A Framework of Smart Manufacturing Promotion for Machinery Industry

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Abstract—This research provides a professional framework for the industry to promote smart manufacturing. Combined with the efforts of the factory in intelligent machinery, a company will be able to promote smart manufacturing more smoothly. In order to enhance the competitiveness of products, a company with forward-looking concept should gradually promote the wisdom of the various operations in the factory. The organization should focus on the wisdom and focus on the development of intelligent design. Develop a cloud design platform for rapid design and proofing to foster intellectual potential for the company. In order to ensure that the goal can be effectively achieved, this paper proposes a systematic driving structure, and plans four major aspects to promote. These four major aspects are advanced design, automation technology, smart manufacturing and cloud platform.

Keywords—Smart manufacturing, Advanced design, Product development, Production automation, Cloud platform.

I. INTRODUCTION

For a typical company in machinery industry, the factory often needs to have full-process production capacity, including various types of iron processing and forming machines, plating equipment, packaging lines and storage space as well. As a supplier, company should be specializing in the manufacture of specific product, such as professional manufacture of a variety of bathroom hardware, kitchen furniture, storage rack, office furniture and many other multi-functional hardware furniture or accessories.

With the change of social and economic structure, the rapid changes in market demand make the product life cycle shorten rapidly. After the product goes on the market, it may be replaced by new products at any time. We are interested in how to effectively shorten the research and development cycle of new products and accelerate the time to market for new products that meet market demands and trends. Competitive advantage has become a major challenge for the industry and a key to winning the company. According to the analysis, the current export market customers have an update module demand for an average of 1-2 years.

The product life cycle is less than three years. It is urgent to combine the industrial design and rapid prototyping technology to assist the company in rapid proofing.

Some manufacturing plants locate in remote areas. The surrounding living environment and transportation convenience are less advantageous. Therefore, there is frequently a labour shortage occur in the field, and it is imperative to introduce intelligent production into the production line. It is imperative to upgrade the technical level. This article provides a professional framework for the industry to promote smart manufacturing. With Combination of all the factory efforts in intelligent machinery, it will help company to promote smart manufacturing more smoothly.

II. A FRAMEWORK OF SMART MANUFACTURING

In order to enhance the competitiveness of products, the company with forward-looking concept should gradually promote the wisdom of the various operations in the factory. The company should focus on the wisdom and focus on the development of intelligent design. Develop a cloud design platform for rapid design and proofing to foster intellectual potential for the company. In order to ensure that the goal can be effectively achieved, this paper proposes a systematic driving structure (Figure 1), and plans four major aspects to promote: advanced design, automation technology, smart manufacturing and cloud platform, respectively, will be detailed item by item.

- **Advanced design**: import CAD computer-aided drawing / CAE computer simulation analysis / CAM computer-aided processing technology, 3D fast printing technology, CPS network entities and industrial design.
- **Automation technology**: metal processing, technical institutions, electromechanical integration, robotic arm.
- **Smart manufacturing**: Big Data analysis, information talent, software and algorithm, Internet of Things/sensor/API.
- **Cloud platform**: remote control proofing, management platform, design community.
(1) **Advanced design**

Import CAD computer-aided drawing, such as Autocad, Solidworks, Pro/e, CAE computer simulation analysis, CAD drawing, do simulation analysis, such as Anasys, Cosmos, Moldflow (mould flow analysis), practical application, CAM computer aid. The processing technology generates the graphics drawn by the CAD to the processing machine (CNC) code (G code), such as MasterCAM, SolidCam, DELCam.

The CPS Netcom entity (Figure 2) is mainly used by "entities" to enable effective communication and coordination between different "systems". It fully utilizes "computing", "control" and "communication". After the technology, the distance between the virtual world and the physical environment is shortened, and then the various information required by the real environment can be quickly reflected in the environment, and the system and equipment can be optimized independently [7][8]. Combined with the design, functional design and preliminary proofing, it helps the company to communicate effectively with customers and quickly grab orders in the international market.

(2) **Automation technology**

Automatic production equipment, including: fully automated plating equipment, automatic pipe cutting machine, automatic internal plug machine, automatic stamping machine, automatic iron sheet forming machine, automatic welding machine and robot arm, automatic plating equipment, automatic flat cutting machine, etc. This can reduce production costs, master product quality, and ensure accurate delivery. Some companies may mainly use metal processing as the main axis and use semi-automatic machines to obtain the bends required for the products. The robot arm can be introduced to form the role of the clamp [4], to reduce manpower to obtain higher profits, and to combine the technical personnel and electromechanical integration position sensor, monitor the movement position of the tool and the shaft, and more. The system integrates the precision control of the machine tool to make the machine manufacturing more accurate and fast. The communication technology is used to integrate the whole plant equipment and even the remote control equipment to reach the intelligent chemical factory [3].

