DESIGN SOURCE:
INFLUENCING THE MAKERSPACE

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1. Introduction

Today's consumer expects choices. They seek control and customizations, frequently rejecting off-the-shelf purchases. With Digital Fabrication technologies becoming easier to use and obtain, people are getting what they want. The rapidly growing movement towards digital fabrication has placed makerspaces around the globe in ever-increasing numbers. The DIY mentality continues to grow, and while many great results are emerging out of it, where does it leave designers and how does it shape public opinion about products made in these spaces? These technologies continue to alter the future of manufacturing and design.

This paper formulates a discussion about the designer's involvement and possible influence in this future. How can we as designers help direct the makerspace and take advantage of a developing network of manufacturing? Furthermore, can we implement designs, which exploit this network in a manner that empowers us, rather than one that relinquishes our creativity and influence?

In an entrepreneurial culture, young designers can utilize these technologies to produce prototypes or products, and effectively communicate their ideas. Physicality is important in design education, and creating physical representation of ideas adds to the body of knowledge rather than drawing from it. Making provides a unique avenue for discovery during design process and can direct and validate decisions made.

The following discussion uses a furniture case study, Kerve, to explore the possibilities of digital fabrication and a network of makerspaces as a means of manufacturing. Kerve was conceptualized as organic forms in wooden furniture made through digital fabrication, created in a network of makerspaces and flat packed for local delivery.

Figure 1. Kerve

2. Design Intent

Designing products specifically for makerspaces and digital fabrication technologies should be at the forefront of our concern as designers of the future. In the conceptualization stage of Kerve, Design Intent establishes physical limitations, technology for making, and a system of manufacturing. Through this we can develop a system that takes the consumer through the development and customization of their product online, offering choices in manufacturing, and involvement in fabrication. In this way designers can co-create a desirable product and help maintain a brand identity.

2.1. Labor of Love

Why do people want to make? “The IKEA effect: When labor leads to love”, is a study that demonstrates the following, “when people imbue products with their own labor, their effort can increase their valuation.” This study also showed that “one crucial factor is the extent to which one’s labor is successful.” Here designers can facilitate this process with well-designed systems that ensure successful outcomes.

2.2. Designers’ role

In developing designs, assembly directions, specs, and planning for mass customization, designers will improve perceptions about Makerspaces and DIY projects. Design is essential in developing products that can be manufactured in a decentralized manner through maker spaces. If DIY represents average Joe (everyone/anyone) and Makers truly represents techies (with its root from *Make* magazine), then what represent designers who want to use these spaces and technologies to produce their products? A designer or small firm can coordinate a system through makerspaces, offering an alternative to corporate mass production. If the DIYers and Makers are the Lead Users: Early Adopters of digital fabrication, what will designers become in this field (Hippel)? Can designers be Lead Establishers: Late Adopters who push these spaces into a legitimate means of mass producing and mass customization, which localizes distribution and breaks us free from big corporate powers? “Personal fabrication empowers the industrial designer by providing the opportunity to bypass the traditional product development infrastructure. But also empowers the amateur designer to design their own products and bypass industrial designers entirely. The role of the industrial designers may then be to help create software that enables the public to do their own industrial design. Much like a tax accountant who helps create the software TurboTax, they are empowering the public, but conversely taking projects away from the professional”(Morris). This is where I would like to position part of my argument —the “bypass”— while it is good for Industrial Designers to bypass corporate production, it is not good for the public to bypass us, both in terms of what that means for our profession and job security and what impact it will have on the quality of designs that come to market. This paper is not suggesting that Makers and DIYers should not continue doing their thing. Rather, it seeks to encourage more designers to be involved in what is being made. Through utilizing a network of these spaces, which exist all over the globe, an individual designer can orchestrate mass produced and mass customized products. Sustainability factors in such a system offer advantages to our environment. Localized production and delivery, and on demand manufacturing could eliminate the need for inventory, reduce waste and minimize shipping expenses.

3. Purity in Design

One area designers can influence is the innovation of what can be made in a typical makerspace. There is an opportunity for the design profession to demonstrate ways of preserving ideals and finding solutions without compromising designs due to manufacturing capabilities of makerspace. Innovation requires reimagining the capabilities of these machines, designers cannot follow the crowd, and we have to push the limits of what these technologies can provide. This presents an element of risk that some of us fear, failure. Without risk in design it is difficult to be innovative, “Failing early, failing often, and failing some more”, we will become the means to our survival as creatives. It is through failures and determination that we achieved some of our greatest discoveries. We have to constantly push our design ideas forward in terms of what can be made and how, not falling victim to the naysayers or simply watching as our careers diminish in importance or evaporate.

