Making for fun or for growth? A comprehensive analysis on the development of makerspaces within the US and China

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

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Spring, 2020

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Fable of Tomorrow: The Future of Innovation

This past year, as part of one my classes, I have had the unique opportunity to be engaged in a global classroom setting, where I have been connected with a graduate student at one of China's premier research institutions. Despite a 13-hour time difference, language barrier, and being over 7,000 miles apart, Xingyu, my global partner and I were able to develop a unique friendship, learning more about each other's culture and lifestyle through our various conversations via email, WeChat, and Skype. Due to these circumstances, it was sometimes difficult to sustain consistent communication with each other. One day, I received an email from Xingyu saying that "because of the nature of our relationship, we may miss each other sometimes. In China, there is a saying that *good things need some wrongs before success*. It tries to give us hope that we can fight for what we want, whatever it is." This Chinese proverb really struck home (for various personal reasons) and I instantly responded to Xingyu, asking for the representation of this saying in Chinese characters. I needed to have the original form of the message. As former Chinese NBA basketball player Jeremy Lin once said, "the more that we appreciate each other's cultures, the more we influence mainstream society" (Bonesteel, 2017). For my 22nd birthday, I got my first tattoo, 好事多磨 (the Chinese proverb), on my chest, serving as a daily reminder to me to never give up and to be open to learning about new ideas. I am proud to hold these words on my body for the remainder of my lifetime, and am extremely grateful for the opportunity I have had this year to learn more about China and Chinese culture firsthand, which is often distorted by mass media and the government. Curiosity, a desire to understand things that may not be the ordinary, and a willingness to learn – this is the basis of innovation. This thesis is about the past, present, and future of global innovation, dedicated to the lifelong friendship with Xingyu.

Introduction

Innovation plays a critical role in shaping the national identities, as well as the diplomatic relationship between the US and China, two of the world's most prominent powerhouses in relation to the global economy and technological output. While the former US president Obama claimed that innovation is in the American's DNA (Melton 2016), President Xi Jinping continues to emphasize the crucial role of innovation in rejuvenating China, that "lack of innovation is 'Achilles heel' for China's economy" (Reuters 2019). Through their design and manufacturing power, the two countries both have an influence on the global value and supply chain that spans far beyond their physical boundaries and consistently set the standard for the global economy.

To cultivate a culture of innovation, the United States and China both embrace the idea of 'maker-movement,' a growing global phenomenon that emphasizes the value and practice of innovation. According to Martin (2015), the maker movement is "the expanding community of hobbyists, tinkerers, engineers, hackers, and artists who creatively design and build projects for both playful and useful ends, typically in collaborative spaces called makerspaces". However, what exactly is a makerspace in the US and China? Given their different social, cultural and political conditions, how do the ideas of makers, maker movement, and makerspace play out in US and China?

The goal of my research is to understand and compare how makerspaces are developing in the U.S. and China, as a lens to understand the innovation cultures grounded in the contrasting political, cultural, and social norms of each respective country. Using two case studies drawn from the makerspace in Charlottesville, US and Hangzhou, China, this thesis aims to demonstrate that the term 'makerspace' is not a universal concept; instead, they are complex socio-technical systems that have contrasting interpretations across the globe. An analysis of the

differing implementations of makerspaces and values embedded in their design will reveal each country's priorities, as well as national values.

Literature Review

In order to address the topic of makerspaces, we must first understand what exactly is a makerspace, and how they are classified by the existing literature. According to Bagley (2014), "there is not a true uniform definition of what a makerspace can be, which can be both a blessing and curse when it comes to identifying one." In her book, Makerspaces: Top Trailblazing Projects, Bagley (2014) classifies makerspaces as "spaces designed allow users to create, build and learn new projects and technologies." Lee (2015) defines 'making' as "a class of activities focused on designing, building, modifying, or repurposing material objects, for playful of useful ends, oriented towards making a product of some sort that can be used, interacted with, or demonstrated." Anderson (2012) defines makers as "groups of people using the internet and the newest industrial technologies to make individual manufacturing products." Davies (2017, 31-3) states that the first makerspace (also known as hackerspace), was founded in Berlin in 1981 as the Chaos Computer Club, and it wasn't until the creation of Make Magazine in 2005 by Dale Dougherty that the present-day maker movement found its way to the general public. In fact, the movement has gone international, and makerspaces can be found across the globe (Wen, 2017). Fab labs, or digital fabrication labs (a subset of makerspaces) were first started at MIT, however now they exist as a global interconnected network in over 50 countries (Wen, 2017). Additionally, between the years 2005-2015, there has been a significant increase in the number of Maker Faires (see Figure 1), and these public expositions have been hosted across the world in numerous places such as Rome, Sydney, Tokyo, and Hong Kong (Wen, 2017).

