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Makerspaces and Contributions to Entrepreneurship

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Abstract

Entrepreneurship is essential to the growth and dynamism of countries and regions, forcing policy makers to search for levers to generate new firms within their municipalities. Without public attention, the maker movement, which refers to the democratization of access to and information on using tools, has risen from a fringe hobby to a prominent lifestyle with important implications for public concern. Modernly, tools have been available only to those working within firms and industry or those willing to pay large costs for their procurement. The maker movement presents multiple avenues to increase access to these tools, with the potential for impacts on the quantity and nature of entrepreneurship. My paper explores makerspaces and how they theoretically contribute to business generation and sustainment. As defined in the paper, the maker movement will influence entrepreneurship through three principle channels. The maker movement attracts more individuals into product design, and thus may launch more "accidental entrepreneurs" if they find that their user solutions have a market. Secondly, the maker movement generates dense but diverse networks, creating new ideas and innovative thinking. Lastly, the maker movement lowers the costs for prototyping, making early sales and acquiring outside funding more realistic.

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1. Introduction

The maker movement has generated a high degree of interest from the public and press in the past few years as it grew from a fringe lifestyle to being highlighted in President Obama's declared National Day of Making (June 17,

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2014). The maker movement, often described as an outgrowth of the do-it-yourself culture, has the potential to increase access to industrial tools and intensify people's desire and ability to use them. However, the subject has not been studied rigorously through the lens of its potential benefits to members or society.

The maker movement functions without a clear definition, due to its diffused origins and independent growth. Broadly, it refers to the increase in do-it-yourself and do-it-together projects and is related closely to the hacker ethic of sharing, collaboration, and learning through deconstruction and reconstruction (Levy, 2001). Maker culture connects inextricably with the diffusion of knowledge through the internet and the increasing available of physical tools. Making can be any type of activity involved in the creation of an object, in any field. The public commonly associates making with 3D printers or other technological projects; however, the terms makerspaces use to describe their members include maker, hacker, tinkerer, artist, crafter, programmer, and engineer (Van Holm, 2014). Dale Dougherty, the founder of Make Magazine, defines making as being part of all human activities such as cooking, knitting, and gardening (Dougherty, 2012).

Makerspaces are an important component of the rapid spread of maker culture. Makerspaces, also known as hackerspaces and fab labs as well as other names, are community workshops where members pay dues in order to access tools and workspace. Despite the presence of three common names, makerspace, hackerspace, and fab labs, they all share a common set of functions and uses; therefore, when using the term makerspace in this paper it refers to spaces under any of those names. I am not arguing that all such spaces are the same, but rather that what distinguishes their differences is not which name they use (Van Holm, 2014).

The primary impact of these organizations is the access to tools; they commonly hold over $100,000 (USD) in equipment, a cost that would be prohibitive for an individual but is manageable when spread throughout the membership. Makerspaces generally have memberships open to the public, those located inside schools being the main exception. Memberships allow individuals access regardless of their previous experience or field of interest and typically cost between $50 and $100 (USD) per month, which is comparable to fees for a gym. Makerspaces also often offer classes, ranging from introductory instruction to certify that members are safely able to use tools up through advanced classes. An additional benefit of makerspaces is access to human capital, as members share knowledge of tools and ideas for projects; they form a dense network of individuals with different training, experiences, and skills, creating an ideal setting for novel designs (Johnson, 2010). Makerspaces are thus a critical innovation of the maker movement, which continue to support its further growth.

My essay contributes to the growing academic literature on the maker movement by identifying ways it expands opportunities for entrepreneurship, both accidental and intentional. The argument here is not supported by empirical data, but is meant to point the way towards future research. With the definitions of maker movement and makerspace posited above, in the next section I develop a framework of how members use makerspaces. Specifically, I focus on how makerspaces contribute to entrepreneurship. I argue makerspaces contribute to the creation of new enterprises, offer an environment supportive of innovation, and make prototyping more available and affordable.

2. How are makerspaces used

I have developed the framework in Figure 1 based on visits to makerspaces across the United States to identify the overarching ways that members use makerspaces. In the summer of 2015, I will begin interviews with members and the management of makerspaces to test the framework and its implications.

When making an object, it is either a replication, meaning a purposeful recreation of something produced elsewhere, or an innovation, referring to any type of creating, tinkering, hacking or effort to produce a meaningful new form. The internet has created an ever expanding number of guides for individuals to engage in the process of replication. Either type of project can be undertaken communally or by an individual. Pinterest, instructables.com, YouTube, and personal blogs all offer items and descriptions so that people can recreate them for themselves. For members of makerspaces, building something they have been introduced to online is still meaningful because the personal capital they situate into the item, similar to the mental engagement contained in gardening and of bringing a process from beginning to end to produce an outcome (Blair, 2009; Wang & MacMillan, 2013). In addition, they are able to alter the item to better suit their needs.

