



Analysis of the Shortcomings and Improvements in the Maintenance and Upkeep of Machine Equipment Throughout Its Life Cycle

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Abstract. In recent years, with the further development of China's economy, machinery and equipment have also begun to be widely used. Machinery and equipment can not only greatly improve industrial production efficiency, but also drive the further development of China's economy. Equipment life cycle management refers to the entire process of equipment procurement, acceptance, and operation, including archive management, value accounting, depreciation provision, use, maintenance, repair, measurement calibration, inventory, leasing, allocation, and disposal. Maintenance and upkeep is one of the important links in the entire life cycle of machinery and equipment. The quality of maintenance and upkeep is closely related to the service life of the machinery and equipment. Timely and correct maintenance and upkeep of the machinery and equipment can effectively reduce the incidence of accidents in the production process, avoid economic losses caused by the inability of the machinery and equipment to operate, and comprehensively improve the management level of the machinery and equipment, Enable enterprises to generate greater economic benefits.

Keywords: Machinery and Equipment · Maintenance and Upkeep · Full Life Cycle Management

1 Introduction

For enterprises, equipment and production are complementary. Equipment is the foundation for ensuring production volume and completing production tasks. Only when the machinery and equipment are in good operating condition can production goals be achieved and exceeded. Among them, maintenance and upkeep work is particularly important during the use of the equipment. With the rapid development of automation and intelligence in China, the structure and function of modern machinery and equipment have been greatly improved. Strengthening the maintenance and upkeep of machinery and equipment can not only extend its service life but also reduce the failure rate. This not only ensures the stable operation of machinery and equipment, but also further reduces the delay in work progress caused by machine failures [1]. Therefore, in the actual use of machinery and equipment, enterprises must strictly follow the operating procedures to

use them correctly, continuously strengthen the management and maintenance of engineering machinery, comprehensively improve the management level of machinery and equipment, implement the maintenance and upkeep of machinery and equipment, and create greater value for the business efficiency of the enterprise.

2 The Concept and Significance of Equipment Maintenance and Upkeep

The maintenance and upkeep of machinery and equipment refers to the cleaning, inspection, lubrication, fastening, and adjustment of maintenance work carried out within a certain time cycle to compensate for the losses caused by equipment operation [2]. Generally, the equipment is operated by simple personnel, while external professionals carry out professional operations.

Machine equipment management is the fundamental work of enterprise production and operation management, an important way to improve enterprise economic efficiency, a prerequisite for safe production, and an important condition for long-term development of enterprises. Only by strengthening equipment management, strictly following operating procedures to use equipment, meticulous maintenance, monitoring of equipment status, and scientific optimization and transformation, can the equipment be in good condition to ensure the continuous and stable operation of enterprise production. In order to fully extend the service life of the equipment and effectively reduce its wear rate, it is necessary to manage and maintain the machinery and equipment [3].

3 Problems in Maintenance and Upkeep of Machinery and Equipment

3.1 Management System and Assessment Requirements Are not Standardized

Modern production and manufacturing enterprises face significant operational pressure and heavy production tasks. The core focus of the enterprise is mainly on business operations, which inevitably overlooks the integrity and applicability of the machinery and equipment management system. The maintenance and upkeep of machinery and equipment have not been given sufficient attention, and there is no clear regulation of relevant management systems. Moreover, there is no complete incentive system and assessment method in the management system. The underlying management foundation is not solid, and the incentive and assessment methods are not clear, resulting in poor implementation of machine and equipment maintenance and serious equipment failures.

3.2 Unreasonable Use of Machinery and Equipment

Most enterprises have situations where their machinery and equipment are not used, overused, or overloaded after purchase. Some equipment is put on hold due to unsatisfactory processes, technical indicators, and other factors, while others operate continuously or with faults for a long time after purchase [4]. This not only wastes resources, but also seriously affects the equipment's load-bearing capacity, causing damage to the equipment to a certain extent and affecting its service life. This increases the cost investment of the project [5].

