

Construction of University Makerspace from the Perspective of Open Innovation

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Abstract. In the context of knowledge-based economy, with the booming of the maker movement, the open innovation theory based on collaborative innovation and user innovation has promoted the makerspace as a significant innovation medium and an emerging form of economy. The review of the maker movement and the analysis of the meaning, operation mechanism and external environment of open innovation can justify the idea that open innovation will become an important thrust to the new round of technological revolution. Based on theoretical research, this paper attempts to explore the use of open innovation theory to provide guidance for the construction of makerspace, cultivate the maker culture, and promote the reform of innovation and entrepreneurship education in application-oriented universities.

Introduction

In 2009, the president of the United States Mr. Barack Obama said at the National Education Innovation Conference that “every student should be a maker instead of just a consumer”, which led to the implementation of “Maker Education Initiative” with a view to making every teenager a maker by creating makerspace and engaging in maker project [1]; in June 2014, at the White House Maker Faire, Mr. Obama called on all civilians to be a part of the campaign for sparkling innovation and encouraging community invention [2]. A package of initiatives fueled on the booming of turning the American maker movement to civilian campaign.

In China, the state government has intensified its efforts to facilitate the “Mass Entrepreneurship and Innovation” in alignment with the “innovation-driven development strategy”. In particular, the Premier of State Council Li Keqiang specifically wrote “many ‘makers’ stand out’ in the work review for 2014 in the 2015 China Government Work Report, and further suggested “two engines” for the future economic development in the work outlook: one is the increase of supply of public goods and services, the other one is “Mass Entrepreneurship and Innovation”. Domestic universities responded to the national strategy positively by carrying out the “entrepreneurship and innovation” activities represented by entrepreneurship and innovation education reform, integration of production and education, and construction of makerspace, which altogether constitute an integral part of the maker movement with typical Chinese characteristics.

As a significant medium and platform of “entrepreneurship and innovation” activities, the construction of the makerspace is associated with the outcome of entrepreneurship and innovation education reform and the level of integrating production and education and serving the society, and can drastically boost the maker culture where the spirit of innovation and entrepreneurship is the

core part. This paper attempts to gain an insight into the original idea for fueling on the development of maker movement by reviewing the milestones of the maker movement, and to explore the idea and plan for the building of makerspace in universities under the guidance of open innovation theory.

Milestones of the Maker Movement

The US maker movement, Chinese “entrepreneurship and innovation” activities, or makerspace in universities has the same subject—maker. Maker and the milestones of the maker movement are the interactive result of technological progress, ideological innovation and cultural heritage.

Maker and Maker Culture

Maker activity is closely linked with university. Halverson asserted that the Fab Lab (Fabrication Laboratory) launched by Center for Bits and Atoms at the Massachusetts Institute of Technology (MIT) in 2001 demonstrates the prototype of the maker activity [3]. Dale Dougherty believed that the mass maker movement was promoted and extensively applied by Make magazine, a magazine founded by him in 2005 [4]. Cory Doctorow was the first scholar who linked maker with value creation, he saw maker as entrepreneur and vividly indicated that the money on table is just like a little krill—a vast number of opportunities for establishing small businesses remain to be discovered and developed by those creative and smart people [5]. Chris Anderson further established the presence of maker and maker activity as the thrust to the new industrial revolution, in the book *Makers: The New Industrial Revolution*, he defined makers as: those who are not profit-oriented and turn all kinds of creative ideas into reality by using 3D printing technology and various open source hardware [6]. Chris Anderson further boldly predicted that the next industrial revolution will not happen in lab or company, but at the home of millions of ordinary people, which will be boosted by those who are called as “Maker”.

