Study on the Specialty Construction of Mechanical Higher Vocational Education Under Intelligent Manufacturing

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Keywords: Intelligent manufacturing, Talent demand, Higher vocational education, Specialty construction.

Abstract. The concept of intelligent manufacturing influences the revolution of manufacture industry deeply, and makes enterprises require more from their employees. Facing the new trend of intelligent manufacturing, the changes of posts and talent demands should be deeply analyzed and the talents training mode should be optimized continuously to meet the changes.

Introduction

Intelligent Manufacturing is a kind of human machine integrative intelligent system composed of people and intelligent machines, which carries out kinds of intelligent activities, such as analysis, reasoning, judgement and decision in the manufacturing process. By integrating people and intelligent machines, the human experts’ brainwork is expanded and extended, even replaced partly. Intelligent manufacturing updates the concepts of manufacturing automation by extending the conception of flexibility, intellectualization and highly integration[1].

The essence of IM is not machine substitution, but the integration of human wisdom and advantages of machine targeting to complete complex work with more creativity and challenge. Under the situation of the great improvement of intelligent manufacturing, the tasks and demands for people in production have changed greatly. The front-line technicians analysis and solve problems according to the data on site and the reading and analysis of data, as well as making decision based on the data will be important tasks for them[2].

The concept of intelligent manufacturing influences the revolution of manufacture industry deeply, and makes enterprises require more from their employees. Thus the construction of higher vocational education and the direction of talents training should be improvement to meet the new challenge. Only by replying to the challenge actively can higher vocational colleges adapt to the new situation and meet the new demands, and can skilled talents conform to demands of intelligent manufacturing be trained.

Mechanical Professionals Demands under Traditional Manufacturing Mode

According to the survey of employment status of mechanical graduates, and the investigation of mechanical enterprises including JIER Machine Tool Group Company, SINOTRUCK and Jinan Diesel Engine Company, the demands of mechanical professionals focus on mechanical equipment installation and adjustment class job, mechanical equipment maintenance class job, machining class job, machining process and management class job and mechanical product design class job. Mechanical equipment maintenance class job mainly includes equipment fault diagnosis, maintenance and after-sales service. Machining class job mainly refers to the operation of general and CNC machining equipment. Machining process and management class job mainly includes machining process planning, production site management and product quality test and control. Product design class job mainly includes CAD, mechanical parts mapping and product three-dimension modelling design. Details of the five classes of job maintained above are listed in Tab.1.
Table 1. Job analysis of mechanical design and manufacture major.

<table>
<thead>
<tr>
<th>NO.</th>
<th>Class of job</th>
<th>Main tasks</th>
<th>Demands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mechanical equipment</td>
<td>mechanical equipment installation and adjustment</td>
<td>Talents are in great demand; Mechanical, electric, hydraulic, pneumatic and sensor knowledge should be mastered and high level abilities of equipment installation and adjustment will be preferred.</td>
</tr>
<tr>
<td>2</td>
<td>equipment maintenance</td>
<td>equipment fault diagnosis, maintenance and after-sales service</td>
<td>Talents are in great demand; Wide knowledge will be preferred, not only the professional knowledge but also the market skills and communication skills.</td>
</tr>
<tr>
<td>3</td>
<td>Machining class job</td>
<td>operation of general and CNC machining equipment, such as lathe, milling machine, CNC lathe, CNC milling machine and machining center</td>
<td>Talents are in great demand; Candidates should be able to operate kinds of processing equipment and select or design proper tools. It is a junior job for mechanical job seekers and the future of successful candidates is mechanical process engineer or mechanical design engineer.</td>
</tr>
<tr>
<td>4</td>
<td>Machining process and</td>
<td>machining process planning, production site management and product quality test and control.</td>
<td>Graduates of higher vocational colleges are demanded less. Besides the abilities required in the above three classes of job, candidates should have good learn ability. The future of successful candidates is mechanical process engineer.</td>
</tr>
<tr>
<td>5</td>
<td>Mechanical product design</td>
<td>CAD, mechanical parts mapping and product three-dimension modelling design</td>
<td>Graduates of higher vocational colleges are demanded less. Besides the abilities required in the above four classes of job, candidates should have good learn ability. The future of successful candidates is mechanical process engineer.</td>
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</tbody>
</table>

Mechanical Professionals Demands under Intelligent Manufacturing Mode

The core of intelligent manufacturing is the establishment of intelligent plant and digital workshop consisting of intelligent equipment to realize intelligent production. With the improvement of intelligent manufacturing, the post setting of enterprises is changing correspondingly. Some traditional posts like work time auditor, blueprinter are missing. On the contrary, equipment maintenance personnel and CNC operators are in great demand.

Intelligent Manufacturing Changed the Post Setting

**Compound Talents are in Huge Demand in Intelligent Manufacturing.** With the popularization of digital R&D tools, traditional technology posts need digital transformation and staffs should have the basic capabilities needed by intelligent production. Thus the application of CAD, CAM, CAE, CAPP, MES, ERP has become the basic capabilities for staffs. And the roles of some traditional posts in production begin to be weakened, even are missing. For example, blueprinter has gradually withdraw from the stage of history, while posts like digital modelling, lean production specialist, reverse modeling, 3D printing, precision measurement and inspection become more and more important. While there are no special specialties corresponding to these posts in higher vocational colleges by now, most of staffs of these posts are trained by enterprises themselves.
Intelligent Equipment has Huge Demand for Mechanical and Electrical Composite Talents. With the numerically controlled, informationized and intelligent transformation of traditional enterprises planned by the government, the application of intelligent manufacturing equipment, such as high-end CNC machine tools, industrial robot, and additive manufacturing equipment, will be popular. Specialists for operation and maintenance of these intelligent equipment are in great demand.

