DIGITAL VERNACULAR

Practicing Architectural Making

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Abstract. Prior to the Industrial Age, most architecture was created by the master craftsman or within the vernacular trades where "design" and "making" were aligned. The Industrial Age, and most recently the Information Age, shifted the role of the architect away from that of the "master craftsman" to the professional "knowledge worker." As a result, a divide between design and making in the practice of architecture occurred. This shift impacted an essential part of the architect's process by degrading the symbiotic relationship between mind and hand and limiting the immediate design consequences that only making can provide. But recent technological developments have changed the economic model of design and making in architectural practice and re-established this lost connection. Most importantly, it has provided new opportunities for craft, design, and architectural practice to align. The purpose of this paper is to examine these new opportunities and define what constitutes the digital vernacular. The paper will seek to define the digital vernacular by evaluating each of the following variables: materials, knowledge, and tools. Using normative practice as a control, the paper will conduct a comparative analysis of these variables by examining economic viability (cost-to-wage ratios), logistical feasibility (training & facilities), and skillset availability within the domain of architecture (insourced versus outsourced). Using this data, and resulting guidelines, the paper will demonstrate the successes and failures of a practice using the digital vernacular as its primary project delivery methodology. The focus of this research is not to build an inventory of equipment and methods; rather it is to develop a higher understanding of what constitutes vernacular practice within the digital age. Exploring the digital vernacular is not intended to seek new form-making, but to improve and inform understanding of traditional vernacular methods and to enable a new generation of master craftsmen. This clarity is imperative as to ensure the quality of design and making with emerging technologies and help to prevent high-volume, low-quality results.

1. Defining the Digital Vernacular

The name *digital vernacular* is a response to a particular mode of contemporary making that embraces the practical, poetic, and ethical principles of vernacular design while utilizing the virtues of both computer-guided tools and hand-guided tools.

Digital, as an adjective modifying vernacular, is defined as always relating to both hand and computer. The origin of the word *digital* stems from the Latin digitalis, or "of or relating

to a finger" (Oxford English Dictionary, 2000). The definition of digital as a "discrete value representing physical quantity" was a natural evolution from working and counting with fingers. In the mid-Twentieth Century, following rapid advancement of electronic computers, the definition of digital evolved to "expression in discrete numerical form" and the now common use of the word. *Digital vernacular* joins the past and present by linking hand sensitivity with computer power.

Vernacular, as it relates to making, is defined as "belonging to, developed by, and used by, the people of a particular place and time" (Oxford English Dictionary, 2000). Vernacular has always referred to that which is native or indigenous. With the advent of digital communication and exchange, the very definition of place and time is changing, and the *digital vernacular* recognizes that place and perceptions of time are no longer bound to specific locations, but are now related to common circumstances, characteristics, or values held in common by a group of people transcendent of traditional place and time. It is important to note that the vernacular does not emerge from an isolated group of intellectuals or specialists but rather from the "spontaneous and continuing activity of a whole people with a common heritage, acting under a community of experience" (Clausen and Belluschi, 1994). The definition of contemporary community and the meaning of heritage are rapidly evolving and the *digital vernacular* is defined in response to this evolution.

1.1. WORKING PRINCIPLES

The *digital vernacular* is defined by several working principles; three of the most important are logic, sufficiency, and play.

Logic has long been a hallmark of the vernacular. Logic is a defining human capability and characteristic, perhaps most simply defined as the practice and art of reasoning. Logic is a vernacular trait, used by common people in specific places and times, to organize, evaluate, and process a manifold of conditions and opportunities that are present in community and individual life. Logic could be described as a tool for editing a world seemingly obscure and arbitrary, revealing the legible and meaningful. An example of an editing tool for the *digital vernacular* might be Ockham's Razor; when faced with several choices, the simplest response is usually the best.

