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Research on the Management of Makerspace under the Background of Industry-University Cooperation

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ABSTRACT
The construction and development of makerspace is a significant pathway to carry on innovation and entrepreneurship education, which has experienced more than a decade. In the process of development. There are bottlenecks, such as the difficulties of market expansion and the limitations of the mentor role. In order to analyze the role of makerspace in innovation and entrepreneurship education under the background of integration of industry and university in China, the study takes a research on the current status of makerspace in China, summarizes the categories and features of them, discusses the implements to improve the management of makerspace. To sum up, to promote the innovation of makerspace, it is vital to establish a development model based on the integration of industry and university and construct a mechanism of operations and services.
Keywords*: integration of industry and university; makerspace; innovation and entrepreneurship*

1. INTRODUCTION

China's economy has stepped into a new stage while the economic growth is stabilizing and industrial transformation has upgraded. In order to adapt to the transformation, it is urgent to carry on the reform of innovation and entrepreneurship education in colleges and universities which enables higher education to upgrade the talent training mode and improve the quality of talent to meet the needs of national construction and social development in China.

The theoretical basis of integration of industry and university is the Triple Helix Theory of American sociologist Herry Etzkowitz and Dutch scholar Loet Leydesdorff. The Triple Helix Theory analyzes the relationships and responsibilities of university, government and industry in the education of innovation and entrepreneurship, and puts forward solutions for university to meet the social needs in the process of talent cultivation. In America, universities closely link cultivation of talents with enterprises and scientific research institutions, so that students can participate in industry and enterprise activities. The deep integration has formed unique Silicon Valley mode and MIT mode which are attracting worldwide attention and have contributed to world economic development. Some universities in China have introduced industrial resources into all aspects of higher education, opened multiple teaching channels, and cultivated outstanding engineers. Under the promotion of many national policies, higher education in China has made positive process in innovation and entrepreneurship education. However, there are still some problems which should be caused attention to. For instance, the concept of innovation and entrepreneurship education lags; there is a shortage of incubation platform. To some extent, it is closely related to the lack of integration of industry and university.

According to the above researches and analysis, this article suggests makerspace which is a low-cost and open-service platform can compose an important part of the incubation chain of integration of industry and university so that to meet the needs of innovation and entrepreneurship. Makerspace is modern workshops where people living in the community, can design and create projects they are passionate about in an environment that drives creativity through experimentation. At the makerspace every student is viewed as a maker and given a space to experiment, test and cultivate new ideas, explore and master new concepts, work through problems with faculty members and collaborate across disciplines.

2. THE INTEGRATION OF INDUSTRY AND UNIVERSITY

The Ministry of Education states explicitly in the 13th Five-year Plan that "the purposes of higher education should be transformed to serve the national and regional economic social development. The orientation of higher education should be shifted to cultivate applied and technical talents. The mode of higher education should be transferred to integration of industry and education[1]. At the end of 2017, the "Several Opinions of the General Office of the State Council on Deepening the Integration of Industry and Education" was released. The opinions emphasized "deepening the integration of industry and education, and promoting the organic convergence of education chain, talent chain, industrial chain and innovation chain are urgent requirements to boost the

structural reform of human resources supply which play a significant role in comprehensively improving the quality of education, expanding employment, upgrading economic transformation and cultivating new driving forces for economic growth" [2]. The opinions guide the reform and development of innovation and entrepreneurship education in higher education and point out the direction for the reform of talent training mode.

The integration of industry and education refers to a common mission that two major subjects of innovation which are industrial entrepreneurship and educational units fulfill by undertaking respective responsibilities, cooperating and supporting each other and realizing a win-win development. The theoretical basis is from Triple Helix Theory (THT) of innovation studies devised by Henry Etzkowitz in America and Loet Leydesdorff in the Netherlands in 1995 to involve the interactions between universities, government and industry. The theory provides a concept and an institutional arrangement designed to describe and foster innovation process (Figure 1). The model highlighters the significant role of the university in the transition from business to knowledge-based society and has been adopted by a growing number of governments and nations. "Integrated work of higher education institutions and industrial enterprises turned out to be not only meaningful for the raised professional level of scientists, developers, pedagogues, postgraduate student of the university but also for the promotion of higher quality and demand for professionals graduated by the universities who are ready for efficient work in high-tech organizations of the real sector of the economy" [3]. The university does not only focus on traditional teaching and research activities but also concentrates on business. This theory puts forward solutions for university to meet the social needs in the process of education. Meanwhile, industry sector cooperates with universities to increase its innovative capacities and incorporate them in process of shaping future engineers. Moreover, industry helps universities design talent training model and curriculum to develop practical skills of graduates. Government institutions are responsible for the facilitation of university-industry relations by adequate policies and regulations. TH theory analyzes the relationships and responsibilities of university, government and industry in cultivation of innovation talents and entrepreneurs [4].

