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Strategic Asset Management Maintenance Framework in Asset Reliability Management for Oleochemical Industry in Malaysia

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Abstract: Oleochemical industry in Malaysia is expanded rapidly and today it is one of the largest oleochemical industry of the global capacity. Aging infrastructure is placing conventional asset reliability management (ARM) practices under pressure. Most oleochemical plants in Malaysia are aging and with deficient ARM framework to maintain production asset. No similar framework has been reported to cater this problem that may due to lack of resources and computerized maintenance management system (CMMS) in placed to support the analysis. Therefore, it is important to establish strategic asset management (SAM) maintenance framework that applied in similar industry to improve overall reliability and availability of plant asset in order for this prime industry to stay competitive. This study will be conducted into 6 stages starts from asset categorization and criticality analysis to priorities types of assets covered under the study. Next data extractor from CMMS based on the critical assets. From the data, identify poor factors that contributed to poor performance of the asset reliability in Oleochemical industry. Thus, this drive the need to develop and modeling of SAM framework to improve asset reliability. Implement and evaluate of SAM framework in the respective Oleochemical plant. At last, validate the deliverables of the framework to the plant assets. Expected outcome from this framework is to improve the reliability of key assets in the oleochemical industry through identification of the factors causing poor performance in ARM through CMMS. Afterwards, the evaluation of the asset reliability in terms of asset availability, mean time to breakdown and life cycle cost via the new framework. It is expected the asset reliability will be improved through new develop SAM framework. In conclusion, the SAM framework able to deliver expected results which increase the overall reliability of key assets based on the implementation and evaluation. The SAM Framework as developed can be used in Oleochemical industry, or adopted by similar industry to improve reliability of key assets. Nevertheless, this framework can be further modified and adopted for any similar industry in order to improve their plant asset performance through reliability improvement.

Key words: *Oleochemical, Asset Reliability Management, Computerized Maintenance Management System, Strategic Asset Management Maintenance Framework*

INTRODUCTION

Global oleochemical markets are being led by surging demands for renewable based products, favorable government initiatives, shifting consumer preferences for sustainable solutions. Asia Pacific led by Indonesia, China and Malaysia, with advantaged feedstocks and markets, accounts for nearly 70% of the global markets and 60% of the total capacity [1]. Oleochemicals find application in a wide range of industrial segments including personal care, food additives, surfactants, soap and detergents. Easy availability of feedstock and rapid expansion of major end-use industries will drive the global oleochemicals market trend over the next few years. Government support in terms of tax benefits, particularly in the emerging markets of China and India, with an aim of promoting biodegradable chemicals production are also projected to complement the region's growth [2].

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Having ample supply of raw materials, coupled with availability of technology, Malaysia companies are poised to tap the growing demand for oleochemicals. Malaysia currently commands a 20 percent share of world's oleochemical production, with exports having grown 5.6 percent in 2013 to RM11.5 billion [3]. Modern oleochemical plants are very capital intensive, today the largest and most modern plants are being erected in Malaysia and Indonesia. These modern plants are excellent raw material integration, gives producers in ASEAN an importance competitive advantage over their competitors overseas [4]. In order to ensure the prime industry in Malaysia to stay competitive with reliable operation and maximize the return of the capital investment, it is prudent to have all invested assets to perform their design intended function in a safe, effective and efficient manner, with minimum unplanned outage. This can only be achieved through established asset reliability management.

Asset reliability and maintainability management are drawing new interest in today's industry. This drives the needs to ensure all assets are properly maintenance and are highly reliable. Increasingly, companies are viewing reliability and maintainability as part of the contractor to improve quality and maintain competitive [5].

Strategic asset management in terms of reliability, availability and maintainability are increasing being adopted by many organizations around the globe to help in facing challenges in highly competitive and rapidly changing business environment. It is crucial as most manufacturing industry is heavily dependent on its machinery and equipment in securing a competitive advantage. The increasing role of maintenance is reflected in its high cost, which is estimated to be around 30 percent of the total running cost of modern manufacturing business [6]. Decision within asset reliability management that include decisions regarding inspection, repair, maintenance and replacement have traditionally been based on a range of practices such as corrective, preventive, condition based, reliability centered maintenance approaches. Whilst there will remain the need of traditional approaches to asset reliability management, more advanced approaches such as risk-based maintenance is being introduced to provide flexibility in the management of assets without comprising reliability on the basis of identified measure if risk. There are standards or guidance documents to implement these approaches such as API 580 and API 581 [7]. Following the emerging trend in asset reliability management, ISO55000 series that standardized guidelines in managing assets was developed by ASTM [8].

Asset reliability management besides being a profit center, it is also one of the drivers for operation safety. Most of the serious accidents that have taken place was due to lack of asset reliability and resulting in catastrophic accident. Asset reliability management was defined as the development, implementation, and execution of a coordinated plan together with managerial control and organizational activities, to ensure that the physical asset is performing its intended function in a safe, effective and efficient manner over its entire lifecycle, in order to achieve the organizational objectives. The "asset" is defined as production installation including the machinery, and equipment that placed to perform a business function [9].