The maker culture formed with makers has deeper segments of historical gene. Daqin Ding thought that these gene fragments can be found in garage culture, Silicon Valley culture, DIY culture and hacker culture. The civilianization, hands-on and innovation of DIY culture and garage culture are the original blood of the maker culture, “it is the pro-innovation garage culture that makes a strong USA today”; the Silicon Valley Culture that worships entrepreneurship, pursues excellence and venture capital, and tolerates failure provides an inexhaustible power to the maker culture, and has led to the rise of internet giants including Apple and Google; notably, the hacker culture stirring up the "open source movement" and "free software movement" has injected the cultural spirits, such as freedom, cooperation, sharing and exploration, into the maker culture, and further made it compatible to the knowledge-based economy age and the internet age, thereby incubating open source systems and communities such as Linux OS and GitHub software project hosting platform.

Open Source Software and Open Source Community

The enormous vitality and market vigor demonstrated by the open innovation practice of the maker movement is considered as the primary reason for a gradual access to the social preferences and the strong support from all state governments in the course of development. Notably, the most famous reason is the success of the open source software and the open source community consisting of makers.

Open Source Software originated from the GNU declaration issued by Richard Stallman in 1985. He published the software programs written by himself on the Internet in the form of source code. These programs allow anyone who holds the open source license to use, copy, modify and disseminate from time to time and from place to place for any purpose whatsoever. However, by no means should anyone who disseminates such programs impose any additional restrictions to the software system in the course of dissemination, or take possession of any modified program, in order to oppose knowledge hegemony, break down the barriers to knowledge dissemination by closed commercial software through sharing. The access to open source software has been supported by a large swarm of software developers and users who pursue openness and sharing, who formed the early hacker group, and built internet-based virtual “open source community” to launch the vigorous open source movement, finally altering the market pattern of the software industry. In 1991, Linus Torvalds released an open source Linux program he wrote to the internet. In the coming years, software enthusiasts and programmers around the world on their own will form a Linux technology development network, pooled efforts to develop the Linux OS as a technically mature and commercially successful computer OS, “today, over 99% of the world’s best 500 supercomputers are running Linux OS”, “Top 10 fastest-running supercomputers are running Linux OS” [7]. Linux OS has been recognized as “the first significant work created by public efforts” [8], which in turn proves the value of “grassroots”.

Considering the success of Linux, Eric C. Raymond theoretically analyzed it in his book *The Cathedral and the Bazaar*. In this book, he vividly compared open source community to the “bazaar”, where all members adhere to the tacit rules, make their own contributions to the community goal, and take pride in it [9]. Eric C. Raymond argued that the key factors determining the success of the open source community include “gift culture” and “reputation competition”: gift culture arises from abundance instead of scarcity (hackers believe that technological advancement makes information more abundant, rather than a scarce item anymore, which is a necessary condition for the existence of gift culture). In the gift culture, the social status is determined by what is given and how much is given, rather than by what is given and how much is given. Hackers can get recognition and prestige in the community they are in by spending time, efforts and creative ideas in the competition. Hackers insist on the gift culture and gain the dominant right over project through innovative competition. In the belief that creating a project will earn more reputation than participating in a project, they gain status and satisfaction in the open source community by relying on the reputation earned through a series of competitions, so that hackers' projects would be more open and inclusive. If software is only understood or needed by the author, then it is even hardly qualified for the competition of reputation, making contribution to an existing project will be more likely to catch attention than creating a new project, and competing with a mature project is even more difficult than filling gap in the field. The explanation for gift culture and reputation competition can be found in Maslow's hierarchy theory of needs and more specially, the theory of needs about Esteem and Self-actualization, the motivation of hackers to gain esteem and self-actualization eventually promotes the quality of Linux and other open source projects comparable to commercial products.

For the commercial value and market strategy of open source projects, Eric C. Raymond also boldly predicted: use open source software to establish or maintain the market presence of proprietary software, or facilitate new software to quickly grab market share; when a hardware company is forced by the market pressure to write and maintain software, but the software is

unprofitable, the open source to user will sharply reduce cost; profit can be earned by selling the appendage; provide free software to user, but collect a fee for the commercial behavior of user in using software brand or assisting user in making secondary software development. Open source software has been commercially successful and finally made its market presence firm in the IT field, making the open and innovative “bazaar” model comparable to the closed and innovative “Cathedral” model. In 2006, a report released by Optaros Consulting indicates that 87% of the organizations used open source software at that time, while Gartner Consulting predicted that over 95% of major IT participants and organizations will directly or indirectly use open source software in their critical mission programmes [10].

