

Research on the Informatization of Shipbuilding Industry Based on the Investigation on Wuchang Shipyard

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Abstract Information construction is a revolution of business management. It has a realistic and profound significance for promoting enterprise management modernization, building a modern enterprise system, enhancing market competitiveness and increasing economic benefits. Taking Wuchang (of China) Shipyard as an example, this paper describes the organization system and training system of shipbuilding informatization, issues concerning key link informatization, and discusses the performance of informatization, promotes the informatization of the shipbuilding industry to provide reference information. Finally, through analysis of problems in the process of informatization, put forward proposals to promote shipbuilding information construction.

The authors Key words Shipbuilding industry; Informatization; Crucial domain; Performance

1 Instruction

In the late 20th century, the world's shipbuilding industry had a series of significant revolution and progress in technology, system and shipbuilding ways owing to the implementation of informatization. The shipbuilding industry was definitely regarded as the most suitable field for information technology application by the European Union, and the EU positively promoted the application of information technology which made a good effect. The information technology has also been widely used in some advanced shipyards from Japan, South Korea and other countries for their production, operation and management, which have greatly improved the efficiency of shipbuilding. The main problem Chinese shipbuilding faces is low productivity, and informatization is a very important way to solve this problem. Therefore, promoting the shipbuilding industry information construction has a great significance for converting shipbuilding mode and enhancing overall competitiveness.

Wuchang (of China) Shipyard, founded in 1934, is a subsidiary of China Shipbuilding Industry Corporation; the mainland's largest modern integrated Shipbuilding Industry Company. Military ships represented by underwater and surface ships, civil ships represented by ocean engineering vessels and non-ship products represented by satellite launchers, the Three Gorges gate, large bridge steel structure are the three pillar industries of the factory. And the development target of the factory is: Military products to do fine, civil vessels stronger, non-ship bigger. The main products are: surface and underwater military ships; ocean engineering vessels and other civil ships; satellite launchers, the Three Gorges gate, large bridge steel and other non-ship products.

As a conventional manufacturing enterprise growing between history and contemporary, Wuchang (of China) Shipyard has established its core strategic object to change from the traditional steel industry to high-tech industry that is based on information technology. Therefore, the popular term "enterprise informatization" serves as a strategic planning for the development of Wuchang Shipyard. However, to realize the enterprise informatization is not as simple as buy a set of software, several equipments, Wuchang (of China) Shipyard has a long way to go. Now, Wuchang (of China) Shipyard becomes a successful shipbuilding industry in information technology construction. In this thesis, take Wuchang Shipyard as an example, mainly to describe the organization system, training system and crucial domain of shipbuilding informatization.

2 The Organization and Training System of Enterprise Informatization

2.1 The process of enterprise informatization

The advance of informanization is a systematic project. Wuchang (of China) Shipyard informatization has experienced six stages: The first stage: the formation of three-dimensional design capability; the second stage: the establishment of three-dimensional design platform; the third stage: the establishment of flexible production line for digital Products; the fourth stage: the establishment of fictitious manufacturing research center; the fifth stage: the establishment of production design management platform; the sixth stage: the establishment of digital shipbuilding IT architecture.

2.2 Staff training of enterprise informatization

Systematic and hierarchical staff training is essential for the process of enterprise informatization, the hierarchical staff training of Wuchang (of China) Shipyard in the process of enterprise informatization includes following aspects:

The first layer is the training about advanced informational management theories for middle and senior managers, and there are many domestic and foreign experts invited for the training.

The second layer is a professional training for informational team. 80% people from the team gained various national professional certifications. The professional technical training which covers database, VB, Delphi, DotNet, Java, Justep, Middleware and Aris has been training more than 200 people.

The third layer is the operation process training for all staffs, training and appraising leaders, technician and managers in the informatization construction. In the informatization construction project of heavy industry company, many rounds of training were carried out about new information management model. It also makes use of the staff training mode in the human, asset and material operation process.

3 Key Links of Informatization

3.1 Development and design informatization

On the basis of 3D (Three-Dimensional) design technology and computer network environment, reconstruct 3D design system, the role of designers and scientific division of labor is defined, the flexible production line of digital products is established by using industrial production mode. According to the requirements of the flexible production line, the function research of CADDSS5 software is enhanced and expanded, research on pipe structure mode, chart generation technology, ship painting technique, design and manufacture technology for digital ship samples and virtual assembly technology is carried out, 3D production design packages for the hull, outfitting and electric device, completed localization of foreign software system are developed, and a complete 3D production design capacity of hull, outfitting and electric device is formed. 3D production design process plan has been made according to the traits of the 3D design. The plan makes the 3D production design of the factory into a systematic and standardized way, and establishes a 3D production design system which based on 3D design and computer networks, have the capability to build 3D production design of 2.5 ships in parallel.