3.3 Insufficient Awareness and Professionalism of Operators in Managing and Maintaining Machinery and Equipment

In recent years, with the continuous development of science and technology in China, the automation and intelligence level of machine equipment has further improved. The maintenance and upkeep of equipment requires high-level technical personnel to operate. The existing operating methods and knowledge concepts of ordinary equipment maintenance personnel are no longer able to meet the needs of modern machine equipment maintenance and upkeep. Usually, after the equipment is purchased, only simple operation and maintenance training is provided to the relevant maintenance personnel. The details and proficiency of maintenance are poor, and problems cannot be detected in a timely manner during the operation of the machine and equipment. Once problems are discovered, they cannot be dealt with and resolved in the first time, resulting in frequent machine and equipment failures and even stopping operation. In addition, operators lack awareness of the management and maintenance of machinery and equipment, and even fail to strictly follow relevant standards and specifications to use the equipment, resulting in increasingly serious equipment wear and tear problems and a reduction in the service life of the equipment [6].

4 Result and Evaluation of Equipment Maintenance Execution Work

The specific maintenance standards for machinery and equipment can be divided into three aspects: good maintenance, qualified maintenance, and unqualified maintenance [7]. This article takes a certain enterprise as an example and selects a total of 12 departments with a high proportion of equipment for analysis.

4.1 Research Example Background

The enterprise has 245 sets of equipment assets worth over one million yuan, of which 131 sets have formulated an annual maintenance plan, accounting for 53%, and the plan execution rate is 75%.

4.2 Analysis of the Development and Execution of Equipment Maintenance Plans

The development rate of equipment asset maintenance plans for departments 6, 8, and 11 million yuan or more is over 95%, and the plan development is in good condition. The development rate of equipment asset maintenance plans for departments with over 7 million yuan is 62%, which is higher than the average. Department 1, Department 2, Department 3, Department 4, Department 5, Department 9, Department 10: The development rate of equipment asset maintenance plans with a million yuan or more in seven departments is lower than the average, and the plan development is poor.

The implementation rate of maintenance plans for departments 1, 5, 6, 7, 8, 9, 10, and 11 has all reached 100%, with good performance. The average implementation rate of maintenance plans for departments 2, 3, and 4 is only 30%. The implementation of

equipment asset maintenance is poor, and planned maintenance should be strictly implemented to maintain the equipment in good condition. The following Table 1 displays the execution status of the maintenance plan.

The development and execution rate distribution of equipment asset maintenance plans for each department is shown in Fig. 1.

Table 1. Statistical Table of Equipment Asset Maintenance Plan

Statistical Table for Maintenance Plan of Equipment Assets above Million RMB					
Department	Quantity (set)	Maintenance Plan Development Status		Maintenance Execution Status within the XX Annual Plan	
		Planned (set)	Proportion of Maintenance Plan Development (%)	Maintenance Quantity (set)	Maintenance Execution Rate (%)
Department 1	19	5	26	5	100
Department 2	60	26	43	5	19
Department 3	30	11	37	6	55
Department 4	30	10	33	3	30
Department 5	12	4	33	4	100
Department 6	7	7	100	7	100
Department 7	21	13	62	13	100
Department 8	38	37	97	37	100
Department 9	6	2	33	2	100
Department 10	9	3	33	3	100
Department 11	13	13	100	13	100
Total	245	131	53	98	75

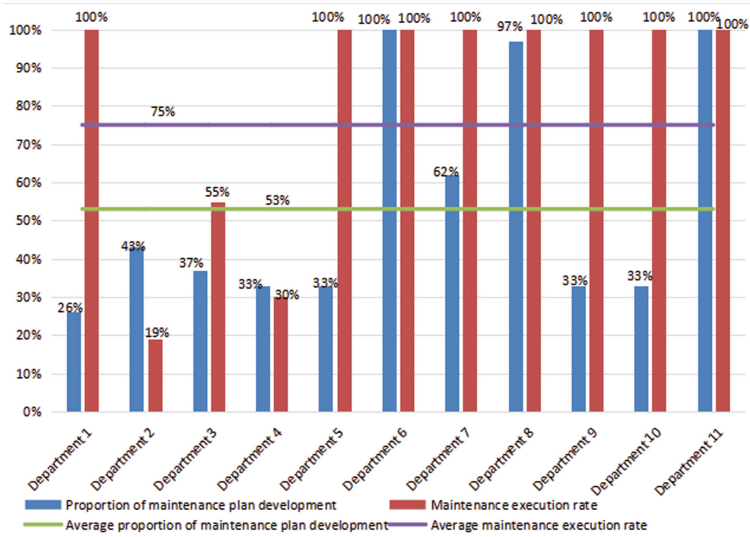


Fig. 1. Development and execution rate distribution chart of equipment asset maintenance plan

