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Maintenance Logistics Optimization through a Strategically Focused Maintenance Resources Organization

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Abstract

The way an organization is resourced for delivering projected maintenance performance is driven by various factors which vary from organization to organization. But strategic drivers are key to determining the maintenance organizational selections that an organization will pursue in order to fulfill its mandate of maintaining equipment reliably. The crux of engrossing on a specific maintenance organizational structure has a lot to do with managing the logistical aspects of maintenance. Having a functional structure is one thing, and having a structure that optimizes maintenance logistics according to defined parameters is something that is worthy researching on. Combinations of organizational forms are also acceptable as long as the basic objectives are met within the business context, and ensuring high efficiency and effectiveness of the maintenance function as a whole. The maintenance structure has to be determined and reviewed periodically for relevance as the technological advances can render some structural orientations irrelevant. The major thrust of forming maintenance crews around physical assets reliability will drive the decisions of the form and sizes that organizations adopt in order to meet their functional mandate.

Keywords

Logistics optimization, strategic focus, organization, maintenance resources

Introduction

The key focus of establishing maintenance teams for heightening physical assets reliability will climax in the resolution of whether to elect for an operator-based or non-operator based, centralized or non centralized maintenance teams (Wiegand, et al., 2007:109). In some industries, the maintenance logistics expenditure institutes a significant component of the operations and maintenance expenditures (Shafiee, 2015:183). Maintenance logistics need to be addressed through a three stratum approach, which embraces the strategic, tactical and operational tiers (Shafiee, 2015:183). The tactical stratum of maintenance logistics engrosses inventory management of spares, maintenance support organizational structure, and the resolutions concerning procurement, outsourcing or leasing of maintenance resources (Shafiee, 2015:186). Maintenance logistics' prominence emanate from the usually massive investments allied with capital-intensive assets, which call for a high operational availability, and whereby any unforeseen failure maybe highly catastrophic (Rahimi-Ghahroodi et al., 2017:712).

The management of spare parts is a purpose of the maintenance function that targets to sustain asset reliability, offering real-time data on the existing numbers of the respective spare parts and assuming the spare parts management procedures that guarantee their availability when needed, thereby lessening costs (Teixeira, et al., 2018:116). Maintenance and machine spares logistics very so often define the life-cycle costs interrelated to the useful life interval of physical assets (Lewandowski and Oelker, 2014:333). The cataloguing of spares is central to control of the massive numbers of spares that possess diverse features and specifications (Teixeira, et al., 2018:116). Management of spares entails chiefly the maintenance and logistics functions, making the assimilation of input data from maintenance plans and organizations a top priority (Teixeira, et al., 2018:116).
An imperative constituent of safeguarding the stability of manufacturing operations is preserving physical assets on a correct, high state of their performance and reliability (Antosz and Ratnayake, 2016:1389). The elementary practices which warranty such necessities is the practice of physical assets maintenance management which encompasses not only undertakings allied with constant checking of the assets' technical status, but furthermore with undertaking preventive and corrective processes associated with failures riddance (Antosz and Ratnayake, 2016:1389). Physical assets spares availability management forms part of the maintenance logistical processes that ensure the availability of physical assets for production purposes, and this is in addition to other inputs to maintenance such as skilled and competent artisans and maintenance tools (Antosz and Ratnayake, 2016:1389). The likes of offshore wind farms require detailed maintenance planning that encompasses procedures which integrate logistics considerations into physical assets maintenance (Dai, et al., 2015:403).

The formulation of maintenance systems and the conforming logistics support is an actually intricate process, through which the intention is to discover the conciliatory solutions concerning the relationships among diverse maintenance processes and the means of their application (Popovic, et al., 2012:1914). Resultant to this, different solutions may be assumed, as this is sanctioned by a series of crucial dynamics and measures, which can be conflicting at times (Popovic, et al., 2012:1914). Modelling techniques for maintenance logistics have been applied to explore the sizes and composition of the skilled manpower and their skillsets, and this is in addition to spares inventory and logistical optimization modelling, e.g. agent-based modelling to explore the effect of diverse skill levels of the maintenance workforce (Iwata and Mavris, 2013:189).