By using the PTC's CADDSS5 and DIVISON software, and on the basis of the SGI advanced graphics workstation and BARCO's 3D virtual reality platform, Wuchang Shipyard virtual manufacturing center is built with international standards, with world-class analysis of the finite element simulation, virtual assembly and workshop logistics simulation software, having engineering digital simulation technology of large steel structures and equipments, and virtual manufacturing technology capability of engineering application, such as virtual reality technology, visual technology, etc., achieving virtual demonstration system of 3D ship samples which facing design and manufacture.

On the basis of using CADDSS5, a flexible production line of digital production, which is based on 3D design, is established. Meanwhile, researches concerning design resources database, configuration technology, system function dynamic configuration and workflow reconstruction technology are carried out. Relevant control platform is established by using OPTEGRA software, management and control platform is built by using WINDCHILL, and a whole information model design of design department is completed. At the same time, the project management subsystem, file management subsystem, design process control subsystem, product data management subsystem, design alteration and version control management subsystem and production design interface subsystem are developed and implemented. By creating and implementing information model, a parallel design environment of engineering visual is provided, cooperative design, digital model assembly, interference checking and design process monitor between different companies are achieved; electronic technical documents and drawing management environment is provided, the 3D model of CADDSS5, 2D drawings, data, issuing process of technical documents, version control, relevance management, data change management are realized and ensure the validity of electronic data.

3.2 Production process informatization

According to the requirements of modern shipbuilding mode, intermediate products are taken as orientation to divide construction area, the space working is regulated to rationalize working process, a large-scale transformation is made, CNC cutting machine, CNC bending machine, laser cutting machine

and other equipments are imported, researches about digital technology of sampling tube, laser marking technology, laser sample processing, laser welding technology and efficient welding technology are carried out, procedural and standardized rules of large-scale ships are built, transfer is realized between total segment unit, modular assembly and intermediate products, engineering change of a number of advanced construction technology is completed, total segment construction, regional outfitting, precision control of shipbuilding, cable pull apply process, shaft installation process is conquered, and lifting and other key technologies is integrated. Initially a modern system of the shipbuilding process was established, the traditional series operation to parallel operation is changed, a key step is stridden in the integration of design, production and management for modern shipbuilding mode, and also a key step for improving the working environment, to enhance the construction quality and shorten the construction cycle.

3.3 Enterprise management informatization

Wuchang (of China) Shipyard reconstructed and optimized its management mode and business process, enacted enterprise information management system which covers the staff, asset, material and other main management department. Regarding human resources management, on the basis of the former personnel information management system, a new human resources management system is established. Human resources management has the features of good resource sharing, non-specialized system maintenance, easy operation and high efficiency. In financial management, the factory made use of computerization of financial assessments, greatly reduced the workload of financial management and standardized business processes. The financial management achieved a new level, and financial management has been in the front rank of the group. In materials management, purchasing department established a marine purchase information management system, realized a whole process of information management from purchase application, trial price, contract management, financial management, warehousing inventory to warehouse management, greatly increased the business management efficiency of material supply department.

In 2002, it completed the structure and implementation of the workshop digital models, made use of group technology to reconstruct the production processes, realized the transmission between three-dimensional design data and workshop data, creatively put forward the control strategy -- "parallel information flow control serial material flow", established the workshop's computer information management system and operation control system, provided valuable experience for enterprise digital engineering. By the reconstruction of informatization, pipe processing capacity increased 1.8 times.

Meanwhile, the information space of the mechanism branch has been made an integrate planning, developed and implemented 16 management systems, 311 function modules, covers almost all functions of management business. In 2004, completed system on-line task, realized the integration of product data and resource data, effectively solved the problem of the "information island". Through the department information management, business process digitization and effective control of workshop production, these have ensured the organic integration of various systems. Take advantage of the functionality of the function dynamical configuration to enable business processes dynamically adjusted. Through the enterprise information integration, realized transparency and standardization of enterprise management, and effectively solved the problems that faced in operation, and it rose the enterprise management to a higher level.

In addition, in Wuhan (of China) Shipbuilding Industry Co., Ltd., the Wuchang (of China) Shipyard carried out a comprehensive enterprise information space engineering. In the enterprise IT information platform, based on large bridge steel structure products, it realized matrix management of the bridge steel structure digital production line, formed a relatively complete enterprise information model design of business execution layer, control layer and management layer. In the process of Wuchang (of China) Shipbuilding information space engineering construction, the project team conducted research on a number of key technologies, conquered the parameterized three-dimensional design technology, parallel design process control technology, integration middleware, dynamic functions configuration, information-driven workshop control and other key technologies. At the same time, through the establishment of the sharing information space project platform, the team completed the inspection of IT platform infrastructure technologies, provided the key technology for enterprise information space projects, and provided technical support to the enterprise information space project.