Innovation can either be an intentional or accidental activity; it can arise accidentally by discovering either a better process or an improvement upon a project intended as a replication. A person can also start a project intending to create something new, either with an idea for how to modify an existing product, exemplified by user lead innovation (von Hippel, 1986, 2005), or develop something intentionally disruptive (Christensen, 1997).

To replicate or innovate is not the only decisions makers face. Either before or after developing an innovation, makers must decide whether they want to capitalize on their creation by selling it, or whether the item was simply a personal project, which can thus be considered a hobby. Once developed, makers must decide whether to publish the item online so that others can replicate it; someone looking to commercialize the product is unlikely to do so, but a maker also may not because they do not feel they have a medium or platform to publish or that anyone would be interested. The web platforms listed above as sources of replication are thus supported and enlarged at this end of the framework, hence the dotted line from publish to replicate.

In this paper I focus on the variety of branches running through innovation to commercial. Included are two types of "accidental" entrepreneurs, or those who do not intend to generate new products but stumble upon innovations. The way that makerspaces can contribute to generating new entrepreneurs is discussed in the next section, followed by the contributions of a supportive creative environment and prototyping.

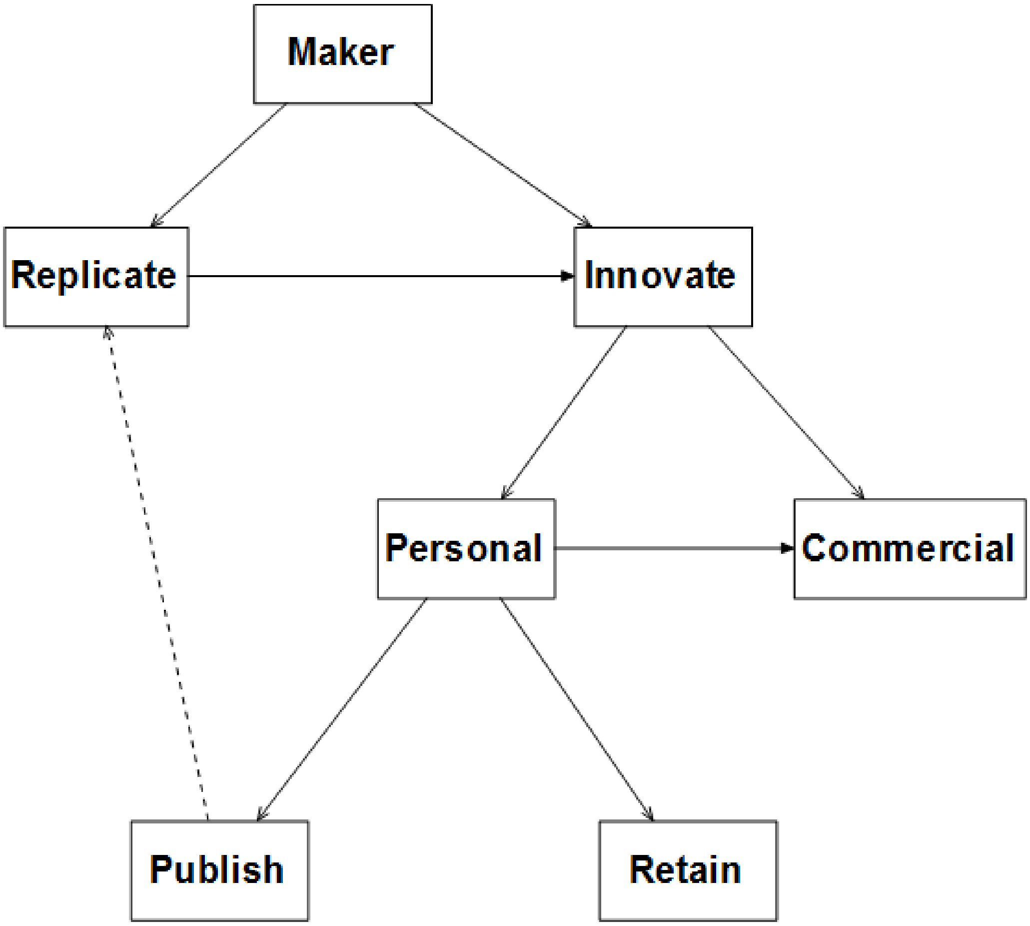

Fig. 1. Framework of Makerspace Use

3. Makerspaces Contributions

3.1. Generating Entrepreneurs

A sizable body of literature exists on traditional paths to entrepreneurship. Studies show that experience in similar lines of work is the primary source of entrepreneurial ideas (Bhide, 2000; Cooper, 1986). Often new ventures are spin-offs of existing firms as former employees go into related services. While experience creates useful knowledge, it makes them unlikely to be disruptive or bring an outsider perspective to bear on their industries. Specifically, those with familiarity with existing ways of solving problems have difficulty developing novel approaches, a problem both in market research and for new entrepreneurs (von Hippel, 1986). That same trend is found across industries with small businesses owners, who are mostly individuals with past work experience in the field and that desire to 'be their own boss' rather than innovative individuals blazing a path (Carland, Hoy, Boulton, & Carland, 1984).

Firms generated by other routes, in particular by lead-users, are under studied but have gathered the attention of researchers in recent decades (von Hippel, 2005). Lead-users are defined by two qualities: being ahead of the market in their needs and having expectations to receive a high net benefit from meeting these needs (von Hippel, 1986).

Studies have documented the prevalence of lead users starting firms based on their solutions, despite the fact that they are often only looking to solve their own problems before identifying that a market exists for their product. Shah and Tripsas (2007) termed such business owners "accidental entrepreneurs" when studying juvenile equipment owners that had developed jogging strollers, hands-free baby bottles, and diaper bags oriented towards fathers. The concept of accidental entrepreneurs has been noted outside studies of user innovations, as Aldrich and Kenworthy (1999) asserted many firms are created "on their way to something else" (p. 20).

