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Research on the Integration and Application of Computer Technology in the Construction of Ship Inspection System

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ABSTRACT

This study aims to explore the integrated application of computer technology in ship inspection systems. With the rapid development of information technology, the application of computer technology in various industries is becoming increasingly widespread, and the shipbuilding industry is no exception. This study proposes a solution for the integration and application of ship inspection systems and computer technology by analyzing the current situation and requirements of ship inspection systems, combined with the latest developments in computer technology. This plan aims to improve the efficiency and accuracy of ship inspection, achieve data-driven management and information sharing, enhance the traceability of the inspection process, and promote technological innovation and industrial upgrading in the shipbuilding industry, and is expected to provide strong support for the sustainable development of the shipbuilding industry.

KEYWORDS

Ship; Inspection system; Computer technology

1. INTRODUCTION

Computer technology has become the core of shipbuilding, and it has had a huge impact on various aspects of shipbuilding, market forecasting, ship design, ship manufacturing, ship supply, and business management. It has significant implications for improving the production efficiency and economic benefits of shipbuilding enterprises. At present, computer applications are not very balanced. Some fields have developed rapidly, with mature software technology and significant achievements, mainly reflected in the process technology and management of ship production. In recent years, with the advent of the information age, China's shipping industry has gradually introduced the informatization construction of ship inspection and supervision into the management of ship inspection. Relevant departments have successively established ship inspection intranet, intranet websites, and ship inspection and supervision business systems. In terms of ship information management, a ship inspection management information system has been developed for small-scale applications such as ship inspection and transportation. This system enables the ship inspection management department to monitor and inspect real-time changes in ship information and overall ship operation while working online, effectively ensuring the comprehensive compliance of ship inspection quality.

2. THE ORIGIN AND CURRENT SITUATION OF THE APPLICATION OF COMPUTER TECHNOLOGY IN THE SHIPBUILDING INDUSTRY

2.1. Shipbuilding Industry

China's shipbuilding industry is growing at an astonishing rate and has now become the world's third largest shipyard after Japan and South Korea. The shipbuilding costs in China are much lower than those in Japan and South Korea, which has led to a gradual shift in the global shipbuilding focus towards China. Due to the continuous growth of maritime transportation, China's shipbuilding industry has achieved good development domestically, with a sharp increase in orders from various companies, greatly promoting the country's economic growth. As for the types of ships, they can actually be classified according to their intended use, mainly including container ships, cruise ships, specialty ships, bulk carriers, etc. Among them, the demand and requirements for bulk carriers are increasing day by day, and gradually develop into the main ship type, while the orders for containers and chemical ships are sharply reduced due to the decline of world trade.

2.2. The Origin of Computer Technology in the Shipbuilding Industry

Since the first computer was invented, the development of computers has been advancing rapidly, and their uses have become increasingly widespread, gradually penetrating into various fields of industry. Especially in the shipbuilding industry, the application of computer technology is in a leading position. The shipbuilding industry first introduced computer-aided design in 1976, which was the first action to widely apply computer technology to industry. The shipbuilding industry has developed CAPDAC (Computerized Advisory Design and Construction System) software, which greatly improves the accuracy and efficiency of pipeline design [1].

With the improvement of informationization level in China's shipbuilding industry, the informationization construction of China's shipbuilding industry has also entered a new era. The widespread use of computers in the shipbuilding industry has greatly accelerated the speed and efficiency of shipbuilding, making it an indispensable part of today's shipbuilding industry. The development of CAD/CAM technology has enabled designers and engineers to have higher precision and efficiency in the design and optimization of ship hulls, greatly improving the overall performance and safety of ships. However, the development of CAD/CAM technology has also brought some problems. By using computer simulation and emulation methods, various performance indicators of ships can be tested during the design phase, greatly reducing the trial and error costs in ship manufacturing. Computer technology has also promoted the automation and intelligence of shipbuilding processes. By introducing technologies such as robot welding, automated assembly production lines, and intelligent logistics management, a large amount of repetitive and physical labor has been replaced, resulting in significant improvements in the productivity and quality of shipbuilding. At the same time, computer technology is increasingly being applied to the operation and maintenance of ships. For example, through the remote monitoring and control system of ships, the operational status of ships can be monitored in real time to identify possible problems and eliminate them, ensuring the safety of ship navigation. The application of computers in the shipbuilding industry not only improves the efficiency and level of shipbuilding, but also provides a new driving force for the sustainable development of the shipbuilding industry. With the continuous advancement of computer technology, the shipbuilding industry is bound to achieve greater development.