Makerspace and Fab Lab

The success of the open source software movement and the open source community has inspired the creative enthusiasm among makers, whose presence is gradually extended from the internet to the real space. In 1984, hackers (later known as “makers”) founded the Chaos Computer Club in Berlin, Germany, who gradually evolved into the most important group, together with other hacker organizations influencing the development of the network information technology. The Fab Lab system initiated by MIT makes use of the resources and platform available in the campus, relies on information technology to share network resources with the world, conducts multi-dimensional and all-round project cooperation according to the actual needs where the university is located, and has explored a more positive model for technology innovation [11]. Today, Fab Lab has evolved into the world's largest distributed innovation lab system, as well as the example of building the open, collaborative innovation lab for global universities. It is also considered as the “first education-based makerspace in the United States.”

As the gathering place of makers and the primary platform for maker activities, “Makerspace” is also referred to as “workshop” or “TechShop”. Despite different names, all of these names have important agglomeration effect and role of demonstration: it provides makers with a space for cooperation, sharing and creation, and provides them with production tools and technical training and guidance to ensure the smooth process of innovation activities; makerspace provides initial financing, production, and marketing among other commercial services for innovation result through resource integration, thereby reducing the difficulty of converting innovation into entrepreneurship; the high-quality maker group gathered in makerspace is interested and more capable of experimenting new technologies and products to help enterprises optimize technology, expand the usage value of product, and realize user innovation at more affordable cost; the innovation environment and maker culture created by the makerspace plays a greater role of demonstration, which is expected to bring the social attention and support to innovation, attract more people to actively participate in innovation. Finally, as the author of *The Maker Movement Manifesto* Mark Hatch expected, “a well-equipped makerspace that provides tools, training and channels can also evolve into a vibrant creative cluster in the city.”[12]

In China, the intensified efforts for “Mass Entrepreneurship and Innovation” pooled by the state government has led to the integration of startup platforms including the original technology industry park, university technology business incubator, and small business startup base, and the newcomer maker platforms including makerspace and innovation works, consequently a swarm of affordable, convenient, all-factor and open makerspaces have been formed. In 2015, the release of the “Guideline of the General Office of the State Council on the Development of Makerspace to

Facilitate Mass Entrepreneurship and Innovation” formally established the underling presence of makerspace as the new entrepreneurial service platform [13]. With the positive guidance of the state government and the extensive involvement of social capital, makerspaces have developed at a fast speed. According to statistics of “China Business Incubation Development Report 2019”, as of 2018, there were 6,959 makerspaces across the nation, serving 414,000 startup businesses and teams. In campus, makerspaces not only undertake the function of transforming technological achievements and social services, but also undertake the function of organizing the implementation of innovation and entrepreneurship education practices, which play a pivotal role in cultivating application-oriented talents with innovation and entrepreneurship capabilities and spirit, incubating and disseminating the maker culture.

Open Innovation and Its Operating Mechanism

From the milestones of the maker movement, open innovation can be always found throughout the process of the maker movement, serves as the essential gene of the maker’s spirit, and also the key factor for determining full of vitality and positive role of the makerspace.

Implication and Main Features of Open Innovation

The professor of Harvard University Chesbrough first put forward the concept of “open innovation” [14]. In the book *Open Innovation: The New Imperative for Creating and Profiting From Technology*, he said that in order to promote the innovation within an organization, the company intentionally, actively and flexibly use the flow of internal and external technologies and creative resources. As a result, the focus of innovation will transcend the boundaries of the internal R&D institution in the company and migrate to other innovation entities (universities, research institutions, other entrepreneurs). Hastbacka argued that open innovation is the two-way circulation process of innovative technologies and ideas within and outside the company [15]. On the one hand, new technology comes into the company through capital, project or production process, on the other hand, the company exports new technology through technology transfer or asset distribution and get market feedback. Lichtenthaler further explored open innovation from the perspective of knowledge production [16]. He suggested that company should integrate and exploit internal and external resources in the innovation process, and engage in knowledge exploration, knowledge retention and knowledge exploitation in an organized manner, until the goal of open innovation can be attained. Yin Hui considered that open innovation is a new innovation paradigm, which crosses the organizational boundaries and complements the resources within and outside the organization through multi-angle dynamic collaboration on the knowledge supply chain between company, research institution, supplier and user [17].

