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Performing Maintenance as per Project Management Approach

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Abstract: ***The purpose of this paper is to provide a framework that can identify and evaluate the effectiveness of a lean maintenance strategy. The framework is developed using lean approach and Project Management methods on existing maintenance strategy. The relation between applying the lean approach and maintenance performance was studied and analyzed. A team from diverse backgrounds was assembled to study and analyze different practices in use in various sections within the division. The scope of the paper will focus on applying a new concept to one type of maintenance that is limited to non - outage preventive maintenance activities. Non - outage activities denotes that the feeder or equipment does not require isolation/shutdown. It was found that the framework is applicable and useful for the strategic management of the maintenance function. It is observed that the applied methods have optimized the maintenance strategies in several areas, that is, optimizing the maintenance quality, optimizing the cost of maintenance, optimizing the resources required for the maintenance and reduction of harmful environmental effects.***

Keywords: Maintenance, Transformation, Alignment, Project Management, Lean, Agile

1. Introduction

With the continuous growth of service requirements, the complexity of assets has increased. Therefore, maintenance has become an essential part of the main operations for all services of a world - class organization. Maintenance is a critical part of a facility's operation. Properly maintained equipment and processes are necessary to keep the facility functioning at its optimum capability. "Ref. [1]"

The concept of maintenance started as a simple concept of "When it broke, you fixed it", that is reactive or remedial action to an event, which is called "corrective maintenance". This concept, over the years, has proven ineffective in the long run. It involves a longer mean time to repair duration and eventually leads to losses and, most of all, affects the reputation of the service provider.

Therefore, the need for other maintenance types occurred such as preventive, predictive and proactive maintenance. This is also due to the design of equipment becoming more complex.

With the development of the maintenance concept, equipment manufacturers started to consider maintenance as an essential factor while designing the equipment, as organizations now focus on maintenance processes as an acceptance or rejection point of the equipment.

Currently, the strategy of "Reliability Centered Maintenance" (RCM) is implemented, which is a type of preventive maintenance and is defined as a process or system to evaluate equipment and develop preventive maintenance tasks and frequencies to reduce likely failure modes. "Ref. [2]". RCM is an effective maintenance tool and has proven to deliver positive results for the organization; however, the traditional approach, which is to plan, schedule and execute maintenance on a task basis for all substations is a complex approach with multiple limiting factors.

Applying the RCM strategy over time will provide opportunities to improve the process if certain criteria are taken into consideration, such as travel times, types of activities, vehicle management etc. In fact, there could be opportunities for a transformation from the existing process to a 'Do Maintenance in a Project Management Approach' where there will be a common approach for all maintenance departments which will provide better, more positive results for all concerned stakeholders that is, which functions or people might be affected by the project's activities or outcomes, who will contribute resources (people, space, time, tools and money), and who will use and benefit from the project's output. "Ref. [3]".

2. Transformation Need

All maintenance approaches have as their basis the requirement to keep the facility's assets at whatever capacity level is necessary for their current operational needs. "Ref. [4]".

The power utility environment contains many assets for different purposes; therefore, there are several maintenance activities performed by different parties. The common maintenance process is as follows:

- Each maintenance section will plan the maintenance activities independently.
- Different planning methods will be followed among departments.
- The number of substation visits against activity frequency is not considered in planning.
- Each maintenance team will visit one substation at different times during the year to perform maintenance for all the assets in that particular substation.

- Clashes/conflicts between different departments/sections are not considered during planning, leading to delays.

Based on the above, this process could be improved through:

- Optimizing the number of site visits for maintenance to substations without compromising reliability and without cancellation/reduction of any maintenance activity.
- Introducing one approach for all maintenance sections for planning related activities.
- Optimizing the utilization of tools and instruments during the planning phase.
- Better control of backlogs resulted from unplanned events.

It is expected that by applying this concept, there will be a positive impact on different levels within the organization and will transform the normal maintenance process to a new one.

In addition, there will be opportunities to apply a new way of maintenance management by following an agile approach which will capture an organization's ability to develop and quickly apply flexible, nimble and dynamic capabilities. "Ref. [5]".

3. Transformation Planning

Continuous improvement is an ongoing process of evaluation, constantly looking for the little things that can make a company more competitive. "Ref. [6]" Transformation can be considered as an advanced level of continuous improvement as it is a complete change and it is usually on a larger scale.