Makerspaces may contribute to the development of more user innovations, and therefore more user entrepreneurs. Working with common tools, members have the opportunity to modify products they own and often look to meet their own needs. Makerspaces give members greater opportunity to tinker with the products they already own, as well as simplify the process of developing new products. Mahr and Lievens (2012) noted, "The increase in digitalization and decrease in the costs of communication have led to the exponential growth of user innovation platforms" and access to industrial tools should only further that trend (p. 169). Some of the most successful projects in computer sciences were developed by users, in part because the means of production were universally available much earlier. Tool availability through makerspaces allows the physical world to be more moldable, and therefore more similar to the digital one (Anderson, 2012; Gershenfeld, 2005) Prior to the surge of the maker movement, numerous user innovations have led to physical products in mountain biking (Lüthje, Herstatt, & Von Hippel, 2005), pipe hanger hardware (Herstatt and von Hippel, 1992), and others; makerspaces should only encourage further developments.

3.2. Creative Environment

Even for those who do not stumble into a new product but rather have an idea prior to joining, makerspaces offer a valuable space for innovation and creativity. Makerspaces provide a flexible, creative environment to aid innovation and provide support as members transform products from idea to reality. Amabile's (1983) componential theory of creativity, composed of three intrinsic and one external factor, clarify why makerspaces are conducive to innovation. The first is domain relevant skills, which are the materials an individual can draw upon throughout the creative process, beyond just specific skills directed towards a single task (Amabile, 1996). Education about the use of various tools, through classic models and informal environments, is a critical cog of makerspaces (Van Holm, 2014). These education models offer individuals a means for developing new skills that are central to the process of producing physical goods. Members acquire a vast range of flexible skills and knowledge that can be used on different fields, domains, and projects.

Makerspaces encourage problem solving methods that include self-discipline and ambiguity tolerance, capturing Amabile's creativity-relevant processes; learning new skills in a supportive environment makes individuals better prepared for the uncertainty that accompanies innovation. Innovation often requires long incubation periods to become fully developed. Steven Johnson (2010) developed this concept as the "slow hunch" in *Where Good Ideas Come From*, in contrast to the theory that inventions come from sudden bursts of understanding. Thus, having the patience to allow the concept to develop becomes critical. Encouraging adaptive problem solving is part of the reason proponents encourage schools to adopt makerspaces as part of Science Technology Engineering and Math (STEM) education (Honey & Kanter, 2013).

Amabile's third component of creativity is the intrinsic motivation to undertake the task. A large body of psychological literature shows that choice enhances perseverance, commitment, and enjoyment of a project (Ryan & Deci, 2000). Makerspaces encourage exploration and the tackling of problems and machines without high levels of formal experience. Intrinsic task motivation is enhanced by the fact that individuals in a makerspace have chosen to be there and get to determine which projects to work on.

