Basic research on reconfigurable intelligent manufacturing system

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Abstract: With the continuous development of manufacturing technology in China, the demand for the technology in the market has grown gradually. On this background, if manufacturing system needs to achieve sustainable and stable development, it must perfect functions, improve productivity and realize the construction of re-configurable intelligent manufacturing system so as to conform to the development of times. There are many contents involved in re-configurable manufacturing system, such as re-configurable physical equipment, production management system and so on. The paper analyzes re-configurable intelligent manufacturing system.

1. Introduction
With the development of society, manufacturing market is highly competitive day by day. Manufacturing enterprises must promote their market competitiveness and meet the relevant requirements of market in time, only in this way can manufacturing achieve stable and sustainable development. Manufacturing enterprises have many problems in the process of operation, such as quality, service, cost and so on. In order to solve these problems, enterprises should constantly improve the quality of products, optimize service and control quality, then ensure that they can occupy a certain position in market competition.

2. Reconfiguration of manufacturing system and its control structure evolution and development

2.1 Concept of manufacturing mode and system
In the field of manufacturing, manufacturing mode has strong representativeness, which mainly refers to knowledge content, core principles and professional techniques adopted in the process of manufacturing system operation, imagination and construction. The contents involved in manufacturing is relatively more, for example, system structure and function, operation mechanism in production process, and every department management in enterprises and so on. At the same time, manufacturing mode is also involved in dynamic concept, which can reflect the whole social benefits of enterprises in market competition and promote the continuous and stable development. If traditional manufacturing mode within enterprises cannot meet all kinds requirements of market and human beings in the process of development, then it will be replaced by new manufacturing mode. With the development of the society, manufacturing mode in China has changed much. In recent years, intelligent technology has continuously been integrated into manufacturing system, which has improved product manufacturing quality and efficiency, meanwhile it has become an inevitable trend for all enterprises that manufacturing system intelligence is achieved.
2.2 Manufacturing system reconfigurability
Manufacturing system reconfigurability contains many contents, which can cover all manufacturing process and activities. People from all walks of life begin intensely research on re-configurable manufacturing and point it out that manufacturing system reconfigurability mainly covers processing systems, business processes, organizational structures, information platforms, etc. The most external form of expression in manufacturing system is workshop processing system, which can mostly show the essence of re-configuration. In terms of actual situation, processing control system and equipment are key in processing system. Therefore, the system needs to change the flock clamp and machine tools of the equipment during the actual reconstruction so that each link of the equipment can effectively complete the production task. At the same time, the reconfiguration control system is also a key part of it, which has strong characteristics. In the face of production tasks, it can form a dynamic effect on the production tasks, thus ensuring that the production tasks are not subject to any interference to achieve the reduction or increase of equipment and meet the requirements of production quality and efficiency.

2.3 Evolution and development of control structure of manufacturing system
Manufacturing enterprises has once experienced single piece and workshop production, however, with the development of manufacturing industry, it has moved towards the development mode of customized mass production. Meanwhile, manufacturing control has gradually evolved from dispersion to collaboration corresponding to manufacturing production. When manufacturing enterprises produced single piece at the earliest, production was relatively easy, and every craftsman could complete manufacturing and design independently, which resulted in less communication between craftsmen. And because of this, manufacturing enterprises mainly adopt the decentralized control management mode in the initial production. With the development of society, people's demand for products is gradually increasing, and at the same time, all aspects of product production are gradually becoming more complicated, and the scale of production is also growing. Under this background, the traditional production mode can no longer meet the production demand, and the manufacturing enterprises begin to adopt more machines and more people production mode, gradually evolving into coordinated control, centralized control and hierarchical control from the traditional decentralized control.