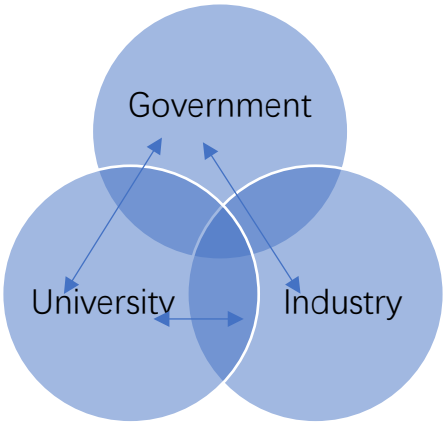

Figure 1. Triple Helix Theory

Therefore, the Chinese government requires in "Opinions of the State Council on Promoting the High-quality Development of Innovation and Entrepreneurship to create an upgraded version of 'innovation and entrepreneurship'", universities deepen the integration of production and education, introduce enterprises to carry on productive practice and strengthen the education of innovation and entrepreneurship [5]. At the same time, the innovative enterprises take a leading role in scientific and technological innovation through aggregating innovative institutions, enterprises and universities.

3. APPLICATION OF INDUSTRY AND UNIVERSITY INTEGRATION IN MAKERSPACE

3.1.An introduction of makerspace

The term "makerspace" in China is put forward by Premier of China Li Keqiang when he presided over the executive meeting of the State Council in 2015. He emphasized "determining policies and measures to support the development of makerspace and build a platform for innovation and entrepreneurship". Makerspace is a collaborative work space inside a school, library or separate public/private facility for making, learning, exploring and sharing that uses high tech to no tech tools. The best part is that makerspace is communal. The goal is to work together to learn, collaborate, and share. Importantly, makerspace allows exploring, creating new things, or improving things that already exist. The University recognizes that students have great potential to turn the fortunes of this country around through their creativity, hence allowing them to express their imagination, build and find solutions to society's problems. Beyond space creation, makerspace offers a platform that connects students and faculty to work with communities and industry to develop solutions to industry and community problems. Makerspace also creates a window to address business challenges and/or challenges at the

University that can be transformed into business opportunities while instilling in students the culture of entrepreneurship.

3.2. Different categories of makerspace

According to different subjects who found makerspace, four categories are existing in China [6]. First, the makerspace is constructed by the internal innovation department of enterprises. Enterprises attach importance to scientific and technological innovation and set up makerspace to develop new products or technologies such as Google and Amazon. Second, a makerspace is established by enterprises to transform. Many enterprises perceive business opportunities with ongoing high attention of the state to makerspace. It can effectively advance the self-development of enterprises through integrating resources. Third, regional governments establish makerspace to encourage people to start up businesses to create jobs and increase new opportunities for poor people in order to support local economic growth. Forth, universities cooperated with businesses in technology transfer by the establishment of makerspace. As the university takes up a new role in innovation promotion, it becomes transformed. Many colleges in China have their own makerspace which provide workplaces and labs, small amount capital of financial support, and mentors with professional knowledge in management, law, accounting, marketing, entrepreneurship and so on for entrepreneurial teams. Through the platform of makerspace, the university is able to combine its nature of teaching, researches and social services. Makerspace in university provides teachers and students a practical place for innovation and entrepreneurship, enriches the form of innovation and entrepreneurship education, and improves the effect of technology transfer of higher education. The application of industry-education integration in makerspace of universities is to integrate all kinds of entrepreneurial resources, fully integrate social resources and school resources, and provide an innovative idea for students' entrepreneurship education.