Principles of sufficiency have guided the vernacular for thousands of years, where long-term ecological and social sustainability was not merely a concept, but a way of life. Sufficiency is characterized by the fundamental idea that people can determine what is enough and what is too much, striving for a balance between needs and desires. Prior to the Industrial Revolution, communities practiced principles of sufficiency not by choice but by circumstance. With limited resources and simple technologies visible to all, a natural check and balance was in place. Sufficiency always balances means and ends in an extended time frame and provides a sober evaluation of what is need and what is desire.

It is also important to describe what sufficiency is not, lest it be confused with parsimony or the assumption that past civilizations were any less intelligent, sensitive, or creative than society today. Sufficiency is not the suppression of dreams or desires. It is not the inhibition of intellect, ambition, or creativity. It is not a call to eliminate specialization or discovery. Rather it is the greater and more challenging exercise of these thoughts and actions, in a context with tangible limits and boundaries that guide more robust, appropriate and meaningful outcomes for the present and the future.

Thomas Princen (2005) writes in "The Logic of Sufficiency" that the paradigm of efficiency and the logic of empire, defined as the "efficient extraction, technological mastery, and accumulation of private wealth" has delivered much to contemporary life. Princen expands, saying "now that the planet is ecologically full it must give way to alternative logics, ones that twist and fall, that have mystery and surprise, that do not maximize anything. They must be at once economic and ecological, rational and self-limiting, innovative and humble." (Princen, 2005). These are foundational ideas to guide the *digital vernacular* and an antidote to much of the nihilistic design operating in the world today. "The expectation that every new discovery or refinement of existing means must contain the promise of higher values or greater happiness is an extremely naïve thought. It is not in the least paradoxical to say that a culture may founder on real and tangible progress" (Huizinga, 1970).

Another fundamental principle of the *digital vernacular* is related to perhaps the most common action undertaken by all people through all ages: play. Johan Huizinga (1970), writing in *Homo Ludens*, states that **"**Play is older than culture, for culture, however inadequately defined, always presupposes human society, and animals have not waited for man to teach them their playing." Play predates culture and is fundamental to the animal nature of being human. These characteristics of play are especially important in defining the *digital vernacular*.

Play as a voluntary and free activity is important if the democratization of design and the voice of the vernacular is embraced. Play guided by specific limits of time is important if the design work undertook is to be framed around the conditions of the present rather than some conditions of future fantasy. If one can say that great works of design reflect their time, then playing within the present, being in the present, is a critical boundary, opportunity, and limit. The clarity, appropriateness, and historical nature of vernacular design are due in part to its powerful expression of a specific time.

Play guided by bounded place is another integral principle relevant to the vernacular, as there are unique qualities and characteristics associated with a specific place. This relates back to the recognition of play as "freedom itself" (Huizinga, 1970), and fosters the ability of people to express their uniqueness and the particulars of the place in which they live and thrive. Bounded place is also another way of describing the essential playground of the *digital vernacular*: the studio. Within the studio, surrounded by materials and tools, the deepest intensity of design is realized under the principles of play.

That play "creates order and is order" is both relevant to the design process and the vernacular (Huizinga, 1970). It is through order that the meaning of design and community can be conveyed and understood. Central to the understanding of the order-making condition of play, is the guidance of play by rules and principles. The best of design is guided by rules and principles, and like play, does not exist without them. There is no way to cheat at good design, and to cheat undermines the fundamental integrity of play. The rules are only the means to the end, the conditions a player must accept and work within in order to participate, as "limited means beget new forms, invite creation, make the style. Progress in art does not lie in extending its limits, but in knowing them better" (Braque, 1994).

2. Makers

Architecture is not simply imagined; it is real; in order to move imaginings into architectural reality, making must occur. The *digital vernacular* has enabled a new generation of makers to move ideas from virtual simulation to physical fabrication. The term *maker*, as it relates to this paper, is defined as those designers and architects that provide full-scale outcomes as their instruments of service.