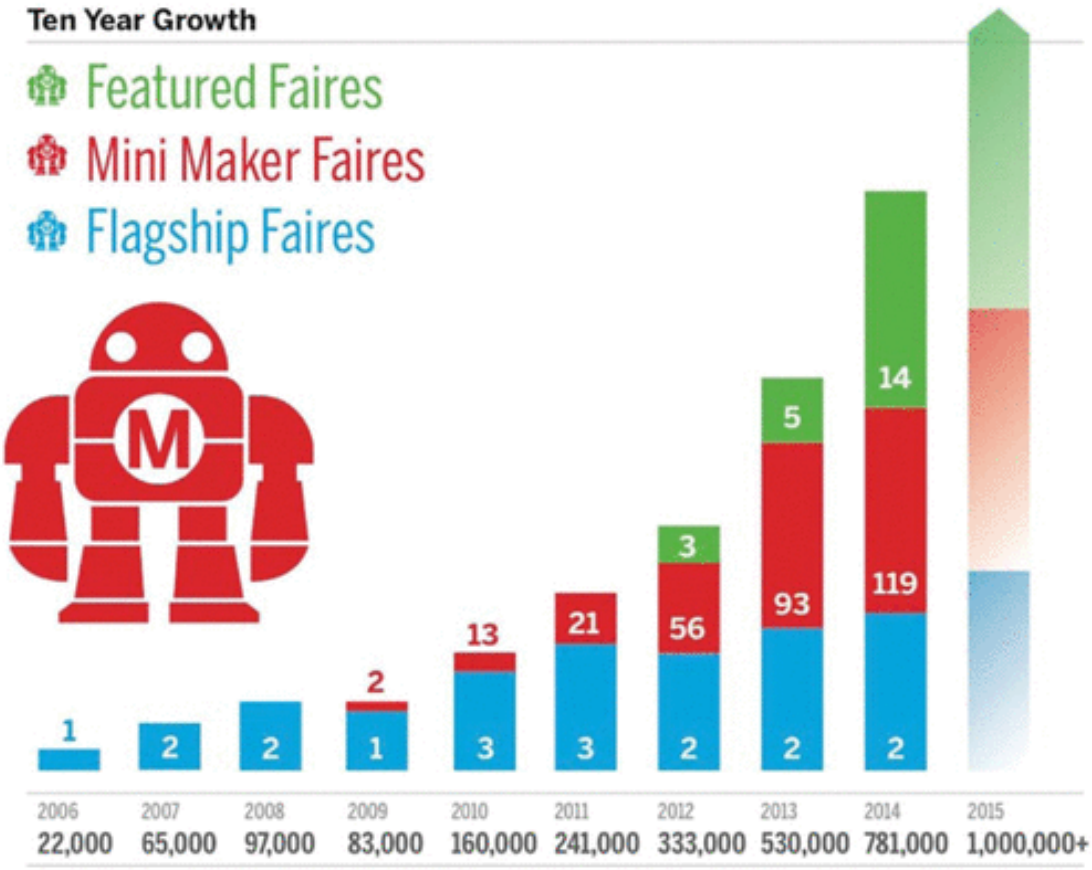

Figure 1: Numbers of Maker Faires per year. (Reprinted from *Making in China: Is maker culture changing China's creative landscape?* By W. Wen, 2017)