2.3. Current Status of the Origin of Computer Technology Application in the Shipbuilding Industry

The shipbuilding industry is an ancient traditional industry. If it can be combined with computer technology to achieve informationization in shipbuilding and operation, it can enable enterprises to stand invincible in the fierce market competition. At present, computer technology has been widely applied in the shipbuilding industry, promoting the informatization process of the shipbuilding industry. Enterprise informatization includes two aspects: production and management. Manufacturing information technology is a technology that aims to automate the entire manufacturing process, using measurement tools, display tools, and control tools to gradually transform manufacturing information into automation. The construction of management information systems refers to the construction of systems such as ES (Expert System) and DSS (Decision Support System). Although the application of computer technology has promoted the rapid development of the shipbuilding industry, the production informatization of shipbuilding enterprises is largely constrained by the level of industrialization, while the development of management informatization is not greatly restricted.

The informationization of design and manufacturing in the shipbuilding industry has attracted great attention, among which CAD (Computer aided Design) technology is an important aspect of application. It is a breakthrough in applying computer technology to the shipbuilding industry and an important manifestation of replacing human labor with computers. The widespread application of CAD technology in the shipbuilding industry provides broad prospects for its development. In the development and design process of ships, computer-aided design can make it more convenient for designers to draw drawings. Due to the rapid development of the shipbuilding industry, the changing demands of customers, and the increasingly fierce competition in the market, conventional shipbuilding CAD systems are no longer able to meet these requirements. With the continuous improvement of computer technology, various CAD software have been widely used in the shipbuilding industry, among which large-scale CAD systems are one of them. Due to the large volume of ships and their industrial production characteristics of single piece and small batch, large-scale design and manufacturing have become very difficult. Even with large-scale auxiliary design systems, it is difficult to achieve fully functional ship design. The development of database technology and multimedia technology has greatly improved the quality of ship design, reduced shipbuilding costs, and shortened shipbuilding time. The informatization of design and production in the shipbuilding industry will enter a new stage [2].

Computers have strong capabilities in processing massive amounts of data, which brings great convenience to management information systems in enterprise information systems. In addition, management information systems are not limited by industrial level, so the use of computers is very important in the shipbuilding industry. For example, Management Information Systems (MIS) have been greatly improved in the fields of financial management and warehouse management in the shipbuilding industry. However, with the continuous changes in people's needs and the constant updating of ideas, China's maritime management is facing many difficulties on the road of informatization, and DSS is gradually being applied to management. In real ship operations, MIS is more commonly used, and compared to DSS, MIS is a more mature and widely used system. The management information system can not only monitor the company's operating conditions, but also predict future operating conditions based on past operating conditions, thus playing a certain auxiliary role in the company's business decisions. It can also use information to control various business activities of the company, enabling the company to achieve its predetermined business goals. DSS is an increasingly sophisticated technology that enables interaction between humans and computers, enabling final decision-making on ships. It will play an increasingly important role in the development of ship safety management in the future.

3. APPLICATION OF COMPUTER TECHNOLOGY IN SHIP INSPECTION SYSTEM

3.1. Improve Inspection Efficiency and Accuracy

The application of computer technology in ship inspection not only greatly improves the efficiency of inspection work, but also ensures the accuracy of inspection results. The traditional inspection method is manual inspection and manual registration, which is time-consuming and laborious. Due to the use of automated testing instruments and data analysis software, especially the development of computer technology, testing can be carried out quickly and accurately without human intervention. Modern testing systems can automatically collect and analyze data from various parts of the ship, and store this information in real time to ensure the authenticity and reliability of the test results. Through computer simulation and emulation, engineers can fully evaluate the effectiveness of the ship before actual ship operations, predict its performance under different environmental and load conditions, and identify design and construction defects early, thereby improving the accuracy and comprehensiveness of testing.