Transformation of the normal maintenance process to a new one requires clear planning since there will be a huge impact on all stakeholders. Plans aid coordination and communication, provide a basis for monitoring, are often required to satisfy requirements, and help avoid problems. "Ref. [7]".

In order to achieve this, several steps must be followed:

1) Form a core team to study the existing maintenance process, collect data for all maintenance departments' related field activities, analyze these data and arrange discussions and meetings when required.
2) The concept of the **lean approach** will be implemented at this stage through the following:

a) Define the process map – current state as follows:

- Define all related maintenance processes, which are, in this case: Corrective Maintenance, Preventative Maintenance with outage - related and Preventative Maintenance with non - outage related.
- On each process, define the following: the number of tasks, a description of each task, the department involved in each task and their role.
- For each task, the maximum and minimum time for this task to be performed will be specified in minutes.
- The lead - time, which is the time to shift from one task to the next, will be specified in days.
- List the issues related to each task.

b) Generate ideas for possible solutions.
c) Analyze each idea by identifying the following: Further Explanation, Benefits, Enablers, Risks and Recommended Next Steps.
d) Based on the above, scoring will be provided for each idea with reference to two points: Benefit and Ease of Implementation. The scoring will be from one to five for each point.
e) The highest scoring ideas will be selected for further studies and possible implementation.

3) After completing the above process, the planning process of the selected idea will start in order to implement it. For maintenance transformation, the idea of **Performing Maintenance as per the Project Management Approach** is selected to be implemented. Project Management provides the necessary body of knowledge to convert inputs into outputs. "Ref. [8]".
4) In order to involve the concerned maintenance department and competent engineers, a sub – team must be established to implement the solution.
5) The sub - team will follow the below approach to implement the solution:
   a) Use a scrum framework (Daily meetings to discuss the progress and the next actions).
   b) Agree to run a pilot project (demo) to test the solution and accordingly, select nine substations covering all different scenarios for a one - year duration covering 132kV substations with non - outage preventive maintenance activities.
   c) List all maintenance activities for all maintenance departments, including their duration, vehicle and manpower requirement.
   d) Align the dates for all activities to satisfy the activity requirement.
   e) Provide awareness about the new process to all stakeholders.
   f) Discuss the challenges faced during implementation and suggest ways to overcome them.
   g) Provide monthly progress reports to the core team.
   h) Evaluate the outcome of the project.

6) The planning of the project will be as follows:

- Finalize the monthly plan based on the annual plan.
- Use the SAP system to plan and schedule work orders that contain the activities to be carried out. All related SAP work orders with planned dates for the whole year are prepared and shared with scheduler.
- Shift dates when required to accommodate unplanned events.
- Confirm the availability of outsourced manpower as per plan.
- To avoid close interaction and conflicts, distribute activities over a period of one week

4. Transformation Challenges

As the transformation process was a new concept for the department, there were challenges before, during and after implementing the idea (**Performing Maintenance as per Project Management Approach**).

These challenges were as follows:

1) **Accepting the change:** Any new idea or approach will meet resistance from all levels. The core and sub - team dealt with this challenge through the following actions:
   - Presented the idea with its benefits to the division head in order to take their approval to proceed.
   - Communicated with all concerned department heads to explain the idea and receive their commitments to support the idea.
   - Provided awareness sessions to all stakeholders, including management and staff, to explain the idea and the benefits.
   - Continuous Engagement of all concerned stakeholders through informing higher management, holding direct meetings, awareness sessions and daily scrum meetings.
2) The flexibility of scheduling the activities to the optimum efficiency on a day - to - day basis was affected.
3) Poor coordination between departments.
4) Extension of work by a particular group due to abnormality noticed.
5) **Covid - 19 pandemic:** Covid - 19 forced certain changes, such as ensuring social distancing and less interaction, which affected the number of people working on one site.

This challenge was solved by ensuring planning during alignment in different slots to avoid interaction among employees.

5. Transformation Execution & Implementation

After completing the planning process, the execution phase of execution begins. The following steps ensure the proper execution of the project.