3.4 Comprehensive assembly informatization

Wuchang (of China) Shipyard has established a unified sharing data platform of ORACLE. In early stage of the informatization, the information constructions were basically undermining mutually; the databases were not uniform; there existed ORACLE, SQLSERVER, ACCESS and FOXPRO database

platform; so it cannot realize information sharing and system integration effectively. In summarizing the former experience, it decided to make the ORACLE as the data sharing platform of the enterprise, and re-developed human resources and material management information system by using this platform. Owing to the use of the unified database platform, it solved the interface problems between each system, and created a good condition for enterprise information sharing and system assembly.

Independent development of business management software system has been successfully used in the mechanism branch, proving the new informatization system –"board - plug-in" platform architecture can support complex informatization projects and the means of "board - plug-in" type information model construction. Wuchang (of China)Shipyard is a key national enterprise which has a staff number of nearly ten thousand and many information construction projects which need to be accomplished step by step. So the enterprise informatization is a long process. Regarding the problems of how to implement those projects step by step, how to ensure information sharing and maintain a sustainable development, it launched a deep study. In 2000, the factory made the "board - plug-in" way of information model construction which is advanced and practical; realized the assembly between the management system and CAPP / PDM system, which proved the openness of this system. In addition, in the process of the system application, it adjusted the business process of the mechanism branch, and the information system of the mechanism branch achieved rapid disposal according to requirements.

4 Informatization Performances

4.1 Enterprise management

Wuchang (of China) Shipyard made use of informatization technology, realized the enterprise information integration, the information system provide dynamic information service for management, enhanced the level of the management transparency, standardization and enterprise management. After importing the information management system, many management tasks has been conducted in the software system according to agreed rules. However, this process is not easy to control under traditional mode, often appearing "where has the policies, where has the strategies". Therefore, the information system makes it obligatory in business management. For example, in the traditional management mode, the planning staff was required to list the quality according to the material inventory. This task is time-consuming in hand, usually lack of material or over-stock. In the new management system, the stock balance is finished by the system, and this can greatly improve the precision of the purchasing plan, and the system can also avoid unnecessary use of money.

4.2 Energy conservation

The factory occupies a small piece of land, which limits the development of the enterprise. It is high time that we make use of digital shipbuilding technology, take low energy consumption and high efficiency way of green shipbuilding development. Over the past 10 years, the growth of the factory's economic has been at a speed of 20% annually. In 2009, it is the lowest energy consumption in the 10,000 yuan output industry.

5 General Problems of the Shipbuilding Informatization

5.1 Information security

Currently, the factory uses the traditional secret and non-secret network to ensure the security of information, but the negative effects of physical isolation(the exchange of information must be manually handled) affects the efficiency of production. Therefore, rational planning in the basic network hardware platform is necessary, and strict security mechanism should be established to ensure that information can be identified, accessed, controlled, stored, destroyed and recovered safely and timely.

5.2 Virtual simulation

At present, the virtual simulation of the factory is mainly achieved on the ship design, production and visualization, but the technology for submarine construction, assembly path planning, lifting mechanics simulation process, the assembly deformation control, accessory processing workshop, assembly workshop and logistics simulation need further research, for the purpose of eventually forming a ship digital virtual simulation platform to assemble the design, production and management.

5.3 Engineering application

As the informatization of the factory has only completed the first project, in accordance with the requirements of the factory informatization framework, it should also integrate water production lines, underwater production lines and management information system into the entire information space for good management.

6 Conclusions

In order to better promote the shipbuilding industry informatization, the following suggestions are put forward.

First, enterprises should gradually establish a digital research system, to realize the integration of the whole product development; establish a visual parallel control system of production process, to achieve intelligent agile manufacturing; establish an enterprise management and organization mode to compatible with the digitalization, to improve abilities of decision-making, adaptability and sustainable development; form an independent intellectual property rights of the shipbuilding industry with information space engineering software products, and on this basis to achieve the industrialization of the software products.

Second, the Government should give strong policy support to shipbuilding enterprises which have a high level of digital shipbuilding, especially financial support to those shipbuilding enterprises who have a bright prospect of engineering application and those who have core competitiveness of digital construction in hardware and software. Concerning the features of the digitalized shipbuilding - integrity, advanced, foreseeability, cross, reality, complexity, long-term, risk, it is necessary to strengthen national policy guidance and macro-control, to improve the management and control level, to ensure the research and development funds be used timely and effectively, and to maximize the effectiveness to avoid risk. Moreover, as digital shipbuilding construction is a long, complex task, so it requires a large number of technical studies as guidance and research funds.<http://www.itpub.net/misc.php?action=viewratings&tid=901425&pid=9073474>

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