Kerve lies at the heart of this topic. Bentwood furniture is typically made in shops that have steam bending and stamping capabilities, and in some cases employs a technique known as kerfing. Kerfing removes portions of the material essentially weakening its structure so that it can be bent and then glued into position. Traditionally kerfing is done on the table saw and is limited to cuts that are perpendicular from the edge of board or sheet. Kerf cutting in this manner can be very time consuming and labor intensive. This case study set out to discover what might be possible through the combination of kerfing and the use of a CNC router. Through many experiments, numerous possibilities of creating 3D forms from 2D sheets of plywood were discovered using this method. The goal was to create a wooden chair that was made using this method and that would allow the wood to be bent and unbent for shipping and storing. By filling the kerfs left by the CNC router with a thin rubber cord, a flexible wooden chair was realized. The objectives of the project were not only to create this particular chair, but also to inspire a conversation about other avenues of making using digital fabrication tools in makerspaces.

4. Designing for Customization

“Demand for individual products has become unstable. What used to be large demand for a standard mass-market products has fragmented into demand for different ‘flavors’ of similar products” (Pine). As the demand for customization increases, designers must design to accommodate. Rather than uploading a base file for anyone to change why not offer a flexible design intended to be changed? In this way, we offer limitations in customization, which maintain design intent, product quality, and brand identity. The term Open Source came from the computer software industry, referencing access to source code to the public. The term has since been adapted as a buzzword referring to all kinds of technologies, products and designs. Open Source places no restrictions on the distribution of content and without cost gives access to designs and origins. The purpose of Open Source is to evolve something through modification by the public. It is appropriate at times in advancing something bigger than ones own capabilities. Design Source seeks to protect a design that plans for modification but doesn’t desire an evolution. Recognizing that the consumer wants choices and control in their products, Design Source aims to prescribe limitations and plan for customization to offer options and variations of a product rather than an evolving product. “Rather than working on single products designed to fit the majority of the population, designers will be creating products that will be modified to suit each individual. Designers will not be creating fixed forms but, rather, forms that can be shifted and transformed” (Morris). With this prediction, designers should be charged to act, placing us at the forefront of what some are calling the second industrial revolution. Designing for customization means we are in control, wherever possible, of the customization process that will take place. “Within a predetermined envelope of variety, there are no cost penalties for manufacturing any one part versus another, yielding a manufacturing system that can quickly respond to changes in demand” (Pine). This statement, and the “predetermined envelope of variety” is not only beneficial in terms of cost and demand, but can also be applied to quality of finished product and maintaining brand identity. Pine is writing mostly in terms of big business, the argument here asserts, that with the advances in technology and the growing number of makerspaces and small batch manufacturers who have this technology, an individual or small business can become the driving force in the production and design of a mass customized product and the system that makes it possible. It is possible for a designer to maintain brand identity, quality control, cost efficiency, and consumer demand through maker spaces by designing for customization.

4.1 Mass-produced verses Mass Customized.

The designer basically has two options for decentralized manufacturing.

1.) Working with a large vendor, such as Wal-Mart or Target, a designer could establish a Grid Network Manufacturing system. In this system designs can be massed produced by using local shops around the globe as small batch manufacturers, which would make and deliver orders directly to local vender locations.

2.) Through online ordering a designer can employ Local Production Shops and/or makerspaces to produce on demand orders of a customized product. In this system mass customization becomes an affordable option for creating a recognizable and customizable brand. Furthermore, the distribution and manufacturing of these products is localized.

Shapeways, Ponoko, i.materialize, and Sculpteo are termed as Online Fabrication Services, but essentially what they have done is create a network of Local Production Shops, as well as some of their own facilities, to create 3D printed products and parts in this manner. Research indicates that no such system/service exist at this level that includes all digital Fabrication technologies (i.e., Laser Cutters, CNC-Routers, Sewing, X-acto cutting, etc). The closest thing is termed Distributed Manufacturing Network, with companies such as 100KGarages, CloudFab, and MakerFactory, but these companies are working with creatives locally to produce products or concepts at a smaller scale. Through establishing a network of these at a larger scale mass customization might be possible.

