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DESIGN THROUGH MAKING: LEARNING FROM LOW-VOLUME PRODUCTION

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ABSTRACT
This paper describes a making-centric teaching methodology intended to illuminate design issues and processes through a low-volume production project. The methodology involves material discovery informing initial design, iteration with human needs and production realities in mind, a low-volume production run functioning as ongoing design critique and refinement, simple tool and fixture making to facilitate production, and relative success of retail sales as design feedback. Developed over a number of years at different institutions and venues, this making methodology allows students to engage with materials and processes to see the entire product development process in an energetic microcosm.

Keywords: Low-volume production, making, do-it-yourself

1 INTRODUCTION

This making methodology has been employed in the context of a second-year level product design studio wherein students are learning a basic design process.
It begins with material exploration by hands-on discovery. Students are introduced to appropriate hand tools and techniques to produce experimental studies that exploit material qualities in the form of many quick studies. They then use the understanding gained from these studies to begin to design a product intended for low-volume production.
After several iterations the students create a production ready prototype. They also construct all the requisite production tools, such as fixtures and jigs, and also plan the steps necessary to produce multiple end products. They utilize available simple production machines (laser cutter, CNC mill, etc.) to manufacture a short-run production. Meanwhile, they have also been organizing a venue to hold a retail sale of the production output. A simple marketing campaign promotes their products, which are then sold to the general public.
I have given this project over a fifteen-year time span in several forms with various end products, such as lamps, bowls and stools. My advisor, Robert O'Neal, introduced the assignment to me while I was his teaching assistant at Rhode Island School of Design. I have preserved the major elements of his assignment, while modifying and adapting it somewhat over the years.

2 PRODUCTION INFLUENCES THE DESIGN PROCESS

The spectre of production influences many aspects of this project and introduces many considerations that are normally absent from more traditional design exercises.

2.1 Material is Basis for Design

To begin the project, students are encouraged to "ask" the given material what it can and can't do through basic tinkering. They learn how it will behave in certain configurations under certain conditions by creating many 3D studies. This is a process that some have called recently "serious play". [1] These rigorous hands-on studies serve as the basis for the initial design ideas. They discover that form can follow material properties and exploit them in an efficient, appropriate and rational way. These hands-on studies will hopefully lead them to transcend their preconceived notions of how a particular material must appear or be formed.

2.2 Strive for Simplicity

Because students are aware they will need to self-produce their designs, they usually tend toward simplicity early on. They ask themselves as the proceed through one iteration after another, “Could I make this?” “Could I reproduce it many times?” “Each one the same?” These constant background questions lead students to a form of analysis that bears some relationship to Design for Assembly or Design for Simplicity criterion. They are not aware of DFA or DFS disciplines, but they actually follow some of the methods developed by Boothroyd and Dewhurst. [2]

They are aware, through intuition and discussion, of the need to: reduce the number of components, to insure that these parts are easy to assemble, and that their parts will need relatively wide tolerances. These concepts are further reinforced subsequently in courses on materials and processes, but this spontaneous lesson in manufacturing science serves as an apt introduction.

Figure 1. Iteration of simple lamp forms using PC sheet

3 LOW-VOLUME PRODUCTION AND MAKING-IT

This aspect of the project raises some questions regarding manufacturing processes and the practice of making things. Because students produce their own designs, rather that creating a model or a prototype as the end product, and because the production volume is low (15-20 pieces) issues of craft, design and mass production become important topics to consider.

3.1 Sense of the Multiple

The end result of many student design projects is a photo realistic 3D model, a proof-of-concept prototype or even a more elaborate simulation of an environment or experience. These, of course, are all valid completions, but this project points the student in different direction. It results in a series of (almost) identical products ready to be sold to a retail audience. Through the course of making, the power of the multiple becomes apparent. Something akin to when a professional designer sees her first work on the store shelf. The reality of creating something that actually functions as a useful object, and then creating many of the same, can have a deep effect on a young designer’s point of view. Many students begin to pay more attention to the implications of the industrial revolution, the realities of standardization, the consequences of proliferation through mass-production, the strength (and danger) of producing so many products, all by dealing with production in a first hand way.