The *digital vernacular* is born from a new relationship between designer, *maker*, material, and tool. For decades, the designer has been divorced from the *maker*, ceding to the *maker* final influence on the quality of the product. There will always be some part of the design that the designer has overlooked, and this leaves the *maker* the task of reconciling the disparity between idea and reality. Craft is born from an intense relationship between *maker*, material, and tool, and is executed with judgment, care, and skill (Pye, 1995). The quality with which design intentions are carried out resides in the hands of the *maker*. It is the investment in the quality of the outcome that allows the recent collaboration between design and fabrication to re-establish more fluid intention-driven projects.

3. Digital Vernacular Tools

In Richard Coyne's (1999) book *Technoromanticisim*, he describes what he refers to as a "Golden Age" where culture existed in a pre-literate state and where the hand was the prehensile tool. Learning and understanding was not done by reading and writing, but by touching, feeling, and doing – this was the basis of all mechanization (Giedion, 1948).   In the context of today's digital world, when presented with new digital tools that allow for a designer to reconnect with the haptic nature of architecture one can easily devolve into a digital utopia. The *digital vernacular*, rooted in the practical traditions, seeks to avoid this digression through careful selection of tools. This selection is not set to impede progress or creativity but rather to root the basis of work in the present, not in romantic notions of the future.

For tools to be classified as vernacular they must be readily available, repairable by the maker, and affordable. Much like the recent democratization of information brought on by the Internet, the democratization of manufacturing and mass customization has brought digital tools within economical reach of builders, *makers*, and architects. This change in accessibility can be seen in the fluctuations of the wage-to-tool cost ratio over the past 100 years in the United States.

In 1922, a carpenter in the U.S. could expect to make \$1.00 per/hour (*Highlights of a Hundred Years, 1899-1999*), while a circular saw sold by Hibbard Spencer Bartlett & Co. (1922), would cost \$285 making the ratio .35%. Comparatively, a carpenter in 2010 earning \$19.00 per/hour can expect to pay around \$10,000 for a new 3-axis CNC (ShopBottools.com) resulting in a ratio of 0.19%. With a ratio as low as 0.19% it is easy to conclude that the wage-to-tool cost ratio puts today's digital fabrication technology within reach of the vernacular trades.

This data is further reinforced considering that in 1996, an entry level CNC cost approximately \$30,000. As stated above, a new 3-axis CNC averages around \$10,000, reflecting a cost reduction of 66% within a twenty year span. The change in entry-level economics is also occurring with additive fabrication processes. Within the past ten years, the price of additive fabrication tools has entered a realm the average person can afford. For instance, MakerBot is an open source 3-D printer being sold for under \$1,000, but less than ten years ago, machines with the same capabilities sold for \$125,000.

Common understanding of this phenomenon is represented in Chris Anderson's 2010 *Wired* magazine article that covered a new revolution in the manufacturing process. Anderson asserts that the democratization of technology has led to a new voice for the individual. Some manufacturing processes, once only available to factories with hundreds of workers, can now be done in a small workshop. In the Industrial Age, products were designed for the masses, and companies focused on mass-market appeal; now, individual *makers* are finding their niche in what Anderson calls a new "Atoms Age". For example, the auto company Local Motors has only ten employees, but is a custom car manufacturing company utilizing peer production, open source technology, and user-generated content. "In an age of open source, custom fabricated, DIY product design, all you need to conquer the world is a brilliant idea" (Anderson, 2010). The power of the micro-factory over the Fortune 500 Company is in its ability to anticipate change, adapt readily, and operate with low overhead due to globalization. These small shops focus on the quality of their products, not the size of their market.

3.1 MAKING DIGITAL VERNACULAR TOOLS

Throughout the history of craft, the tools of building trades have evolved slowly over time. This is due to the fact that all craftsmen conduct the same task, with the same tool repeatedly until they can perform it with predictable skill. As Henry Petroski (1992) observes in *The Evolution of Useful Things*, it is the creative and reflective artisan that in the midst of routine pays attention to the details of the tool and devises improvements. It is understood that all tools make other tools and each is connected by the evolutionary development instigated by the craftsman before.

