

Research and Exploration of Automatic Maintenance of Mechanical and Electrical Engineering

Chunjuan Zhang^{1, a} Feng Wang² Liangqun Si¹

¹The elevator and Internet school, Chongqing Energy College, Chongqing 402260, China.

²Chongqing Hongyu Seiko Co., Ltd. 400000, China.

^aZhangchunjuan323@126.com

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Abstract. In recent years, the rapid development of mechanical and electrical engineering automation technology. Especially in computer technology has been fully applied in the mechanical and electrical industry, to achieve the automation of the maintenance of the mechanical and electrical industry, greatly enhance the development level of maintenance automation in the mechanical and electrical industry. This article briefly analyzes the development status of mechanical automation technology, clarifies the shortcomings still existing in mechanical automation technology, and makes clear the advantages of the application of automatic maintenance technology of mechanical equipment, and explores the future of mechanical equipment automation maintenance technology. Direction of development.

1. Analysis of the Development Status of Mechanical Automation Technology

At present, the level of mechanical automation technology in China still has a big gap with other countries. Moreover, the development of mechanical automation in China is still in its infancy, and many advanced automation technologies have not been well utilized in the mechanical field. In addition, China's mechanical automation technology is currently mainly concentrated in the two directions of intelligence and automation, and the combination of mechanical technology is not close enough, the development of mechanical technology in our country is relatively slow, and many advanced theories are introduced from other countries. However, China's current research on mechanical theory is still relatively weak. The mechanical staff's own comprehensive quality is not high, lack of innovation and innovation, and lack of practical ability, so that the development of mechanical and electrical automation in China has been constrained by the development speed of mechanical technology [1]. The field of mechanical automation must have a higher standard of product quality and function. Although China's mechanical automation technology has made great progress compared to the past, it still needs to be improved in many aspects, and it still has a long way to go in terms of development [2].

2. Application Advantages of Mechanical Automation Technology

2.1 The Improvement of Production Efficiency and Production Level

The application of mechanical equipment automation technology in the mechanical maintenance industry can effectively improve the production efficiency and production level of mechanical equipment. This is because automation technology possesses unparalleled accuracy and sensitivity of human beings and can perform very flexible mechanical equipment operations. Greatly enhanced the performance of mechanical equipment, making the products produced by mechanical equipment more perfect, and greatly reduced the time for mechanical equipment to produce products, thereby greatly enhancing the production efficiency of mechanical equipment and achieving the rapid development of the mechanical industry [3].

2.2 Reliability and Security Improvement

The reliability and safety of mechanical equipment are very important. If the reliability of mechanical equipment is insufficient, mechanical equipment will often cause failures, which will increase maintenance costs and greatly affect the production efficiency of mechanical equipment. However, if the safety of mechanical equipment is insufficient, there will be many hidden safety hazards in production, which may cause safety accidents when people use mechanical equipment, which seriously threatens the life safety of operators. Mechanical devices are not only used in the manufacturing industry, but also widely used in other fields. However, in any field where mechanical devices are used, the reliability and safety of mechanical devices must be guaranteed. Automation technology greatly enhances the safety and reliability of mechanical equipment. The reason is that automation technology can perform real-time automatic monitoring of the operating status of the equipment. Once the mechanical equipment fails, it will be diagnosed immediately and set the emergency procedures to solve the problem, which greatly protect the safety and reliability of mechanical and electrical equipment [4].

2.3 More Complete and Diverse Functions, More Applicable

The effective application of automation technology in mechanical equipment can make the functions of mechanical equipment more complete and more diversified and can meet the production of products in different processes, so its applicability is also stronger. This is because the application of different automation technologies in mechanical devices can enable mechanical devices to integrate multiple different functions and achieve integrated control, verification, compensation, and adjustment functions to meet the application of mechanical devices in different fields. Demand, its application range is more extensive [5].

2.4 The Development Direction of Mechanical Automation Technology

In the future, mechanical automation technology will surely develop in the direction of intelligent development. This is due to the limitations of the machine. Because the machine requires mankind to operate, it will not perform autonomous thinking and will only operate in accordance with the prescribed procedures. Although the automation technology realizes the automatic operation of the machine [6], it still requires people to perform simple operations. The automation technology also does not have the ability of thinking and data processing. However, through intelligent research on automation technology, people can effectively make up for this deficiency, so that automation technology has certain functions of people, enabling them to process and analyze data, thereby greatly reducing the difficulty of product production and achieving Intelligent control of equipment, and the direction of development of intelligent will also greatly improve the level of development in the field of mechanical [7].

