Investigating the Value Chain of Modern Artisanal Innovation

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Abstract--**Handmade and custom artisanal goods have seen a global resurgence across several niche market segments, especially over the last decade. However, the study of modern artisanal production and the economy around it has largely been ignored. Besides accounting for only a small scale of production and consumption, artisanal goods are perceived as not conforming to contemporary development and production processes. We argue that current artisanal production has moved away from purely traditional methods and has evolved to incorporate innovative practices. In fact, due to their willingness to experiment, they are quicker to integrate new solutions into their products and processes. Similar themes can also be seen in the practices and perception of their consumers. This provides a niche phenomenon that is ripe for analysis from a technology and innovation perspective. In this paper, we will analyze artisanal value propositions and techniques for design, production, and the effect of branding on such niche products. Through interviews with key decision makers, enablers, funders, and consumers of artisanal projects, we investigate their motivations, methods of design and production, and use of creative design, branding, and technological tools. We then describe implications for researchers, policy makers and practitioners in the manufacturing industry, artisanal or otherwise.**

I. INTRODUCTION

Traditional artisanal producers have focused mainly on craft based occupations such as cabinet making, jewelry making, weaving and cheese making, to name a few. These "cottage" industries were not usually seen to be innovative as the design and production processes were often characterized as being deeply rooted in tradition and family, with an inherent tendency towards conservatism. Artisanal work essentially requires intensive training, practice, skill and coordination between small groups of people [21]. Historically, such knowledge has been unique to each place or region which assists in building brand loyalty and premium pricing, With the rise of mass manufacturing, artisanal production suffered from a decline, as low cost products entered the market as substitute [7].

In recent years, advances in technology, access to like-minded collaborators, and interested niches of high potential customers have created new opportunities for makers, tinkerers and self-employed "artisanal innovators". These creators are generally inquisitive and practical, and like to design, prototype and showcase products they create to other people [10]. Though the underlying ideas driving artisanal production have remained unchanged, what has changed is the ease of transition from the phases of ideation and invention to final production and commercialization [6]. While such producers are not necessarily described by the traditional definition of artisans, they share many common characteristics with them. We define modern artisanal innovators as makers and producers who bring values of craft-based tradition, a strong focus on quality and premium sourcing of raw material, and combining these with modern approaches like online collaboration, 3-D printing and prototyping, and utilizing crowdsharing and crowdfunding platforms, as they seek to create and capture demand in niche markets.

Thus, these recent trends have reversed the fortunes of both traditional artisanal producers, as well as newer types of market entrants. Several technological trends have contributed to the recent rise of the maker movement as well as artisanal models of production [10]. The Maker movement extends DIY culture to technology, and celebrates the creation of new devices and tinkering with existing products. It propagates the use of open-source hardware and engineering-oriented pursuits such as robotics, electronics and 3-D printing in traditional activities such as woodworking, metalworking and traditional arts and crafts [1]. New collaborative platforms and tools, like computer-aided design and rapid prototyping, for example, are redefining what it means to be an artisanal producer. The rise and affordability of manufacturing equipment such as 3-D scanners and printers, hardware and sensor kits, and open-source software, have unleashed the creative abilities of hobbyists, tinkerers, crafters and the like [10]. The DIY phenomenon that was previously confined to domestic practices has gone mainstream. Modern "makers" now have the ability to easily access resources, share knowledge online and gather feedback from other makers to better collaborate and produce objects, and thus reach mainstream audiences [13]. By comparison, the reach of traditional artisan products to the end user was not as dominant as it is today owing to the viable supply chain systems and platforms to cater to niche markets.

As a result of these new developments, traditional models of artisanal production have undergone a metamorphosis. In the past, custom production was typically accomplished in small quantities using traditional forms of production. Many artisans were part of a long legacy of family businesses, based on trade practices handed down over generations [21]. Today, we find modern artisan innovators who adjust their production processes through traditional customized or handmade production at one stage, but also incorporating the scale and benefits of mass production in following stages [11]. With the rise in platforms for design, funding, sourcing, and distribution, we believe that artisanal production is poised to play a growing role in the global economy. This has vast implications on policy, education, employment, and urban businesses. In this paper, we will explore the factors that support and shape the emergence of this new economic form.

