Art of Workmanship in the Digital Age

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INTRODUCTION

Digital technology is becoming more engaging and exciting than ever. Over the past 20 years, computers have evolved from simple automation, as in the case of the metaphysical shift of drafting with a drawing machine (CAD), to a more personal and social medium that is fostering new ways of thinking, analyzing, testing, fabricating, and networking. Because of this paradigm shift in the use and perception of digital technology we are intellectually redefining the traditional meaning of craft. The word "craft" brings to memory the "handmade" object. It is generally associated with manual dexterity, skilled artistry, and the art of making (process), but can also express cultural identity (such as folk art) and past traditions. Within the notion of craft, not only is the final product important but also the process of making, which is tied to a particular philosophy or skill. *Throughout* history, technologies and prosthetics have been rooted in our primordial human need to extend the physical limitations of the hand.[1] Craftsmen have incessantly modified their tools or have been the early adopters of new tools or technologies; from jigs and fixtures needed to hold the work and guide the tools, to sawing machines, electric kilns, hand-held power tools, to today's CNC manufacturing, laser cutting, and 3D prototyping.

Even though the conventional idea of craft usually does not bring to mind a high-tech process, technology has always been there to advance craftsmanship. However, craft within the digital realm is still perceived as something of a paradox, because the hand plays a minor role on coaxing the material. Hence the question, can an electronic medium such as digital design be considered a rich medium just like traditional painting or sculpture? Today, generative and parametric designs have more parallels that ever with traditional media, where traditional skills are being rediscovered in a virtual context. We are seeing a new *craft-resurgence* in the figure of the digital craftsman within the subculture of *hacking* and *tinkering* (crafting) the algorithm (code) or the conception of parametric constrains. These *computer* enthusiasts are passionately pushing the boundaries of their work and are determined to investigate design boundaries within the virtual world.

Moreover, artisanship could be defined as an innovative, artistic, and resourceful modus operandi that pushes the boundaries of a limited medium. Therefore, what aspects of craft within a digital practice could be considered artisanship? This paper explores the possibilities of the traditional notions of craft within a theoretical framework centered on design authorship, principles of form giving, implementation process, and the influence of digital technology.

As early as the 17th century people such as John Ruskin, founder of an Arts and Crafts community in England, began to express his artistic competence for machine-made objects versus handcrafted ones.[2] Today many critics feel that the digital medium denies the possibility of emotive content, or loses the "creator's touch." Additionally, there is the perception that the digital medium output lacks connections with established traditions and culture. Do we need to sacrifice craft in the digital realm? There are aspects of digital technology that are congruent with the craft discourse. It could be argued that craft exists not only in the role of the hand or in physical activity but that it lies also in the realm of human impetus and intent as well. This is the position on the idea of craft in the twenty-first century. Possessing the power to skillfully manipulate and control the process of creating forms, motion, and spatial emulations that are directly informed by technology are at the very heart of the conceptual core of craftsmanship.

Although, popular consensus has it that craft follows antiquated methods of production, craftsmen throughout history, especially noticeable since the Industrial Revolution, have always embraced new tools, which consecutively and unmistakably have directly influenced their craft and ultimately their design. Therefore, the discourse that the machine takes over is a futile one, because man has always taken control of the machine. Mankind not only has wanted to control it, but also has gone a step further on the human-computer interaction, relentlessly pursuing the humanization of the machine.[3]