While there seems to be an acceptable recognition of mass customization as a concept, it continues to be developed as an implemented practice. “Mass customization should motivate both academics and practitioners to further explore the subject. Despite the increasing attention it is receiving in literature, mass customization is still a novel concept lacking more extensive development” (Silvera, Borenstein, and Fogliatto). According to Silvera, Borenstein, and Fogliatto in their essay on Mass Customization: Literature review and research directions, where they summarize their own take on the subject through an extensive literature review, there are two views on Mass Customization as a concept. First a broader view that “promotes mass customization as the ability to provide individually designed products and services to every customer through high process agility, flexibility and integration. Second a narrower view proposed by many authors is that, “They define mass customization as a system that uses information technology, flexible processes, and organizational structures to deliver a wide range of products and services that meet specific needs of individual customers (often defined by a series of options), at a cost near that of mass produced items."

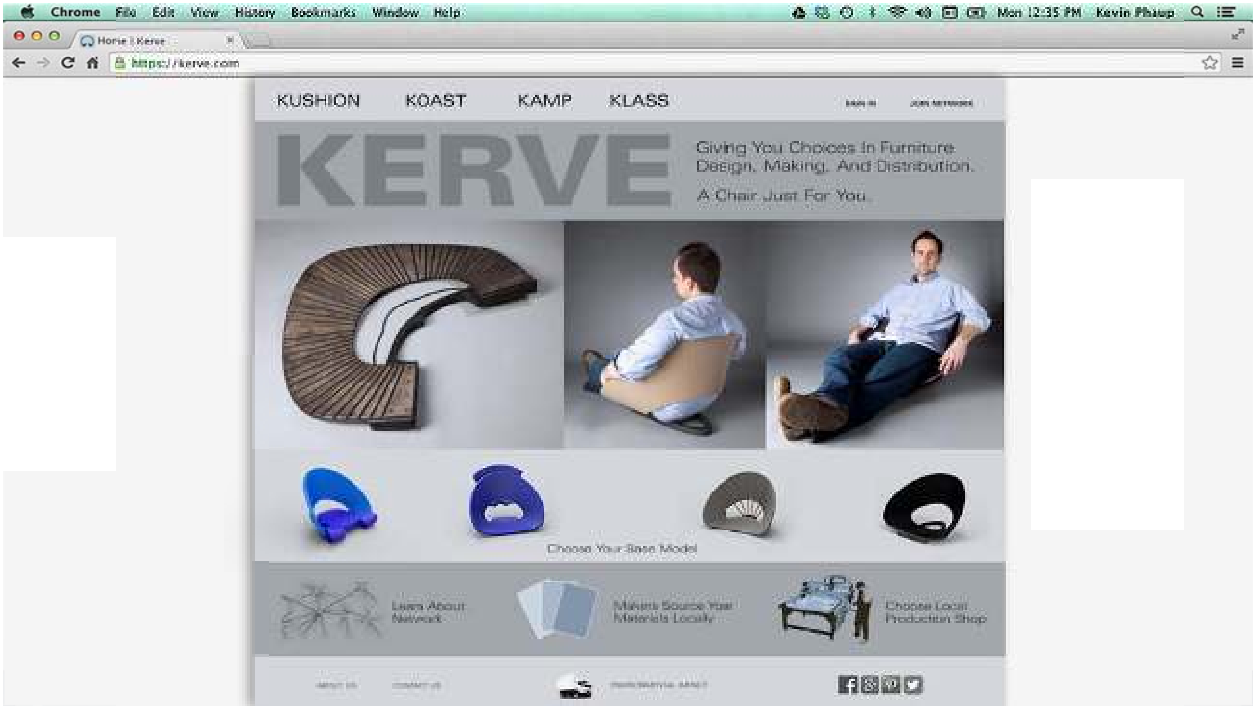

Figure 2. Kerve Home Page

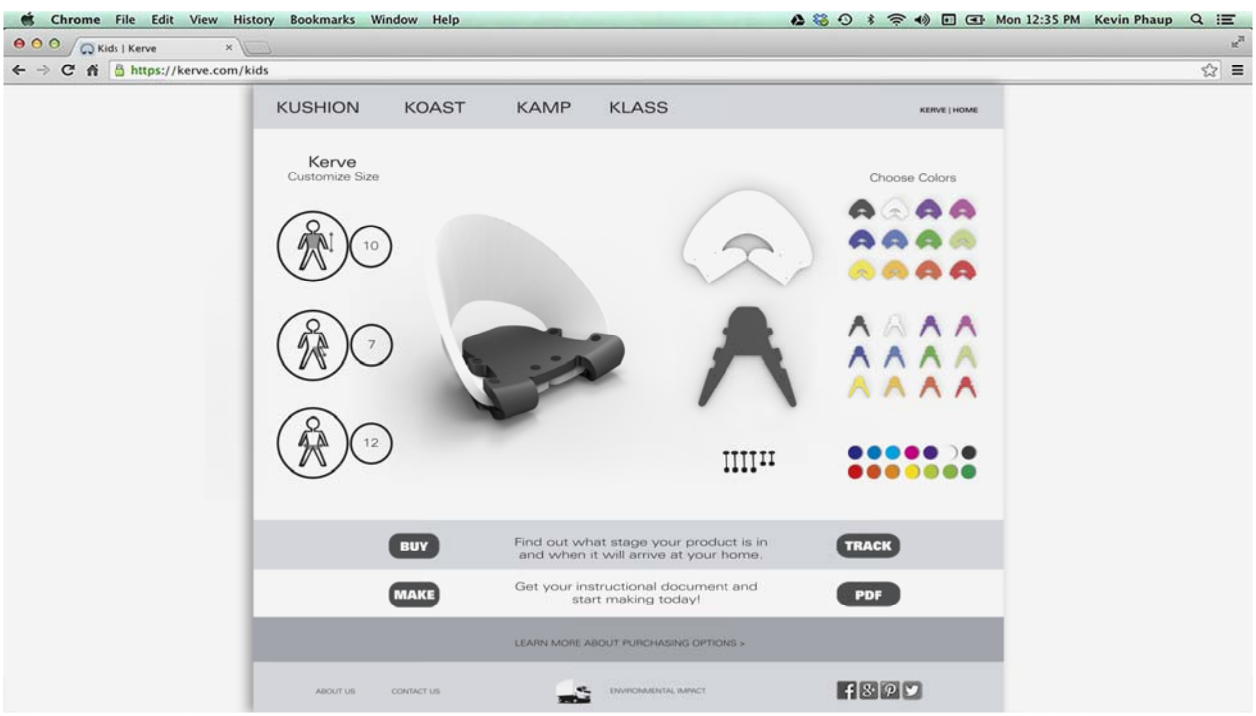

Figure 3. Kerve Customize Page

Kerve is in development and seeking to create a family of chairs available for mass customization. Figures 3 & 4 show the family and a mock up of web interface and customization. Options are defined to determine the appropriate level of customization that meets customer needs, while maintaining an appropriate level of quality and a brand identity that is