3.3. The features of makerspace

On the basis of the features of low cost, convenience, efficiency and openness, makerspace in university has three major spectacular traits [7]. First of all, it focuses on vertical industries. Any type of entrepreneurial activity belongs to division fields of different industries, which rely on a mass of industrial resources in the process of operation. Based on the leading corporations, the makerspace with integration of industry and university can provide students with rich industrial knowledge thereby greatly improving the incubation quality of makerspace. Next, the whole chain of entrepreneurial resources is integrated in the makerspace of university. The partnerships of makerspace are constituted by universities, enterprises and third-party operating companies. Enterprises have the advantages of sites, technologies, production and market resources. Universities have an edge on venues, scientific achievements, education training and others. Third parties have the mature operation and management methods, social capital, human resources and other advantages. Combined the three parties with their strengthens, entrepreneurs in makerspace can resolve the problems and dilemmas quickly and effectively. Last, the makerspace provides professional services for entrepreneurial teams. The whole chain of entrepreneurial resources has provided fundamental bases for startup companies. The integration of universities, enterprises and the third party guarantees human resources management for professional services. In this way, the makerspace in the university supplies work space, social space, network space, and resources sharing space for mass entrepreneurs.

4. IMPROVEMENT OF OPERATION OF MAKERSPACE

Firstly, it is imperative to establish a cooperation mechanism. The leading group of makerspace should be formed including the representatives of universities, businesses, and third-party operating companies. The leadership group carries out the design of big pictures, overall arrangements and sustainable promotions of makerspace, coordinates the relationships of the three parties and ensures the smooth and productive operation of makerspace. In the research on Triple Helix Theory, researchers generally agree that a certain mechanism should be formed to ensure the stable interaction and equal exchange of the three parties, which are university delivering knowledge and developing technologies, industry providing products and related services, and government facilitating policies and regulations. Secondly, it is critical to form an operation and management mechanism. University is responsible to establish and select entrepreneurial teams. Enterprises provide the physical space, technical support, equipment and market resources. The third-parties carry out training, tutorials and consultations to teams and investment docking. A management organization takes a role to carry out education reform according to the demands of entrepreneurs. Finally, it is vital to improve the evaluation of feedback mechanism. The evaluation should be built on performance-oriented and problem-oriented bases, conducted periodic feedback, and reflected problems which are rectified immediately. The market feedback including the popularity of products, market share and financial situations and development of members of start-up companies, is incorporated into the evaluation system of entrepreneurial teams to test and analyze the problems and deficiencies of makerspace and make a timely response on the analysis.

5. CONCLUSION

Traditional education manners were failing to shape graduates as future knowledge workers with described attributes. As a response to that, universities have started improving and modifying approaches to teaching and learning what is strived for work-based and problem-based in higher education. Engagement on real-world projects and complex problems has proved to be valuable for the transition of students into successful knowledge workers. To facilitate these initiatives, makerspace, with the presented defined role of integration of university, Industry and Government, their relationships and functions inside the model is recommended. Adjusted and defined in accordance with the goals and needs of collaboration parties, makerspace is believed to represent an effective form of learning, valuable support for education and a platform to provide tools and learning resources to the public.

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REFERENCE

[1] Ministry of Education, The 13th Five Year Plan for The Development of National Education. http://www.moe.gov.cn/jyb_xxgk/moe_1777/moe_1778/201701/t20170119_295319.html

[2] General Office of the State Council: Several Opinions of the General Office of the State Council on Deepening the Integration of Industry and Education. http://www.gov.cn/zhengce/content/2017-12/19/content_5248564.htm

[3] Leydesdorff , L. & Etzkowitz, H.(1998).The Triple Helix as a model for innovation studies. Science and Public Policy, 25(3), pp.195-203.

[4] Xiuping Zhang, Xiaoying Huang. Triple helix theory: the innovation mode of traditional "industry-university research" theory, Journal of Dalian University of Technology. 14, 2013.

[5] General Office of the State Council Opinions of the State Council on Promoting the High-quality Development of Innovation and Entrepreneurship to create an upgraded version of Innovation and Entrepreneurship. http://www.gov.cn/zhengce/content/2015-05/13/content_9740.htm

[6] Shengdan Wang, Shuilian Wang. The Exploration of The Operation Mode and Support System of Mass Creation Space in Colleges and Universities in China. Industry and Technology Forum. 16(1), pp.227-229.

[7] Lu Qiuping. On Innovation of Makerspace in Higher Education Based on The Integration of Production and Education. Social Sciences of Chinese Youth, 3, 2018, pp.97-103.