Maintenance Logistics Considerations for Assets Reliability

A principal difficulty with Maintenance, Repair and Overhaul (MRO) as well as logistical support for multifaceted technical systems, is to control the mounting data tide and system intricacy (Candell, et al., 2009:937). The maintenance logistical requirements form part of the overall maintenance management system that is aimed at attaining high maintenance effectiveness and physical assets reliability, as shown in the figure below.

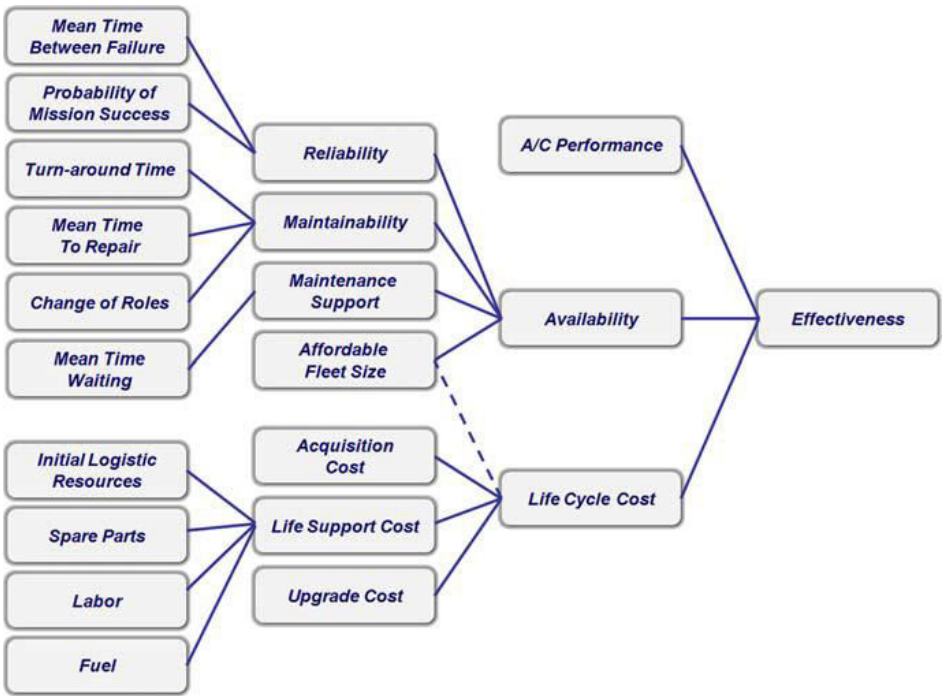

Figure 1: Maintenance logistics support as part of maintenance management system to attain overall maintenance effectiveness (Candell, et al., 2009:940).

Maintenance logistics falls within the maintenance support system of the overall maintenance system of the organizations. The maintenance logistics require proper planning and organization to ensure physical assets availability and reliability. The figure below shows the positioning of maintenance support planning with relation to other maintenance activities.