5 Countermeasures for Strengthening the Maintenance of Machinery and Equipment

5.1 Establish and Improve the Management System for Machinery and Equipment

In the entire life cycle management system of machinery and equipment, maintenance is an indispensable link and plays an important role and value in the management of machinery and equipment. Enterprises should establish a complete machinery and equipment management system, with consistent planning and dedicated personnel responsible for comprehensive management, clear responsibilities and authorities, establish a complete incentive system and assessment methods, fully leverage and mobilize employees' work enthusiasm, and use strict systems to constrain and manage personnel, so that the management and maintenance of machinery and equipment are highly valued and ensure the normal operation of machinery and equipment, Implement strict management of machinery and equipment, effectively control the operation and maintenance costs caused by machine equipment failures [8].

5.2 Enhance the Relevant Abilities of Machine Equipment Users

The use of machinery and equipment involves various aspects of the entire life cycle, including equipment management personnel, users, maintenance personnel, etc. The characteristics and responsibilities of each position are different. Only by establishing a clear and clear equipment management system, clarifying the responsibilities of personnel in each position, coordinating actions, closely cooperating, and operating and

assessing according to the system requirements, can we first establish a clear and effective equipment management system, Only in this way can we ensure the orderly progress of all aspects of the entire lifecycle of machinery and equipment.

Secondly, the automation level of modern machinery and equipment is increasing day by day. Personnel involved in the use of equipment should abandon their old and outdated thinking, treat new equipment with new ideas, perspectives, and methods, and scientifically carry out comprehensive maintenance and upkeep of the machinery and equipment.

Finally, enterprises should strengthen personnel training, regularly organize professional training, select more outstanding talents, and provide corresponding technical support for the development of the enterprise [9]. New employees should receive standardized training to have a comprehensive understanding and understanding of machinery and equipment, strictly follow operating procedures during use, and carry out maintenance work according to plans. Old employees also need to strengthen their training efforts, gradually shifting from the use and maintenance methods of equipment with lower mechanization to the use and maintenance methods of equipment with higher automation. Only in this way can personnel involved in equipment use and maintenance gradually adapt to the current situation of continuous updates and iterations caused by technological updates, and better learn, understand, and use equipment.

5.3 Strengthen the Inspection and Assessment of the Execution of Machine and Equipment Maintenance Plans

Based on the management system of machinery and equipment, formulate daily maintenance and annual comprehensive maintenance plans for machinery and equipment in the fourth quarter of each year, and submit them to relevant management departments. The machinery and equipment management department has the responsibility of supervising and inspecting the implementation of maintenance and upkeep of machinery and equipment, and supervising and conducting on-site inspections based on the maintenance schedule, and reporting the inspection results. Incorporate the results of the maintenance and upkeep of machinery and equipment in each department into the assessment system, conduct a comprehensive assessment of the work attitude and professional ability of relevant personnel, with a clear reward and punishment system and efficient execution, constrain the behavior of personnel responsible for machinery and equipment, supervise work execution, mobilize work enthusiasm, form a virtuous cycle of regular maintenance and upkeep, reduce equipment failure rate, and ensure equipment integrity, To further enhance the production and operation of enterprises and create greater economic benefits.

