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A Probe into China Engineering Education Reform Based on "China Manufacturing 2025"

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Abstract. "China Manufacturing 2025" is the action plan for China to transfer from "a manufacturing big country" to "a manufacturing power". Here we probe into China engineering education reform by interpreting the connotation of "China Manufacturing 2025" and analyzing the new requirements it puts forward for engineering talents and education. It is found that "transformation and upgrading". "innovation and development", "integration of informatization and industrialization", "intelligent manufacturing", "green development", "optimizing structure" and "improving quality and effectiveness" are key elements of "China Manufacturing 2025". It is suggested that a large number of new talented people who are specialized in innovation, research and develop, digitization, ecologicalization and technology, are needed to serve in this field so as to make this kind of industrial structure transfer from a labor intensive industry to a knowledge intensive industry with innovative and high value-added services. It is also suggested that these talents should be cultivated by promoting and establishing modern vocational education system with the traditional concept of engineering education being changed and the integrated system of industry and education innovated.

Introduction

The exposure of serious economic structure hollowing-out by the international financial crisis puts the reshaping of international industry pattern on the agenda and triggers a tide of international industry upgrading. Developed countries proposed successively "Reindustrialization" strategies [1] like CPS-based "Germany Industry 4.0", "America's National Strategic Plan for Advanced Manufacturing", "New industrial France", "British manufacturing 2050" and "Japan Revival Strategy" and so on[2], which bring both opportunities and challenges to the transformation and upgrading of China manufacturing. "China Manufacturing 2025" is the action plan for China to transfer from a manufacturing big country to a manufacturing power and proposed a new research subject for higher Engineering Education.

Connotation of "China Manufacturing 2025"

Transformation and Upgrading as the Urgent Requirements

As a pillar of the national economy, manufacturing plays a great role in supporting the national production and development.[3] However, the increase of national consumption demand improves people's quality mindedness, which depends on the continuous updating and supply of basic facilities to improve the quality of social management and public service and the manufacturing and innovation of technical equipment to develop new industry. In addition, a stable environment at home and abroad is needed to realize the steady growth of national economy and harmonious social development. All these put forward urgent demand for the transformation of manufacturing industry, i.e. transferring mode, adjusting structure and promoting updating.

Innovation and Development as the Theme

Though holding the lead in manufacturing scale, China manufacturing industry is relatively backward in innovation capacity. Poor core technology and absence of generic technology lead to

high external dependence of high-end equipment and key technology with more industries of low added value like OEM (Original Equipment Manufacture) and less self-owned brands.[4] Extensive mode of production and development results in low energy and resource utilization efficiency and prominent environmental pollution problems. Innovational development has become the theme of improving the development level of manufacturing industry. The only way to transfer from a big manufacturing country to a manufacturing power is to bring into full play the leading role of the market, establish manufacturing innovation system, cultivate innovative talents, enhance the research and development capacity of core-component technology and promote the industrialization of scientific and technological achievements.

Integration of Informatization and Industrialization as the Starting Point

The coming of "Internet Plus" era provides good opportunities for the intelligentization of manufacturing industry and promotes the integration of informatization and industrialization. It is of necessity to strengthen Internet infrastructure construction, deepen the application of Internet in manufacturing field, keep constant development of smart devices and products, establish a highly-effective platform with simultaneous progress of management, technique, manufacturing, sales and services, so as to speed up the development of intelligentize. It is aimed, in the year of 2025, that the popularizing rate of broadband Internet will reach 82%, digitalization of researching and developing tools 84%, numeral controlization of key procedures 64%.[5]

Intelligent Manufacturing as the Core

The growing popularity of i-robots has become a significant symbol of the present scientific and technological industry.[6] According to spirit of the 2016 National Conference of Manufacture and Informatization, great emphasis should be placed on the utilization of intelligent manufacturing engineering, the innovative application of key equipment, and the promotion of comprehensive standardized technical system, industrial alliance, and establishment of intelligent parks. Meanwhile, pilot work should be done in these fields so as to ensure the success of these works.[7]

Green Development as the Guide

Green development, currently, has become the most popular strategy of international economic development. China has always treated green development as the main driving force on the way to become a manufacturing power. To realize the sustainable development of economy, China must take important actions, such as cultivating green technical talents, stepping up efforts to develop new energy and new techniques, speeding up the transformation and upgrading of manufacturing industry, developing green manufacturing, and constructing new systems of green manufacturing.