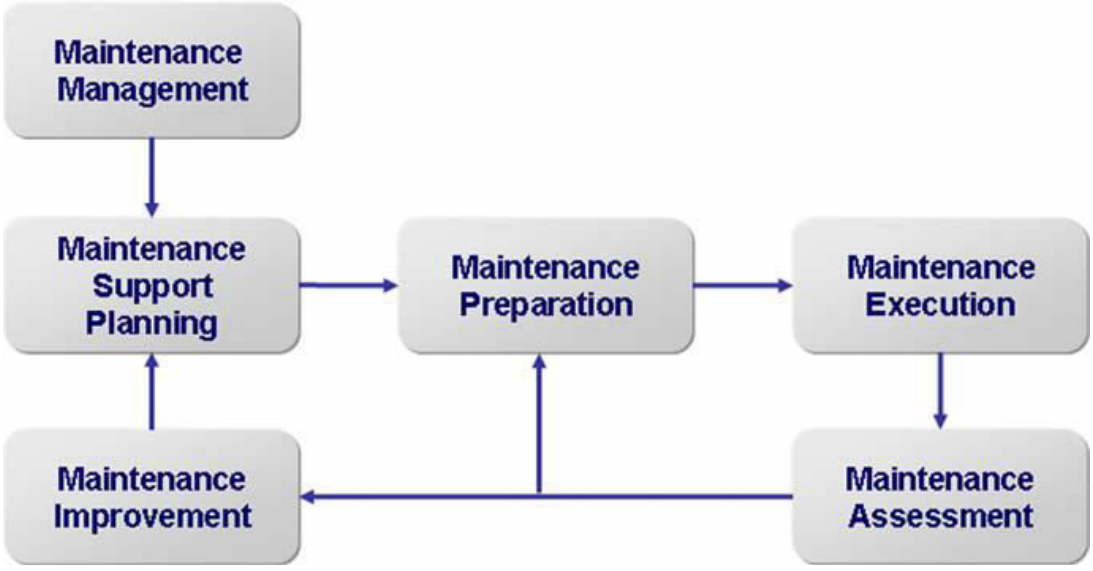

Figure 2: Maintenance Support planning relative to other maintenance activities (Candell, et al., 2009:940).

The maintenance logistics management is of high significance in industrial setups such as offshore petroleum and wind energy, as a failure to provide appropriate maintenance services may undesirably upset assets reliability performance and safety (Shafiee 2015:182). Maintenance logistics is acknowledged as a vital competitive element in

the offshore industrial setups having a noteworthy bearing on assets reliability and business profitability (Shafiee, 2015:183). Well-organized maintenance logistics is obligatory as any failure to deliver appropriate maintenance logistics pertaining to absence of spares, lack of rigging equipment/ transportation, or unavailability of skilled manpower may grossly affect physical assets availability (Shafiee, 2015:183). The two key strategic inclinations for maintenance logistics pursue either the cost-efficient strategy or the responsive strategy, which are in a way two contradictory prodigality frames, and as for any system, a position between the two extremes can be attained (Rahimi-Ghahroodi et al., 2017:713). The time spend related to maintenance logistics comprise of the resources mobilization time and the transportation time of the machine spares from the warehouse or supplier to the work site (Santos, et al, 2018:2). Thus maintenance logistics need to counteract challenges that delay maintenance activities to be promptly executed in a cost-effective manner, and to ensure high assets reliability and availability.

Different Forms of Maintenance Organization

The organization of maintenance logistics ought to be formulated in a manner that takes cognizance of the physical assets availability or reliability effects of spares or maintenance tooling or skilled manpower unavailability (Shafiee, 2015:183). The maintenance logistical planning and organization process integrates workforce and team planning, equipment and tooling logistics as well as spares logistics, and all these have to be allied to the maintenance strategy (Lewandowski and Oelker, 2014:334). The complicity of this scenario calls for intensive information analysis for the broad system, which may culminate in the choice of autonomous or decentralized decision-making systems for logistics planning and control (Lewandowski and Oelker, 2014:334). Maintenance logistics calls for optimally available resources as a necessity to meet the projected operational availability while reducing the overall service costs (Rahimi-Ghahroodi et al., 2017:712). The planning and organization of resources such as machine spares, maintenance technicians, and maintenance tools should not be determined in isolation, as their combined effect on the overall performance of the system is tremendous (Rahimi-Ghahroodi et al., 2017:712). The common omission is that unlike machine spares inventory management which forms a requisite portion of maintenance logistics for any kind of system, tooling and maintenance technicians are not always regarded as bottlenecks in maintenance logistics (Rahimi-Ghahroodi et al., 2017:712). A maintenance logistics system is organized so as to warrant the well-timed fashion in which preventive or corrective type maintenance activities are deployed, maintenance of simple or highly complex assets is carried out, optimized supply and management of machine spares is rolled out, as well as the timely execution of related logistical tasks meant for physical assets reliability and availability (Nour , 2017:128).
Some maintenance organizational structures are considered below.