1) Follow **Change Management Approach** by:
   - Identifying the **objective** of the change, that is, changing the maintenance philosophy to be on a divisional level instead of on a departmental level with a single yearly plan.
   - Identifying the **stakeholders** (who will affect/be affected positively or negatively) by the change.
   - Proper **marketing** for the change to all concerned is done through:
2) Conducting meetings with all concerned department heads to apprise the progress and obtain feedback.
3) Conducting awareness sessions with all concerned maintenance departments, managers and staff.
4) Conducting direct meetings with concerned managers and engineers.
   - Identifying **new ways/methods** of doing things, such as conducting daily scrum meetings with all concerned stakeholders.
   - **Training** the staff on the new ways/methods as follows:
5) Each member of a sub - team prepares a plan for all departments for selected months.
6) Awareness sessions for concerned stakeholders.
   - **Monitoring** the implementation of the change and taking corrective and preventive actions through the following:
7) Applying mechanisms for obtaining feedback from all concerned stakeholders.
8) Daily scrum meetings with all concerned stakeholders.
   - Measuring the **effectiveness** of the change by comparing the results before and after and noticing the results of the change.
9) Project Implementation Process:
   - Maintenance work planners follow up with maintenance work schedulers to ensure the availability of required resources.
   - Planners ensure that related SAP work orders are in SCHD status. SCHD status means that the related activities are ready to be carried out at the site with a defined date and time.
   - The Team leader executes the activity in the field and provides feedback.
   - Schedulers complete the SAP work order process.
10) Monitoring & Control:
   - Daily follow - up and progress updates in daily scrum meetings.
   - Schedulers provide their feedback to planners.
   - Planners review feedback and categorize them as positive, issues, future opportunities or not related.
   - Follow up on execution of initiatives and preparation of periodic performance reports such as Project Progress Report and Monthly Progress reports.

6. Transformation Results

Implementing the new approach results in positive impacts being achieved on many levels:
On a **Team** level:

- A new team - based approach for non - outage preventative maintenance.
- Promoting open - mindedness and changing mentality.
- Encouraging big - picture thinking and learning while implementing.

On a **Departmental** level:

- A switch from monthly planning to annual planning.
- Reduced visits to Substations.
- Simplification of resource scheduling.

On a **Divisional** level:

- Centralized planning for all maintenance sections.
- Maintenance is planned for all activities for each substation.
- Thinking at a divisional level without departmental boundaries and limitations.

On **Corporate** level:

- Supporting strategic objectives on corporate level, city level and achieving United Nations Sustainable Development Goals 2030 (Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable).

An effective maintenance strategy involves the overall effectiveness of maintenance and its relationship to the organization's business strategy. "Ref. [9]".

In addition, there are tangible results, to be gained from implementing this new approach:

- Reduction of site visits due to alignment of activities among different sections.
- Time and cost savings due to the reduction of site visits by different departments.
- Reduction in calls to the control center. In the current practice, a visit to any site requires an information update to the control centers.

By applying the new approach, site visits are expected to be reduced, and the number of calls to the control center will be reduced.

This will have a positive impact as it will allow the control center to focus more on other important activities related to the network.

- Vehicle usage optimization. This is due to the alignment of activities so that staff from different sections can use the same vehicle for the site visit.
- CO2 emission reduction. As a result of vehicle usage optimization, a positive environmental effect will be a reduction in CO2 emissions, which is equivalent to planting more trees.
- Cost savings from Centralized Planning and Simplified Scheduling due to the alignment approach of having a clear yearly plan.

The team used the 5S Lean Six Sigma methodology and applied Lean & Agile Thinking using a Process Transformation Framework as follows:

- S1. Sort (remove unnecessary items): Reduction of site visits by limiting them to their frequencies.
- S2. Straighten (organize): Aligning different activities together in planning (GIS, TRAFO and FPS).
- S3. Scrub (clean everything): Annual plan with dates for each activity allows tracking and avoiding backlogs.
- S4. Standardize (standard routine to sort, straighten, and scrub): One plan for all teams for the same activity to enable clear tracking for future improvement.
- S5. Spread (expand the process to other areas): Apply at a Divisional level rather than a Sectional level.

The objective of the lean process is to eliminate unnecessary waste and promote continuous improvement through learning, iterative product development and fast customer feedback loops. “Ref. [10]”.

