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ASSESSMENT OF MAINTENANCE PERFORMANCE OF POWER PRODUCT MANUFACTURING INDUSTRY USING CMMS

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Abstract *:* In the global market, it is very difficult for the manufacturing industries to sustain unless they take specific measures for complex maintenance problems due to increase in competition and advancement in technology. To manage maintenance activities without hurdles, a computerized maintenance management system (CMMS) is the right package to be preferred. For managing maintenance materials, assets, and planning, computerized material management, and inventory control, resource and asset management, and computerized maintenance planning and scheduling are significant input factors considered for the case study in the power product manufacturing industry. These factors are chosen after the extensive literature and expert opinions from industry and academia. Evaluating the output of the CMMS performance in terms of profit, income, and sales are collected year-wise in different phases after its implementation. Finally, a decent outcome is achieved due to the effective management of input factors with CMMS implementation.

Index Terms **- Asset Management, Maintenance Management, Computerized Maintenance Management System, MSMEs, Manufacturing Industries, Sustainability, Industry 4.0.**

I. INTRODUCTION

CMMS is a package for handling the complex task of maintenance. It is utilized as a maintenance solution for all organizations or manufacturing industries. CMMS also known as Enterprise Asset Management (EAM) software, is designed to help schedule, plan, manage, and track maintenance activities associated with equipment, machines, vehicles, facilities, assets, and services. CMMS provides a central storage location for the majority of maintenance data and information for assets, manages and controls work and materials management/parts usage processes, and tracks maintenance activity over the lifecycle of an asset. All maintenance activities can be monitored and analyzed through robust CMMS reporting and dashboard tools. CMMS solutions are accessible via mobile devices and tablets these days. CMMS is a well-adopted maintenance solution package in many manufacturing industries large as well as micro, small and medium scale enterprises in India [1-5]. Nowadays the demand for implementing CMMS is growing. According to one business report the demand for CMMS may rise to USD 1.8 billion by 2031. There are many key players of CMMS in the market [23]. Some of the authors applied AHP, VIKOR, TOPSIS, Fuzzy-AHP, and Fuzzy-TOPSIS, multi-criteria decision-making (MCDM) techniques for the selection of CMMS [9, 18, 20, 25].

II. LITERATURE REVIEW

CMMS is an essential requirement for the manufacturing industry to maintain the machines, equipment, services, and asset management system [8]. Many case studies were carried out in gas companies, windmill companies, process industries, and in power systems to see the impact of CMMS in the industries [3, 5, 24, 25]. The new technologies like Internet of things, cloud computing, data analysis, and augmented reality play important roles in the implementation of predictive models with the help of information technology (IT) or information and communication technology (ICT). These technologies are adopted to develop a strong architecture of predictive models. The model follows the principles of Industry 4.0. The framework provided the readiness for guided decision-making to detect the failures, collecting and analyzing for optimizing maintenance work orders [8, 10, 11]. The advantages of CMMS include an easily accessible platform for the search and storage of data. The second utility is automated report generation and analysis as an output capacity. Finally, automatic work order generation and inventory management for reordering the stock when reaches to certain minimum level [22, 24, 25].

When CMMS is not implemented in the industries, many problems originate such as a halt in production which leads to delays in product manufacturing time, increased downtime of the machines, overstock in the stores, and delays in reorders. So, the industries may lose competitiveness and sustainability in the market due to low productivity. Therefore, it is the need of the hour to implement CMMS in the industries for proper maintenance management to achieve the sustainable and corporate goals of the manufacturing industries [16-19].

III. OBJECTIVE

The case study is carried out to validate the impact of maintenance performance after the implementation of CMMS in the manufacturing industries. To analyze how input factors such as computerized material management & inventory control, resource & asset management, and computerized maintenance planning and scheduling affect the output in the form of profit, income, and sales of the industry.