II. METHODOLOGY

In order to better understand and document this phenomenon, we conducted a series of interviews with key decision makers in different parts of the value chain. To gain insight into the design and development process, we interviewed platform developers who provide standardized hardware toolkits (Arduino). They were selected based on their experience in playing an influential role in the maker movement. We also interviewed investors in the maker phenomenon (Lux Capital), to understand their perspective on the emergence and growth of artisanal innovation. To understand the production processes, we interviewed specialists in integrated production at scale (Dragon Innovation), since they have experience in guiding entrepreneurs through the prototyping, testing, and production of hardware solutions. We also interviewed members of a non-profit research institute who are industry experts studying the artisanal innovation phenomenon to draw conclusions about its impact on society at large (Institute for the Future). In total, there were four interviews with industry experts who referred us to sources of primary and secondary data that we included in our analysis. They also reflected the views of their companies and the teams they worked with.

The questions for the interviews were designed to elicit a broad understanding of the factors contributing to the rise of the maker phenomenon, the tools available to modern makers, as well as a better understanding of the limitations as well as commercial potential of artisanal production. Interviews were conducted both in person, through site visits, as well as over the phone. Based on the themes that emerged from the analysis of the interviews, we analyzed the relevant literature to develop a comprehensive overview of artisanal innovation. We also uncovered the various factors that have encouraged the emergence and have influenced the phenomenon. In the following sections, we describe the broad underpinnings of the artisanal innovation and innovation phenomenon, the new platforms that enable rapid progress from ideation to commercialization, the role of technology, and the emergent marketplaces for artisanal products. We conclude by looking at the potential market and value propositions created by artisanal production, and provide a set of managerial guidelines for small and large businesses interested in tapping into this phenomenon. The rest of the paper is organized around the emergent themes from our review of the literature, as well as discussions with key decision makers.

III. ROLES IN THE ARTISANAL VALUE CHAIN

In order to understand why the maker phenomenon has gained significant momentum in the recent past, it is important to understand the roles of different players in the value chain. In particular, the roles of the designer and the maker have been recombined, in contrast to their earlier separate roles in design phase and manufacturing phase. We argue that this change is due to the impact of 3-D printing technology on the production process [16]. The emergence of enabling technologies aids designers not only for rapid prototyping, but also shifting an important component of manufacturing from industry to home [29]. Zach Schildhorn, Vice president of Operations at Lux Capital, a Venture capital firm, remarked that "3-D printing is an Industrial Scale Solution which not only is used for prototyping but also for manufacturing" [26]. Another important frontier is the idea crowdsourcing, i.e. the ability to gather lead users, makers, and hobbyists and so on to develop a new idea by providing funding for the initial investment. Chris Anderson argues that many makers are turning into entrepreneurs through DIY practices, embracing open source and online 'co-creation' [1]. He points out that "the great opportunity in the new Maker Movement is the ability to be both small and global, and thus both artisanal and innovative" [1].

There is also a great deal of collaboration that exists between maker and the supplier. Different parts of the value chain of production of an artisan good that can be impacted, according to Alex Goldman of the Institute for The Future. Talking about his experience working on his present project on 'Makercities', an online game in which players build ideas about the future of technology, refine the ideas of others, and eventually implement their ideas in the real world, he concludes that "makers are going to stop producing things and start producing systems" [27]. We also found a similar sentiment, that there is an increased blurring in the ownership of ideas, reflected in prior research on the maker movement [32].

Historically, the production of artisanal goods emphasized skills, craftsmanship, and customization. This level of focus began to diminish with entire industries shifting to 'mass manufacturing' owing to the industrial revolution. Due to recent reinventions of fabrication, we are now witnessing and increased emphasis on customization and personalization. These fabrication processes since evolved to provide micro-batch production and rapid prototyping to allow capabilities for the rise of mass customized goods [23]. To provide an illustration of the degree to which personalization is possible in contemporary customized goods, Zach Schildhorn from Lux Capital, gives the example of Sole, a shoe company that is developing an interactive tool that uses 3-D scanners to build a digital model of the customer's foot which is then used to design customized pair of shoes [26].