(3) **Smart manufacturing**

In addition to the efforts to expand the smart development design, a company should further move toward the automation of the production line and link all single automated production equipment to form a more efficient production system. For the production line type, through the logic design of the programmable controller and the connection design of the Internet of Things, combined with the setting of the action sequence sensing of each type of machine in the production line, the automation of the production line process can be practiced. In recent years, Industry 4.0 has flourished, and Industry 4.0 is defined as the real-time control and analysis of end users through virtual and real integration of IoT/Sensor/API to drive innovation in production, service, and even business models [1][6]. It also uses machine learning to increase machine vision. The system that integrates the two can enhance industrial automation and detection processes with big data analysis [2]; more advanced analysis through cloud and edge machine learning algorithms [5]. It can analyse huge machine vision data to distinguish the good and flawless model of the product, and automatically update the recognition algorithm of the machine vision system without human intervention.
In order to enhance the competitiveness of products, all operations in the factory should be gradually promoted to be intelligent, and the focus of promoting wisdom can be further expanded towards smart development and design [9][10]. In order to enable the internal innovation concepts to be fully discussed, extended and quickly entered into the market, product innovation should not be a process of randomness and randomness. It should be quickly integrated and carried out from design to market combined with professionals in various fields. If it can be quickly implemented from design to manufacturing, manufacturing to marketing, the company's competitiveness will be greatly enhanced. Through the innovative design and application of product functions, appearance, colour and materials, it will help SMEs to escape the fate of low-cost foundry and widen the gap with competitors. By building a remote 3D monitoring and printing platform at the cloud service level, the cloud 3D proofing system allows industrial design, structure and strength analysis, in addition to intensive discussion and correction through the line, can also be specified at any remote end and connected. The 3D printer prints and takes samples. After combining design, functional design and preliminary proofing, 3D printing helps the company to effectively communicate with customers and quickly grab orders in the international market. After the order is established, the actual mould opening production will be carried out. Compared with the traditional direct mould open correction method, it will save a lot of time and quickly introduce the design into the market.

The biggest challenge for traditional SMEs is product design, function or service innovation and market access. The focus of this program's talent development will be to quickly introduce design concepts into the market segment with rapid proofing. In the traditional mould-making method of manufacturing samples, the mould often undergoes multiple trial and error methods and repeated revisions to meet the design size and quality requirements. The innovation of this project is to assist the discussion and structural analysis of the design block with the cloud service. After the customer and the company establish the style and function, they can use the 3D printing to quickly proof the sample, and then further confirm the error, that is, the 3D printing model can be used for mould turning and mass production, which will achieve fast delivery and a small variety of future customized production modes (Figure 3).

3D printing is an emerging topic in industry in recent years, and 3D printing technology belongs to Rapid Prototyping Technology (RP). The so-called RP technology is a technology that can produce the required prototype in a short time. Rapid prototyping technology is a new manufacturing technology developed in the 1980s. Unlike traditional cutting, RP uses a layer-by-layer material accumulation method to make solid models. Since 1987, when 3D SYSTEMS of the United States first disclosed liquid manufacturing, also known as the Stereo Lithography Apparatus (SLA) system, many advanced countries have developed a variety of RP systems. The purpose of RP is mainly to design visualization, design verification and review, functional testing, etc. In the new product development process, RP can optimize the product design and shorten the product development cycle and reduce development costs.

Figure 3  Develop Procedure With Sample Making Of 3D Printing

III. CONCLUSION

In order to implement the quality of execution that promotes smart manufacturing, the company must establish a rigorous management mechanism, meet regularly to discuss progress and implementation status, focus on and brainstorm, and follow the PDCA management cycle of planning, execution, verification and revision to control. In addition, the budget execution progress is equally divided, audited and controlled on a monthly basis.

The company should strive to improve the process planning, product design, automation and intelligence. The industry's product and service development process combined with the cloud proofing platform can increase the company's information and wait for opportunities to develop international marketing channels to help the company increase international visibility.
The internal knowledge exchange and management platform can accelerate the innovation and development of competitive products through internal resources and knowledge of internal members, so that the participants can compete internationally. Combined with rapid proofing and market, the company's products can quickly enter the market and get a head start.

In order to fully automate every workstation, the company should gradually introduce all kinds of fully automatic production equipment, including: fully automated plating equipment, automatic pipe cutting machine, automatic internal plug machine, automatic stamping machine, automatic iron plate forming machine, Automatic welding machine and robot arm, automatic plating equipment, automatic flat cutting machine, etc., can reduce production cost, master product quality, and ensure accurate delivery. In addition to the efforts to expand the smart development design, the company should further move toward the automation of the production line and link all automated production equipment to form a more efficient production system. For the production line, through the logic design of the programmable controller and the connection design of the Internet of Things, combined with the setting of the action sequence sensing of each type of machine in the production line, the automation of the production line process is practised.

REFERENCES