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Establishment of a Talent Cultivation Platform for the Intelligent Industry in China

Abstract

Under the *Zhejiang Action Plan for Made in China 2025*, Zhejiang is actively promoting equipment updates, industrial upgrading, and business format innovation. The workers in labor-intensive manufacturing sectors are increasingly being replaced by robots. This trend requires employees to develop high-quality technical skills. Now more than ever, vocational colleges should cooperate with industries, research institutions, and regional enterprises in research, development and upgrading of products for small and micro enterprises in Zhejiang.

Innovation and education requires research and production. Zhejiang Institute of Mechanical and Electrical Engineering (ZIME) is taking initiative by training skilled, innovative professionals for regional industry development.

ZIME, one of the best vocational colleges in Zhejiang, is working toward better developing its vocational education system, keeping it in line with the national innovation development plan.

Key words: *Made in China 2025, Higher Vocational Education, Action Plan China 2025, Talent Cultivation*

1 Introduction

In May 2015, the state council issued the action plan "Made in China 2025", the first ten-year action plan to implement strategies to build a strong manufacturing industry in China. The program clearly outlined its objectives of "mainly accelerating the deep fusion between a new generation of IT and manufacturing industry, boosting intelligent manufacturing to satisfy the needs of economic and social development and national defense construction for significant technical equipment, completing multilevel and diverse talent education system, promoting industrial transformation and upgrading, cultivating a manufacturing culture with Chinese characteristics, and accomplishing the historical transition from scale to competitiveness" (Made in China 2025). The action plan "Made in China 2025" outlines strategic ways to promote intelligent manufacturing such as "researching and formulating intelligent manufacturing development strategies, accelerating the development of intelligent manufacturing equipment and products, boosting manufacturing process intelligence, and deepening the application of Internet in manufacturing". Zhejiang's objective in the 13th Five-Year Plan regarding industrial transformation and upgrading is to develop a competitive

manufacturing industry. The Zhejiang Province Action Plan for "Made in China 2025" and the Action Plan for Accelerating and Boosting Intelligent Manufacturing Development (2015-2017) both have specified eleven key industries: robot and intelligent equipment, transportation that uses renewable energy, modern traffic equipment, Internet of Things (IoT), cloud computing, big data, and industrial software. Both plans have also outlined the development goals and tasks of intelligent manufacturing.

2 Development of Chinese Manufacturing Industry and Cultivation of Technical Professionals

2.1 Characteristics of Development of China's Manufacturing Industry and Roles of Technical Professionals

In the last decade, Chinese manufacturing industries have evolved, increasing in strength and making significant contributions to the nation's economic and social development. In 2014, China had a total of 100 Chinese enterprises among the FORTUNE 500, including 56 manufacturing enterprises (excluding Hong Kong, Macao and Taiwan enterprises), with the number of Fortune 500 enterprises second only to the USA for two consecutive years. According to the China Statistical Yearbook in 2013, China's secondary industry had around 232 million employees who have received 10.2 years of education on average. These professionals have expert knowledge and special skills and mainly deal with creative labors at the front lines of production, service, and management. As of 2015, vocational education has cultivated 80 million skilled professionals in technical fields and has trained more than 150 million professionals of various types every year. About 70% of students who have graduated from technical schools have worked as technicians, and about 75% have worked as operators.

2.2 "Made in China 2025" represents new requirements on the cultivation of skilled technicians

"Made in China 2025" outlines a "three-step" strategy for building a powerhouse of manufacturing using nine strategic tasks, five key projects, and many significant policies (Made in China 2025 and Engineering Technical Talents Cultivation Research Topic Group, 2015). It also emphasizes that skilled professionals are the fundamental preconditions for building a manufacturing powerhouse. "Made in China 2025" considers innovation, quality, efficiency, integration of informatization and industrialization, and green technology as top priorities and outlines specific requirements regarding the necessary skills needed to accomplish these goals. Firstly, traditional industrial sectors using unsophisticated technology need to be substituted with emerging industrial sectors that use more advanced technology. This requires a plethora of innovative entrepreneurs and researchers in the fields of science and technology. Secondly, industries gathering at the low end of the value chain need to rise to both ends of the "smile curve of manufacturing industry." This process requires a a large number of professional in research & development and marketing management. Thirdly, manufacturing sectors must pay attention to boosting manufacturing quality in regard to

production and process-oriented operations (Huang & He 2015). This process needs the support of field engineers and technicians. “Made in China 2025” clearly outlines ten key fields, each needing highly skilled professionals.