According to Wen (2017), national governments across the world are embracing the maker movement, "as it combines technological innovation, modern manufacturing and the cultural and creative industries." In 2014, former president Barack Obama announced June 18 to be the National Day of Making, to honor the American pastime of innovation and entrepreneurship. He claimed that making would 'ensure our Nation's progress,' and promoted the goal of becoming a 'nation of makers' (Wen, 2017). In the United Kingdom, the movement has a larger emphasis on artisan design and crafts, however the British government has developed public policy to encourage the development of a creative economy (Wen, 2017). In China, the maker movement is strongly supported by the national government, with new national goals focusing on

innovation and creative production from China (Wen, 2017). In Spain and the Netherlands, Fab Labs have been established and have become popular spaces for design thinking and open-source manufacturing (Wen, 2017). The movement has even stretched to Japan, where the principle of monozukuri (Japanese culture of 'making things'), is transitioning to a modern maker movement with the rise of Fab Labs and co-working spaces (Wen, 2017). Zen Hack Weekends have become prominent in Japan – a practice where meals and meditation are combined with sessions of brainstorming and programming (Wen, 2017). In her book, Fablife, Hiroya Tanaka (2015) claims that Fab Lab is looking for the alliance of two extremes, such as hardware and software, technology and ecology, and virtual and reality – this reflects the core principle of Yin & Yang (see Figure 2). The maker movement has even spread to developing countries such as India and South Africa, with local initiatives to support merchants who essentially function as makers (Wen, 2017). It is clear that the movement has gone global, and each culture has their own unique twist on the growing maker movement.

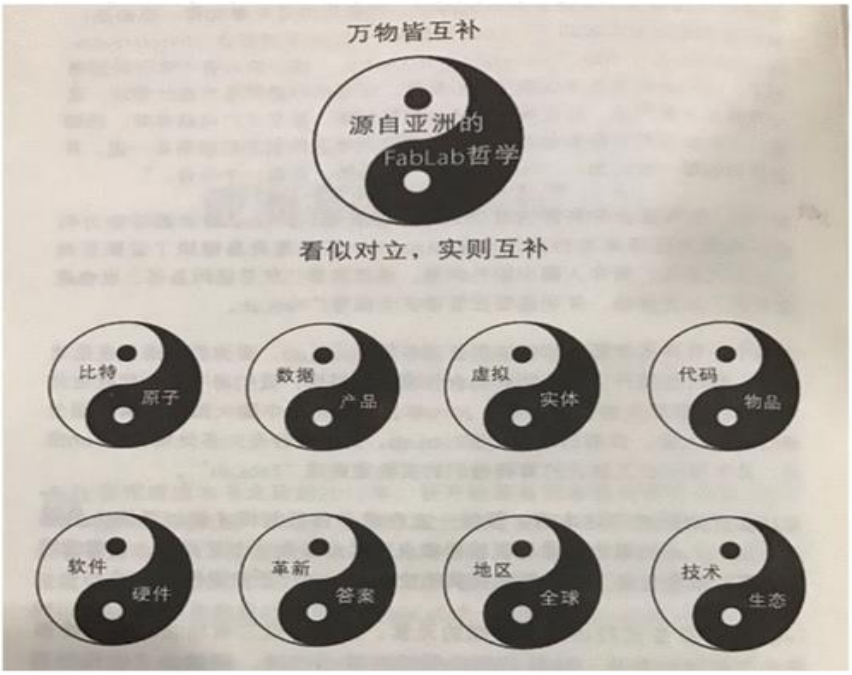

Figure 2: Fab Lab philosophy from Asia. (Reprinted from *Making in China: Is maker culture changing China's creative landscape?* By W. Wen, 2017)

STS Framework

I will be using the Value Sensitive Design (VSD) framework to guide my analysis. The concept of VSD was developed by Batya Friendman, a software developer who realized that the engineers who were involved in designing and creating a technology often forgot to consider the user experience – the primary people who would be utilizing the given technology (Rouse, 2016). Although the concept originated in the field of information technology and computer science, VSD is relevant to general innovation and the design of technology and complex systems. The key idea behind VSD is that moral and human values can be expressed in engineering design. There are numerous STS studies revealing that social and political biases can be inscribed in technical artifacts, systems, and infrastructure. For example, the architect and urban planner Robert Moses designed overpasses in Brooklyn, New York at a low height, enabling middle class vehicle traffic through but too low to allow bus traffic that was primarily used by lower class citizens (TU Delt, 2020). An underlying function of this overpass was to serve as a racist border separating the wealthy from the poorer African Americans. A values hierarchy can be utilized to translate values into design requirements (see Figure 3). I will be