DESIGN AUTHORSHIP AND EXPRESSION

The emotive or sensual touch is considered an essential part of craft. Examining the work of traditional artists using traditional mediums such as oil-on-canvas we quickly access the shortfalls of the digital medium. It cannot truly replicate the physical attributes of paint impasto. The thick and textured paint, natural pigments of the colors, the texture of the woven cloth surface, the smell of the fresh paint, and the stroke mark transmits vital empathy and become one with the maker. Computers lack the ability to truly re-create this engaging experience. We can agree that no plotter can replicate these surfaces. Digital print is characterized by its uniform, smooth surface, deprived of textures and haptic stimuli. Each medium and each material has its specific strength and limitations. Even oil painting, with its incredible rich history and culture still has its limitations. Old masters had to work within the limits of the canvas in terms of its size and support, and the limited color palette of natural pigments. Similarly, digital artists design in a virtual environment of infinite size and unlimited colors, but they are trapped in the physical limitation of a video display.
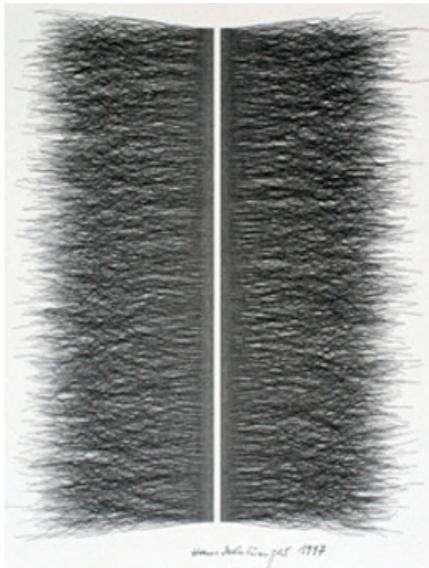
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As a medium, digital technology has the ability to augment the virtual and ephemeral visual qualities by engaging the sense of hearing, therefore deepening the emotive content. Digital technology may lack the haptic experience, but with the use of narrative in the form of video and sound, a sense of embodiment and an embedded rationalization process form an engaging experience. Such narrative has the capacity to draw on the sensual and even visceral experience by moving light in virtual space and making use of sounds that are not accessible through traditional media.

Digital designers are not physically involved in making the (brush) strokes, but are involved in setting the program parameters that make the stroke. Even John Ruskin with his anti-machine sentiment during the Arts and Crafts movement in England acknowledged in his seminal book, *Seven Lamps of Architecture*, that what makes objects worthless are not the material per se but the absence of human intent. He stated, "For it is not the material, but the absence of human endeavor, which makes the thing worthless."[4] Another key element to ensure the survival of craft within digital media is to recognize that programming, notwithstanding its abstract language, contains all the properties of craft practice. In this case, it is not about a physical material such as wood, glass, or paint that defines the craft practice but an ephemeral one likes a choreographer's notations for dance. It is the process, the experiment, the critical thinking and the love of the immaterial (coding) that define digital artisans and designers. Controlling the programming code will not only redefine the relationship with the computer, but will diminish the mystical fear of the current generation to think of the computer as a mysterious black box with an omnipresent, incomprehensible technology that surrounds it. If one is still unsure about the notion of programming or writing code as a craft, ask anybody that has ever had a "computer virus" enter their computer system and systematically destroy critical information with a highly crafted solution of "codework."

World-renowned German digital artist Hans Dehlinger believes that the first decision an artist makes in any drawing process, whether the drawings are by hand or computer driven, are the questions of starting points and the "character" of the line. Specifically, these questions address the individual character of each pen stroke or the detail crafting of the algorithm that begins as a process of rational constrains in designer's mind. (Figure 1)

The relationship between a composer and a performer is comparable to the relationship that the cotemporary architect has with computer language coding, wherein the composer uses a specific code notation that the performer interprets. In the modern era, the separation of the conceptual idea from the intricacies involved on the actual implementation of the work has ruled the modus operandum, but is not novel. American minimalist artist, Sol LeWitt, exemplifies this relationship[5] in his instructions for locating the eighth point on a surface, in the work entitled "The location of 100 random specific points" at the MASS MoCA exhibit[6] (Figure 2). This clearly illustrates the prescriptive intentions and authorship of a well-crafted design brief. LeWitt's prescriptive writings still allow room for the illogical and intuitive that are characteristic of an undefined or explorative state of mind.

Figure 1. Hans Dehlinger Untitled, 1997 digital drawing, Graphite on paper, 6x5 inches. ©2012 Hans Dehlinger.