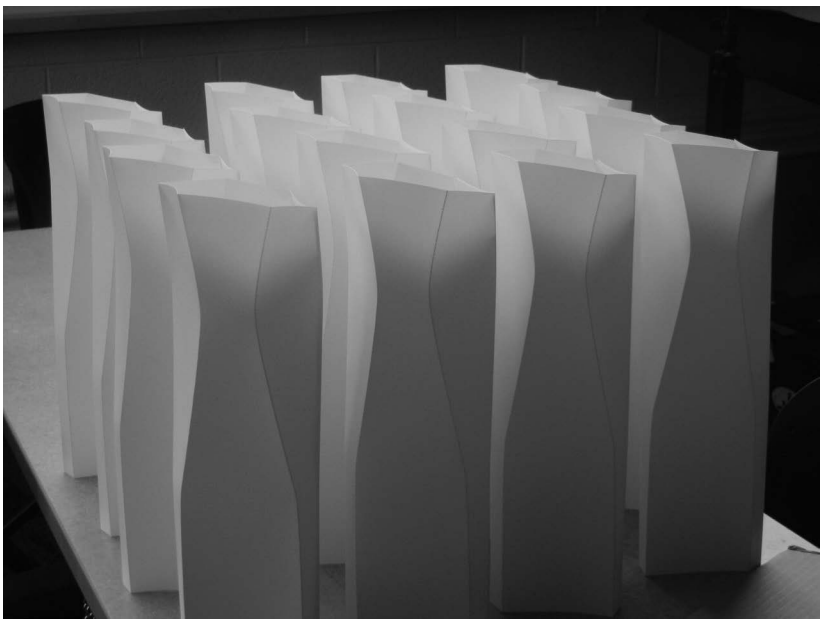

Figure 2. A number of lamp diffusers awaiting fixtures

3.2 Making Tools

By producing their own design, students are resolutely confronted with the amount of labour and the type of work that is required to achieve the desired output. They are the sole agent that determines the quality of the product. It is their head and hand engaged in this work of production. Perhaps not until this point are students able to more fully grasp the relationship between design and production. When they engage in the workmanship of risk in this way [3], they are gaining an understanding of making practices, in the context of a design project, which hopefully will lead them to comprehend and participate in this moment of design practice. A moment characterized by the increasing ability of designers to use manufacturing as another tool in their toolbox. [4]

A major indicator that students are grasping the design production relationship is when they begin to create tools and fixtures. These tools themselves need to be designed and produced by what might be termed a higher order of design. For students to think and create on this level, they need to develop a greater understanding of the entire product development process.

It also places students squarely in the middle of the DIY manufacturing movement going on around the world. Our classroom and shop spaces become a DIY workshop for a time, with the students designing prototypes, making simple tooling, using fixtures and jigs to reproduce parts, as well as utilizing our CNC mills and laser cutting equipment. Just as their professional and amateur counterparts are doing outside the academy.

Over the course of this on-going project much has changed in terms of the relationship of the designer to the production of her design. We see it around us as designers gain more control of the production processes that once dictated what was made. Production processes and techniques have been scaled, adapted, made accessible or invented, that allow interested designers to become manufacturers of their own work. Designer and materials expert Chris Lefteri states it this way, “Modern technology is having a profound effect not only on the materials that can be employed, but also on the scale of production and the locations in which “manufacturing” can now take place. To an extant, this relies on designers being able to control both the design and the means of production.” [5]