- The centralized-maintenance team organization comprise of the maintenance artisans pooled together to perform different activities and all required resources are assembled together with specialists established for indicated tasks (Wiegand, et al., 2007:109). The focus is on a skilled workforce, with their associated asset care and machine spares, and the /repair facilities equipped with the requisite infrastructural provisions (Wiegand, et al., 2007:109). The maintenance logistical functions such as planning, purchasing, contractor outsourcing, and spares inventory management are all controlled from one centre (Wiegand, et al., 2007:110). This organization structure allows for the easy of coordinating the activities, allowing economic use of resources, easy control of data and knowledge gained from experience, and balanced resources loading (Wiegand, et al., 2007:111). The drawbacks tend to be massive costs incurred for planning and controlling vast resources, travelling delays caused by long distance to work site(s) and long decision making processes for maintenance (Wiegand, et al., 2007:111).

- The decentralized-maintenance organization has the various maintenance teams being allocated to specific work stations and operating as independent units (Wiegand, et al., 2007:110). The maintenance technicians are generally multi-skilled to permit for the execution of varied activities (Wiegand, et al., 2007:110). The decentralized-maintenance team is more process inclined and it possesses the following advantages: broad process knowledge, swift response time and reduced travel time and costs, faster decision making processes, and high motivation emanating from responsibility (Wiegand, et al., 2007:111). The disadvantages tend to be: higher total expenditures due to replication of resources per unit, high overall maintenance spares levels, lack of specialist skills and limited sharing of knowledge gained from experience (Wiegand, et al., 2007:111).

- An integrated-maintenance organization entails maintenance technicians allotted to units with full-fledged resources like for the centralized maintenance organization, with specialists stationed at their

respective sites. Despite the higher maintenance efficiencies attained due to this arrangement, the high overall costs is the major drawback for this kind of organization (Wiegand, et al., 2007:111).

- Dependent on the cost structure of maintenance services, outsourcing the maintenance/repair services can be adopted as a dominant strategy that the maintenance organizational structure can assume (Shafiee, 2015:186).

Cost-effectiveness of the maintenance system is generally pursued when organizing the maintenance logistics, with optimum spares inventory, skilled manpower and maintenance tooling and/or transportation means being established (Shafiee, 2015:186). The purchasing decisions for optimum maintenance logistics also need to be established for ensuring high assets availability and reliability (Shafiee, 2015:187).

Logistics Organization for Optimization – Case Study

The Case Study was conducted for a single business unit manufacturing company in South Africa. The three major areas that were assessed included the following:

1. Maintenance Organizational Structure for optimum logistics
2. Maintenance Spares Management
3. Strategic outsourcing - contractors

Maintenance Logistics Organization

The organizational structure that was adopted by the organization took the form that is as depicted in the figure below. The structure was adopted so as to deal with having adequate spare parts for maintenance activities, to undertake preventative maintenance activities timely and to respond to breakdowns swiftly.