With a view to the study of open innovation, scholars not only focused on the cooperative innovation (also referred to as “collaborative innovation” in China) between enterprises, universities, R&D institutions and other multi-agents, but also explored a new innovation model (user innovation) from the perspective of innovation source. Eric von Hippel of the Massachusetts Institute of Technology (MIT) first proposed the hypothesis of innovation source variability [18]. He argued that users and suppliers of an enterprise may become the innovation source, and found that in many industries such as scientific instruments, engineering plastics, and line terminations, new ideas proposed by user or improvements implemented by user are of great technical and market value for the enterprise. He referred this innovation implemented by user as “user innovation”. In

2005, Eric von Hippel focused on user innovation behavior and user-centered innovation system in his book *Democratizing Innovation*. He further explained the motivation of user innovation by a number of empirical studies - revenue is greater than cost, demand is not satisfied and user loyalty. He found that user innovation with widespread commercial appeal is often developed by Lead user who can not only take the lead in market trend, but also gain benefit from the solution that meets their needs [19]. Compared with the average user, makers have the potential to become lead users, who are willing to spent time and efforts to implement personalized modification on the product or to develop new use. An excellent open source product will be favored by makers, which can in turn attract more users to participate in innovation activities such as application development.

In summary, open innovation shows certain characteristics as described below: first, resourceful innovation entities participate in the knowledge production activity based on knowledge sharing to create a broader innovation network; second, the innovation process integrates talents, funds, knowledge and technology to complement the resource advantages; third, personal interest and organizational goal reach a balanced state in the innovation process. The maker activity based on open innovation breaks down the barriers of closed innovation, improves the efficiency of knowledge production and resource exploitation, creates opportunities for more people to get materials and spiritual wealth and enhance self-worth, and attain the end of “Mass Entrepreneurship and Innovation”.

Operating Mechanism of Open Innovation

As early as in 1996, Organization for Economic Cooperation and Development (OECD) first proposed the concept of The Knowledge Economy, placing knowledge production in the important position identical to material production [20]. A report issued by CAS writes “in the 21st century, knowledge economy will gradually predominate the international economy”. In the knowledge economy age, open innovation as a knowledge production pattern for new economy forms such as maker is running by unique mechanisms, including internal operating mechanism within the innovation organization featuring knowledge innovation and new knowledge application, and external operating mechanism featuring open innovation as part of social economy activities.

Lkujiro Nonaka gained an insight to the innovation activities conducted within Japanese corporate organizations, classified knowledge into explicit knowledge and implicit knowledge, and proposed the knowledge transformation and spiral movement model (SECI) [21]. He considered that an organization transforms personal knowledge to employee knowledge through various means, namely the transfer from implicit knowledge to explicit knowledge, then the explicit knowledge is processed, organized and extracted by using the knowledge management tool, until it becomes another explicit knowledge that is readily accessible, so that employees can improve their knowledge and skills. This process appears to rise spirally, also referred to as “knowledge spiral”. Lkujiro Nonaka found that the operation of the knowledge spiral is continuously promoted by four powers (socialization, externalization, combination and internalization): the power of socialization facilitates knowledge sharing among individuals and enhances the exchanges between implicit knowledge; the power of externalization guides members to express implicit knowledge and turn into explicit knowledge through meaningful conversation; the power of combination urges members to combine the concrete explicit knowledge with the existing knowledge and expand the knowledge foundation; the power of internalization drives members to turn explicit knowledge into their own implicit knowledge by learning new knowledge. The cyclic operation of the referenced four powers