The final component of creativity for Amabile is the social environment. Indeed, makerspaces already possess many of the trademarks of a creative environment including the dense networks necessary for ideas to flourish.

Highly connected networks improve the quality of ideas produced by individuals (Björk & Magnusson, 2009). They are particularly powerful for central actors with high absorptive abilities (Tsai, 2001). Members not only become part of the makerspace networks, but also join larger networks between different makerspaces; for instance, Mitch Altman of Noisebridge, a makerspace in San Francisco California, has developed the Makerspace Passport to help stimulate and encourage collaboration between individuals in different cities and spaces.

In addition, the members of makerspaces encompass important aspects of diversity. While Moilanen (2012) found their members to be by and large young, Caucasian, and highly educated, aspects such as career, industry, and educational background provide important levers to create new connections. User communities are traditionally built around products or specific activities (for instance, mountain biking). In contrast, makerspaces are built around tools; this fact may reduce some of the utility of comments, but if an individual can get feedback from other users as well as a community filled with diverse knowledge of means and processes with tools, their product will benefit.

Makerspaces also arrange themselves as open communities, where ideas, knowledge, and machines are shared. Moilanen (2012) found that socialization was one of the most prominent reasons members joined makerspaces, which allows members to get input on projects through all phases of its creation. The openness in makerspaces is similar to user communities, where there is a free sharing on innovations and ideas (Franke & Shah, 2003)..

3.3. Prototyping

Prototyping is an important component of bringing a product to market. Makerspaces allows members to find design issues early through the active development of the product as its first users and make adjustments accordingly. In addition, going through the process of prototyping in a makerspace provides members the opportunity to gain input from other members, giving them immediate feedback and potentially improving the design. Neither of these benefits are available from producing a prototype professionally through a design firm. Through this community process, the member presents a better functioning, better tested model when they seek funding to launch their venture.

A story related by Mark Hatch (2014), the CEO of TechShop, illustrates the power of access to tools and prototyping. Jack Dorsey and Jim McKelvey developed the idea of Square, which uses a cellphones audio jack to read credit cards magnetic stripe, thereby making access to credit card readers much less expensive for small merchants. They initially took the concept to venture capitalists seeking seed money but were unable to generate interest. After their failure, they then went to a TechShop in the Bay Area and built a working prototype of their product. They used this prototype during a second round of meetings and raised $10 million.

The warning that individual results may vary applies here; few products developed in makerspaces or through traditional methods have the same value as Square. Similarly, few products coming through venture capital or industry R&D labs are successful, but it is the exceptions that fund the remaining operation. Thus, makerspaces need few winners to justify their role in innovation ecosystems. With the democratization of entrepreneurship (Aldrich, 2014) and the various new means of bringing products to market through online vendors such as Etsy or crowdfunding such as Kickstarter, a novel means to develop, test, and prototype new products is necessary.

4. Conclusion

Each makerspace is unique and how it contributes to its local community is shaped by its founders and members. Some makerspaces have a more entrepreneurial focus and offer services similar to incubators or coworking spaces with the additional benefit of onsite tools. Alternatively, others spaces emphasize the open access of tools and applying new learned skills to community projects. Many spaces fall between those two extremes. Others lie somewhere off that spectrum as well. The discussion above is not meant to indicate that every makerspace will be a driver of entrepreneurship in the future, but rather to capture the aspects that can contribute to new firms and the support of firms once founded. The challenge of all of these spaces clustering under common names is identifying a specific organization's purpose. In the future, there may be a need for greater refinement in the names used to identify whether a space caters to entrepreneurs (perhaps IncuMaker), versus a traditional makerspace that caters to the public.

The primary form of product developed in makerspaces may be user-led innovations, of the more sustaining rather than disruptive sort; however, all innovation is cumulative. The fact that segments of the population that would never contribute to product design without the introduction of makerspaces has large implications for the future of technology. Already in the last decade researchers have noted that closed innovation has opened (Chesbrough, 2003) and innovation has democratized (von Hippel, 2005); makerspaces are the latest expansion of access and opportunity. It has the potential to push society over a tipping point of engagement with design.

Contributing to entrepreneurship may not even be the primary impact of makerspaces, which also have the potential to contribute to community development, education, and sustainability. In the United states makerspaces are focused towards gender issues and the environment, while spaces opening in refugee camps likely have very different concerns. The strength of the maker movement exists in its openness and flexibility; its influence in all these areas is deserving of thorough theorization and study as well.

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