In summary, we see that the artisanal economy is redefining the roles, expectations and capabilities of makers, designers, suppliers, entrepreneurs and customers, even as it creates new opportunities to unleash and deliver value. In the figure below (Fig.1), we portray the value chain of artisanal innovation from producer to consumer, as well as the various social and technological factors that have influenced its emergence. In the following section, we will describe in detail the relationship between the different stakeholders and the influencing factors.

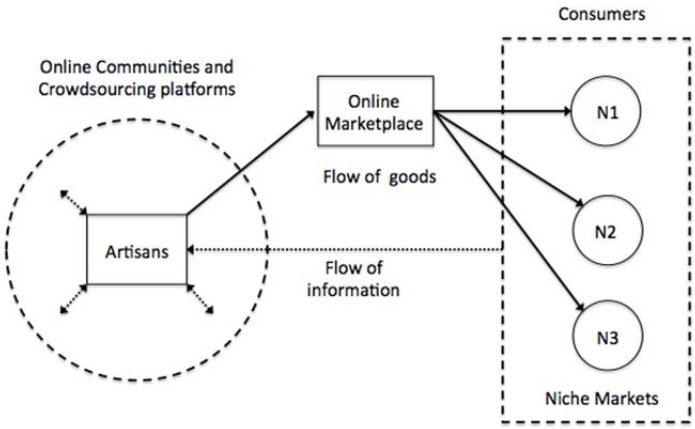

Fig. 1 The Artisanal Innovation Value Chain

IV. EMPHASIS ON NICHE MARKETS

One of the most important findings of our study is that a number of artisanal businesses have found considerable success in lucrative but niche markets. To explore this further, we looked into the reasons behind the increased interest in artisanal innovation, mainly from a small and committed set of consumers.

Firstly, as far as artisanal products are concerned, there is a greater level of consumer engagement with the maker. Due to this interaction, there is a certain value component that the consumer receives, which is not available in a typical mass-produced good. The concept of value co-creation best describes this shift, where producer and consumer come together to create mutually desirable commodities [24]. Users become excited to be involved in making something unique. The more they are involved in the design and production process of the product, the more unique it becomes, and this in turn increases the emotional involvement and the commercial value attached by the user. Hence, such products can be sold at higher price points to compete against the cheaper, mass-produced items [17]. One of our interviewees, Massimo Banzi, the founder of 'Arduino', an open source hardware kit that can be used for building prototypes using electronics, believes that the rules of interaction design have been employed very successfully by artisanal producers, similar to his experience with students [25]. In his experience, in interaction design, involving students in various projects related to building prototypes and then explaining the concepts helps them better understand both the concept and the practical application faster. 'Arduino', among other things, is now being used as the base for building 3-D printers [25].

Makers are tapping into the elements that drive today's experience-based economy. The availability of 'Interaction design software' coupled with the low-cost and widely available tools for invention and production, lets consumers turn their ideas into a product and thus themselves into makers [12]. We see that a growing community of self-taught consumers is constantly expanding the pool of makers. These consumers can in turn end up being successful makers and entrepreneurs themselves. This idea is similar to the concept of "pro-sumers", which had been predicted and advocated by the futurist Alvin Toffler [33], but it is seeing immediate and practical application in the world of makers.

V. NEW PLATFORMS, NEW SOLUTIONS

In addition to the trends described above, artisanal innovation also has benefited from the rise of new technological platforms that fulfill various roles in the value chain. Crowdsourcing, for example, helps designers not only get funding and feedback, but also help companies do things well [3]. Kickstarter, for example, allows startups to not only receive funding for their ideas, but also receive feedback to refine their offering [19]. This was possible only because they reached out to a network of people outside of their internal ecosystem and it proved to be helpful. Large and small companies thus need to be able to tap into both their internal and external networks and use innovative ideas as they develop new products and services.

