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Implementation of CMMS Software for a Maintenance Plan in a Manufacturing Industry

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***Abstract*—**This paper proposes an effective maintenance method by considering the implementation of the Computerized Maintenance Management System (CMMS) software to plan a maintenance activity in a manufacturing industry. Globally, maintenance is a very important activity in the manufacturing sector to prolong the life span of equipment and machinery; it is also applicable to all household items. It is obvious and well known that apart from giving long life to equipment, it reduces the substantial financial losses for repairs and save the production downtime. In some cases, appropriate maintenance of plant equipment and machinery reduces the tendencies of injuries to personnel in the job floor. But before the maintenance process can be carried out, proper and effective work order planning and scheduling must be in place in other to achieve the set goals and objectives of a maintenance shop. Brief reviews of common planning tools which include the Computerized Maintenance Management System (CMMS) are presented. An interesting outline of analyses on planning and scheduling for effective job planning in a typical manufacturing industry using the CMMS is also presented and discussed. Finally, the steps to adhere to in making job planning effective in a manufacturing industry are also highlighted.

***Keywords*—**Advanced Downtime Analysis Programme (ADAP), Computerized Maintenance Management System (CMMS), Corrective Maintenance (CM), Executing Department (ED), Maintenance Department (MD), Preventive Maintenance (PM).

I. Introduction

THE majority of people are familiar with the meaning of planning in everyday life activities, we think in advance, the things to be done on a working day basis consciously or unconsciously. The maintenance section in any manufacturing or production organization makes advances in decision on which the executing department has to consider and execute the work on ground or at hand by raising job work order requisition to the department involved in executing the job [1]. As such, planning can be referred to as a systematic way of deciding about and doing things in a purposeful manner. In the context of a formal organization and their management, the concept of planning has a specific connection [2]-[5]. It is deciding in advance what is to be done in the future for a specific period of time and then taking the necessary steps to do the things decided upon. It is a process of thinking ahead into the future and trying to anticipate what is likely to be done, how it will affect the organization positively, what direction the organization should take and how to deal with the future events. Planning also includes the determination of course of action from among alternatives to achieve the goals of the organization [6], both in the immediate future and in the long run. The very thoughtful aspect of planning bring to mind such images like neat, orderly and disciplined approach to work, goal-oriented behavior, thinking about and arranging things in advance, careful allocation of scarce resources etc. Therefore, in a simple definition, Planning can be defined as the process of setting future objectives and deciding on the ways and means of achieving them [2].

Others ways in which planning can be expressed are;

- Defining the products / outcomes that will be delivered by the project or program.
- Identifying activities needed to deliver the products.
- Defining the quality requirements associated with the products.
- Identifying the dependencies that will affect the project or program. This includes dependencies between the activities within the project, as well as the dependencies to / from activities outside the project. This also includes planning the costs of achieving the set goals and objectives.

Scheduling can be explained as developing the timing model, or schedule [7]. Estimating how long activities will take to complete and finally, it determines the sequence in which activities should be completed. So, in view of this, *planning* and *scheduling* are the processes used to develop the plan and associated schedule, moreover it covers a single, coherent set of data which may be held in a single or in a number of documents.

When information is held in several documents, there needs to be a means to ensure consistency and coherency throughout all the documentation. This might be achieved by defining and implementing a configuration management strategy / process and or by using a software tool that allows elements of the plan and schedule to be linked to each other in a coherent manner. These tools include the Computerized Maintenance Management System (CMMS), the Advanced Downtime Analysis Programme (ADAP), Preventive Maintenance (PM) and Corrective Maintenance (CM).