In contrast, today's programming language defines a more restrictive relationship because the code notation interpreter is a machine without the capacity to comprehend ambiguity or "interpretation." In my opinion, the digital medium demands a strong creative ingenuity to exert the author's intent and overcome the machine limitations. In traditional art, the "signature" of the designer is manifested on the execution (process) and the final visual aesthetics. Therefore, creative thinking and carefully assembling the parameters for action while allowing for "chance" or variance to occur with the execution of the code is at the center of craftsmanship. The logical-driven process of creating an algorithm or computer language requires a different set of skills. In 2001, American artists Casey Reas and Ben Fry invented programming software named "Processing" while attending the MIT Media Lab. The intentions of Reas and Fry were to explore programming as a fluid and immediate medium. The artists formulated the code, and from the resulting interactions they were rewriting the code and alter the algorithms, to allow for interpretation. If the designer is looking for a high degree of consistency at implementation, then the details need to be precise, and the specific interaction between the various elements will need to communicate a clear intent.[7]

In terms of the vital role of craft to engage the senses, if we favor or prioritize only one way to communicate with the senses, we are at the risk of missing new experiences and will stifle creative alternatives for teaching and promoting concepts and skills valuable for communicating and exploring design.

Besides representing the design idea, digital images and video also carry a visual narrative that mainly is expressed by using patterns such as variation, metaphor, and juxtapositions of elements. The narrative is not only about drawings that simply illustrate design intent, but also about the process that the artist employed to create the imagery. The capacity to illustrate has been augmented by the digital medium and has created a more immersive experience. At first glance, it seems that the process has become homogeneous across designers because the product tends to possess a uniform appearance. However, as designers/artists are "feeling" the medium and understanding its limitations, they can manipulate the output to express a distinct and personal character or style. A great example of this is the work of artist Manfred Mohr (1938), a graduate of École des Beaux-Arts in Paris and pioneer of algorithmic art. Mohr creates algorithmic visualizations and drawings with a strong emphasis on rhythm, repetition, and systematic constructivism logic (Figure 3). Mohr gives the viewer an intimation of multi-dimensional spaces that, however much they exist in the mind, remain beyond sensory experience.[8]

The discourse of design and craft has always sustained itself in relation to the history of making. Particularly, the focus has been on the methods and procedures that give uniqueness and a sense of ownership to the final product. In Italy and northern

Europe during the first half of the 15th century artists began experimenting with the use of oil as a pigment binder. By the end of the 15th century,
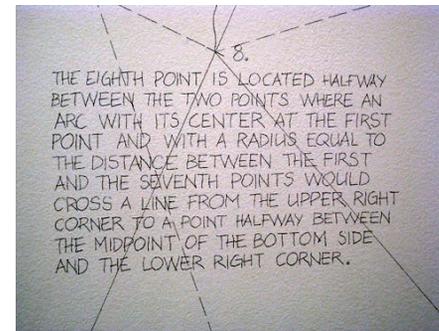
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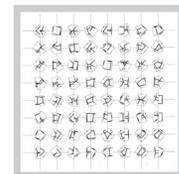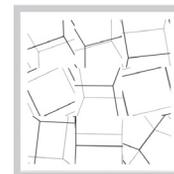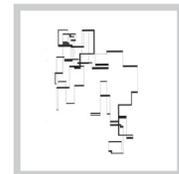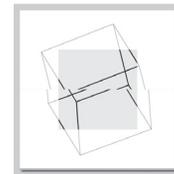
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Figure 2. The location of one hundred random specific points. August 1977 Black pencil and black crayon. Photo: Will Reynolds. ©2012

Figure 3: Manfred Mohr, "Dessins Génératifs—Cubic Limit II", Galerie Weiller, Paris, 1977. ©2012 Manfred Mohr.

tempera, which was the main medium used for wood panel paints, was almost obsolete. Creative people are constantly in search of new methods and means within their process to either improve or to create new experiences. In oil painting, for example, Italian painter Antonello da Messina (ca. 1430–1479) introduced a new technical improvement by adding litharge known by its chemical name, lead oxide, to the pigment-oil mixture to accelerate the drying process.[9] Leonardo da Vinci (1452–1519) enhanced this mixture by adding 5% natural beeswax and cooking the oil mixture at a very low temperature to prevent the darkening of the brilliance inherent in natural pigments.[10] Italian painters secretly kept this particular technique for nearly three centuries. It allowed them to create a distinct identity in their work, distinguish their product, and promote a local movement based on the methods, manipulations, and procedures of the medium.