recognizable and consistent. Not only does it strive to design a product that is customizable in form, but also in terms of the system in which it is manufactured. From the interactive interface that reflects the brand and offers the customization, to choices in how it is fabricated and delivered. Kerve offers a customizable form that is derived from a base chair, the consumer can simply input the required measurements online and watch as the chair changes to the correct proportions for them. The development of a family of chairs seeks to offer choices in application for the consumer. Currently being developed are versions designed for children, camping, the beach, and the home. On the website each version can be viewed in various material finishes and the consumer can decide how they want to proceed for manufacturing (see figure 4).

Figure 4. Purchasing Options Diagram

“Mass customization can occur at various points along the value chain, ranging from simple “adaption” of delivered products by customers themselves, up to the total customization of product sale, design, fabrication, assembly, and delivery” (Silvera, Borenstein, and Fogliatto). Kerve falls into 3 of the 8 categories of Generic levels of Mass Customization defined by Silvera, Borenstein, and Fogliatto.

1. Additional Custom Work— represented in the online interface, being developed, by which a consumer can customize their product at the point of delivery or at the point when they purchase the product online.
2. Fabrication— represented as tailored customization. The customization is taking place in the previous step, but is implemented through a carefully defined and described set of instructions provided to the consumer/manufacture depending on the client’s choice in the following step.