3 Grasping the opportunity of “Made in China 2025”, and bringing forward policies for coping with higher vocational education

3.1 “Made in China 2025” creates opportunities and presents challenges for higher vocational education

“Made in China 2025” has created a systematic blueprint for the future development of China’s manufacturing industry. The cultivation of talent plays a main role in making these goals a reality. The national top-level design warrants the cultivation of high-quality technical professionals as its primary strategy for medium-and long-term development. Vocational schools have plenty of room for improvement. China must better support higher vocational education in regard to training and should boost the quality of the skilled workforce by adopting the production-learning-research integrated model (Cao 2015, Luo 2017).

The trends of China’s intelligent manufacturing have the following four features. Firstly, intelligent manufacturing equipment, i.e. industrial robots, is the key point of development. Secondly, satisfying individualized market demands is the main development characteristic. Thirdly, utilizing the full life cycle is a necessary element for manufacturing intelligent equipment and products. Fourthly, systematic innovation and diversified applications are the key to the development of intelligent manufacturing. Ultimately, the shortage of highly trained technical workers in manufacturing industry has restricted the development of intelligent manufacturing, and this shortage is present in basic manufacturing fields. According to a survey based on China’s mechanical industry, by 2020 enterprises in the intelligent manufacturing sector of China’s mechanical industry will have up to 5.82 million employees, including up to 3.50 million technical workers in total, and up to 90% of annual newly increased workers will have completed a vocational education program (Department of Planning, Interpretation II to Made in China 2025, 2015). Workers who have completed undergraduate courses and higher courses on applied technologies or more than 4 years of higher vocational education will be in high demand.

Due to recent trends, policies must be implemented to solve the difficult problem of technical talent shortage and structure matching. These policies must explore new ways to actively cultivate talent.

3.2 Problems in Development of Higher Vocational Education in China

Vocational colleges face many challenges. China’s current vocational education system has many problems and will not catch up with the development of manufacturing industry at present (Made in China 2025 and Engineering Technical Talents Cultivation Research Topic Group, 2015). Therefore, institutions should keep in mind the following problems:

1. The quality of talent cultivation is yet to be improved. The broad application of modern technologies has promoted manufacturing process reengineering and recreation, and the flexibility of production methods has greatly raised the production and operation efficiency of manufacturing industries. All of these developments and changes have created new requirements for workers. These workers need strong technical and theoretical knowledge with relatively strong operating abilities. They also need comprehensive knowledge and skill structures to cope with developing trends in manufacturing.

2. Specialty adjustment must be keep in mind the transformation of industrial structure. According to "Made in China 2025", innovations must be cultivated in fields like high-end equipment manufacturing, new-generation IT industry, maritime engineering equipment manufacturing, biomedicine engineering, etc. However, at present, Chinese vocational colleges are not prepared to develop the skills required in these fields. What's more, due to "big and all-embracing" specialty construction, these schools have not created specialty programs that match the regional manufacturing industry. Thus, there is a shortage of technical workers who can aid in the transformation of regional manufacturing industries.

3.School management is relatively constrained. Many vocational colleges are still hyper formal, superficial, and inattentive to school-enterprise cooperation. The content and form of school-enterprise cooperation are also relatively simplified. Due to a lack of incentive policies and an endogenous driving force, industrial enterprises are not highly involved in school management or the development of higher vocational education.

3.3 Policies to further improve higher vocational education in China

Higher vocational colleges should focus on the following priorities in order to set up talent cultivation platforms and boost industrial transformation and upgrading:

1. Deepen institutional reforms and educate workers.

Vocational colleges should commit to development and employment that is aimed at deepening institutional mechanism reform, while also encouraging the fusion between industry and education through cooperation between schools and enterprises. Colleges should abandon the old school paradigm and leverage its own advantages to develop higher vocational education characterized by four patterns of cooperation: cooperative growth as a driver, cooperative education as a mechanism, cooperative management as a system, and cooperative employment as an orientation. Vocational colleges should cultivate the talents urgently needed by enterprises, align with the recent government requirements to innovate vocational colleges and promote regional industrial development, and adhere to the specific requirements of enterprises. Thanks to cooperation between college resources and intelligent manufacturing enterprises using the principles of "joint development, management, application, and sharing", an education and manufacturing synergetic development philosophy characterized by "one entity, two responsibilities" will be realized. Additionally, a

new interest community for the development of intelligent manufacturing will be formed (Department of Planning, Interpretation II to Made in China 2025, 2015).