How is this the same in the digital medium? Authorship involves a voluntary act and a followed execution. A skilled hand creates through its intended actions, making skill and craftsmanship a participatory attribute and an expression. We know the computer is inherently a tool for the mind, and as any other tool, it extends our processing skills, which makes it again a participatory attribute. Its final product is not a physical artifact but the processing and transmission of symbols. In the context of the digital medium, craft exploration refers to the circumstance where designers apply specific technical knowledge (skill) in an undetermined and open exploration of form, constrains, and limitations that they establish to guide the form generation that is their unique expression.

PRINCIPLES OF FORM GENERATION

Form giving is a dynamic process. This iterative process gives the work its exceptional meaning. There is a common misconception that generative design methods, which are parametric in nature, are prompted by a random set of rules that creates arbitrary forms. The main approach of generative designers to form giving is, in fact, a different methodology than the traditional Cartesian *method* (Cartesian Grid) of selecting a basic *shape primitive* and then transforming, adding, subtracting parts to it. These new form-generation systems start by creating basic geometric components as the initial building blocks and establishing a logical criterion that through its repetition and variation will define a larger component or system. This is called a bottom-up development method. Strong evidence of craftsmanship is found on the cleverness and resourcefulness of the designer to create virtual props, molds, temporary scaffolding to generate the necessary formwork that will contour the final form (Figure 4).

Algorithmic design is neither new nor indispensable for creating and shaping form; but a new breed of digital craftsmen saw it as their novel opportunity to enhance once again their tools. At this point the software became the new material to craft. Due to the widespread use of communicating media, designers have formalized ways to work together within a global framework.

A good example is the SmartGeometry Group, a global network that has come together to form a voluntary organization of design communities.

New Constellations New Ecologies
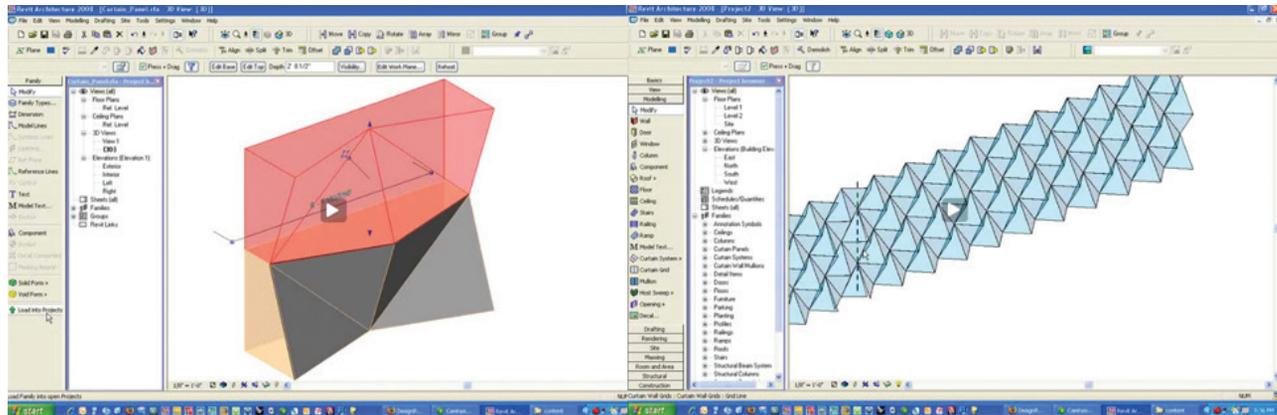
Their main purpose is to create a culture that explores the potential of digital crafting. They gather to share ideas and knowledge with the goal of improving digital tools and with persistence, to conceive projects that will benefit from these tools. Just as the medieval institutions that organized every aspect of their craft, the guilds, craftsmen are using new technology as social networks (Twitter) to complement their organization.[11] "SmartGeometry promotes the emergence of a new paradigm for digital designers and craftsman where mathematics and algorithms are as natural as pen and paper".[12] They promote generative design methods in which the artifacts are created by a set of rules or algorithms based on parametric modeling.