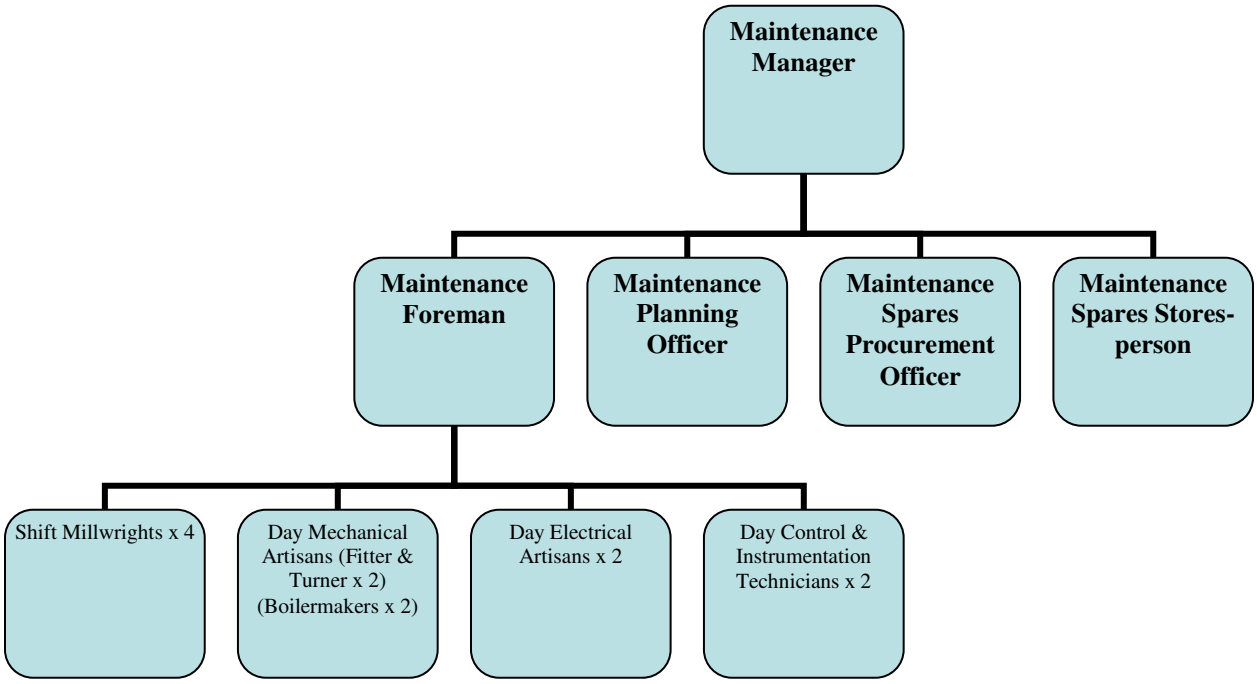

Figure 3: Maintenance Logistics Organization

All the maintenance functions were congregated under the maintenance manager and the maintenance system was coordinated through a SAP computerized maintenance management system (CMMS), thus a centralized

maintenance organization was adopted. The shift millwrights were working 12 hour shifts to provide 24 hours cover for the processing plant in case of breakdowns. This enabled the prompt attendance to breakdowns whether they were electrical or mechanical. The artisans all reported to the maintenance foreman who was responsible for their supervision. In the event of a breakdown occurring, a call out procedure and an escalation procedure was adhered to in order to speed up failure resolution and decision making during downtimes.