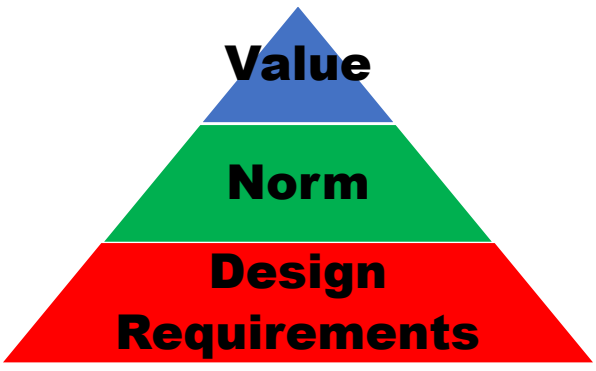

Figure 3: Value Hierarchy

navigating the value hierarchy from the bottom-up to guide my analysis, focusing on the analyzing` makerspace design to investigate and understand the norms and values of each respective country. A key component of VSD analysis is the connection between the engineers

and the actual users, and developing a comprehensive understanding of the direct and indirect stakeholders. Another important principle of VSD is the analysis of the idea of pervasiveness, that is, how a given system will spread and affect people in the long run. I will use these key tenants of VSD to guide my analysis of makerspaces within the United States and China.

Method

My research method will consist of an extended document analysis on the state of maker movement and makerspaces within the U.S. and China, using case studies of a novel set of makerspaces to reveal the values and practice of innovation in these two countries.

1. Chinese Makerspace Hupan Liangcang (湖畔良倉):
2. US Makerspace Scholarly Lab

My research aims to take a comparative lens on the development of makerspaces within the United States and China. I think it is especially important to note that I will be reviewing Hupan Liangcang because this Chinese makerspace is relatively new, and to date little American literature exists on the topic. I will be analyzing how makerspaces are implemented and utilized within each country, using original Chinese as well as American sources, in order to gain a comprehensive understanding of makerspaces.

Hupan Liangcang: China's "National Group Innovation Space"

Located in Hangzhou, the capital of the Zhejiang province, Hupan Liangcang is designated as a "national makerspace" (国家级众创空间), serving as an innovative partner of Alibaba Group, a Chinese multinational technology company specializing in e-commerce, retail, Internet, and technology, consistently competing with other colossal vendors such as Walmart and Amazon. Designated as Alibaba's "Smart Campus Supplier", Hupan Liangcang offers a

variety of entrepreneurial infrastructures to start-ups, incubators, or civic innovators, realizing Alibaba's mission "to make it easy to do business anywhere." The infrastructure provided includes innovative entrepreneurial space, investment and financial services, as well as training and education. Currently, Hupan Liangcang has 14 unique office spaces, focusing on different core incubation areas, including but not limited to e-commerce, cloud computing, intelligent manufacturing, and new retail. The primary goal of these office spaces is to further advance the development of promising startup businesses. Many of these office spaces are configured as massive campuses, and within these campuses there are large numbers of independent office areas and work stations designed to house many businesses. For example, the eGamesTown Liangcang Incubator located in Shaoxing City is over 9,500 square meters in area and has more than 800 work stations (see Figure 4). According to Interactive Planet Academy (2020), since its

Figure 4: Aerial view of eGamesTown Liangcang Incubator (Reprinted from *LC Place*, 2020)

founding in 2015, Hupan Liancang has served over 2,000 companies, financing over 2 billion yuan, which is equivalent to over $238 million. The company Hangzhou Ruipo Intelligent Technology Co., Ltd. was once incubated within Hupan Liangcang, and after many years of hard work as well as incubation support, has successfully developed the first Chinese produced distributed full platform operating system, known as Relaper OS (Longakang, 2019). According to the founder, Fu Linli, the Relaper OS directly serves the computing needs of China, such as autonomy, security, reliability, and compatibility, and will soon challenge the traditional PC operating system market (Longakang, 2019). It is clear that Hupan Liangcang desires to incubate businesses that seem to promise innovation and can offer valuable contributions to China.

There are at least three types of office space in Hupan Liangcang - incubator, accelerator, and makerspace. Incubators are typically designed to jumpstart businesses from an early, preliminary stage, while accelerators are generally catered towards settled businesses in order to "accelerate" growth and sales in a short time period. Makerspaces, on the other hand, are mostly seen as idea labs where individuals can tinker through hands-on experience and brainstorm ideas. Having all these different types of innovative space housed in one location indicates an ecosystem that connects individual innovation all the way to formal business development. Makerspace in China is translated as *chuang Ke kongjian* (创客空间), meaning a space for makers; innovation space in China is translated as *zhongchuang kongjian* (众创空间), meaning a space for grassroots entrepreneurs (Wen, 2017). The mixture use of these labels suggests a tight connection between makership and entrepreneurship.