With the extensive array of software available to designers, digital tools could be quite overwhelming for an unskilled designer. In this case, rather than assisting the creative process, it may hinder it, since there is not a predetermined path or fast rules on when and how to use digital tools. Moreover, only *through* "hands-on" *experience* will designers be able to differentiate the appropriate tools for the task and determine how to use them across the different scales of the exploration. Therefore, traditional methods of analyzing and thinking through the design possibilities such as sketching, physical models, collaging, etc. are nonetheless an important part of the process for any digital novice. Either approach to form generation, whether it be top-down design, which relies on the inherited language form of primitive solids or the bottom-up approach that relies on parametric constrains, each are greatly valuable to the development and investment made by the designer using digital fabrication.

FROM BITS TO ATOMS

Much of the digital fabrication machinery, such as CNC millers and routers, laser cutters, and fused deposition modelers, are not new. In fact, engineering and industrial disciplines have been using them for many years to analyze, test, and build components for automotive, aerospace, dental, and medical, and other industries. In the last 50 years, we have seen significant changes in the design and fabrication processes that have had profound

Figure 4: Example of a digital mold (left) used to create the diamond shape curtain wall system (right). ©2011 Design Reform.

effects on old manufacturing materials. These processes are creating new materiality and new effects on traditional materials.[13] It is important to note that this paradigm shift is at the very core of making and crafting. It is in this manner that designers are redefining themselves to understand the effect of digital information and its conversion from the design software to a format that communicates with the machine's construction and tooling logistics. Designers are designing the actual process of making and crafting through the writing of algorithms while exploring the aesthetic and tectonic boundaries.

Because of the complexity of these new geometric explorations, mainly curvilinear shapes or *shapes that form complex* relationships, designers are decidedly more engaged in the making process to be sure that their design intent is attained. Digital design data is so directly integrated with construction data that it allows for better control of the making/crafting process. The critical and closely interrelated conversion from digital data to the physical artifact is not a linear sequence, but a process that flows and informs in a bidirectional manner. Because of this reallocation of direct responsibility to the designer on the quality and craft of the final built object, designers have a renewed interest in the nature of the material and material craft. Bidirectional methods of digital fabrications such as a three-dimensional scanner are employed during design development to either initiate or pursue a dialogue between analog designs (physical models) and digital complex geometries. Digitizing a physical model to translate physical information into digital design data allows for forms that may have been created using other digital tools, such a laser cutter, to be re-manipulated or refined by direct hand manipulation. This interaction creates a closed loop between hand, technology, and machine. Another evidence of craft is the iterative process of creating molds and castings and the multiple revisions thereafter that are informed by physical prototypes from which components are subsequently made. This process is not any different than traditional creative endeavors such as pottery and sculpture.

"Tooling," a term coined by Benjamin Aranda and Chris Lasch, is the current techniques generated by computer language (code) that explores natural algorithms patterns and the fabrication and assemblage process.[14] In the machining process, it is important to be knowledgeable of the tools setting and its specific provisions. For a novice designer, especially students, it is a struggle between realizing what is their true design intention, the intrinsic geometric properties of the shape, and the material and tool limitations. Various traditional techniques of craft such as carving, bending and folding, casting, and knitting are being investigated within the framework of digital fabrication because it has been made faster, easier, and *cheaper* to pursue them.[15]

Ultimately, the most valuable impact digital fabrication has had is the creation of a new breed of craftsperson. The spirit of craftsmanship has been reinvigorated, and technology has challenged them to undertake it. Digital fabrication has created a new frontier for artisanship, a rich and fertile ground in which craftspeople can innovate, create, and craft new pathways.

Generative modeling tools and fabrication methods have opened up new opportunities for smaller architectural studios with a strong interest in craft to explore it because the processes are becoming less expensive. The real challenge falls in the traditions that the construction industry follows and the need to change the prevailing perspective within the industry as a whole, to create a basis for a bigger network. Construction industry mentality is still attached to the grid and to prefabricated building components: anything else is a challenge.