2. Meet the needs of industrial transformation and build up competitive strength.

Vocational colleges should proactively satisfy the needs of industrial transformation and focus on the priorities of industrial development. Colleges should combine "industries, posts, abilities, and courses" as well as gain support from "bases and teachers" (Department of Planning, Interpretation II to Made in China 2025, 2015). These colleges should also conduct regional industrial post surveys and make predictions to clearly determine the goals for talent cultivation. Specialty programs should be adjusted in lockstep with economic trends. Vocational colleges should pay more attention to the cultivation of the middle and high-end technical workers needed by industries and increase the percentage of technical education provided through TVET in general. Along with the advancement of intelligent manufacturing, enterprises are also changing the structure of jobs. The fast development of the industrial robot industry creates a great demand for the high-tech professionals who are adept in robot applications. In addition, the industry has a huge demand for versatile talent. Along with numerical control, information and intellectualized reconstruction for traditional enterprises is a national priority. Manufacturing equipment (such as high-end numerically-controlled machine tools and industrial robots) and additive manufacturing is more prevalent than ever. Therefore, schools should update their curriculum by centering on the optimization of intelligent industrial chains, production line and value chains, and fine mapping and optimization design for disciplinary development, all while stressing the latest techniques, processes, materials and tools involved in intelligent manufacturing.

3. Expand social service scope and boost industrial transformation and upgrading.

In order to support regional economic growth, vocational colleges should constantly expand the scope of social services and become an indispensable link in the chain of regional economic and social development. With the current economic transformation and the development of modern industrial systems, vocational colleges should intensify cooperation between government and enterprise and should base curriculum on regional economic and social development objectives to adequately leverage their own scientific and technological advantages. They should promote innovation, get involved in regional economic development, and boost the transformation and upgrading of regional industries.

4 Thoughts and Practices of Zhejiang Institute of Mechanical & Electrical Engineering for Coping with "Made in China 2025"

Given the development trends and new opportunities arising from "Made in China 2025", schools need to research the related policies on intelligent manufacturing, solve the problem of technical talent shortage, actively explore new approaches to talent cultivation, and create green energies for industrial transformation and upgrading. Zhejiang Institute of Mechanical and Electrical Engineering (ZIME) among other higher vocational colleges in Zhejiang

province, has worked towards these initiatives. ZIME has optimized talent training programs and has adopted new technologies and skills related to big data, IoT, Internet + and intelligent manufacturing. Additionally, ZIME aligns with the intelligent manufacturing industry of the Zhejiang province. A leading intelligent manufacturing and training base in the country has been built thanks to cooperation among government agencies, enterprises, and ZIME. Meanwhile, relying on the intelligent manufacturing base, ZIME has carried out projects to deepen cooperation among industries, education facilities, and research facilities on intelligent manufacturing and social services by adopting these major practices:

1. Optimizing talent cultivation patterns and alignments towards the intelligent manufacturing industries of Zhejiang province

The proposal of "Made in China 2025" has far-reaching influence on the reform of manufacturing industries, creating new requirements regarding the needs of enterprises. (Made in China 2025). Facing the new development trends of "Made in China 2025", higher vocational colleges should constantly analyze changing talent needs, highlight the fusion between manufacturing and teaching, optimize talent cultivation patterns, and build an optimal chain of talents with the development of industrial chains. By reviewing specialty positions and centering on the key developments and emerging industries of Zhejiang, ZIME proactively aligns with the "Action Plan of Zhejiang Province for Accelerating and Boosting Intelligent Manufacturing Development" and tracks the development trends of intelligent manufacturing technologies. As a result, ZIME has upgraded its talent cultivation programs from traditional manufacturing to intelligent manufacturing and has transitioned from skill-oriented education to technology-based talent education. By proactively adjusting specialty programs, strengthening cooperation between information technology and manufacturing disciplines, and deepening in-depth applications of internet in manufacturing, ZIME offers a plethora of related majors on intelligent manufacturing such as intelligent manufacturing technology, intelligent control technology, IoT application technology, industrial robot technology, industrial design, mechatronics, die design and manufacturing, and CNC technology. ZIME also offers programs of emphasis related to digital design, intelligent interactive design multiaxis machining, numerical control and maintenance, industrial IoT and so on. These programs aid in the cultivation of technicians for manufacturing transformation and upgrade, as well as the development of Zhejiang's intelligent manufacturing. Despite tough conditions in the current job market, Zhejiang Institute of Mechanical and Electrical Engineering consistently educates technical talents for "Made in Zhejiang." In recent years, the initial employment rate of its graduates reached 99.05% on average and 100% for key disciplines.