will effectively transfer individual knowledge into an organization, and expand the knowledge foundation of individuals and the organization, which would in turn create more knowledge. Lkujiro Nonaka maintained that the attempt to create new knowledge is the re-creation of the organization and all members in the course of continuous self-renewal, innovation is the matter concerning all members within the organization, instead of the closed internal business of a few people or department. This coincides with the concept of knowledge sharing, mutual communication, and knowledge integration advocated by open innovation, which in turn highlights the advantages of open innovation compared to closed innovation in the knowledge production. He further underscored that the priority for an organization is to develop concepts and ideals that are continuously innovative, mobilize all kinds of resources to promote the sharing of implicit knowledge and enhance the practice wisdom among members, and form the “motive power of creation” in the process of knowledge transformation. Lkujiro Nonaka’s viewpoint clearly indicates the direction for how to maintain competitive edge in the knowledge innovation activities within an open innovation organization, such as makerspace (open source community).

Innovation is not only the constant theme of organizational development and growth, but also the main driving force for economic and social development and more notably, the collaborative innovation among different economic entities can represent the latest development model in the era of knowledge economy. Henry Etzkowitz described the knowledge production model for the collaborative innovation between “university-company-government” with reference to the DNA helix model in the field of biological researches, also referred to as “triple helix model”[22]. Henry argued that a knowledge-based and closer collaboration between university, company and government must be established, innovation can spirally rise only when the said three subjects fulfill their roles simultaneously; Henry suggested that university, company and government must open up organizational boundaries, cluster and integrate all factor resources from their organizations, and restructure their organizations, thereby forming a close cycle of innovative factors and achieving the end of collaborative innovation. Henry’s triple helix theory proves that only to the extent that open innovation is enforced, university and government, company can establish market economy activities and good cooperation, better exploit the strong radiating effect of technological innovation. Henry’s viewpoint has been verified in Silicon Valley. Hu Shuhong described and explained that the innovation system in Silicon Valley results from the favorable interaction between all innovation subjects, factors and innovation environment by using the triple helix innovation theory[23]. The Silicon Valley Model is the principal example imitated by Chinese innovation clusters including technology industry parks and makerspaces.

Prerequisites for Open Innovation

As an important innovation model in the era of knowledge economy, open innovation has to be realized after meeting certain prerequisites, which is considered as an important environmental factor for why makers and maker activities can exist and develop.

The first one is technical factor, the precondition and foundation of open innovation is knowledge sharing. The dissemination range and efficiency of information as the knowledge medium will directly influence the degree of openness and the effect of innovation. It has turned out that the rise of maker activity is closely related to the progress of information technology. The open source Linux OS was jointly developed by global software developers on the internet platform. Dai Jianjun considered that information technology has reduced information asymmetry, lowered the threshold

of innovation, broadened the scope of innovation subjects, facilitated the integration of innovation factors and resources, improved the transformation efficiency of innovation results, and reduced the innovation cost. Until now, information technology has continuously promoted the open innovation model in breadth and depth[24]. For example, makers are enabled by 3D printing technology and open source software and hardware technology to achieve "desktop innovation" at an affordable cost, release innovation results and capture attention on the internet. Moreover, makers also have the opportunity to get invested and commercialize result and start up a business by crowd funding and other Internet financing instruments; blockchain technology can play a positive role in affirming right, transferring or appraising innovation results by tapping its properties such as decentralization, non-tampering, distribution and sharing, which is expected to gradually solve the problem related to intellectual property protection in open innovation practice, and to remove the obstacles for more market participants to accept and participate in open innovation.