Asset reliability is often misunderstood by organization as a mere financial burden. Inspection and maintenance of plant and machinery has traditionally been based on prescriptive industry practices [10]. There are other identified challenges such as insufficient resources, suppliers and training support [11]; technical challenges such as aging equipment, corrosion, degradation and cracking [12]; human induced error challenges [13], as well as challenges in engineering design [14]. While previous studies are mainly focused on maintenance rather than asset reliability as a holistic approach, asset reliability management requires organization to upkeep their asset holistically [15]. Organizations have expressed their challenges in implement asset reliability management and the major concerns were regarding managerial decisions, human resources, cost and degradation. Some of the challenges can be related to operation reliability such as inadequate work procedures, record keeping, safety culture, training and competency etc. it is important to raise awareness of the importance of asset reliability management [9].

A review of literature was used to establish a framework identifying asset reliability and strategic maintenance as an integrated part of the organization's management system. Traditionally, the way a maintenance department has kept an operation in existence is to fix it when it has broken down. A modern maintenance department however is taking the role broader by helping to realize reliable assets and operation, thus grow profits for the organization [16].

Maintenance strategy was viewed as identification, resource allocation and execution to repair, replacement and inspection decisions [17]. Maintenance regime was summarized as part of asset reliability management as Corrective Maintenance (CM), Preventive Maintenance (PM) and Predictive Maintenance (PM) [18].

Corrective maintenance (CM) refers to only routine servicing is performed on the asset until it fails. This can be justified when the impact of failure is inconsequential or the investment in preventive measures exceeds the expected benefits of improved reliability and availability. Preventive maintenance (PM) refers to assets are replaced or returned to good condition before failure occurs. PM action is performed on the asset at the scheduled time based on usage or time drive regardless of its actual condition. Under the regime of PM, some assets may be over maintained or replaced prematurely. Predictive Maintenance (PDM) monitor the running condition of the asset continuously or intermittently to carry out PM actions only when failure is judged to be imminent. This includes vibration monitoring, thermography, oil analysis and ferrography that support PDM. An effective maintenance strategy is one that fits the needs of the business. Its performance is judged based on certain measurable criteria. Maintenance effectiveness measure elements was categorized as maintenance approach, information management and continuous improvement [19]. With elimination of non-value adding work on over-maintained assets, the workforce and resources engaged in maintenance activities will be optimized [10]. Support system for strategic initiatives as above need to be in placed in order to deliver the expected benefits. Technology advancement and effective deployment of information technology in support of maintenance has created new options for maintenance such as e-maintenance, computerized maintenance management system (CMMS) which allow seamless flow of asset maintenance information and reliability measurement [10].

The term "asset management" first came to light in mid-to-late-1960s [20], and the study in asset management started to surface in the fields of transport system, public infrastructure, public health system, etc [21]. Along the way, the petroleum industry adapted the emergence of asset management practice and it has become an important part of the industry. Reason is petroleum's either onshore or offshore assets are known to be high risks, thus strategically managing the physical assets is highly important, as a way to be sustainable [9]. Competition on a global scale, fast-changing customer needs, shorter product life cycles demand a high level of efficiency in all industrial environment [22]. In fact, maintenance represent a key factor production reliability [23], several different strategies are applied but a growing focus is put on predictive maintenance to optimize total plant operation [24].

In manufacturing, maintenance cost is a major part of the total operating cost of manufacturing and production plants as it represents from 15 to 40 percent of the costs of produced good [25]. Thus, having an optimal maintenance strategy in terms of cost, equipment downtime and quality is an important efficiency enabler [26]. Maintenance is related to all the processes of a manufacturing firm and focusses not only on preventing equipment breakdown but also on improving business performance in terms of productivity and defects elimination. Various maintenance strategies have been examined in both academic and industrial realms and multitude of maintenance strategies have been recommended in an effort to develop maintenance management, which supports both reactive and proactive maintenance [27]. Defining the best maintenance strategy represents a critical issue for all kind of production plants. Through emerging internet technology, data driven maintenance strategy is developed and applied in an oil refinery plant. Maintenance is deemed as a focal point in the production process of refinery plants to ensure reliable operation [28].

Computerized maintenance management system (CMMS) are computer-based software programs used to control work activities and resources used, as well as to monitor and report work execution. CMMS also served as a tool for data capture and analysis. It provides management with value added information necessary for maintenance decision making [29]. CMMS seamlessly links with enterprise resources planning (ERP) systems support the information of the industry from "fail to fix" to "predict and prevent" maintenance, at the same time it enables integration between maintenance to internal and external business processes to improve overall business performance [30]. E-maintenance leverage with novel information technologies to make optimal maintenance decision at the right time and place based on data analysis and predictions [31].