IV. CASE STUDY

A case study is carried out in a power product manufacturing industry. The company manufactures portable generators, water motors, lawn- movers, cutters and agriculture implements. The company has been a leader in the power product manufacturing industry for the last thirty years. The data is collected for the last five years from 2018 to 2023. Input factors data collected from the industry regarding Computerized Maintenance Material and Inventory Control, Computerized Maintenance Planning and Scheduling, and Resource and Asset Management and plotted in the graphical representation. The input factors selected for the case study are chosen from an extensive literature survey [26-36] and the expert views from industry and academia. The ranking of the input factors is also done through the MCDM techniques which are explored from the literature [37-53] and applied accordingly. Also, the graphs were plotted for profit, sales, and income of the industry. The description and presentation of the input factors and output factors are explained as follows.

CMMIC: Computerized Material Management & Inventory Control

It has been observed in Figure 1 that the improvements in computerized material management and inventory control are taking place annually in different phases from 2018-2023 after accepting CMMS in the power product manufacturing industry. That is the overall decrease in the inventories concerned with maintenance. This turned out to be a significant cost savings in the industry. The inventory stocks optimized from 72% to 16% in five years.

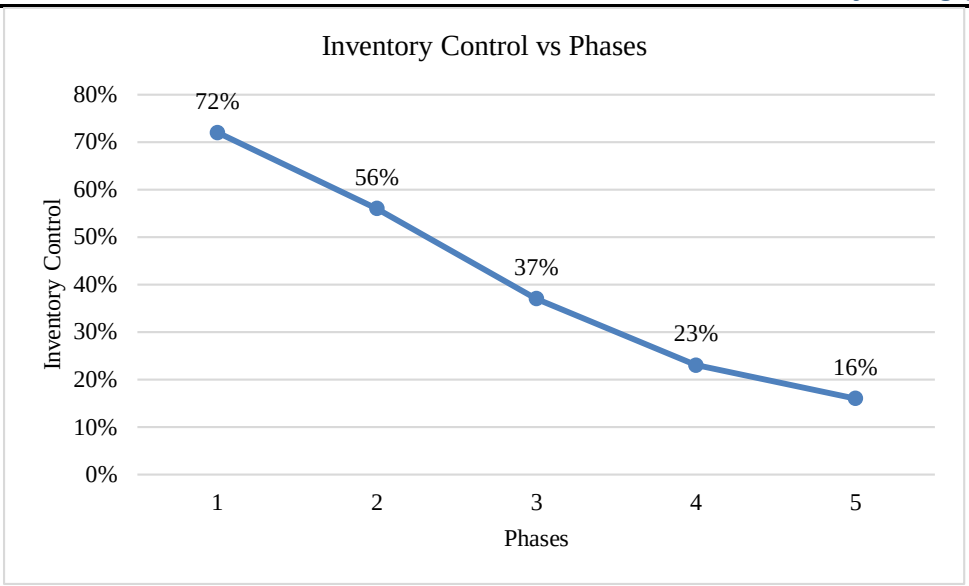

Figure 1: Inventory Control vs phases

RAM: Resource & Asset Management

It has been observed from figure 2 that the improvements (that is overall decrease in the average failure rate of the assets) in computerized asset management and resource management are taking place in phases from 2018-2023 after adopting CMMS in the manufacturing industry. This is observed that annual failure rates are controlled from 48% to 10% in the five years.. This factor also turned out to be substantial cost savings in the industry because increase in the availability in the system.