3.2. Implement Data-Driven Management and Information Sharing

The application of computer technology makes ship inspection information management more efficient and transparent. By establishing a comprehensive ship inspection database, various information such as historical inspection data, images, videos, etc. can be stored and managed comprehensively, greatly facilitating queries and in-depth analysis, and making it easy to compare and access historical inspection records. In addition, with the assistance of computer network technology, information sharing and collaborative work can be carried out between different departments and regions, improving the cooperation and response speed of exams. Utilizing the massive data generated by digital management, utilizing methods such as mathematical statistics and machine learning, to conduct in-depth analysis of test results, identify potential patterns and trends, will play a very important guiding role in scientifically formulating maintenance plans and safety management strategies. Digital management also provides a transparent regulatory platform for operators and regulatory authorities, promoting the formation of ship safety performance and industry standards [3].

3.3. Enhance the Traceability of the Inspection Process

By utilizing computer technology, the traceability of ship inspections can be greatly improved. This traceability not only ensures the completeness and accuracy of inspection results, but also provides strong support for ship maintenance, repair, and insurance claims. In the detection process, the computer system can record in detail the various steps, responsible persons, instruments used, and detailed information of the detection, thus forming a complete chain of detection records and providing strong support for the smooth progress of ship detection work. After a ship malfunctions, relevant accident reports can clarify the background and development trend of the accident, providing strong support for identifying the responsible party and formulating accident handling plans. By tracing the audit process, various departments can detect omissions and deficiencies in the audit early and make timely improvements, further optimizing the quality of the audit.

3.4. Promoting Technological Innovation and Industrial Upgrading

The application of ship inspection information system not only greatly improves inspection efficiency and accuracy, but also promotes technological progress and industry upgrading in the ship inspection industry. With the breakthrough and development of technology, more and more new detection methods and instruments are being developed, making the inspection methods and means more

diversified, and the accuracy and efficiency of inspection are also increasing. The scope and depth of inspection are also becoming wider and wider. By utilizing advanced sensing and data analysis technologies, comprehensive and in-depth evaluation and analysis of various aspects of ship structure, materials, performance, etc. can be obtained, providing more scientific and accurate guidance for ship design and manufacturing, promoting the transformation of the shipbuilding industry from traditional manufacturing mode to intelligent manufacturing mode, while also reducing the cost and energy consumption of shipbuilding [4].

4. SPECIFIC PRACTICES ON THE APPLICATION OF COMPUTER TECHNOLOGY IN SHIP INSPECTION

4.1. Management System

In order to effectively improve the efficiency of ship inspection work, different usage permissions are set for each user on the management platform of the ship inspection system, so that they can perform their respective functions according to their usage permissions, and provide functions such as data query, business statistics, and report printing. The ship inspection information management system based on microcomputers has multiple management functions and can effectively solve various business requirements related to ship inspection. In the current design of the inspection management system, the Struts 2 technology based on MVC (Multiview Video Coding) for the World Wide Web application architecture is mainly used, which includes product inspection management, drawing inspection management, and ship inspection management. These different management modules can be divided into multiple parts, mainly including initial checks, operational checks, etc. The first acceptance is after the first survey and corresponding report is made, and the content of the operation acceptance is basically the same as that of the construction acceptance. There is currently no comprehensive standard for the management system of using computers for inspections. Some regulatory authorities may establish a single inspection management system, and in the management system of ship operation inspections, the operation process will be divided into multiple levels [5]. Through this system, one can have a detailed understanding of ship applications, maintenance, etc., and the system's data is shareable. All technical information will be updated in a timely manner. The implementation of the inspection and quarantine management system includes a large amount of maintenance work, with the main purpose of preventing the arbitrariness of maintenance work and ensuring the safe return of ships. On the query interface, you can view the construction progress, past maintenance, inspection status, and more of the vessel.

4.2. Regulatory System

There are many problems. Due to its limited functionality and inadequate supervision, the management function of the system is not complete, and the control of inspection and quarantine certificates is far from sufficient. With the widespread application of computers in the shipbuilding industry, various ship inspection agencies have also established corresponding regulatory systems, becoming an important support for ship inspection informatization. The National Ship Inspection and Monitoring System obtains various information about ship inspections through VIMS5.0, the Ship Inspection and Certificate Issuance Management System, and merges this information to introduce it into the National Ship Inspection System. This system covers many basic functions of ship safety inspection and is an important component of China's ship safety inspection and supervision system. The ship inspection and issuance system is a management system based on computer technology. The overall architecture of the system is relatively complex, mainly designed for the characteristics of ship inspection business, including input modules, client modules, etc. The system has a wide range of applications, reflecting both decentralization and centralization. It not only achieves the unity of

the work screen for ship inspection, but also enables data exchange with other systems, achieving data sharing and greatly improving the efficiency of ship inspection.