In addition to being aided by open source platforms and enabling tools for prototyping, makers can now discover a market for their niche products via market places such as Etsy for handmade craft, or Tindie for hardware products. Further, small artisanal producers can plug into an extended supply chain that can help them scale up ideas with initial success into more conventional commercial ventures. A good example of such an intermediary is Dragon Innovation, which helps companies scale highly complex consumer electronic products in volume. Scott Miller, the co-founder of Dragon, states that recent changes in this area include the cheaper cost of components, social media efficiency in terms of reach and reduction of other barriers to entry such as crowd funding through Kickstarter and Indiegogo [28].

The general perception of the niche market's effect on local manufacturing is positive. Our interviewees stressed on the opportunities and advantages in contrast to outsourcing

manufacturing, which usually caters to large number of mass-manufactured products. There is also an opportunity to rethink local manufacturers. Focusing on niche production is an advantage to product designers as well, as they can share the same location, time zone, and associated ease of transactions. Another convenient aspect of small-scale production is that the problem of intellectual property is less of an issue given the small volumes and discerning customers demanding custom products.

The author Christopher Frayling describes the frontier of rising artisanal production as "In the boom times of the early 2000s, the public talk was of design: now it is more of a craft, a shift which mirrors the parallel move from, 'creative industries to 'productive industry' and manufacturing [14]. This shift has led to the increasing possibilities for large producers to adjust their production processes to accommodate such production at a large scale [11].

VI. THE RISE OF 3-D PRINTING AND RAPID PROTOTYPING

One of the most impactful technologies in the design and fabrication process has been 3-D printing. 3-D printing has a number of advantages such as reduction in wastage of materials in manufacturing. This is due to the product being an accurate depiction of the Computer Aided Design model and thus allows makers to produce their products in small batches at a convenient pace and cost. The potential impact of 3-D printing on the mode of consumption has been discussed in prior research, since consumers will prefer customized and personalized products to mass-manufactured goods [4]. There has also been instances in which instead of purchasing goods, users instead buy the design and print themselves [9]. Disruptive technologies such as 3-D printing have a transformative effect on the relationship between a company and its customers [18], and it is a result of the increasing democratization of technology. Currently, rapid prototyping is perhaps the most mature application of additive manufacturing/3-D printing technology in artisanal innovation. By enabling the multiple iterations of the design process, rapid prototyping reduces manufacturing costs. Using 3-D design and rapid prototyping, artisans can also have more control over the production process [34]. Thus, 3-D printers are becoming increasingly ubiquitous in the production process and through the promise of increased profits and quality, have the potential to disrupt traditional practices [35].

Zach Schildhorn, of Lux Venture Capital firm associates their company's initial advent into the whole concept of artisanal manufacturing though the world of 3-D printing [26]. Having researched about 3-D printing and its disruptive future potential, Lux made their first investment in the sector on Shapeways, a 3-D printing marketplace and service, company. They viewed them as "very strategically well positioned to take advantage of both increase in capability and material set and decrease in cost on the production side and also increasing access to content and creation on the creation side" [26]. These are the two major trends in the 3-D printing space according to Zach and their team of researchers [26]. Though 3-D printed goods are not particularly artisanal, it is an important enabling tool, which can be used for rapid prototyping says Alex of Institute for future [27]. The availability of low cost 3-D printers has enabled makers to not only print products at home but also to share designs on sites such as Thingiverse and Fab@home. Major manufacturers have also been attracted to industrial 3-D printing for rapid prototyping as well as for actual production of products. Prototyping can be a time consuming bottleneck for electronic hardware production as well. Thanks to open source collaboration and tools such as Arduino, rapid prototyping of electronic hardware has been simplified to an extent.

VII. ONLINE MARKETPLACES FOR ARTISANAL PRODUCTS

Online communities are crucial for knowledge sharing, providing a source for market research and help foster relationships between makers and customers [8]. Artisanal producers have benefited from new venues to find interested customers, and online marketplaces that provide access to smooth transactions. Etsy.com, an online marketplace, which acts more like an online community with members who are eager to share their knowledge, in contrast to a typical marketplace, was founded in 2005 for vendors who wanted to sell handmade products. Etsy had over 54 million members with around 1.4 million active users as of 2015 [30]. In 2014, its annual revenues were $195 million, a result of its charging 20 cents for each item a vendor posts and a 3.5% commission on each sale [8]. Throughout its journey, right from its launch to its rise and eventually leading to Etsy going for an Initial Public Offering in April 2015, Etsy has proven to be a good example of how an online community flourishes by member participation.