Creating such innovation place has been advocated by the provisional and the central government since 2015, when Prime Minister advocated the idea of "mass entrepreneurship and

innovation" (大众创新，万众创业). According to the General Office of the State Council (2015), a group innovation space is defined as a new kind of low-cost, accessible, total-factor and open service platform for start-ups which is accustomed to the traits and needs of innovation and entrepreneurship in the era of network, established by market mechanism, professional service and capitalization. My interpretation is: "supported by both national innovation policy and commercial business partnership, these group innovation spaces become an umbrella label to house makerspaces, which can be for-profit or non-profit, and connect them to business opportunities at the right timing." In Whitepaper of Chinese Group Innovation Space (2018), such hybrid space is characterized as "Innovation hub with Chinese characteristics".

Innovation with Chinese characteristics

In his book, *Makers: The New Industrial Revolution*, Anderson (2012) categorizes makers into three groups: 'zero to 1 makers' – those who wish to learn to use tools to make; 'makers to makers' – those who have their own field of interest and are working with other makers on projects; and 'makers to market' – those who have an ambition to commercialize their work. Anderson's three categories create a pyramid, with '0 to 1 makers' at the base, 'makers to makers' in the middle and 'makers to market' at the top (Anderson, 2012). However, in China, 'makers' are often equated with 'innovators' and 'entrepreneurs'. In China, the pyramid hierarchy of makers is inverted (see Figure 5), with the majority of makers being 'makers to market' (Wen, 2017).

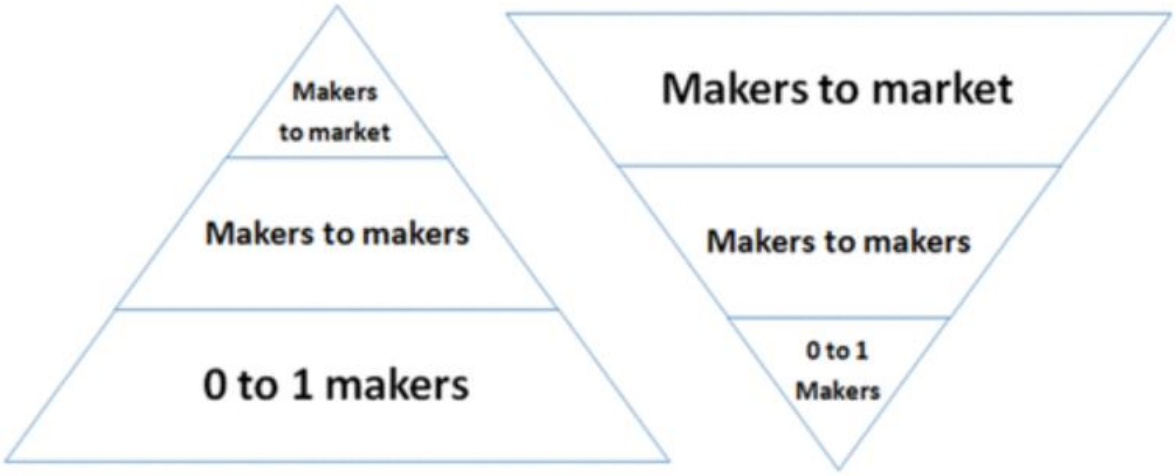

Figure 5: Traditional hierarchy of makers (left) and China's hierarchy of makers (right) (Reprinted from *Making in China: Is maker culture changing China's creative landscape?* By W. Wen, 2017)