The polygenesis of tools continued uninterrupted until the Industrial Revolution. As with other products of this time, tools were being developed and conceptualized inside the corporation far from the craftsman's domain. This disconnect continued until the 21st century democratization of digital tools. Now, a craftsman has access to parts, plans, instructions, and assistance to build most any *digital vernacular* tool. It is at this intersection between availability of material and community knowledge that defines a *digital vernacular* tool. If a tool cannot be built by, maintained, afforded, and evolved by the *maker*, it is not a vernacular tool.

4. Practice

Practicing the *digital vernacular* embraces the inherent opportunities provided by new technology while maintaining the virtues of working manually with hand tools. The combination of designing and making is counter to the organizational structure set forth by many professional and trade organizations. When an architect is directly involved in the making and implementation of a proposal, there is a shift of responsibility that is not currently recognized within the bounds of normative practice. This is not to say that *digital vernacular* practice is a replacement for the traditional model of practice, but rather an alternative model. As such, the *digital vernacular* should be acknowledged as a legitimate part of the profession of architecture. The *digital vernacular* holds within it the attributes common to the profession: lengthy and arduous education, expertise and judgment, registration, and relative autonomy (AIA). The *digital vernacular* is but a specialization of practice. The core expectations of an architect are unchanged.

4.1 NORMATIVE PRACTICE

For the purposes of this paper normative practice will be addressed as the standard project delivery methodologies defined by the American Institute of Architects. Currently, architects working in the U.S. are guided by deontological ethics that demand a clear separation between design and making. Article 3.6.1.2 of AIA's Standard Form of Agreement Between Owner and Architect clearly states:

"*The Architect shall not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work in accordance with the requirements of the Contract Documents. The Architect shall be responsible for the Architect's negligent acts or omissions, but shall not have control over or charge of, and shall not be responsible for, acts or omissions of the Contractor or of any other persons or entities performing portions of the Work.*"

The American Institute of Architects (2009) reinforces this position in *The Architecture Student's Handbook of Professional Practice* when it states:

"*Professions traffic in ideas and services rather than in goods or products. They have knowledge outside the ken of the layperson.*"

The result of these rules is a standard contract model that separates knowledge, discipline, responsibility, and service into: client, contractor, and architect. [Figure 1] The architect is the guardian of the "ideas and services" and determines if the work done by the contractor is consistent with the contract documents. The contractor is required to build to the contract documents and is wholly responsible for budget, schedule, safety, and final project delivery. In this sense, the architect's deliverables are the drawings and specifications, while the contractor's deliverable is the actual building. Recently new models have developed around design-build and integrated project delivery with marginal success primarily because they are still based on this division of responsibility. This separation of accountability within normative practice stands in contrast to the fluid decision-making and clear logic provided by the vernacular. Looking at the vernacular's historic ability to succeed within natural limits it is only reasonable to question the current model of practice.
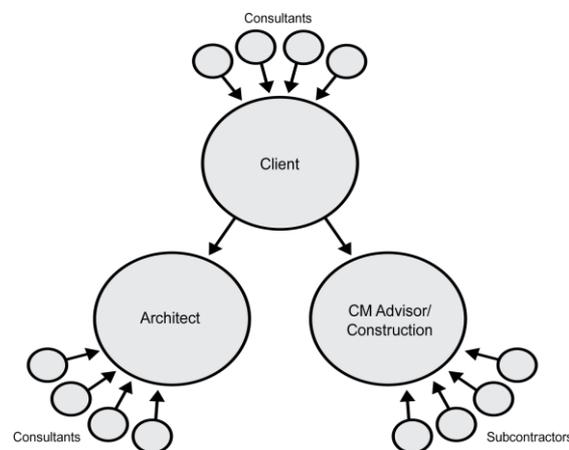

Figure 1. Normative Practice Organizational Diagram (adapted from Holden, 2012).

SECTION THREE: DIGITAL TOOLS IN DESIGN AND CONSTRUCTION

4.2 DIGITAL PRACTICE

The use of digital modeling to produce architecture has profoundly impacted the profession. The most apparent influence is in the limitless possibilities to generate complex forms. BIM fabrication tools such as Grasshopper and Digital Project are acting in response to the demands of digital practice. What is designed can now be readily fabricated by others. Practicing digitally has created a process-based change to the profession. As Branko Kolarevic (2003) asserts in *Architecture in the Digital Age*:

"The digitally based convergence of representation and production processes that represents the most important opportunity for a profound transformation of the profession."