3. Design— collaborative in its intention is customizable in the sense that options are available in terms of when, where, and by whom the product is manufactured, and tries to establish the most practical, economical and environmentally friendly delivery location.

As defined by many of the articles reviewed for this essay, Mass Customization is enabled best through digital fabrication technologies. Silvera, Borenstein, and Fogliatto state that the importance is in the transfer of information from customer to manufacture in determining the success of a mass customization system. "Agents of information transfer are the manufacture and its customers. The manufacture defines to what extent the customers may customize their order, customers' feedback the information on their choice of design elements. The customer-manufacture interface is uniquely defined according to the company developing and implementing a mass customization program." The assumption in reading their essay is that the manufacture represents a medium to large scale manufacturing organization, and the company being discussed could represent a design firm. A new possibility exists for a similar system that could be utilized by individual designers as well as smaller design firms. In this system the designer is in direct connection with both the consumer and the manufacture, where manufacturers are now medium to small scale, even to individuals that have access to digital fabrication technologies.

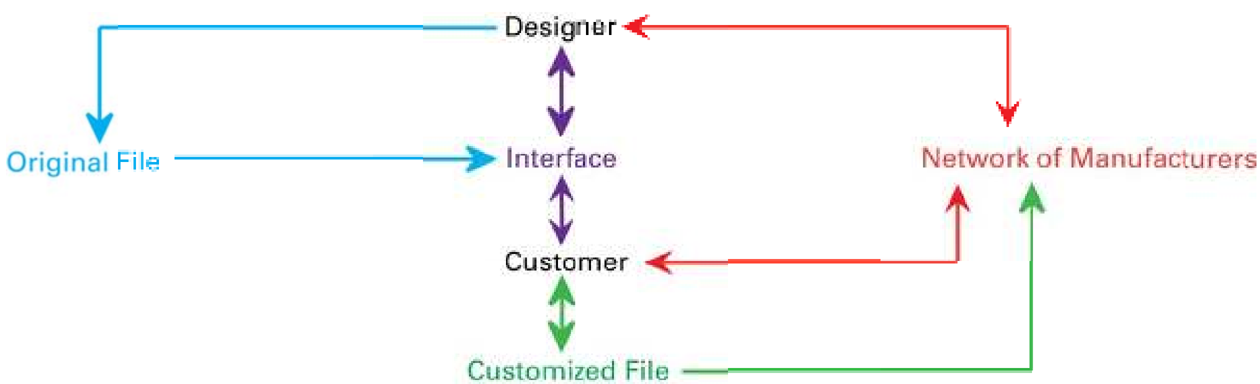

Figure 5. System diagram

4.2 Quality control in a Decentralized manufacturing system

One of the core problems in producing a product in a decentralized manufacturing system is the issue of quality control. How do you follow through on specs, materials, and tolerances? In developing the system, the designer can implement a certification process for local production shops and makerspaces to ensure safety and durability concerns are consistent. The certification process could produce a pre-determined number of products by each manufacture to demonstrate their ability to consistently make the product. Furthermore, determining the appropriate level of customization and offering it at the front end of the purchase directs the customization that happens. This paper speculates that a person invited to customize their product in the purchasing stages will be less likely to customize, outside of the given parameters, after the fact. This paper doesn't suggest that this concept completely solves the issue of quality control in a decentralized system, but recognizes it as a step in the right direction.

5. Design for Today, Dream about Tomorrow

The case studies presented here focus primarily on the use of CNC router and laser cutter in these maker spaces. However, it is necessary to mention the rapidly expanding field of 3D printing when discussing a decentralized manufacturing system. The rate of change and concept development in 3D printing is exponential, but the transition from conceptual technology to useable technology is slow. Meaning that the consumer grade printers that currently exist in most makerspaces are currently not suitable for producing a high-quality product. However, the industry is still moving/changing rapidly and is inspirational to the dreamer/futurist. While designers must keep up with technology and any potential for future use, we must also design for what's available today.

6. Conclusion

This paper discusses a system for manufacturing, a system that is largely already in place, low hanging fruit if you will. The network of makerspaces will do one of two things for designers, pass us by, or make us more independent. The case study presented has only scratched the surface and exposed the possibilities of distributed making. In this world we live in, with internet capabilities, advanced software, digital fabrication, and new start-ups everyday, we have all seen that it only takes one determined person to set things in motion.

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