4.3. Information Data Platform

There is a phenomenon in China where the information and data platforms for ship security checks and ship inspections operate independently, and there is a problem of information and data not being shared. In order to ensure the smooth progress of ship inspection and safety checks, relevant departments need to establish a unified information platform. By understanding the test results of ship inspections, the safety inspection process of ships can be greatly improved, and the number of safety inspections for ships with good conditions can be reduced. Additionally, centralized monitoring and investigation of ships with poor conditions can be carried out, thereby promoting the safety inspection and ship inspection of ships and enabling faster development of the shipbuilding industry. Although the use of computers in ship inspection can greatly improve inspection results and increase the work efficiency of inspectors, it also greatly reduces their workload. Testing personnel must also pay attention to this and continuously improve their professional skills. Inspectors should learn to summarize, generalize, and disseminate various issues during the inspection process, and conduct research on the problems existing in the ship. They should strengthen their learning and training of ship professional knowledge, seek advice from experienced experts, enhance communication and exchange with peers, and study how to apply computers to ship inspection to reduce staff misjudgments and promote the development of ship inspection industry [6].

5. FUTURE DEVELOPMENT TRENDS

In China, with the rapid development of ship communication and navigation technology, its application in multiple fields is becoming increasingly common. The reasonable utilization of this technology will be conducive to establishing a high-precision and intelligent ship communication and navigation system, ensuring the organic integration of multiple disciplines such as microelectronics, optoelectronics, and computers, and enabling deep integration of communication and navigation, networks and computers. Broadband and digital communication networks have become important parts of future communication development. Due to the comprehensive development of communication network technology, the actual transmission range of optical communication is longer and more efficient. In order to make the development of communication networks more efficient, it is necessary to strengthen the research and development of optical fibers and optical switches. With the rapid development of superconductivity, nanotechnology, and optical path integration, the future ship communication network will achieve full digitization.

At present, communication and navigation systems with high precision, small size, easy operation, low energy consumption, light weight, and high intelligence are the development trend of communication and navigation technology, and with the rapid progress of other related technologies, further promote the precision of communication and navigation systems. For example, the chip level atomic clock in the United States has an actual size of 16 millimeters and a stability of $1 \times 10\text{-}10$. It can be used for navigation, positioning, timing, and synchronous communication [7]. The components related to navigation communication and navigation technology in the future will become increasingly precise. This development trend is mainly based on the existing level of precision to effectively improve the manufacturing process and requirements of various components, not only to improve the precision of various components in navigation communication and navigation systems, but also to ensure the safe operation of navigation communication and navigation systems.

6. CONCLUSION

The application of computers in ship inspection has shown its broad development prospects and application value. This system can not only significantly improve the efficiency and accuracy of detection, but also achieve digitalization, informatization, transparency, traceability, technological innovation, and industrial upgrading of detection. With the development of computer technology, it will be increasingly and deeply applied to ship inspection work, providing strong support for the healthy and sustainable development of China's ship inspection industry. We hope that in the future ship inspection work, more innovative technologies can be applied to the inspection work, making the inspection work more intelligent and efficient. We should also recognize that the application of computer technology has brought us many conveniences, but it has also raised many new questions for us. How to ensure the security and confidentiality of information, prevent the misuse of information, and cultivate a group of comprehensive talents with ship professional knowledge and computer application knowledge are all important issues we face. When promoting the deep integration of computer technology and ship inspection system, in addition to emphasizing technological innovation, it is also necessary to strengthen institutional construction, enhance talent training, and strengthen safety guarantees, so that this integration can be carried out steadily and continuously.

With the acceleration of economic globalization and informatization, international cooperation and communication in maritime inspection are increasingly valued. By sharing technological achievements, unifying standards, and coordinating supervision, the inspection level and efficiency of countries around the world continue to improve, making greater contributions to maintaining global shipping safety and prosperity. The combination of computers and detection methods is an inevitable trend, but it also poses higher requirements and greater challenges for detection personnel. Only by constantly exploring, daring to innovate, and strengthening collaboration can our scientific and technological innovation work have greater development and achievements.

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