   This opportunity has been leveraged by many firms successfully. For example, SHoP Architects uses a technique they call "direct fabrication" where the design drawings produce the final fabrication geometry (Holden, Nobel, and SHoP, 2012). This method of working presses against normative practice and dated rules that shape the profession by expanding the architect's traditional instruments of service to include direct fabrication files. SHoP has fundamentally changed the organizational diagram produced by normative practice [Figure 2]. Further integration is accomplished by consolidating consultants (outsourced become insourced) and further engaging the clients and contractors in the design process. SHoP was able to do this not by limiting their responsibility, as the AIA recommends, but by increasing it, folding the "responsibility of others" into their design process. Digital practice is a step towards practicing the *digital vernacular*, but it has yet to break from normative practice's separation of design and making.
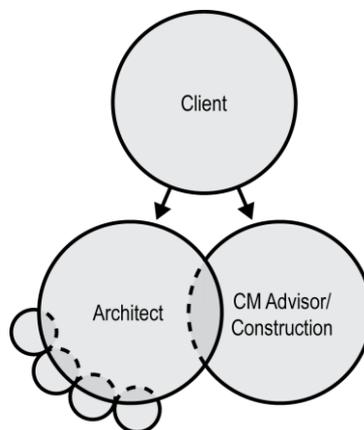

Figure 2. Digital Practice Organizational Diagram (adapted from Holden, 2012).

4.3 PRACTICING THE DIGITAL VERNACULAR

To make with the hands provides immediate consequences to design decisions. In a *digital vernacular* practice, an architect can conceive, design, model, fabricate and realize a design without interruption. A fluid motion of designing, testing, and iteration can be achieved by the architect(s). Understanding the importance of designing and making, David Pye (1999) observed:

"Design, like war, is an uncertain trade, and we have to make the things we have designed before we can find out whether our assumptions are right or wrong... 'Research' is very often a euphemism for trying the wrong ways first, as we all must do."

The *digital vernacular* allows for designers to edit logically, achieve sufficiency, and play with design variables to seek solutions. Design cannot be faked within the *digital vernacular*, it is authentic in its successes and failures. It is rooted in the craft guild practices, bounded by the unique context of time and place. The *digital vernacular* further compresses digital practice's process of design by integrating all aspects of design and construction into one entity [Figure 3]. The architect is wholly responsible for design and construction, reaching beyond the limitations of normative practice.
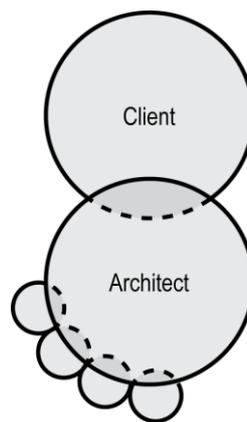

Figure 3. Digital Vernacular Practice Organizational Diagram.

4.3.1. Designing a Door

To make evident the virtues of *digital vernacular* practice, a brief case study is provided that describes the process of design and fabrication of a door undertaken by makeLab, an architecture and digital fabrication studio.

When faced with the design challenge of a door in normative practice, an architect generally thinks in terms of size, material, appropriateness of style, and performative specification. Variables such as compliance with building code and panel configuration are considered. The door is then sourced with a local vendor who represents manufacturers that produce thousands of doors of consistent type. This process could be called "refined shopping" in that it takes special knowledge of the design conditions to select, or shop, the appropriate product. Given the fact that each manufactured door bears no distinguishable feature from the hundreds of others, it's hard to claim true authorship of the final product.