2. Build China's leading training base for intelligent manufacturing professionals through cooperation between the government and colleges

"Intelligent" means "Zhi Neng" literally in Chinese. "Zhi" refers to information and digitization and "Neng" signifies the capacity of lean manufacturing. In order to become a manufacturing powerhouse, China must propel industry-education-research integration and

pool resources from government agencies, colleges, and enterprises to achieve the transformation. ZIME engineering establishes a "whole chain" talent cultivation system of manufacturing industry that is supported by the government, colleges, and enterprises, creating cohesion between talent training and selection. In accordance with the new requirements proposed by "Made in China 2025" and the "Action Plan of Zhejiang Province on Intelligent Manufacturing Development", Zhejiang Institute of Mechanical and Electrical Engineering will build several training bases for intelligent manufacturing to satisfy training needs in the Zhejiang province.

Firstly, the college will build a provincial level training base for "Zhejiang intelligent manufacturing." As a public service platform boasting the highest integration level in the country, it will have the most advanced equipment and will align with the needs outlined in "Made in China 2025." It will be jointly built by FESTO, a well-known automatics supplier from Germany, and SAP, a leading global provider of enterprise management software solutions and technologies. Secondly, ZIME will set up an industrial robot applied technology training base to cultivate a highly skilled workforce who understands core technologies like industrial robots, automatic production lines, and internet and communication programming techniques. Thirdly, ZIME will build an intelligent manufacturing (discrete industry) factory. The intelligent manufacturing factor will promote automation and versatility in manufacturing process to improve quality and efficiency. Fourthly, ZIME will establish a training center for production line control technologies. The center will integrate such advanced technologies as industrial robots, 3D printing, internet, visual inspection, IoT, automatic control, measurement detection, fieldbus control, information management, etc.

3. Optimize social services by relying on an intelligent manufacturing base

Vocational colleges should still actively serve regional economic and social development in addition to cultivating a talented workforce. ZIME has optimized its social services by relying on an intelligent manufacturing base. Firstly, it relies on intelligent manufacturing to enhance its training programs. Keeping in mind the ten key fields and the seven major emerging industries proposed by "Made in China 2025", ZIME aligns with the requirements of the "Action Plan of Zhejiang Province on Intelligent Manufacturing Development" (Made in China 2025), develops a more professional and systematic training base, expands its social training, and increases the ability and level of ZIME in serving society. ZIME carries out programs in technician training, further study of engineering technicians, practical training, training of vocational college teachers, new job development, technical innovation, etc. Secondly, ZIME implements project development aimed to serve the industrial transformation and upgrading of Zhejiang. ZIME strives to provide technical skills related to developing intelligent equipment and products, boosting intelligent production processes, cultivating new type production modes, strengthening an enterprise's overall intelligent capabilities in R&D, production, management, and service. ZIME has set up eight innovative teams and research institutes on intelligent manufacturing projects such as industrial robot R&D and integrated application technology, automatic system integration and intelligent instrument technology, mechatronics equipment R&D technology, measurement and control

and industry network technology, IoT technology application, and numerical control equipment.

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TVET@asia The Online Journal for Technical and Vocational Education and Training in Asia

CITATION:

Ding, J. (2017). Establishment of a Talent Cultivation Platform for the Intelligent Industry in China. In: TVET@Asia, issue 9, 1-9. Online: http://www.tvet-online.asia/issue9/ding_tvet9.pdf (retrieved 30.06.2017).

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