

Exploring the development trend of mechanical engineering intelligence

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Abstract. This paper discusses the characteristics and development trend of intelligent mechanical engineering. Intelligent mechanical engineering is characterized by high quality, high efficiency, four-dimensional intersection, energy saving and environmental protection. The development trends include networking, informatization, integration, automation control, product intelligence and artificial intelligence, etc. These trends will push mechanical engineering towards a new stage of more intelligent, efficient and sustainable development.

Keywords: mechanical engineering; intelligence; development trend.

1. Introduction

With the continuous development of science and technology, intelligence is becoming an important development trend in the field of mechanical engineering. Intelligent mechanical engineering has the characteristics of high quality, high efficiency, energy saving and environmental protection, which not only improves the production efficiency, but also lays a solid foundation for the future industrial development. This paper will discuss the characteristics and development trend of intelligent mechanical engineering, and look forward to the new development opportunities that intelligence will bring to mechanical engineering.

2. Intelligent mechanical engineering characteristics

2.1. High quality and efficiency

Intelligent mechanical engineering is characterized by high quality and high efficiency, which are of great significance in modern manufacturing industry. Firstly, high quality is one of the key features of intelligent mechanical engineering. Through the introduction of advanced sensing technology, automatic detection devices and data analysis systems, intelligent machinery is able to monitor the parameters in the production process in real time, discover and correct the deviations and defects in production in a timely manner, so as to guarantee the quality of products. High-quality products can not only meet customer needs, but also enhance corporate reputation and market competitiveness.

Table 1. Characteristics of intelligent mechanical engineering

diagnostic property	higher quality	high efficiency
Quality of production	Strict control of the production process, product qualification rate of more than 99.8 per cent	30 per cent reduction in production cycle time and 20 per cent reduction in production energy consumption
cost-effectiveness	Increased raw material utilisation by 10 per cent, reducing scrap rates and secondary processing costs	15 per cent reduction in production costs and less waste of resources
production capacity	20 per cent increase in productivity and output per hour	10 per cent increase in capacity utilisation, continuous and stable production line operation

Secondly, high efficiency is another significant feature of intelligent mechanical engineering. The application of intelligent technology makes the production process more automated and digital, greatly reducing the intervention of manual operation, thus improving production efficiency. Intelligent machinery can achieve accurate production planning and scheduling, reduce stagnation and waste in production, and effectively reduce production costs. At the same time, high efficiency can also shorten the production cycle, faster response to market demand, creating more business opportunities for enterprises [1].

2.2. Four-dimensional convergence, four-dimensional integration

Intelligent mechanical engineering leads the development of modern manufacturing with its unique features - four-dimensional intersection and four-dimensional integration. Firstly, four-dimensional intersection emphasizes the integration of the four dimensions of time, space, energy and information. Through real-time data collection, transmission and analysis, intelligent machinery is able to achieve a high degree of synergy in the production process and precise scheduling and resource allocation across time and space, thus enhancing production efficiency and resource utilization.

Secondly, four-dimensional integration emphasises the high degree of integration of various resources and links in the manufacturing process. Intelligent mechanical engineering is able to organically combine technologies from multiple fields, such as mechanical, electrical, electronic and computer, to achieve holistic design, manufacturing and management. This comprehensive integration not only reduces the complexity of the system, but also improves the stability and reliability of the system, providing enterprises with a more sustainable production method.

The characteristics of four-dimensional intersection and four-dimensional integration make intelligent mechanical engineering play an important role in modern manufacturing. It can not only bring about the improvement of production efficiency, but also enhance the optimal use of resources and reduce energy consumption and environmental impact. At the same time, intelligent mechanical engineering also provides enterprises with a more flexible and efficient production mode, so that they can better adapt to the changes and demands of the market.

2.3. Energy saving and environmental protection

Intelligent mechanical engineering has significant features in today's industrial development, in which energy saving and environmental protection become strikingly important aspects. These features not only concern the sustainable development of enterprises, but also have a profound impact on environmental protection and resource utilisation.

Firstly, intelligent mechanical engineering is committed to energy saving and consumption reduction. Through the introduction of advanced energy-saving technologies, such as high-efficiency motors and frequency converters, intelligent machinery can achieve fine management and control of energy

and reduce energy waste. In addition, the intelligent production process can optimise scheduling and resource allocation to avoid unnecessary energy consumption, thus achieving energy saving in production.

Secondly, environmental protection is one of the important features of intelligent mechanical engineering. With the increasing prominence of environmental issues, intelligent mechanical engineering focuses on the selection of environmentally friendly materials and the reduction of environmental impact in the design and manufacturing process. By reducing the generation of waste, optimizing the process, and realising the resourceful use of waste, intelligent mechanical engineering can reduce the negative impact on the environment and achieve more sustainable development.

The energy-saving and environmentally friendly features of intelligent mechanical engineering not only help reduce the production costs of enterprises, but also enhance their social image and market competitiveness. By reducing energy consumption and reducing environmental pollution, enterprises can better respond to the call for sustainable development of society and lay a solid foundation for future development.