Several distinguishing factors led to the initial success of Etsy. These included the tools it offered members to communicate and share knowledge on the website apart from the usual blog posts, video seminars, group discussions, etc. It also encouraged vendors to share their experiences, which might be useful for other vendors, which can eventually help the whole community grow through increased revenues. Etsy rewarded members who contributed to the community and the reward system was made transparent to motivate other participants. The incentive systems in place ensured that members placed the long-term interest of the community ahead of their own short-term gain, and could thus sustain and grow the community for the benefit of all members [8].

In November of 2013, Etsy introduced new rules for sellers to let them have their products manufactured by other firms, contradictory to purely handmade production, and help their most successful vendors to scale their business so that they find Etsy to be a viable option [30]. These new

guidelines soon received mixed reviews. Some customers and sellers have complained that Etsy has now begun to sway away from being a platform promoting purely handmade goods to evolving into a sales engine for small businesses [5]. But Alex Goldman of Institute of the Future argues that it is quite common for artisanal producers to have the temptation to scale things up and they would be more than happy with the new set of rules [27]. Despite the hiccups, Etsy can be viewed as a tremendous success in opening up a new venue for artisanal producers and consumers. As Zack Schildhorn of Lux Capital points out, "Etsy strives on the story and the maker behind the objects. People are interested in that story which is unique, and it is considered one of the most important drivers for the make" [26].

VIII. POTENTIAL EVOLUTION OF THE MARKET

The rise of artisanal manufacturing aimed at niche markets needs to be seen in the larger context of the changes to the manufacturing economy, particularly in the US. Over the past few decades, the impact of automation, the rise of software algorithms, intelligent computers and robotics, and the rise in outsourcing and "other sourcing" have dramatically changed the job prospects of the average American worker. These trends point to the continued and likely decrease in job security, job certainty, and the decline of less of fixed income, fixed location jobs [31].

Manufacturing is considered to be crucial for U.S. economy, not for its ability to create jobs but for its potential to drive innovation and productivity growth in a global landscape [2]. There, three important emergent trends: a) the Internet of things, b) advanced machinery and tools like 3-D printing combined with new materials and methods, and c) distributed innovation, are transforming how we think about traditional manufacturing. These trends can be precisely beneficial to tech-savvy artisanal makers and producers. If artisanal products remain true to the spirit of hand-designed, handcrafted and customization; while taking advantage of these emerging trends in manufacturing, not only can jobs be preserved, but new jobs created in completely new areas. Hence it is necessary for the U.S. economy to embrace such changes. From a policy perspective, the focus needs to be on providing better infrastructure, funding for new technology investments and expediting permitting processes, all of which help small businesses thrive and eventually lead to more innovation with better job opportunities.

As pointed out, these emerging trends are creating a difference in the maker ecosystem as well. Given the availability of a new set of enabling technologies such as 3-D printers, platforms to share knowledge, access to open source software and hardware and the likes, there is a rise in the user-manufacturer [22]. A new generation of the DIY makers has been motivated to share ideas, tools and techniques through collaboration over online communities [20]. A manufacturing forecast for the year 2020 suggests that the transition of mass manufacturing to mass customization will be prevalent, also there will be more of made to order kind of production [15]. This bodes well for the future of artisanal production with an emphasis on quality, customization and authenticity.

IX. CONCLUSION

In this paper, we looked at recent developments at the frontiers of the maker movement, and described the rise of artisanal products that take advantage of technological tools and collaboration platforms. Through primary interviews with key decision makers at various parts of the maker value chain, we showed that the impact of the movement is broad-based and can impact several industries. We described why artisanal production is becoming more popular and viable, even as technologies emerge to make several of the process elements very mechanized, structured, and scalable. We believe that this phenomenon will have vast impact on employment, education, commercial, and economic policy. Thus, it is crucial to discover, describe and analyze the various factors contributing to its emergence.

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