Optimizing Structure as the Route

The unreasonable structure of the manufacturing industry has a serious negative impact on the development of it mainly due to the mode of the traditional manufacturing industry, which has the following drawbacks, like high inputs, low returns, great resource consumption, serious environmental pollution. In order to speed up the technical reform and management optimization of the traditional industry as well as the development of the service-based manufacturing industry, regarding optimizing structure as the acting point, and technology the guide of development should always be kept in mind. In this way, the realization of transforming from a labor-intensive manufacturing industry to a knowledge-intensive one with innovation and high value-added service can be ensured.

Improving Quality and Effectiveness as the Expectation

The issue of product quality is the main factor influencing the competitiveness of "Made in China" in the international market. A lot of factors have negatively impacted the quality of products made in China, including backwardness of manufacturing equipment, carelessness of manufacturing process, imperfection of applying for product quality system certification, as well as industrial standard not integrating to the international standards. In order to continuously improve the

competitiveness of China's manufacturing industry, it is suggested that the following measures should be taken, including promoting advanced quality management methods, perfecting quality inspection system, boosting the establishment of industrial brand, realizing industrial stands connecting to the international standards, and improving product quality.

New Demands of "China Manufacturing 2025" for engineering talents

In the era of "China Manufacturing 2025", intelligent production will liberate low-grade labor force from the production line. Many kinds of labor will be replaced by intelligent equipment, including those that are labor-intensive, mechanically repetitive, easier-to-process, and dangerous. In realize the transformation of the manufacturing structure from a labor-intensive one to a knowledge-intensive one with innovation and high value-added service, related talents should be extended to the front-end of product manufacturing, which requires a lot of personnel who are specialized in innovation, research and development, digit, ecology, and technology.

Innovative Talents

In the era of knowledge, wisdom has become the most important productive factor. Since there is no clear boundary of science and technology, day by day the cycle of transferring scientific and technological innovation achievements into products has become shorter and shorter. The upgrading, replacement, and even subvert can take place at any time anywhere. Those who can create the most advanced product, technology craft or equipment can definitely be the one leading the whole field. In contrast, those who still stick to the old routine and always follow others must be left behind, getting no opportunities to compete with others. Thus, intelligent supermen who are the so-called creative people are needed in enterprises. They are the ones with sharp eyes, solid knowledge, broad vision, and braveness. In the process of constantly defying themselves, they get the chance of leading the fashion and creating the future.

Research and Development Talents

With the theme of "innovation and development", we need to fundamentally improve the ability of independent innovation, and actively introduce and train a batch of talents with innovative consciousness, innovative ability and research and development capability. To ensure the overall efficiency and flexibility, talent resources should be effectively integrated, and meanwhile, the integration of government, industry, research and production should be further promoted. In this way, the overall system can effectively functioned, and talents can cooperate with each other and get improvement in every field so as to ensure that every talent can develop their abilities. Under the atmosphere of "public entrepreneurship and innovation", independent product research and development should be strengthened so as to change the dependence on foreign core technologies. The construction of our own brands must be sped up to increase the added value of products made in China. Intensive adjustment of production methods should be enhanced to reduce energy consumption and environmental pollution.

Digital Talents

Future trend of global industrial upgrading lies in the main line, integration of industrialization and information, and the main direction, intelligent manufacturing of traditional manufacturing industry plus information network technology. China, to seize the opportunity in the revolution of science and technology, is bound to the development of intelligent manufacturing industry.[8] The rise of technology, such as robotics, has injected new power into the manufacturing sector, due to which, both labor shortage and production costs, in the long run, have been reduced. The construction of smart factories and digital workshops, and the coming of the robotic era have liberated a large number of traditional manufacturing labor force. However, substituting humans with machines is not simply replacing traditional labor force by robots and other smart devices, but liberating people from the heavy labor intensity and jobs which are harmful to human body, and at the same time increasing the demand for skillful talents of smart equipment, and proficient professionals of

information network. Only by accelerating the training of intelligent talents can we better realize human-computer interaction, and better enjoy the bonus brought by technological progress to the field of manufacturing industry.

Pro-ecology Talents

Implementing green manufacturing with the main focus of green development is an important integrative part of China's transformation and upgrading plan. Having the whole world in view, technological and industrial revolution has already come. Thus, with the emergence of new technology, new materials and "Internet plus" mode, a number of new industries have also emerged. Strengthening the development and training of talents' green skills can help people master related skills of the green industry, develop their sustainable awareness and green economy related knowledge of environment and resources. It is not only the need of our country of green manufacturing, but also the general trend pattern of International Education.