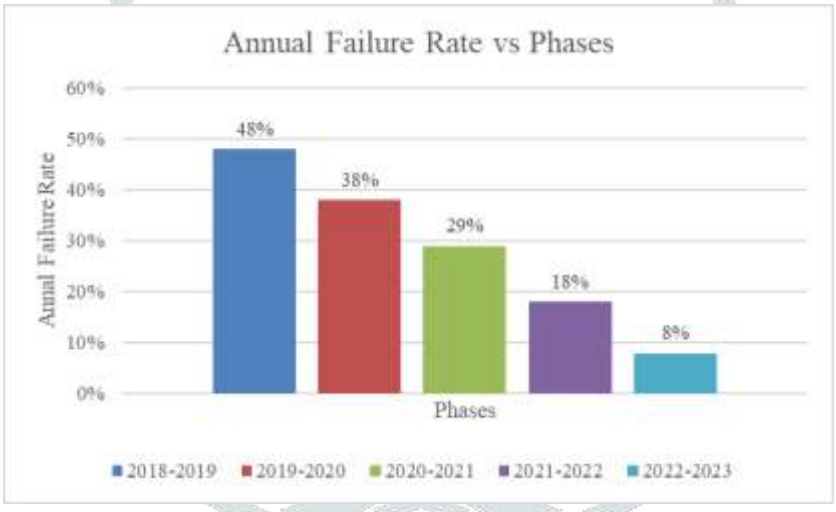

Figure 2: Annual Failure rate vs phases

CMPS: Computerized Maintenance Planning & Scheduling

The figure 3 exemplifies the progression of executed and planned work orders over five phases from 2018-2023. With the implementation of computerized planning and scheduling, the initial two phases had success rates of 45% and 58%, the rates improved further rising to 69%, 80%, and 88% achieved in the third, fourth, and fifth successive years in the subsequent phases. The adoption of CMMS further enhanced planning and scheduling performance, leading to reduced asset downtime and increased worker productivity in the industry.

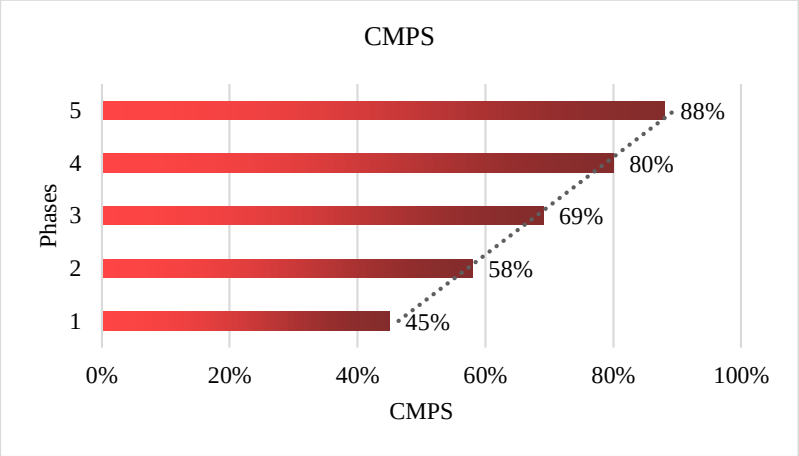

Figure 3: CMPS vs phases

Income

The income collected (in thousands of units) from the annual reports of the company is shown in Figure 4 below. Then a graph is plotted between income and phases in year wise during 2018-2019, 2019-2020, 2020-2021, 2021-2022, and 2022-2023 and it was found Rs 3379, Rs 3334, Rs 3211, Rs 3975, Rs 4278 respectively.

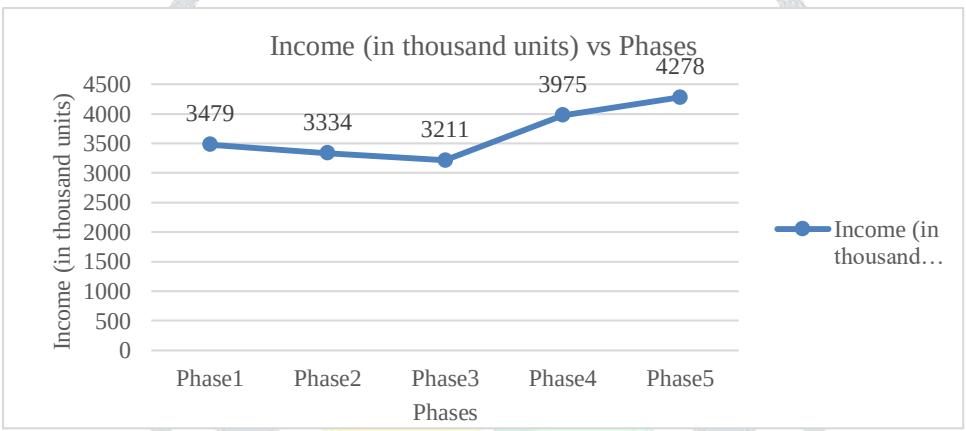

Figure 4: Income vs phases

Sales Output

It has been observed visibly from the above figure 5 that the progress in sales output (in thousands of units) is taking place in different phases from 2018-2023 after adopting CMMS in the manufacturing industry. This data collected for the sales output for the last five years and a graph is plotted between sales and phases year that is during 2018-2019, 2019-2020, 2020-2021, 2021-2022, and 2022-2023 and it was found Rs 3772, Rs 3506, Rs 3418, Rs 4217, Rs 4764 respectively. It is showing growth almost in all the phases except the COVID-19 period.