Production enterprises can conduct statistical analysis on the implementation of equipment maintenance and display it using trend charts. The completion rate of equipment maintenance refers to the ratio of the number of completed equipment sets to the total number of planned equipment sets. *The following Table 2 displays the analysis report on completion rate of equipment maintenance plan.*

Table 2. Analysis report on completion rate of equipment maintenance plan

XXX Company Analysis Report on Completion Rate of Equipment Maintenance Plan													
Annual	2022		Department		XX department		Statistical date		2023.1.1		Formula	Number of Equipment that has Completed Maintenance/Total Number of Planned Equipment Sets	
	January	February	February	March	April	May	June	July	August	September	October	November	December
Month	January	February	February	March	April	May	June	July	August	September	October	November	December
Target Value	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Actual Value	80%	90%	90%	60%	70%	50%	100%	80%	80%	50%	60%	70%	90%
Number of Equipment Maintained According to Plan													
Number of Planned Maintenance Equipment Required													

(continued)

Table 2. (continued)

XXX Company Analysis Report on Completion Rate of Equipment Maintenance Plan																																																		
Annual	2022	Department	XX department	Statistical date	2023.1.1	Formula	Number of Equipment that has Completed Maintenance/Total Number of Planned Equipment Sets																																											
Month	January	February	March	April	May	June	July	August	September	October	November	December																																						
<table border="1"> <caption>Trend Chart of Maintenance Plan Completion Rate</caption> <thead> <tr> <th>Month</th> <th>Actual Value (%)</th> <th>Target Value (%)</th> </tr> </thead> <tbody> <tr><td>January</td><td>85</td><td>100</td></tr> <tr><td>February</td><td>90</td><td>100</td></tr> <tr><td>March</td><td>80</td><td>100</td></tr> <tr><td>April</td><td>95</td><td>100</td></tr> <tr><td>May</td><td>55</td><td>100</td></tr> <tr><td>June</td><td>65</td><td>100</td></tr> <tr><td>July</td><td>105</td><td>100</td></tr> <tr><td>August</td><td>90</td><td>100</td></tr> <tr><td>September</td><td>75</td><td>100</td></tr> <tr><td>October</td><td>65</td><td>100</td></tr> <tr><td>November</td><td>75</td><td>100</td></tr> <tr><td>December</td><td>95</td><td>100</td></tr> </tbody> </table>												Month	Actual Value (%)	Target Value (%)	January	85	100	February	90	100	March	80	100	April	95	100	May	55	100	June	65	100	July	105	100	August	90	100	September	75	100	October	65	100	November	75	100	December	95	100
Month	Actual Value (%)	Target Value (%)																																																
January	85	100																																																
February	90	100																																																
March	80	100																																																
April	95	100																																																
May	55	100																																																
June	65	100																																																
July	105	100																																																
August	90	100																																																
September	75	100																																																
October	65	100																																																
November	75	100																																																
December	95	100																																																
Trend Analysis																																																		
Cause Analysis																																																		
Improvement Measures																																																		

The calculation method for the completion rate of equipment maintenance plan is shown in formula 1:

$$\begin{aligned} & \text{Equipment maintenance completion rate} \\ & = 100\% * \frac{\text{Number of equipment that has completed maintenance}}{\text{Total number of planned equipment sets}} \end{aligned} \quad (1)$$

5.4 Centralized Maintenance and Upkeep of Machinery and Equipment During High Temperatures

Most manufacturing enterprises have heavy tasks and are unable to allocate a significant amount of time for downtime maintenance. Enterprises can utilize the annual high temperature holiday period in the third quarter to organize relevant maintenance personnel or external maintenance companies to shut down for comprehensive maintenance work, which not only avoids delaying production but also meets the urgent needs of equipment maintenance work.

6 Conclusion

Machinery and equipment are the foundation of enterprise production and operation, and are key resources for creating benefits for enterprises. Strengthening the full life cycle management of machinery and equipment is particularly important. Only by establishing a sound management system and incentive measures for machinery and equipment, strengthening the training of personnel related to equipment use and management, exploring advanced maintenance methods and technologies, sorting out machinery and equipment maintenance plans in advance, and executing them according to the plan, strengthening supervision and assessment during the process, and clear rewards and punishments after the process, can enterprises maintain efficient operation of machinery and equipment for a long time, which helps to improve equipment reliability, Reduce maintenance costs, maintain equipment performance, reduce failure rates, reduce downtime, extend equipment service life, ensure normal operation of equipment, and effectively improve the economic benefits of the enterprise [10].

In short, only by ensuring the good and stable performance of the machinery and equipment can the safety and operational efficiency of the machinery and equipment in use be ensured, and the achievement of the project schedule and quality objectives be ensured [11].

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