The second factor is system guarantee. The experience of developed countries shows that the state protection of intellectual property rights and the support for innovation is one of the important reasons for innovation. Take the United States for example, in 1980, the US Congress passed the "Bayh-Dole Act", which aims to clarify the ownership of the intellectual property rights related to the research results developed by the universities funded by the US government, determines that any university funded by the government is obliged to organize the patent application and to transfer technology in the form of patent licenses, clearly specifies that patent investors has the right to share the benefits of technology transfer, and further stipulates that the proceeds earned by university from technology transfer should be redirected to the education and research works in the university[25]. The "Bayh-Dole Act" has a positive influence in that the US universities have rapidly released the vitality and initiative of innovation, and become one of the main forces of the state innovation system step by step. The number of patent applications annually filed by the US universities has hit 1,600, compared to less than 250 patents annually filed in previous years. University professors took the initiative to link scientific researches with corporate innovation, other professors started up their own businesses with the support of VC institutions such as angle fund, and became the entrepreneurs of incorporating hi-tech companies. The US Congress and the state government have gradually established the IPR system framework which consists of the "Bayh-Dole Act", "Federal Technology Transfer Act", "Presidential Memorandum on Government Patent Policy", "National Competitiveness Technology Transfer Act", and "Technology Transfer Commercialization Act", stimulated the vitality of innovation and brought the US economy into a virtuous circle, making it the most competent and innovative country around the world.

The third one is cultural factor, the social culture influences value orientation, the maker culture reflects a distinctive theme that fits the present age, and the spirit of innovation and entrepreneurship as part of the maker culture is considered as a critical spiritual and cultural wealth in the era of knowledge economy. "Maker culture" attracts more knowledge workers to walk into open source communities, maker clubs, and startup cafes, expanding the group of innovation subjects; "maker culture" extends the sphere of innovation activities from the technology field to the management field, even the life field, and encourages cross-border cooperation among the makers with different backgrounds, expanding the field of innovation and driving industrial revolution; "maker culture" facilitates the detachment of innovation activities from the niche group to the mass, and promotes the integration of innovation and entrepreneurship, underpinning the goal of "Mass Entrepreneurship and Innovation".

Makerspace Construction Guided by Open Innovation Theory

As maker activity is the newcomer in China, the university maker culture is greatly influenced by DIY culture and the entrepreneurial culture from Silicon Valley, while less influenced by hacker culture and open source idea. In China, undergraduates lack of maker education and have little knowledge of the maker culture before enrollment, the vast majority of university makerspaces just crosses the natural development course of makerspace, hardly finds a balance between the practice of innovation and entrepreneurship education and the transformation of technology results, a lot of issues have been exposed in this process.

Main Issues in University Makerspace

First, the builder and operation manager of makerspace have a cognitive deviation of the maker activity and lacks open and innovative thought. Some universities are inclined in the transformation of achievements by research teams or projects, tend to be over-commercialized after the introduction of government or social funds, and show clear signs of imitation, but neglect the cultivation of maker culture and innovation spirit, lack of openness; other universities transform engineering training centers to makerspaces, but the way of managing and operating makerspaces generally follows the idea of holding extracurricular practice activities with low level of innovation, which is weakly related to the actual social needs and cannot meet the requirement for integration of industry and education, collaborative talent cultivation, and collaborative innovation.

Second, the operation and management of makerspace lacks of collaborative innovation mechanism, the management unit of university makerspace is generally in line with other campus Tier-2 units, making it impossible to break down the information, technology and resource barriers: for space, it cannot use abundant teaching and experiment venues in the university; for time, it cannot be open to teachers, students and the society for 24 hours; for breadth, it cannot coordinate various innovative resources within and out of the university; for depth, it cannot involve in the whole process ranging from teaching, research to social services.

Third, the internal and external environment of makerspace remains to be improved, the maker culture of “Mass Entrepreneurship and Innovation” should be actively nurtured and widely disseminated. The readily accessible open knowledge network should be constructed by the whole society. The legal system framework for IPR protection should be further improved. The talent cultivation model, technological innovation mechanism and social service awareness within the university should be further optimized and adjusted.

Fourth, the management and operation of makerspace lacks a management team with open innovation awareness and maker experience. With a view to the transformation of technological achievements, there is no entrepreneurial guidance team composed of law, finance, company operation and marketing talents. Regarding education and teaching, there is no maker guidance team composed of double-qualified teachers.