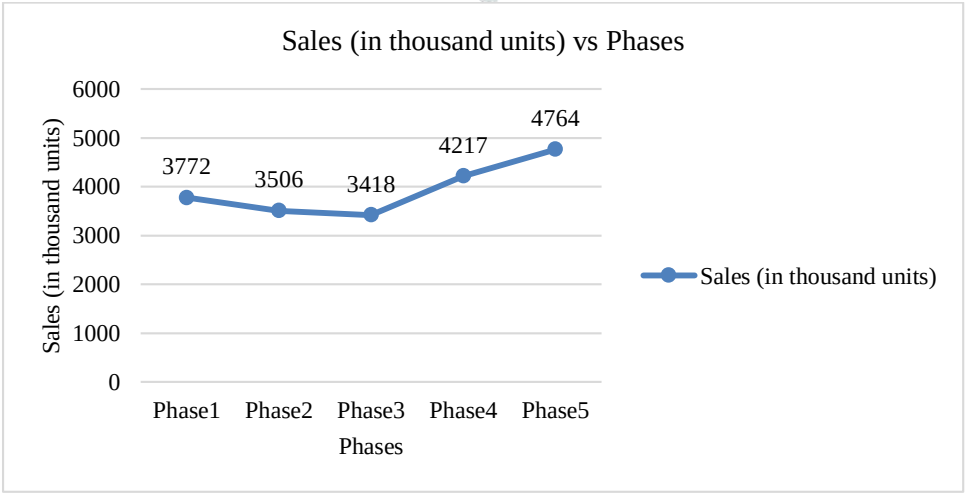

Figure 5: Sales output vs phases

Net Profit

It has been observed evidently from the figure 6 that the profit growth is taking place annually in different phases from 2018-2023 after implementing CMMS in manufacturing industry.

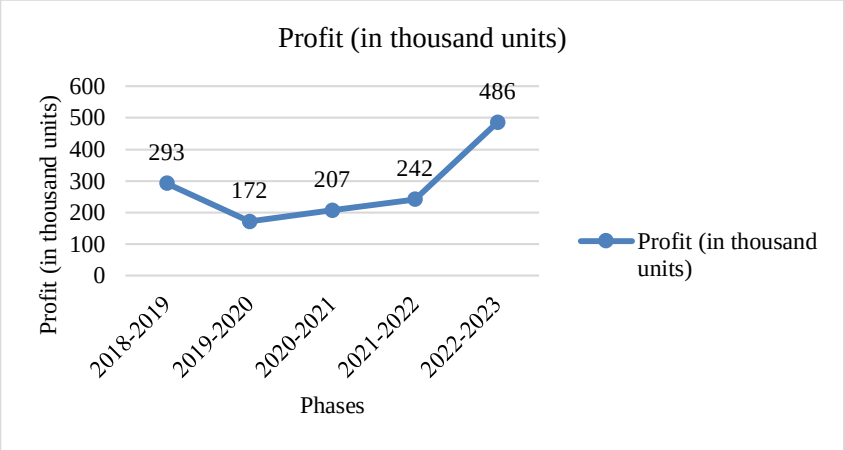

Figure 6: Profit vs phases

V. Limitations and Future Scope

I. Machine learning and deep learning along with Artificial intelligence adapted for future developments.

II. This case study is confined to north India only.

III. The study can be done in all parts of the country and other countries for better generalization of results.

IV. Further, an energy management system can be incorporated.

VI. Conclusion

From the above case study analysis, the trend of growth in the output factors is observed in the form of improvement in sales, income, and profit except in the Covid-19 period. This is possible with the smart management of input factors, resource & asset management, material & inventory management, and maintenance planning & scheduling through CMMS. Consequently, CMMS made a significant contribution to the growth of the manufacturing industry. As a result of the increase in maintainability and availability, leads to an increase in productivity due to lower failure rates, better inventory control, better asset management, and an increase in profitability. Thereafter, competitiveness and sustainability can be achieved.

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