7. Transformation Lessons Learnt

As this approach was new to the maintenance departments, there were several lessons learnt at different stages:

- Engaging all stakeholders plays an essential role in the success of the initiative through continuous updates and progress reports.
- An effective proposal supported with technical data and benefits always eases the decision - making of top management.
- Forming the right team with the right people for the task is the first step towards success. In addition, employees from different technical fields and different levels can work productively together with good team management.
- Thinking at a divisional level without departmental boundaries and limitations. This will enable better decision - making and deliver better results.
- Higher management empowerment towards the need for change, along with competent teams, will result in big achievements.
- Effective teamwork is a major key to success.

A real case success resulted from applying the alignment concept to the planning of activities for an entity outside the organization’s authority where normally, a special permit was required in advance to work inside this entity.

Previously, each department/section sent their requests on different dates, which led to multi - visit and multi - permit issuing. On many occasions, the working team had to cancel the work scheduled on that date because the permit was not issued on time by the concerned entity.

By applying the alignment concept, the permit requests for all concerned team's activities are sent to the entity at one time, ensuring that work permits are issued on time, and that work proceeds as scheduled.

8. Case Study (Implementation of Alignment Concept)

In Dubai Electricity and Water Authority (DEWA), the Transmission Power Division undertook a project for the implementation of the alignment concept in the concerned maintenance department. Ten sections were involved in this project for a duration of one year.

Nine transmission power substations with a voltage level of 132kV were selected for this project. These nine substations presented different scenarios in terms of asset types, activities performed and frequencies of performing the activities.

The objectives set for this project were as follows:

- Streamlined Planning Processes.
- Standard work for all repetitive processes.
- Resource optimization and simple resource - sharing mechanisms.

The project started with collecting data related to the maintenance activities from all concerned sections with their durations, frequency, manpower and vehicle requirement for each substation as shown in table 1.

Table I: Example of activities for different sections for one Substation

Section	Substation	Activity	Frequency	Manpower	Vehicle
Civil	A	XXX	1 Month	2	1
Telecom	A	YYY	1 Year	1	1
GIS	A	ZZZ	6 Months	2	1
FPS	A	SSS	6 Months	1	1
Security	A	BBB	1 Year	1	1

Table I is an example of activities for different sections with their frequencies. Frequency is the number of times that the activities are performed during the year. For example, the activity (XXX) for Civil is performed on monthly basis

which is twelve times a year. The activity (YYY) for Telecom is performed once a year only.

Manpower requirement is the required number of people to perform the activity. The vehicle requirement means the number of vehicles required to perform this activity.

After collecting this data, the next step was to align the activities in order to examine the possibility of combining the activities. Accordingly, the Alignment Planning Sheet was developed.

From Table I, as an example, it can be seen that there is a possibility of combining Telecom with Security activities and GIS with FPS activities. The next step is to study the duration of the activities to decide whether the combination of activities is possible. Combining activities means that both sections will visit the substation together, using the same vehicle.

Table II: example of alignment of activities for different sections for one substation

Section	Substation	Activity
Security	A	XXX
Telecom		YYY
GIS	A	ZZZ
FPS		SSS

Based on this study, an annual plan was prepared for all nine substations, aligning all activities with the required details. On a monthly basis, all related SAP work orders with planned dates for the whole year were prepared and shared with the scheduler.

Planners followed up with schedulers to ensure the availability of the required resources and all related SAP work orders were scheduled. The activities on field were executed, and schedulers completed the SAP work order process.

The result of this project was positive as there were significant cost savings, in addition to a positive environmental effect, which is mainly the reduction of CO2. These were a result of the reduction in the number of visits to the substations.

The alignment of maintenance activities enhanced the planning and execution of the activities at a divisional level and opened the door to several ideas to improve further, such as automating the process, upskilling of planning across the division, sharing resources and many more that are currently under study.

9. Conclusion

In conclusion, the following recommendations can be listed:

- Transformational ideas for major processes should be part of the organizational culture.
- Any transformational changes in a process should follow a proper change management approach in order to gain the desired results.
- Engagement of all stakeholders is necessary to ensure the success of any transformational change.
- Alignment of activities has a great impact on the organization; however, it should ensure that related activities are not affected.
- Alignment of activities can be applied to all substations in the utility provided that thorough analysis is done by all concerned parties in order to ensure the best alignment.
- Automation of the alignment process can be a great option for developers in order to save time.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

This paper is completely prepared by the authors in terms of gathering the data, analyzing and writing the final version.

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