3. Measures to Improve Maintenance and Management of Mechanical Equipment

3.1 Establish a Complete Mechanical and Electrical Equipment Maintenance Management System

In the maintenance of mechanical and electrical equipment companies can develop a scientific management plan and system maintenance plan. When formulating maintenance plans for mechanical equipment, enterprises must proceed from the actual conditions of the company's possession of mechanical equipment, conduct in-depth familiarization and understanding of the components of the company's internal mechanical equipment, and perform statistics on failures of mechanical equipment during operation. After a company has established a good management plan and an overhaul plan, it can use it as a basis to summarize the actual mechanical and electrical equipment maintenance and management system suitable for the company's mechanical and electrical maintenance and management. Afterwards, the company must analyze and study the status of mechanical equipment during the maintenance and management of mechanical equipment and formulate maintenance and management strategies for mechanical equipment at different time periods. In the process of implementation of the system and strategy, the company must continuously analyze the maintenance and management of the mechanical and electrical equipment, find out the

deficiencies in the system and strategy, and then formulate scientific response measures to make up for the lack of systems and strategies. In addition, there are special requirements for different types of mechanical equipment in the maintenance and management of mechanical equipment. In this regard, the company can adopt planned maintenance or on-site maintenance to complete special inspections. Among these two types of maintenance methods, planned maintenance can predict the failure of mechanical equipment and provide guarantees for the normal operation of mechanical equipment. When on-site inspection, maintenance personnel perform maintenance work at the equipment working site and can maximize the maintenance the role of work.

3.2 Improve Management

The maintenance and management of mechanical equipment need to consider many factors, not only to find the fault on the mechanical equipment, but also to find the root cause of the fault, the location of the fault, etc., only to find these contents Come out, carry on the scientific comprehensive analysis research to be able to establish a comprehensive and efficient maintenance management system in the maintenance and management of mechanical and electrical equipment. This maintenance management system can link mechanical equipment from design to production and work from each stage of use to maintenance, making the maintenance and management of mechanical equipment more systematic and comprehensive. During maintenance and management of mechanical equipment, it is necessary to note that there are no equipment failures, causes of failures, and other problems.

4. A New Mechanical Equipment Maintenance Model

A new model for maintenance decisions that combines mechanical equipment and automation. This model establishes an intelligent maintenance decision support system through intelligent technologies such as artificial neural networks and mechanical equipment maintenance systems. The feature is that it can comprehensively consider various factors that affect the working status of the equipment and realize intelligent maintenance decisions. This reduces equipment failures, extends equipment life, and reduces maintenance costs.

4.1 Use of Mechanical Equipment Maintenance System to Achieve Maintenance Decision - Making

The knowledge base consists of seven rule bases: a reliability decision rule base, a maintainability decision rule base, a monitor ability rule base, an economic decision rule base, a maintenance logistic ability judgment rule base, a maintenance mode selection rule base, and a control rule base. The first six rule bases store factual knowledge, and the last rule base holds rule control knowledge. The multi-user library facilitates the management of knowledge and improves the efficiency of reasoning. The reasoning method uses forward reasoning, and the rules in the fact memory and the rule base in the working memory are matched under the conflict resolution strategy, and a conclusion is drawn. Through the knowledge of the first six rule bases, the reliability, maintainability, monitor ability, economy, and logistic support capabilities of the equipment are determined. Then, based on these intermediate conclusions, the rule library is selected by way of reasoning to obtain an optimized maintenance. the way.