3. The development trend of mechanical engineering intelligence

3.1. Networking and informatization

The intelligent development of mechanical engineering is increasingly driven by the trend towards networking and information technology, both of which have brought about tremendous changes and opportunities for the manufacturing industry. First of all, networking refers to the connection and synergy of various links in production, management and service through technologies such as the Internet. Intelligent mechanical engineering achieves digital and automated control of the production process through the establishment of an intelligent manufacturing system, thereby improving production efficiency and quality stability. Networking can also achieve remote monitoring and diagnosis, timely detection and resolution of problems in production, and enhance the operational reliability of equipment [2].

Secondly, informatization emphasises the collection, transmission and analysis of information through big data, cloud computing and other technologies to provide a more accurate basis for decision-making. Intelligent mechanical engineering can collect data from the production process, analyse changes in process parameters and quality indicators, optimise production plans and scheduling arrangements, and improve the utilisation of resources. In addition, information technology can also provide enterprises with deeper market insights and help them adapt to market changes and rapid changes in demand.

The trends of networking and informatization have brought many opportunities and challenges to mechanical engineering. In achieving networking, issues such as equipment interconnection, communication standards and data security need to be addressed; in promoting informatization, challenges such as big data processing, privacy protection and intelligent analysis need to be dealt with. At the same time, enterprises also need to make adjustments to their organizational structure and management model to adapt to the changes brought about by smart manufacturing.

3.2. Integration and automated control

One of the development trends of mechanical engineering intelligence is integration and automation control, the combination of which has brought unprecedented opportunities and changes to the manufacturing industry. Firstly, integration emphasises the organic integration of technologies from multiple fields such as mechanical, electrical and electronic to build an intelligent manufacturing system. By seamlessly connecting data and information from various links, companies can achieve a high degree of synergy in the production process, thereby improving production efficiency and product quality. Integration can also reduce the complexity of the system, reduce incompatibility problems between equipment and achieve optimal allocation of resources [3].

Secondly, automation control emphasises the introduction of automation technology in the production process to achieve intelligent and unmanned production processes. Intelligent mechanical engineering can achieve automated operation and control of production equipment through technologies such as sensors, controllers and actuators. Automation control can not only improve production efficiency, but also reduce the risk of manual operation and reduce the impact of human factors on product quality. In addition, automated control can monitor the status of equipment in real time during the production process, predict equipment failure, and achieve more reliable production.

The trend towards integration and automated control presents opportunities for innovation in mechanical engineering, however there are a number of challenges to be faced in realising this trend. Companies need to overcome integration challenges between different technology areas and address equipment compatibility and communication issues. In addition, automation control requires delicate equipment commissioning and data analysis to ensure system stability and accuracy.

In summary, integration and automation control are important trends in the intelligent development of mechanical engineering. Through the full application of these two aspects of technology, enterprises can achieve the improvement of production efficiency, the optimal use of resources and the intelligence and reliability of the production process. In the future development, enterprises need to strengthen technical research and development and personnel training to cope with the opportunities and challenges brought by intelligent manufacturing.

3.3. Product Intelligence and Artificial Intelligence

The development of mechanical engineering intelligence is gradually moving in the direction of product intelligence and artificial intelligence, and these two trends will profoundly change the pattern and way of manufacturing. First of all, product intelligence emphasises the integration of intelligent technology in product design and manufacturing, so that products have the ability to sense, analyse and make decisions. Intelligent mechanical products can collect and process data in real time through sensors, embedded systems and other real-time data collection and processing to achieve the monitoring and control of product status. Such intelligent products can not only meet the personalized needs of customers, but also enhance the competitiveness and add value of the products [4].

Secondly, artificial intelligentisation is increasingly used in mechanical engineering. Artificial intelligence technologies, such as machine learning and deep learning, can analyse huge amounts of production data, extract hidden patterns and associations, and optimise production processes and decision-making. Artificial intelligence can also be applied to predictive maintenance, which reduces downtime and repair costs by analysing the state of equipment, detecting possible failures in advance and carrying out maintenance [5].

The trend of product intelligence and artificial intelligence will bring great changes and opportunities for mechanical engineering, but it also faces some challenges. Firstly, product intelligence requires enterprises to strengthen the research and development and application of intelligent technology to improve the design and manufacturing capacity of products. Secondly, artificial intelligence requires a large amount of data support, so enterprises need to build a perfect data collection and storage system to ensure the quality and safety of data. In addition, the application of artificial intelligence also requires the support of professional talents, and enterprises need to strengthen the training and introduction of talents and establish interdisciplinary teamwork.

4. Conclusion

In conclusion, the development trend of mechanical engineering intelligence is leading the manufacturing industry towards a more efficient, intelligent and sustainable direction. Features such as networking, informatization, integration, automation control, product intelligence and artificial intelligence will profoundly change the face of the manufacturing industry and bring innovation opportunities for enterprises. However, the realization of intelligence needs to cross a number of fields such as technology, talent and data, as well as addressing issues such as security and privacy. Through

continuous innovation, cooperation and exploration, we can expect intelligent mechanical engineering to achieve even greater excellence in the future.

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