Why does this inverted relationship exist in China? To investigate, we must take a closer look at the supply chain history of China. China has consistently been the manufacturing hub of the world, offering cheaper labor and extreme production capacity. When outsourcing manufacturing, China is often the optimal choice for many companies due to these reasons. This has made China an integral part of the global economy, and an especially key component of the U.S. economy. In the context of China, the large proportion of makers being 'makers to market' represent the large workforce that is involved in commercial hardware manufacturing. Recently, Chinese politicians have aimed to push the country from simply being the 'world factory.' In 2004, Chinese politician Liu Shifa from the Ministry of Culture stressed to change the focus from 'made in china,' to 'created in China,' from strictly manufacturing to creative work, through redirecting economic and social development towards the creation of ideas, services, and knowledge (Lindtner, 2012). Currently, the Chinese government is thoroughly pushing a new industrial growth policy called *Made in China 2025*, designed to transition the country from big manufacturing to a strong one, with a greater emphasis on innovation, new generation

information technology, intelligent manufacturing and a robust multi-player talent development structure (Wen, 2017). Consequentially, there has been a rapid increase in these innovation and incubator labs, while traditional makerspaces, meant for play and self-discovery, remain in low numbers. Over 80 old neighborhoods in Shanghai were redesigned into art/design loft-spaces and incubator labs, under the rubric "creative industry clusters" (Lindtner, 2012). These urban redesign efforts are ways that Chinese politicians are trying to create and mobilize a high-quality workforce that can help China thrive in the global economy focused on information and knowledge production (Lindtner, 2012). The norm that China is strictly a manufacturing hub is changing, due to the top-down approach being pushed by the Chinese National Government. However, traditional makerspaces are not completely non-existent in China. For example, Zhejiang University, one of China's most prestigious institutions of higher education, recently opened the 'Cookie Makerspace,' filled with high tech instruments such as 3D printers and laser engraving machines, available to use free of charge for makers. Yi Haoxiang, a student at Zhejiang University reported that "majority of makerspaces merely provide premises and most teams are essentially engaged in software development. It is very rare to find such a makerspace which offers a wide spectrum of first-class facilities in universities" (Zhejiang University News, 2016).

US Makerspace: Scholarly Lab

The development of makerspaces in the United States is taking a far different approach, vividly contrasting the landscape of China. The U.S. model follows the traditional hierarchy of makers, as opposed to the inverted relationship that exits in China (see Figure 5). The U.S. lacks the same level of national support that innovation spaces have in China, instead drawing the majority of support from maker communities themselves and technological companies like Intel

(Davies, 2018). Although former president Obama embraced the maker movement with open arms, the initiative was short-lived and has not been continued by current president Donald Trump. In the U.S., makerspaces generally exist in refurbished areas, with few being built as new spaces. Makerspaces are becoming especially popular in the context of K-12 education, having the "potential to revolutionize the way we approach teaching and learning" (R. Steven Kurti et al, 2014). The costs are typically covered by grants or university/library funding – very rarely do we see financial assistance from the local/state government (Small, 2017). Kurti (2014) emphasizes how the nature of the makerspace learning environment promotes collaboration amongst peers, as students work together to overcome a challenge, explaining concepts peer to peer. Halverson and Sheridan (2014) believe that the best way to democratize the space is through libraries, given their history as "free, embedded community resources to all." Here at the University of Virginia, we have a modern makerspace known as the Scholars Lab, located in one of the libraries on grounds (see Figure 6). According to the program website, the space is a place for "crafting, tinkering, and experimentation with technologies like 3D

Figure 6: Scholarly Lab makerspace located in Charlottesville, VA

printing, sewing, physical computing, and augmented reality" (Scholar's Lab Makerspace, 2020). The space is open to everyone; there are no fees for usage and no prior experience is required to work in the space. Aside from allowing students and community members to experiment with soldering or 3D printers, the Scholarly Lab also hosts free workshops and lectures to train and mentor anyone interesting in learning in topics such as microcontrollers with Arduino and Rasberry Pi, GIS analysis, sewing and craftmanship, and much more. Kurti (2014) also mentions that outside of an educational environment, makerspaces are simply adult playgrounds for thinking and whimsical construction; learning is not the primary focus. Sarah Davies (2018) conducted a series of interviews with makers and hackers across the United States to understand how makers characterize their practices and experiences and how this relates to the general understanding of the maker movement. Davies' (2018) research indicated discrepancies between the promising public claims of how makerspaces will stimulate innovation and entrepreneurship and the actual experiences of makers and hackers. The majority of makers that Davies interviewed were not utilizing the makerspace to develop business ideas, prototype products or innovate, but rather work in the space on the side, simply as a leisure activity (Davies, 2018). In her interviews, Davies found that the majority of projects were not focused on real-world problems or innovative solutions, but rather to satisfy wonder, engage in playfulness, or doing something "just for grins." Davies (2018) found that hacking was not a practice simply associated with the work being done in the makerspace, but a general classification to a way of life. Her interviewees indicated that hacking was intimately connected to their sense of self; those who simply get things done, creative problem solvers impatient with limitations and instructions. Additionally, unlike China, in the United States the term makerspace is not used conjointly with incubation labs and accelerators. In the United States, incubator and accelerators