The following process illustrates an alternative scenario using *digital vernacular* practice. In the winter of 2013, makeLab was commissioned by an industrial engineering firm (TPM) to design a conference room for an existing research facility. The room was required to attenuate sound, hold at least six people, be completely open on its short sides and be movable within the research space [Figure 4]. As the framework of the portable conference room was being constructed, a unique door had to be designed for access. The room's short ends measured 12 feet [3.65 meters] in length and required a single door to span the length without obstruction. To further complicate the design, the door would need to float above the ground without secondary support due to the fact that the conference room moved on wheels. MakeLab decided against "shopping" or purchasing the door not only because there were no stock doors that met the requirements, but because even the simplest door exceeded the modest project budget. Driven by cost, availability of materials and customization, makeLab designed and constructed the door in the spirit of the *digital vernacular*. The immediate consequences of working with the mind, body, and soul allowed for a fluid solution to a complex problem.

Figure 4. TPM Conference Room, makeLab 2013.

This fluid approach was evident in the development process of the door design. The door was first conceived in sketch form and then digitally modelled. At first glance, the design seemed plausible: two rails interlocking at the top and bottom of the door to form a sliding framework which would allow the door to move in and out without binding. On the computer, the design may have seemed plausible, but given a closer look, larger more complicated questions emerged. Would the sliding mechanism bind? Would the sliding mechanism hold its own weight? Should it be reinforced? Would the increased weight of stronger material cause binding of the sliding mechanism? Should the slide be made with bearings, self-lubricating HDPE plastic or some alternative material? These questions are not profound or even overly observant but within the domain of the *digital vernacular* they all can be physically tested and evaluated for their worth.

A defining characteristic of the *digital vernacular* is that it does not seek new form making but rather, a higher understanding of the past and how digital tools can further our

understanding of the built environment. After many tests using complex rollers, bearings, and guides, makeLab decided to look to the past in order to move forward. The solution for the slider was found by dismantling a large table with a removable leaf. The table retracted and compressed to receive the leaf by using a mortise-and-tenon joint guided by compression rollers. This solution was simple, elegant, and efficient and showed promise for integration into the sliding mechanism.

   Prototyping of the door began with half-scale models that tested not only the assembly but the kinetics of the design. The first tests failed on many levels: some materials did not allow for the rails to slide (lubricant was introduced with little success), while others were cut too tight or too loose and the door would fall. With each successive prototype attempt, the digital model was modified. An iterative process of design and build between the mind and hand ensued. Successive iterations increased in scale and complexity until the final door was achieved [Figure #5]. When practicing the *digital vernacular* failure is reclassified as necessary and fruitful. The heroic failures in the testing of the door allowed for a fluid integration of designer, *maker*, material, and tool.

Figure 4. Door and Entry, TPM Conference Room, makeLab 2013.

5. Conclusion

Given that logic, sufficiency, and play are the guiding principles of the *digital vernacular*, the design and fabrication of the door is a manifestation of these principles (as was the conference room). The door was born out of the given conditions of time and place, making the solution logical and constructible. The door was not guided by a desire for new form making that technology can provide; it only sought to accomplish its task—open and close a large area.

   The working principles—logic, sufficiency and play—are fully utilized in the final product. Logic is a continuous tool that keeps sufficiency proportionate and influences each decision made through the process of play. The final outcome achieved sufficiency,

balancing needs and desires within the context of tangible limits and boundaries of the project. The failures and iterations of the door were explored through play and the constraints that govern play: time and place. The solutions were rooted in the present and not conditions of future fantasy, as well as met the physical limitation of a set deliverable date. The context of the conference room, the place in which the door exists, provided the parameters in which *makers* can play.

The *digital vernacular* is further evidenced by the tools used in completion of the conference room door. These vernacular tools, readily accessible and affordable, directly contributed to makers meeting the principles of logic, sufficiency and play. The seamless integration of the tools allows for fluidity from design to creation, which is essential to the *digital vernacular*.

The door functions but only because makeLab used specialized skills of digital applications, materials, and ultimately physical testing. The convergence of designing and making allowed makeLab to operate at its highest and best use, culminating in the principles, processes and tools that exemplify the foundation of the *digital vernacular*.

Acknowledgements

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