Practical Exploration of Promoting and Complementing the University Makerspace Development

If the university makerspace is constructed by still following the closed innovation practice, it will run counter to the direction of maker movement and double-qualified work. Consequently, Chinese universities cannot provide an important support for the national innovation-driven strategy despite

the intensified global innovation competition in the era of knowledge economy, or effectively access and exploit the global innovation resources in the era of knowledge economy. Zhuhai JL College is a new application-oriented undergraduate college. It has actively explored in the construction of makerspace under the guidance of open innovation idea.

First, stick to the principle of open innovation, receive investment funds and refer to the achievements of the mankind, bravely push the latest technological achievements to the market, extend the path of innovation from the global perspective, promote collaborative innovation and integration of industry and education between university, government and company. JL College registers and sets up the Research Institute for SME Advanced Technology based on makerspace, which directly provides knowledge technology services to the society, facilitates the overall integration of knowledge chain, industry chain and value chain, builds a more efficient innovation chain; internally, assigns the mission of innovation and entrepreneurship education reform to makerspace at the top-level design, especially the interdisciplinary and professional integrated practical teaching and innovative engineering training functions, develop the makerspace to the hub of circulation of campus and off-campus resources, and undertake the function of transforming scientific research achievements and incubating new startups. JL College's makerspace has overlapping functions with teaching, scientific research, student affairs and other departments. Subject to the traditional organizational structure, oversizing, redundancy, bureaucracy and other deficiencies will arise. In breadth, refer to the successful case of the government “one-stop public service platform”, involve Tier-2 units in the platform construction and the project-based operation mechanism. In depth, construct the two-level makerspace systems in campus, which will not only tap into the advantage of the makerspace resource integration at the campus level and break down the barriers of disciplines, but also exploit the advantage of disciplines in Tier-2 college, incubate and nurture special projects, and make the innovation and entrepreneurship work fully covered.

Second, complement the operational mechanism. JL College follows the basic principle of encouraging and supporting innovation, the college officers take the lead to promote the construction of double-qualified work management system and guarantee mechanism. Offer greater autonomy to makerspace in site, fund and management authority, provide makerspace with special innovation and entrepreneurship funds, discipline competition funds, proceeds from the transformation of technological achievements, and a part of education and teaching reform funds for centralized management. Subject to all laws, regulations and policies governing the state supported IPR protection and transformation of achievements, make further efforts to delegate power and empower, create a favorable environment that supports, encourages and ensures innovation, inspire the enthusiasm and vitality of “Mass Entrepreneurship and Innovation”, and enhance the core competitiveness of all innovation subjects.

Third, strengthen the building of talent team. JL College proactively solicits professional managers with proven experience of innovation and entrepreneurship from enterprise, taps into its disciplinary advantages to build the management and operation team composed of experts in the field of education, scientific research, law, finance and management, strengthen the training of double-qualified faculties by making full use of social resources, enhance the operation and management capabilities of the university technology innovation team. Internally, serve the teaching and research activities and the innovation and entrepreneurship practice by faculties and students; externally, serve the innovation efforts by regional economy and society and industry enterprises.

Fourth, make sustained efforts to enhance the maker education and foster the maker culture. JL College continuously deepens the reform of innovation and entrepreneurship education, fosters the interests of faculties and students in innovation as driven by self-actualization, cultivate the rational innovative thinking of students and their learning attitude of applying theory into practice in explorative and experiential manner, make students as part of the group and society in an open and sharing spirit through project-based innovation activities and social practices; actively guide teachers to engage in collaborative innovation based on the makerspace, attract more resource inputs to the innovation and entrepreneurship activities, create an atmosphere of innovation and entrepreneurship, and nurture the maker culture of the whole society participation.

Conclusion

To sum up, application-oriented universities should deepen the reform of innovation and entrepreneurship education with the concept of open innovation. By improving the operation mechanism, strengthening the talent team, cultivating maker culture and other measures, the application-oriented university should comprehensively promote the construction of maker space, build it into an important innovation carrier and new economic form, and make due contributions to the connotation construction of higher education and the improvement of social service ability of colleges and universities.

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