Skilled Talents

Improving quality and efficiency can continuously improve the competitiveness of products which are "Made in China", which can be achieved by strictly checking and improving product quality in the whole process of product production. The technical and skilled personnel working in the front line of production, engaging in product manufacturing, processing and service are the backbone of China's workforce. Therefore, their quality directly affects the quality of products "Made in China". It is urgent for China to cultivate a large number of personnel who are with professional consciousness and technology. These personnel should have not only superb skills but also strict working attitude, habits, and artisan spirit. Only by doing this can China take advantage of the demographic dividend and improve the quality and efficiency of China's manufacturing products.

New Demands of "China Manufacturing 2025" for Engineering Education

Driving for talents is the basis for "China Manufacturing 2025", and transformation and upgrading is the route for it, which forces the transformation and upgrading of the engineering education to cultivate new talents who can adjust to its goals.

Vigorous Promotion of Modern Vocational Education to Cultivate Skilled Talents

Thanks to the establishment of a large-scaled, systematic and perfect vocational education, Germany, internationally, has become the world's top manufacturing industry, cultivating a large number of advanced technical and skilled talents for the development of manufacturing industry. From the domestic point of view, the economically developed areas in the southeast coastal part of China, like Jiangsu, Zhejiang, Guangdong and other areas where vocational education is relatively in a leading position, have transported a large group of talents to promote the development of the local industry. In order to meet the demands of economic development, we have to change from the extensive to the intensive. China must take a new road to industrialization paving a way for the urgent need of accelerating the development of modern vocational education, enlarging the scale of schools, and training a large number of technical talents. At present, firstly, it is necessary to do a good job of publicity, change people's prejudices about vocational education, and enhance the attractiveness and appeal of vocational education. Secondly, it is also necessary to increase financial support, improve conditions and provide good hardware and software facilities for vocational education.

Construction of Modern Vocational Education System to Promote the Transformation and Upgrading of Talents

The current vocational education in China includes vocational school education and vocational training. Vocational school education is divided into preliminary, intermediate and advanced levels, of which secondary vocational school is the main part of vocational education in China, aiming at training low and medium skilled personnel. [9] The transformation and upgrading of China's

manufacturing industry leads to an increasingly larger and larger demand for senior technical personnel including more high advanced talents, professional and technical talents, and smart personnel. Since this type of talents is cultivated by higher occupation education, the level of vocational education is supposed to be extended from the low-end to the advanced. More efforts must be put into developing higher vocational education, constructing secondary vocational education, higher education, applied undergraduate and graduate education, guiding the transformation from local colleges to application-oriented universities, and training professional masters and doctors. Through the higher extension of technically talents, the training of high-level application-oriented talents will also be strengthened.

Change of Traditional Concept of Engineering Education to Achieve Variable Cultivation of Talents

The adjustment of the major of engineering education should be adjusted to meet the change of the current market. The cultivating target of talents should be based on the demand for talents. [10] Currently, proficient workers in one particular line can no longer meet the demand of the modern manufacturing industry. The modern manufacturing industry calls for talents with rigid occupational spirit and exquisite skills to meet the demand of high-quality components. It also calls for talents with knowledge in all fields to achieve understanding of the entire production line. Besides, it still calls for talents with green awareness to meet the requirements of green production and development. What's more, it calls for talents with mastery of information network so as to achieve skilled operation of smart equipment. The demand for single-skilled talents in traditional manufacturing has shifted to the needs for inter-disciplinary talents in new manufacturing industry. At the same time, the content of engineering education is changed from single skill training to advanced technical skills training.

Innovation of Production and Education System to Realize a Win-Win Situation

Since engineering education is directly involved in economic development, vocational education should always be enterprise, production, and application oriented. The integration of education and production is supposed to be deepened by formulating policies, thus promoting the cooperation of schools and enterprises and realizing cultural integration of them.[11] To promote the perfection of major and the revolution of teaching, mutual understanding and learning between vocational education and university education should be enhanced and relationship between research and teaching should be strengthened. To make students better apply what they've learned in schools into the working context, the cooperation between schools and enterprises must be enhanced and combination of practice and theory should be promoted. To cultivate more required talents for enterprises and the whole society, it is significant to promote the integration of government, industry, education, research and application through the guidance of policy and government as well as the integration of education and culture in engineering education.

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