II. Maintenance Planning Tools

A. Computerized Maintenance Management Systems (CMMS)

Computerized Maintenance Management Systems provide a way for companies, industry or organization to track

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equipment and inventory assets, detail when and how work orders are to be performed in maintaining those assets, and accumulate all of the associated costs for labor, materials and tools [9]-[10]. Also, we can say that for proper effective planning; coordination and scheduling of the maintenance function can be and for many years accomplished without computer support. However, with the current advance in technology and rapid economic data communication, job preparation is accomplished far more efficiently with the support of a Computerized Maintenance Management Systems. There are many functions attributed to the CMMS but to mention a few, this includes:

- CMMS allows companies or organization to electronically track orders for work (work orders) within a centralized software package.
- A work order goes through several stages called *Status*. It must first be "*approved*" by a maintenance administrator before it becomes an active work order "*in progress*". Once the workers complete the task or work, it will be "*completed*" and then close. Work orders can now be automatically created by the CMMS through preventive maintenance (PM). PM procedures are essentially a listing of work orders that have to be performed at a certain time interval.
- Usually, the CMMS packages allow the users to track and enter all of the equipment (assets) at the facility. This makes it easier to select what needs to be done when a work order is created.
- CMMS packages can also assist the users in tracking materials in the storerooms (inventory).
- According to Igerson [8], the advantages of CMMS makes it more useful and effective compared to other softwares in terms of planning such as:
- Eliminate the nightmare of paperwork. Companies still tend to print out work orders for the maintenance personnel for convenience, but the software can organize these records and make lost work orders a thing of the past.
- It helps to make work force more efficient, it assists workers plan their efforts. They spend less time tracking their work and more time fixing equipment. If each worker saves an hour everyday (which is typical) the savings for a large maintenance department can be enormous in financial terms.

B. Advanced Downtime Analysis Programme (ADAP)

The Adaptive Downtime Analysis Programme (ADAP) is a package that is well utilized and captures any downtime situation that occur in an organization or manufacturing companies due to slow response of an execution department that is involved [9]. It also creates no chance of argument between two or more execution departments, (that is, it captures clearly the responsibilities and actions of every execution department). The program has been effectively employed to reduce downtime in the industries.

C. Preventive Maintenance

Preventive maintenance is a schedule of planned maintenance actions aimed at the prevention of breakdowns and failures, the primary goal of preventive maintenance is to prevent the failure of equipment before it actually occurs. It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail [11], [12]. Preventive maintenance activities include equipment checks, partial or complete overhauls at specific periods, oil changes, lubrication and so on. In addition, workers can record equipment deterioration so they know when to replace or repair worn parts before it causes system failure. Recent technological advances in tools for inspection and diagnosis have enabled even more accurate and effective equipment maintenance. The ideal of using preventive maintenance method would prevent all equipment failure before it eventually occurs.

D. Corrective Maintenance

Corrective maintenance can be defined as the maintenance which is required when an item has failed or worn out, to bring it back to working order [9], [11], [12]. Corrective maintenance is the most commonly used maintenance approach, but it is easy to see its limitations when equipment fails, it often leads to downtime in production, and sometime it causes spreading of damage to other parts. In most cases this is costly in business. Also, if the equipment needs to be replaced, the cost of replacing it alone can be substantial. Reliability of systems maintained by this type of maintenance is not known and cannot be measured. Therefore, corrective maintenance is carried out on all items where the consequences of failure or wearing out are not significant (less important items) and the cost of this maintenance is greater than preventive maintenance.

A typical work order cycle using the CMMS software is presented in Fig. 1.

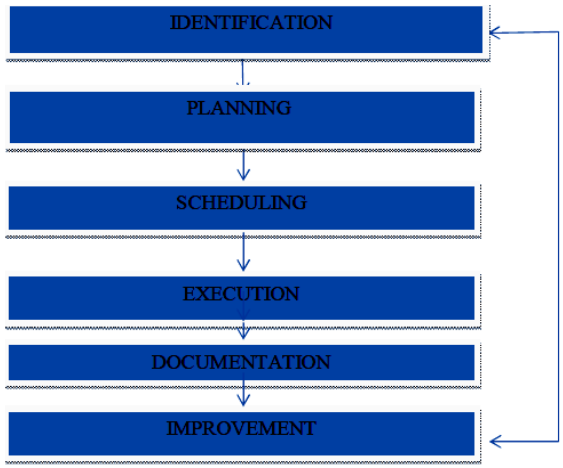

Fig. 1 Typical work order cycle using the CMMS software

The work cycles are hereby explained in detail:

Identification: This section has to be conducted by the factory inspectors; these are the people in charge of identifying problems on any plant machinery and equipment on the field. They have simple ways of identifying problems and apart from this, they also have devices / equipments that can identify faults, then after their findings, they raise work request and emphasize the priority of the repairs to be done.