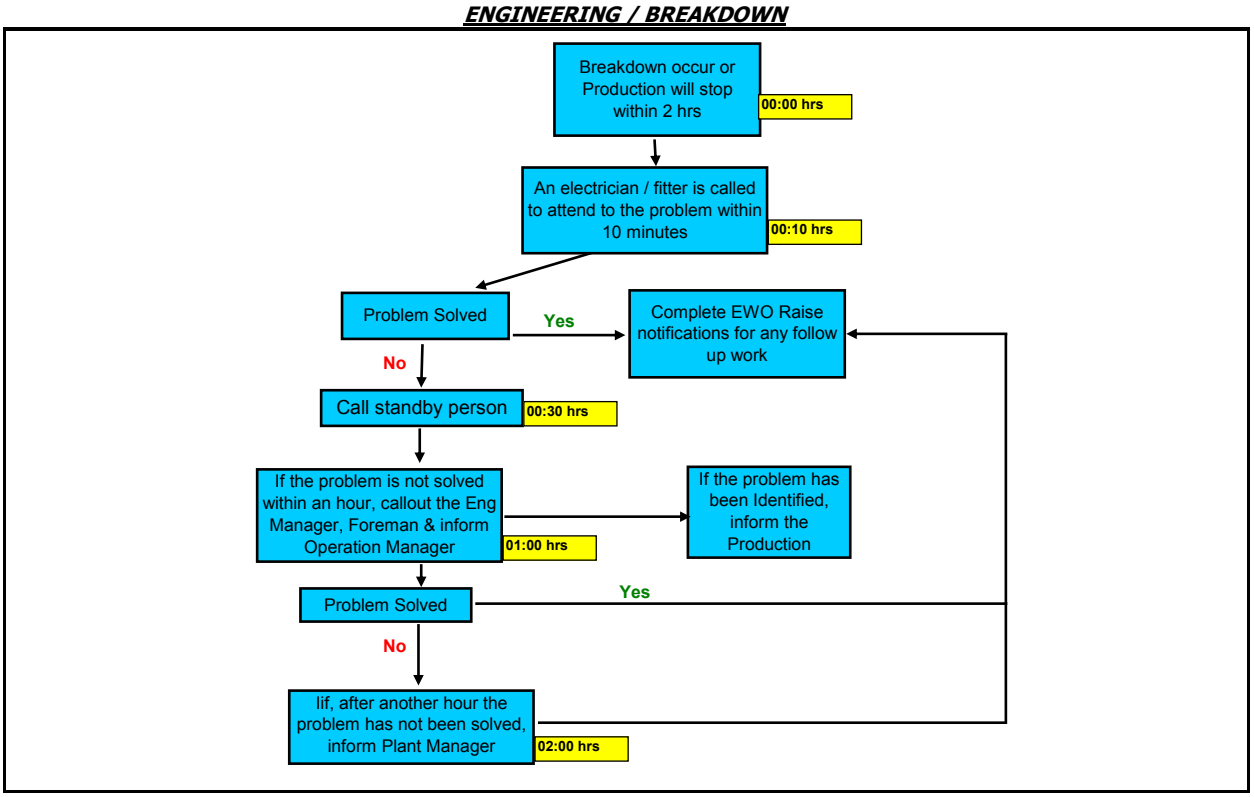

Figure 4: Breakdown call-out/escalation procedure

The escalation procedure allowed for a swift decision making process that sought to minimize downtime and the overall negative impact on the business. The call out procedure enabled extra maintenance resources to be mobilized in order to minimize downtime duration. Below is shown a workflow for handling breakdowns by the maintenance team.

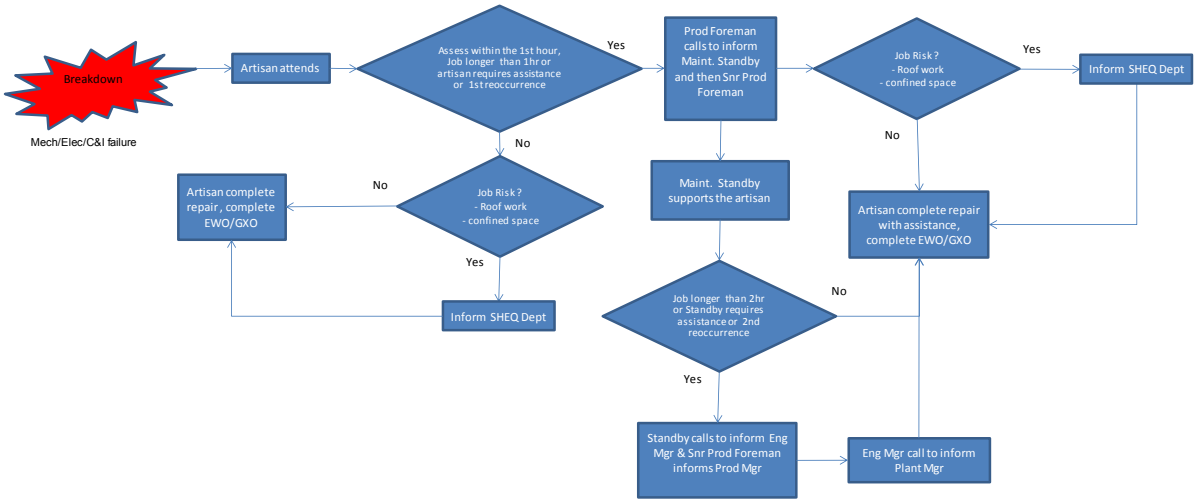

Figure 4: breakdown reaction process

The day artisans had the main responsibility of carrying out mainly the preventative maintenance tasks and planned corrective maintenance tasks. This was unlike the shift millwrights whose sole responsibility was to undertake reactive maintenance tasks in the event of equipment failures.

Maintenance Spares Management

The spares management was the responsibility of the stores person who ensured that all critical spares were adequately stocked. The spares were categorized into critical and non critical spares depending on a rating criterion for their impact on the organization in the event of stock-outs and equipment failure(s). The maintenance procurement officer was responsible for purchasing spares to replenish stock or to do direct purchases for spares requirements in the plant. The figure below is an extract of the procedure for managing maintenance spares.