CONCLUSION

The now vastly accessible digital technologies once thought to be reducing our manual skill are, in fact, leading us to build a closer relationship to the art of workmanship with the emerging exploration of digital fabrication.[16] Both digital design and fabrication are allowing us to reconnect directly with craft by streamlining the process that exists between the design concept and final built object. Human impetus has pushed forward traditional industry protocols. In essence, as we immerse ourselves in these new digitally driven processes it is clear that we are still redefining and controlling the tools and techniques and that craftsmanship is still a key significant factor within contemporary digital culture. Architects and designers are returning to materiality, craft, and the realities of making by mastering a new set of skills. Without the advent of digital fabrication, all of these new form explorations are just speculations of unrealizable "paper architecture" trapped in the virtual realm—a body of work that might be very seductive and greatly crafted yet imprisoned within the virtual world.

Perhaps one of the most valuable declarations regarding the quintessentially human need to craft was made at a pivotal moment in the American construction industry's shift. At the beginning of the century, Frank Lloyd Wright declared the following in his book *The Art and Craft of the Machine*:

> Is it not more likely that the medium of artistic expression itself has broadened and changed until a new definition and new direction must be given the art activity of the future, and that the Machine has finally made for the artist, whether he will yet own it or not, a splendid distinction between the Art of old and the Art to come? A distinction made by the tool which frees human labor, lengthens and broadens the life of the simplest man, thereby the basis of the Democracy upon which we insist.[17]

Our innate human need to craft is equivalent to our desire for freedom. We need more research into techniques for making digital architecture and to keep pushing forward for the Art to come. ◆

FIGURE REFERENCES

Figure 1: "THE ALGORISTS." THE ALGORISTS. N.p., n.d. Web. 1 Sept. 2012. <http://www.verostko.com/algorist.html>.

Figure 2: "MASS MoCA :: Sol LeWitt :: Wall Drawing 305." MASS MoCA. http://www.massmoca.org/lewitt/walldrawing.php?id=305

Figure 3: Manfred Mohr, "Dessins Génératifs—Cubic Limit II", Galerie Weiller, Paris, 1977.

Figure 4: "Revit—Diamond Curtain Panels." Autodesk. N.p., n.d. Web. 1 Sept. 2012. <http://designreform.net/2008/11/hexagon-curtian-panels>

ENDNOTES

1. Sennett, Richard. *The Craftsman*. New Haven: Yale University Press, 2008.

2. Ruskin, John. Chapter 2. In *The Complete Works of John Ruskin*. New York: Thomas Y. Crowell, 1905

3. Schneider, Michael L., and John C. Thomas. "The humanization of computer interfaces." *Communications of the ACM* no. 255 (1983).

4. Ruskin, The Complete Works of John Ruskin. 45.

5. McNay, Michael. "Obituary: Sol LeWitt: American artist whose treatment of forms and colours defied critical analysis". The Guardian, April 11, 2007. Accessed April 17, 2011.

6. "MASS MoCA :: Sol LeWitt :: Wall Drawing 305." MASS MoCA. http://www.massmoca.org/lewitt/walldrawing.php?id=3057 "{Software} Structures by Casey Reas et al." Whitney Museum of American Art: Artport. Accessed November 1, 2012.http://artport.whitney.org/commissions/softwarestructures/text.html.

8. Pearson, Matt. "Chapter 1." In *Generative Art*, 2012 ed. Greenwich, Conn: Manning, 2010.

9. Eastlake, Charles Lock. *Methods and Materials of Painting of the Great Schools and Masters*, 2009 ed. New York: Dover Publications, 1960.

10. Ibid.

11. Staley, Edgcumbe. The Guilds of Florence. New York: B. Blom, 1967.

12. "Smartgeometry Group (Smartgeometry) on Twitter." Smartgeometry Group. Accessed September 1, 2012. https://twitter.com/Smartgeometry.

13. Dunn, Nick. "Future Fabrication of Architecture." In *Digital Fabrication in Architecture*, 2012 ed., 183-85. London: Laurence King Publishing, 2012.

14. Ibid.

15. Ibid.

16. McCullough, Malcolm. *Abstracting Craft The Practiced Digital Hand*. Cambridge, MA: MIT Press, 1996.

17. Wright, Frank Lloyd. *Frank Lloyd Wright Collected Writings, 1939-1949*. Edited by Bruce Brooks Pfeiffer. NEW YORK: New York: Rizzoli International Publications, 1992.