Changes of Post Structure Put Forward New Requirements for Vocational Ability

Under the background of intelligent manufacturing, development tendency and the posts and talents demands of enterprises are influencing higher vocational education and the standard of talents training are changing to meet the posts demand. Posts skills needed in intelligent production enterprises appear different from intelligent equipment manufacturing enterprises.

Product Design Post Play Important Role Still in Intelligent Production Enterprises. Besides the high demand for application ability of CAD and CAM, the requirement for skilled application of CAE becomes increasingly prominent, because more and more enterprises pay more attention to the important role of CAE in product development.

Higher Professional Abilities are Needed by Mechanical Manufacturing Posts. Updated professional abilities are needed by mechanical manufacturing posts, and more and more enterprises value multi-function and combined talents. CAM programming and information-based management will be popular. AS more operational tasks are performed by robots, process technologists are free to pay more attention to the process layout, process implementation and the process optimization. Then some new post skills like CAPP, PDM, and dynamic simulation of machining process are needed.

Demand for Lean Production Management Increases, Shortage of Lean Production Specialist Becomes Severe. With the emergence of digital factory and unmanned workshop, higher requirements and new meaning are put forward to the plant layout and optimization. More simulation methods and platform are adopted to assist the normal operation of unmanned workshop, including ergonomics simulation, production and logistic system simulation, manufacturing execution system, part flow static and dynamic analysis.

Intelligent manufacturing actually realizes the optimization, digital control and state real-time monitoring of manufacturing process. Enterprises’ demands for skilled type of work will decrease, and more staffs will engage in jobs such as product design, process optimization and production system management, which needs greater abilities to analyze and solve problems. Thus more knowledge type of works will be needed for enterprises.

Specialty Construction of Mechanical Higher Vocational Education to Suit the Intelligent Manufacturing Transformation and Updating

Course offering and the Demands of Intelligent Manufacturing Transformation and Updating in Mechanical Enterprises

In intelligent equipment enterprises, basic knowledges about machinery and electric is essential and underlined, such as mechanical drawing, CAM, electrical and electronic technology, precision detection and tolerance matching, hydraulic and pneumatic technology. These basic knowledges must be mastered by each staff. The core technologies of industrial automation, including PLC, servo motor, stepper motor, sensor and C programming language, are also essential for all jobs. And industrial network control technology and network technology are widely used. Mechanical and electrical drawing is still the basic demand, and computer aided drawing tools are generally required to be mastered. Besides the maintenance class post, all types of posts have the computer aided circuit drawing requirements. Equipment manufacturing and equipment maintenance account for the biggest number of post requirement. On-site programming and debugging, system integration, equipment function development and modification contribute fewer jobs, but these jobs require more knowledge
and belong to high technology work. In summary, the course offering of mechanical higher vocational specialty should reinforce the content of mechanical, electric and hydraulic mentioned above.

**Course Content and Professional Standards of Intelligent Manufacturing**

The reconstruction of course content should reference the relevant international standards, and corresponding professional standard suit to the situation of our nation should be developed. Intelligent manufacturing has been studied and practiced for many years in the developed countries forming a number of core technologies, and implemented many successful cases. Before the development of teaching standard of vocational education with international level and the introduction of foreign high quality courses and textbooks, full exploration and practice should be carried out first.

**Teaching Process and Intelligent Manufacturing Process**

In the process of higher vocational colleges providing services to intelligent manufacturing transformation and updating in mechanical industry, a series of specific issues will be encountered, especially the problem of how to break through the bottleneck of resources. In the teaching process, introduction of some intelligent manufacturing cases would enable students to understand the situation of enterprises in advance. Colleges should carry out the faculty construction and develop teaching materials, as well as reform teaching mode to make students develop creative and working-process-oriented learning. And all these activities should be connected with intelligent manufacturing. That means the following issues should be reconsidered and carried out under the situation of intelligent manufacturing: the construction of experimental and training sites working as intelligent plant or digital workshop, the development of intelligent manufacturing related textbooks and digital teaching materials, the cultivation and organization of faculty team which is composed with double-quality teachers, and the co-construction and sharing of high level practice training base.

**Reinforce the School-enterprise Cooperation, Realize Specialty Establishment Together**

The current situation is, on the one hand the demands for advanced technicians for intelligent manufacturing and practice rise sharply, on the other hand there is a large shortage of advanced technicians but a large number of low skilled personnel and fresh college graduates cannot find job. The most important is that the shortage of advanced technicians has begun to restrict the progress of the relevant technical fields and become the constraints of industrial development. Various means should be taken to reduce the shortage of advanced technicians, such as reinforce the school-enterprise cooperation, implementing embedded course, reforming the specialty installation program and the post practical training mode, offering short-term courses or establishing specialty together. On the other hand practice the “exit is the entrance” mode education, which means to design course content from the view of the ultimate objective of talents cultivation, to solve the problem of college graduates employment.

**Acknowledgements**

The research was financially supported 2015 Province Vocational Education Teaching Reform Research Project “Cultivation Practive and Research of Technical and Skilled Talents Based on the Background of Enterprise Intelligentized Production” (Grant No. 2015051).

**Reference**