Emerging information and communication technologies (ICT) is one of the key prerequisites that offers a more controlled content sharing, information exchange within the phases of the maintenance processes, coordination with other processes and connection to strategic business objectives and stakeholder requirements [32]. Such integration will contribute to the achievement of primary objectives of active maintenance such as recording functioning quality statistics and using monitoring techniques (e.g. vibration measurement, thermography or ferrography), improve the effectiveness and efficiency of the maintenance process, reduce associated risks, and contribute to business sustainability [33]. Computerization is essential to a successful framework development endeavor. With continue data build up, the benefits of having an individualized maintenance framework will become apparent [34].

Although during the last years there have been some efforts towards increasing the level of productivity in maintenance decision making, existing approaches are still under development and suffer from some limitations. The degree of proactivity is usually low and decisions are narrowed to recommendations about the maintenance schedule, task and strategy. Wider framework that can support integration in manufacturing processes is not presented [35]. A maintenance strategy comprises of a process and framework, which are the supporting structures needed to manage the maintenance function of assets in an organization and cumulatively lead to the overall maintenance plan [36]. A unique framework for maintenance was developed and applied in a cigar producing factoring in 2004 [27]. The framework utilizing varying maintenance strategies across the enterprise, often using variants of multiple strategies on one piece of equipment alone. The framework uses elements of reliability centered maintenance (RCM) and total productivity maintenance (TPM), etc. to develop a unique solution on a company-by-company basis. The other framework created is based on value driven maintenance planning (VDMP). The value of maintenance is defined as the delivery of maximum availability at the minimum cost [37]. It differs from RCM by classifying equipment into different maintenance classes, each of which is associated with a functional requirement specification [38]. A holistic generic framework for maintenance management was proposed as well which advocates the usage of three pillars, namely the information technology (IT), the maintenance engineering methods and the organizational or behavioral pillar. A clear perspective of three pillars of business activities is maintained within each one of these pillars namely operational, tactical and strategic. They also recognized the difficulties facing the modern maintenance management environment, and the proposed framework was designed to use new advancement in IT such as CMMS to support the maintenance function and complexities [27]. Another maintenance framework to offer practical solution to the complexities of maintenance for distribution network service provider such as gas, water, electricity etc. was proposed [39]. As a limitation, such frameworks do not detail activities, methods or work flows required to meet the requirements and outcomes of maintenance strategy. There is a need to establish a conceptual strategic asset management maintenance framework that indicated the essential activities, relationships and mechanisms of various type of asset with above mentioned maintenance strategies as the basis of asset reliability management system.

Maintenance serves as an important function in business with significant investment in physical assets and plays an important role in achieving organization goals [10]. Some of the important factors behind demands on maintenance performance measures (MPM) are summarized as below [40].

a) To measure value created by the maintenance to ensure maintenance output is creating value as needed for the business, align with business goal of the company
b) To justify the organization's investment made in maintenance organization that are producing a return on the resources that are being consumed.
c) To revisit resource allocations, to determine if additional investment is required and to justify the investment and to ensure the resources as allocated utilized in an effective way.
d) Contribution of maintenance towards health, safety and environment (HSE) issues to minimize accidents or pollutions.
e) Necessities of a systematic approach for the knowledge growth in the field of specialization, replacing preventive maintenance with predictive maintenance with the aid of rapid technology advancement.

f) Adopting new trends in operation and maintenance strategy in response to market demand, for the reduction of production loss and process waste.
g) Integrate the MPM system to provide a rewarding return of maintenance services.

Maintenance performance indicators (MPI) are utilized to evaluate the effectiveness of maintenance strategy [41]. An indicator is a product of several measurement metrics. MPI generates a quantified value to indicate the level of performance, taking into account single or multiple aspects. The selection of MPIs depends on the way in which the MPM is developed. MPI can be used as measurement on asset availability, reliability and maintainability besides overall equipment effectiveness (OEE). When designing the MPIs, it is important to relate them to both the process inputs and outputs [40].

EXPECTED FINDINGS

It is expected that through this research, factors that lead to poor performance in asset reliability will be identified, with the aid from the data collected and analyzed from CMMS, asset reliability will be improved through propose strategic asset management (SAM) maintenance framework which detail activities, methods or procedures required to meet the requirements and outcomes of maintenance strategy. A strategized framework which indicates the essential activities, relationships and mechanisms of asset maintenance with its reliability management. Through this develop framework and flow chart, measurable maintenance performance is tabulated in terms of asset availability, reliability and maintainability.

CONCLUSION

The present research offers insight to both maintenance academics and practitioners in oleochemical or similar industry in Malaysia a strategic asset management (SAM) maintenance framework to improve reliability of plant and equipment, maintain cost effective maintenance program, improve efficiencies and effectiveness of maintenance activities, improve industry competitiveness, improve workplace safety and provide sustainable plant throughput. Through identified factors that contributing to maintenance poor performance, desired outcomes of asset availability, reliability and maintainability can be met through strategized asset management (SAM) maintenance framework as proposed for various asset types with defined maintenance strategies to improve the asset performance. However, there is a need for theoretical as well as empirical research in the future to validate the multifaceted perspective in the present study and to obtain more insight into the nature of asset maintenance and reliability management, to further improve the framework to suit other similar competitive industry.

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