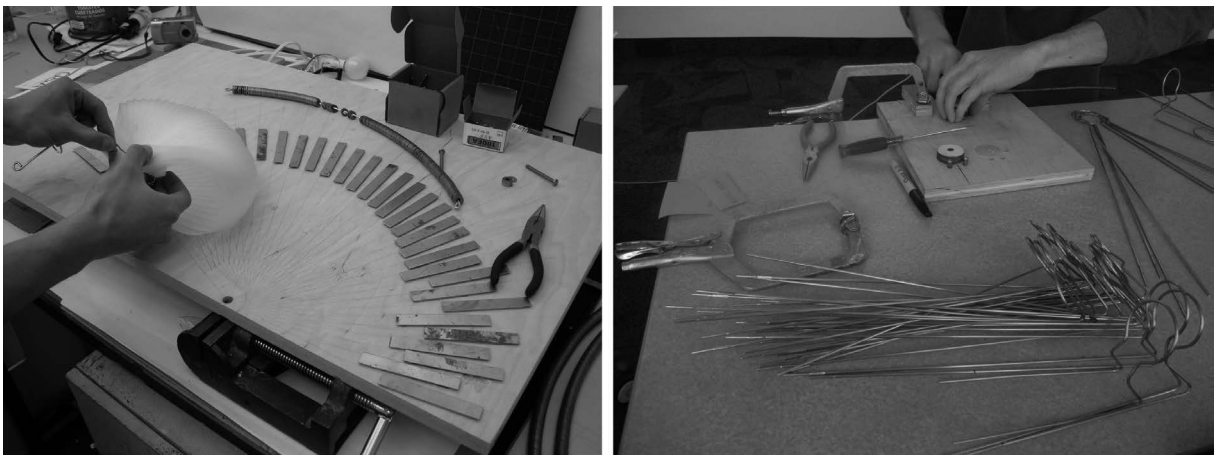

Figure 3. Student-made fixtures used for cutting sheet plastic and bending steel wire

Of course it is not only are designers that are becoming involved in the making, but other interested parties as well. There are many DIY workspaces popping up, such as Fab Lab and TechShop, and garage production facilities that point to the democratization of production as well as the parallel rise in accessibility to the internet marketplace. [6]

4 EVALUATION THROUGH LOW-VOLUME PRODUCTION

During the production phase of the project, there are some opportunities for students to reflect on the rightness of their design. If there was some improvement opportunity that was missed in the iteration phase, it usually presents itself more clearly to the students as they do the work of production. Of course, many times it is possible to make necessary design modifications as production proceeds, but other times problems are more difficult to address at this stage.

4.1 Problem Finding Through Production

This form of self-evaluation can be very valuable. It comes as a natural consequence of the strengths or weaknesses of their design. The production process is providing feedback to students and they are free to interpret the feedback and re-evaluate their design. This evaluation comes as a direct response, not to some teaching authority (professor), but to the knowledge contained in the production process itself. This feedback loop is perhaps a continuation of the design iteration process, but of a higher order. The design is further developed (even considered production ready), and therefore a more sophisticated critique can be delivered through the act of producing the product.

Furthermore, when design problems are discovered in this way, the information can have a greater impact on student learning. The difference between telling the student all that is problematic with their design, and letting the production process teach them directly may greatly influence the degree of student learning. [7]

Figure 4. Students engaged in product production

4.2 Sell It: Critique from Customers

The final phase of the project is the sale. Students identify an appropriate location to temporarily set up shop. They conduct a small marketing campaign, typically involving social media, local news outlets, and local university and design community outreach, to advertise the sale. These sales have had several permutations, but I always insist there be some retail selling by the students to potential customers. This face-to-face interaction is crucial for the informal yet memorable critique it provides the students. They hear first-hand the genuine initial perceptions, practical concerns, aesthetic opinions and even high praise of a discerning public. For many students this experience can open their eyes more fully to a sense of how their work may be received by the marketplace. When one student sells out quickly and another sells hardly any at all, the blunt message the market sends becomes a point of discussion and self-evaluation.

Figure 5. Product Sales

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[5] Ibid.

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