Planning: involved with the primary purpose of improving the company or organization in which work is performed. Planners look not only at existing conditions and problems but also develop a vision with goals and strategies of what an organization could be in future.

Scheduling: It is a subject to review and update at appropriate intervals which results in version control being required to ensure that only the most recent version is available and also is a subject to distribution within a manufacturing system.

Execution: execution involves the actual delivery of set goals and objectives of the company on time. The execution section comprises of Mechanical, Electrical, Process Control, and Instrumentation. As such, the execution department has to execute the job that was raised through the Work Request from the inspection team and which has to be approved before the commencement of the job.

Documentation: This involves the record keeping that involves planning, scheduling and execution of the project the company embarks upon. It is also important to document the cost, materials; labor used or spent during the project for future accountability.

Improvement: This has to do with the analysis of the satisfactory performance of the project, the failure experienced during the work, the cost, how the job plan went and the procedure involved.

The CMMS software is capable of effective monitoring of the work cycles to ensure effective execution of the project and reduce the downtime in the system.

III. Effective Job Planning

The following are some steps to adhere to in making job planning effective in a manufacturing industry:

Knowledge base of the project- In this aspect, the organization or factory is expected to have a clear view of the project they intend to execute. The relevant knowledge base and expertise is relevant to successfully deliver a project. For instance, in a cement factory, if the company wants to change part of their rotary kiln shell due to a problem of too many hot spots, it is expected that the organization will know the appropriate time for the change, they will plan ahead of the time for effective achievement in doing this and also ensure that it does not affect the peak production periods.

***Analyze the way forward to execute the projec*t** – This involves the planning, scheduling and execution of the project. This is conducted by the maintenance and project planning department of the organization. They plan ahead of the project and consider the people to be involved, the material handling systems, time-frame and stepwise procedure to implement each phase of the project either to the contractors or the in-house project executors.

Cost estimation – At this junction, the organization needs to estimate the required cost for the project and also, the cost estimation must include the cost of all the resources required for each of the phases such as the material, plant labour, sub-contract labor and external tools and equipment hire.

Health and Safety - However, in any manufacturing industries or organization, there must be someone referred to as the "Safety Officer or Safety Manager". His / her responsibility is to make sure that all safety equipment, materials are in place during the execution of the project, and must emphasize that the company comply with the Health and Safety acts. Safety must be given a high priority to avoid casualties.

Timeframe – Being time conscious is very important and essential in any manufacturing industry as any downtime on any section will adversely affect the production. As such, specific timelines have to be strictly adhered to in order to achieve optimum results.

Resources **-** the availability of the resources (human, capital and material) required for each phase of the project is very important. For instance, to remove or align the brick from the shell is the duty of the mason while to cut the shell is the responsibility of the welder. It is expected that each of them are fully equipped with the materials needed to do the job. Again, the organization has to indicate the procedure / the support system required to facilitate proper job execution without bureaucracy.

Execution -It is the duty of an organization to know and select the best contractors to do the job. This could be the in-house project executors or the outsourced sub-contractors of the project. And before making the final decision on the execution of a project, it is expected that the company conducts a verification exercise in order to ensure that the contractors and all the people involved are capable of handling such a project. Lastly, shortlist all the contractors that has to be involved and list as well the jobs that needs sub-contracting.

IV. Conclusion

Common planning tools used in the manufacturing industries have been presented and discussed. The benefits of using the Computerized Maintenance Management System (CMMS) software in particular have been highlighted in this paper. The implementation of the CMMS software helps the maintenance department to move from conducting corrective maintenance to preventive maintenance which not only keeps the organization running more smoothly, but also impact on the safety and quality of life in the organization. Generally, it is much less expensive to maintain something than to fix it when it eventually breaks. The use of preventive maintenance also extends the life span of the equipment. Using the CMMS software for the maintenance of projects generally will ultimately lead to positive achievement of goals and objectives in executing the project; reduce the downtime in the system and ensure a breakthrough.

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