4.2 The Steps for Solving the Optimal Maintenance Cycle Are as Follows:

- (1) Presume an overhaul cycle based on experience;
- (2) According to the fault distribution function $F(t)$, the repair time distribution function $FMC(t)$ and the overhaul time distribution function $FPT(t)$ perform random sample sampling.
- (3) Calculate the number of random failures N during the T period;
- (4) Substituting hypothetical overhaul cycles and special random numbers obtained by random sampling:

$$A = \frac{T}{T + \sum_{j=1}^N M_{CTj} + M_{PT}}$$

4.3 Implementation of Device State Prediction

In the condition monitoring of equipment, commonly used prediction methods include principal component analysis, regression prediction, deterministic time series prediction, time series model, neural network, and Grey theory. The first four methods are traditional methods. The use of factor analysis and statistical methods for prediction has a good prediction effect on linear systems, but it is not suitable for the prediction of nonlinear systems. Studies have shown that most of the complex machinery and equipment nowadays do not meet the "maintenance probability line". The faults are random and have strong nonlinear characteristics. Therefore, the traditional prediction methods are not applicable. The neural network has a strong capability of approaching nonlinear mapping, as well as self-learning, self-organization and self-adaptability.

Table 1. Statistics Statistical Analysis of Mechanical and Electrical Equipment Failure Information.

No.	Failure form	General failure	Complex fault	General fault	Serious failure	Downtime	Rating	Failure factor	Occurrence probability	Severity
1	Gear failure	6	7	8	12	8	3062	0.4532	0.15	0.4625
2	Link failure	4	6	4	9	9	5900	0.0900	0.45	0.4265
3	Brake failure	5	6	2	8	10	2000	0.0312	0.36	0.2545
4	Transmission failure	3	2	10	7	6	1340	0.0215	0.05	0.0512
5	Bearing failure	6	8	7	8	5	2560	0.4035	0.16	0.4236

5. Formulation of Selection Strategies for Maintenance Methods of Mechanical Equipment

Through the above analysis, it can be seen that maintenance of mechanical equipment, whether on the maintenance surface, technically, or economically, does not occupy absolute advantages over regular maintenance, and it cannot replace regular maintenance methods, let alone become The omnipotent maintenance method, therefore, under the existing technical conditions, only the scientific formulation of mechanical and electrical equipment maintenance method selection strategies, identify the maintenance methods that meet the operating conditions of mechanical equipment, can play the biggest advantage of various maintenance methods, output mechanical The most economical equipment.

5.1 Mechanical Equipment Maintenance Probability Line

Through the statistical analysis of mechanical and electrical equipment faults, the mechanical and electrical equipment failure rate curve can be obtained, which is called the mechanical and electrical equipment maintenance probability line. This curve divides the range of mechanical and electrical equipment failure rates over time into three areas: early failure period, accidental failure period, and depletion failure period. In the early failure period, the so-called break-in period, the initial failure rate during this period is very high, but as time goes by, the failure rate drops rapidly, and the failures that occur are mainly due to design, manufacturing defects, or improper use. Inflicted; into the accidental failure period.

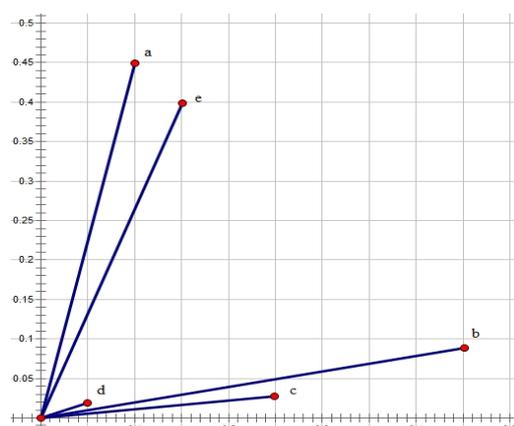


Fig 1. Mechanical and electrical equipment maintenance probability line.

5.2 Selection of Maintenance Methods for Mechanical Equipment

(1) Statistical mechanical Equipment Failure Information

mechanical equipment failure information includes statistical data on the number of failures (stop frequency) and failure consequences (downtime, economic losses, etc.) of mechanical equipment. The information collection period is preferably one year. The collection period is taken from the smooth section of the occasional fault area of the maintenance probability line. After the collection is completed, draw the relationship between the shutdown time and the shutdown frequency of the mechanical equipment by referring to the maintenance probability line.

(2) Primary maintenance method based on statistical results

For the mechanical equipment with long downtime and high frequency of shut down, initially selected for maintenance or improved maintenance; for mechanical equipment with low downtime, but requiring a longer downtime once the machine is shut down, the mechanical equipment for the primary election; high frequency of shut down, mechanical equipment with short downtime, primary repairs afterwards or improved maintenance; mechanical equipment with short downtime and low frequency, primary maintenance afterwards.

