improve maintenance.

2.5 SPARE PART MANAGEMENT

Spare parts Inventory Management plays an important role in order to achieve the desired state of plant availability. Since most of the industries nowadays are going towards for sophisticated technology and capital intensive industry such as aerospace, the breakdown of the machineries and equipment ridiculously expensive. The three elements that contribute towards an effective spare parts management are maintenance inventories, spare maintenance policies and parts demand forecasting. According to [16], there are some literature discussed about the relationship between spare parts and inventory models in terms maintenance inventories, maintenance policies and spare parts demand forecasting [17] [18][19][20]. Besides that [21], discuss about demand forecasting and classification that contributes towards the effectiveness of stock control.

Spare Parts and Maintenance Initiatives	Literatures
Maintenance Inventories	[17]–[19]
Maintenance Policies	[17]–[20]
Spare Parts Demand Forecasting	[17]–[19], [21]–[23]

Figure 2: List of Literatures on Spare Parts and Maintenance Model Requirement in Spare Parts Management

In terms of spare parts management, [17] gives a comprehensive overview of the studies available in the market. Previously, [24] introduced the Multi-Echelon Technique for Recoverable Item Control Model for inventory spare parts management. Furthermore, one of the popular approach in industry is the adoption of the classification technique. This approach used the ABC-classification scheme based on Pareto's principle to manage the spare parts inventory. Besides that, the VED (Vital, Essential, and Desirable) classification based on the criticality and demand of the item is also quite popular. Based on [25] the study on Multi- Criteria Inventory Classification of spare parts have included various factors such as stock-out penalty cost, demand distribution, stock ability, substitutability and scarcity.

On the other hand, [26][27], used Analytical Hierarchical Process (AHP) to address the spare parts utilization by using scalar measure of importance based on the criteria rating. They developed the criterion based on the usage value, criticality and the ABC classification.[28] illustrate the use of Saaty‟s AHP to evaluate the criticality of spares. [29] has applied AHP to formulate integrated criteria which includes factors like cost of lost production, inventory constraints, safety and environmental issues. Meanwhile, [21] explore the classification of the most critical spare parts in plant maintenance. [23] has shown the classification technique based on the essential demand pattern. In order to understand the demand pattern [23] used the basis of classification technique.

Next, [25] has provided an extensive review of multi criterion classification for spare parts based on their uniqueness. By incorporating the general grouping method, [30] define the grouping based operational control policies. [31] introduced the process of developing the criticality and control of the spare parts based on to criticality, specificity, demand pattern and usage. It can be concluded from the literature review that the studies on spare parts management focused on the objective of either maximization of availability of the equipment or minimization of cost. Nevertheless, there is a need for systematic actions while managing spare parts based on below:

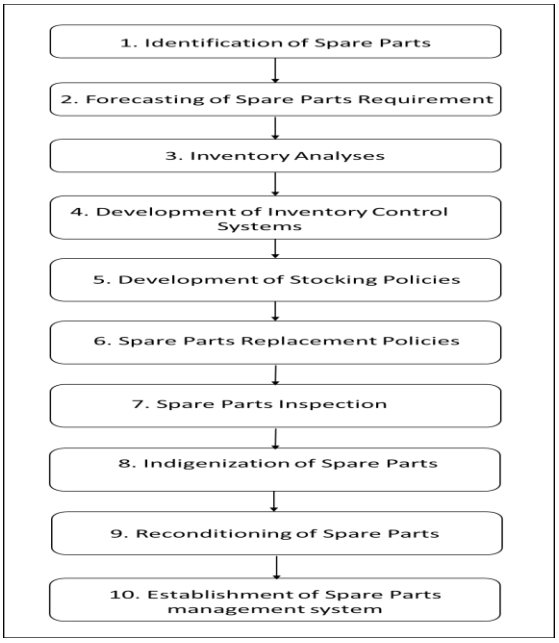

Figure 3: Systematic Approach of Spare Parts Management

3.0 CONCLUSION

Unproductive downtime of the equipment had direct impact towards the organization profits. Subsequently, maintaining high inventories of spare consuming a significant portion of capital investments. Inventories are considered the most significant part of asset in large organization and require a lot of money in order to maintain the large size of the inventories. This makes the management of spare parts and maintenance effectiveness a critical issue that is worth studying carefully. Therefore it is essential for the particular industries carried out spare parts inventory management effectively in order to achieve an effectiveness of maintenance for the organizations.

Specific job description is set. Reasonable benefits and rewards introduce to reward based on the workload. Effectiveness of top management is very essential to ensure the lower management are engaged in workload with a comfortable situation.

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