3. Physical reconfiguration of manufacturing system

3.1 Design of CAPP system in reconfigurable manufacturing environment
During the design of the reconfigurable unit, the relevant personnel must first select the most high-quality part routing. Different tools, fixtures and machine tools need to be installed to realize functions. During this period, the processing order of the parts is particularly critical. At the same time, there are relatively many parts processing routes. Therefore, during the selection of the part processing route, it is necessary to timely select the actual process conditions of the existing equipment, so as to ensure the effective development of the reconfigurable manufacturing unit design work. Compared with the traditional CAPP system, the CAPP system under the reconfigurable manufacturing background has strong characteristics, and it can simulate people through computers and other technologies. The traditional CAPP system mainly has three design methods, namely creation type, search type and hybrid type. These three design methods have certain drawbacks, and can only process relatively fixed resource products in manufacturing enterprises, to a large extent, it limits the development of manufacturing companies. Under the background of reconfigurable manufacturing environment, the new CAPP system can effectively make up for the deficiencies of the traditional CAPP system. During the dynamic change of manufacturing resources, the reconfigurable manufacturing CAPP system can also achieve stable operation, thus meeting the production requirements of enterprises. It can be seen that CAPP system has strong dynamic responsiveness and flexibility under the reconfigurable manufacturing environment, and it is more suitable for the
development trend of modern market.

3.2 Framework design of CAPP system in reconfigurable manufacturing environment

Process design and route planning involve relatively more content, including props and machine tool selection, as well as parts processing and clamping parts. Generally speaking, during the process route of parts processing, unexpected situations are easy to occur on the processing site. If relevant personnel fully understand the actual phenomena of on-site tooling in the early stage of process design, it will lead to the phenomenon of route deviation of the original process route, and then the actual production route can not be processed according to the original process. In this context, process planning is called linear process planning, which cannot meet the relevant conditions of reconfigurable manufacturing units, and non-linear process planning can be designed for this situation. Non-linear process planning can fully meet the relevant requirements of reconfigurable manufacturing. The design core of non-linear process planning is to store parts according to the original process route, and implement them in the process route database without changing the original sequence of parts. Then to carry out the parts ratio according to the production scheduling and manufacturing resources, and then select the most high-quality parts process line.

4. Optimizing the multiple process plan of reconfigurable manufacturing unit

4.1 Multiple process scheme representation method

In a variety of feasible process plans, including network diagram, process planning and other contents, it can be seen that the expression forms of feasible process plans are also relatively diverse. The multiple process network graph is the directed assignment graph, which has the characteristics of acyclic, etc. In the directed assignment graph, each process is each node, and there is a close relationship between the processes. The line weight in the directed assignment graph refers to the specific index of the costs, working hours, efficiency and other related contents required by the process. Each process route and the relationship between the process routes can be shown in the network diagram of the multiple process plan, but this plan has some drawbacks and cannot fully show the specific sequence of the parts process in the network diagram. Compared with many process network graphs, the expression ability of multi-process graphs is relatively strong, which can fully make up for the deficiency of multiple process network graphs.

The process involves a relatively large amount of content, which can be completed by combining multiple processes and the operation type, and machine tool information construction must be completed by each process. Therefore, during the process design, relevant personnel can express it as seven-bit code, such as machine tool type expressed by the first bit code, lathe expressed by L code, milling machine expressed by M code. Operational types are represented by the second and third codes, such as 101 codes at the end of the machine and 202 codes at the outer circle of the car. Specifically as shown in Table 1:

| Machine Type | Operation Code | Operation Type       | Fixture type | Cutting Tool Type | Process Code  |
|--------------|----------------|----------------------|--------------|-------------------|---------------|
| Machine Tool | 101            | Cylindrical Lathe Cutting | 202          | 101               | L101202101    |
|              | 202            | Radial Facing        | 101          | 101               | L202101101    |
|              | 303            | Stairs               | 202          | 101               | L303202101    |
|              | 404            | Internal Thread Lathing | 303          | 101               | L404303101    |
5. Conclusion:

In summary, with the continuous development of modern society, the manufacturing system has gradually improved. Nowadays, the reconfigurable intelligent manufacturing system has gradually entered the manufacturing enterprise. The manufacturing system has strong background in the reconfigurable intelligent background. Flexibility and agility can promote the quality and efficiency of production to a large extent, and its recombination is relatively strong. On the basis of guaranteeing the production capacity of manufacturing, the adjustment of manufacturing functions and engineering can effectively meet the relevant demand of modern market for manufacturing enterprises. There are relatively many contents in the manufacturing system. Therefore, during the design of the reconfigurable intelligent manufacturing system, relevant personnel should pay more attention to the physical equipment and constantly improve all links of the system, so as to realize the sustainable and stable development of the manufacturing industry.

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