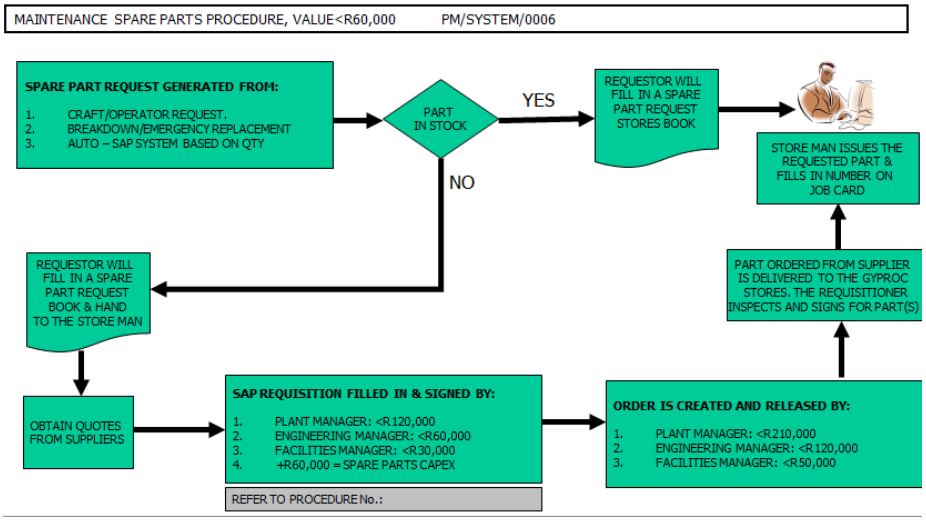

Figure 5: Maintenance Spare parts procedure

The maintenance spares were requested through the SAP CMMS as per the workflow depicted in figure 5 above, and the procedure was meant to prevent stock-outs of critical spares.

Strategic outsourcing – contractors

A list of approved contractors was kept by the maintenance planning officer according to their critical skills to the organization. These contractors formed part of the approved vendors list for the organization and they could be contacted through speed dials on a breakdown basis or a planned basis. The list of approved contractors was also available to the maintenance manager, maintenance foreman and the procurement officer.

Discussion of findings

The manufacturing firm was geared to react to breakdowns swiftly as it had skilled manpower available to deal with breakdowns promptly in the form of shift millwrights. The maintenance function's organizational structure was formulated around the need to respond to equipment failures swiftly, and to strategically manage maintenance spares to prevent catastrophic failures in the process plant. Critical spares were managed through the critical spares list that was derived through a structured criticality ranking methodology meant to minimize the overall risk on the business. The critical contractor resources were carefully chosen and listed for urgent access and availability in case of emergency situations that required their assistance. Maintenance logistics determine the structural arrangements of the maintenance function, and if the maintenance team structure is not aligned to the maintenance logistics of the organization, then inefficiencies and lack of cost-effectiveness in the maintenance system is introduced. Thus the assessment and consideration of maintenance logistics optimization is imperative for organizations, and this is the role of the strategic formulation of the maintenance resources organization for many businesses. The strategic requirements of organizing maintenance resources need to be done in full consideration of maintenance logistics aspects.

Conclusion

Various traits of the maintenance logistics have been researched on, with modelling techniques being applied to understand the rationale for inventory levels, logistics, labor force sizing, and labor force skill-sets (Iwata and Mavris, 2013:188). Maintenance logistics targets to optimize the maintenance system by rationalization of the human, material, financial and informational resources linked with the actions of maintenance and monitoring the operations of the physical assets by applying specified implements and exploration of data provided by them (Nour , 2017:130).

Flexibility is recommended with regards to maintenance logistical organizational choice centered on assessed cost-effectiveness and the maintenance system strategic intents. Other relatable structural situations like legislative controls, skills matrix, training availability, skilled manpower, machine spares suppliers proximity, contractor skills and availability, need to be assessed before the final strategic maintenance logistics organization is derived. Amalgamation of organizational types is tenable, and this holds as long as the strategic intents are satisfied, and high physical assets reliability and availability are maintained. A strategic approach need to be arrayed to assess organizational efficacy and relevance to the maintenance logistics factors in full consideration of all input attributes like manpower, skill-sets, machine spares and maintenance information control. The maintenance logistical structure need to be reviewed continuously and in light of changing operational dynamics.

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Biographies

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