are for profit organizations run by angel investors and venture capitalists designed to help new businesses enter the market or expand to the next level. Makerspaces, on the other hand, are isolated labs that are used by the hackers as a side activity, defined as a DIY, countercultural practice of self-reliance and independence.

Discussion

To guide my investigation and analysis of makerspaces in China and the United States, I am deconstructing the VSD values hierarchy to help unpack the values and norms embedded within the design and implementation of the Chinese and American makerspaces. One of the key differences I have noted from my case study on makerspaces within China and the United States is the space themselves, addressing the fundamental question – where do the makerspaces actually lie? In China, we can see that the spaces are vast, expansive centers designed to hold grand amounts of people and businesses, often in a campus like format – part of a larger corporate infrastructure, namely the Alibaba Group. On the other hand, we note the majority of spaces in the U.S. are either found in libraries within educational institutions, or scattered as isolated labs, housing distinct communities of 'hackers.' The implementation of makerspaces within the China and the U.S. alludes to the east/west culture differences – respectively the 'We' (collectivist) versus 'Me' (individualistic) culture. This is the general principle of how the importance of the individual is viewed in relation to the group. China's implementation reveals the collectivist nature in how the makerspaces belong to a larger group, Hupan Liangcang, and how the business 'incubated/accelerated', etc. in the innovation space will become affiliated with the whole, Alibaba Group. Conversely, the United States implementation reveals the individualistic nature in that each makerspace, especially in an educational setting, is specifically catered towards the group it will serve. The structure and layout of a makerspace in an

elementary school library will be much different from one in a university setting. Additionally, the various projects occurring within makerspaces in the U.S. are actually solely for personal, individual reasons, rather than trying to innovate and solve prevalent world problems. For my stakeholder analysis, in China I have assessed the direct stakeholders to be the Chinese National government and Alibaba Group, entities which value economic prosperity through Chinese based innovation – all to move away from the norm that China is strictly the 'world factory.' The new norm is a creative China, focusing on 'in-house' innovation through the Chinese concept of 'guanxi.' In the United States, one of the major direct stakeholders are be educational institutions, valuing a modern 21st century education and creativity, achieved through design thinking, problem centric approaches, and peer to peer learning. Another key direct stakeholder in the United States are the makers themselves, who value the 'hacking' lifestyle and community, as well as the individualistic nature of hacking itself. The primary indirect stakeholders in China are rival corporations to the Alibaba Group, as well as global business competitors, while those in the United States are the federal government, as well as young students who will utilize the makerspace. I think one of the key reasons why these differences in implementations exist is due to policy differences – the U.S. does not have any current policy analogous to the *Made in China 2025*. I believe that ultimately, the usage of makerspaces as an integrated modern ecosystem, backed by the support of the national government, will allow makerspaces to be tools that drive China towards innovation and intense technological advancement. In the case of the United States, I believe that makerspaces will remain as an educational vehicle, and innovation will need to come by some other mechanism, such as from anomaly characters such as Einstein, Zuckerberg, or Bill Gates.

Conclusion

Through comparing the makerspace design and operation in the US and China, this thesis reveals the complexities of makerspaces as socio-technical systems, as well as shows the vividly contrasting landscapes that have developed in the US and China. I have greatly enjoyed my participation in the global classroom as well as my research on makerspaces within the U.S. and China. It will be interesting to track the progression of the maker movement, and I would not be surprised if the movement becomes stagnant in the United States. With that being said, I believe the movement will proliferate in China, and we will soon see that China can sufficiently create and manufacture on its own, with the ability to support its economy without the need of other countries outsourcing work to China. Currently, the world is trying to figure out how to mitigate the spread of the novel COVID-19 (corona) virus – and right now this will take precedence over makerspace development. Perhaps we can utilize the makerspace methodology of maximizing collaboration to try and combat this global pandemic!

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