(3) Analysis of the importance of mechanical equipment

The role of different mechanical devices in the production process is not the same. The mechanical and electrical equipment that has a large impact will have a major impact on the production process in the event of an outage. Therefore, this type of equipment is required to have a very high reliability, and the maintenance is based on reliability. Therefore, mechanical and electrical equipment maintenance should be preferred. If the conditional technology or mechanical and electrical equipment maintenance conditions are not mature, maintenance will be carried out during the selected period. When the maintenance efficiency is not high, the maintenance will be improved and preventive measures will be taken.

(4) Selected mechanical and electrical equipment maintenance methods

By considering and optimizing the combination, the economical and safe maintenance method can be selected. It is worth noting that the selection of maintenance methods is not static. With the different stages of the life cycle, the maintenance methods will change or even adjust.

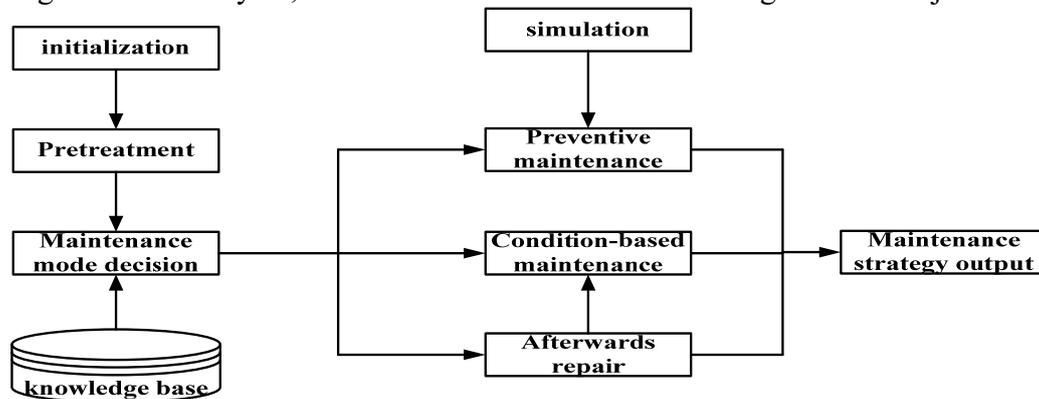


Fig 2. Mechanical and electrical design automation maintenance model work flow.

5.3 Future Directions for Maintenance of Mechanical Equipment

Networking In the information age, the importance of the network is self-evident, but for the mechanical industry, it is even more necessary to move toward the development direction of the network, to realize the concept of network integration of mechanic in the future. A small device can certainly be used to remotely control mechanical equipment for production activities, and this device can provide real-time control of the operating status of each mechanical device, thereby greatly improving production efficiency. **Miniaturization** Because of the large size and complex structure of some production equipment, this has increased the difficulty of transportation and management of these production equipment, and it has also been difficult to repair and maintain this equipment. Therefore, the volume of these production equipment must be reduced. Make the necessary reductions to facilitate transportation, repair, and maintenance. With the continuous development of technology, the volume of these production equipment will be smaller and smaller, and eventually

achieve the goal of miniaturization. This will not only facilitate the transportation, inspection and maintenance of these production equipment, but also in the same scope. Place more production equipment inside to increase productivity.

6. Conclusion

Conclusion This article made a brief analysis of the status of the development of mechanical automation technology, clarified the application advantages of mechanical automation technology in the field of mechanical maintenance, and explored the future development direction of mechanical automation technology. Automation technology has a very important significance in the field of electroencephalograms. Through the application of automation technology, the production efficiency around mechanical maintenance can be greatly improved, large-scale production can be achieved, and product quality can be effectively guaranteed, making its functionality more comprehensive and quality. Well, it improves the reliability and safety of mechanical equipment. Continuous research and development of automation technology also makes mechanical equipment more and more functional and can be effectively applied in multiple maintenance areas. In the future, as China's mechanical automation maintenance technology becomes more and more mature, its advantages will also be gradually brought into play, and will be further and further on the road of development of intelligence, network, and miniaturization.

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