

Modelling Form: Ways of Making, Hybrid Crafting

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Introduction

This paper discusses a practice-based project - started at the European Ceramics Working Centre (EKWC) and continued during the FabLab Made@EU Residency) - which aimed to redefine overlaps between craft and digital forms of making, asking whether an exchange of methods and processes may generate new domestic applications in the context of interior architecture¹. The intention was to integrate the hand-made and digital technology, craft and design thinking by developing a hybrid method of modelling form in ceramics. Therefore the project investigated the role of digital manipulation as a design tool for creating and developing form from a maker's point of view. In doing so, it explored interrelations between digital and traditional ceramic processes, knowledge(s), materials and techniques with a focus on the physicality of forming.

The work was developed with the scope of readdressing the form and functionality of radiators as domestic objects for warmth related to space. Since clay is a traditional material associated to architecture (fired ceramics have contributed historically to the materiality of buildings as moulded surface decoration, brickwork, tiles and stoves), ceramics was considered alongside digital methodologies of planning architectural space. Software was used to initiate digital forms to be rendered into clay and developed into heat-releasing three-dimensional prototypes adaptable to the interior walls of buildings. These initial solutions represent material interpretations related to the haptic interaction between people and the space of domestic or public interiors; they were intended to alter the ways in which people relate to warmth, proposing a different interaction.

Therefore, in terms of developing a making approach, clay becomes central to the exploration as a craft and digital material. In discussing the contemporary relationships between craft and technology the notion of 'hybridity' is often used to convey the integration of processes of making. In this view, my project was centred on the concept of hybridity seen as a symbiotic process between the crafted and the digital; and focused on the idea of fabrication of form through translations from one medium into another. It indicated that by situating form-fabrication in a digital context (e.g. Rhino programme) the ceramic medium facilitates a series of semantic translations between the making languages of digital technology and craft². It also suggested that by moving toward the digital, a ceramic craft production brings together physical and virtual design materials, juxtaposing formats of investigation.

The project posed the following questions:

- Can digital modelling facilitate an intuitive approach to making, enabling a meaningful interrelation between digital and physical form?
- What relationships are at play between the tacit knowledge of craft-making and that of digital-design?
- How the use of digital forming changes the nature of craftsmanship (and that of the craft object)?

Project Objectives

Whilst based on practical hands-on knowledge of materials and techniques, the scope was to investigate how digital design is incorporated into contemporary ceramic craft by:

- Investigating digital models of modelling for craft practice by developing new method(s) of production (interconnecting digital production techniques with traditional ceramic processes)
- Developing new skills by combining digital and hand-crafted fabrication methods (interrelating digital tools with established craft hand-tooling to develop a hybrid practice)

Context: The (Re)Place / Re-placing of the Maker in Contemporary Culture

As the project focuses on ways of making in ceramics, considering digital modelling as a craft method of forming, I set out to understand how the processes of hand-making is changed when facilitated by technology. In this view, I planned to address “traditional” craft of modelling in studio ceramics in relation to digital production at a time when makers are confronted by a growing accessibility of digital manufacturing technologies. In arguing the re-placing of craft in relation to technology, Dormer (1997) already suggested that the reinvention of craft can be achieved by converting the processes involved at the small craft and designer-maker level to industrial scale factory production (Dormer 1997:168).

As ceramic craft has been historically confronted by industrialisation - which replaced craft knowledge and skills with mechanisation, automation and a machine-driven production - modelling skills have been diluted by a CAD/CAM approach to form-making. Computers were used in manufacturing from the 1960s as “rapid prototyping” (RP) tools and were accessed and adapted by creative practitioners in the 1980s, in spite of their technical complexity. Such technological shifts tend to strip down or devoid a production of craftsmanship content, as the maker seems removed from the act of making: in the digital age a rational, rather than an intuitive method of making seems to be at play; and this tends to undermine, simplify, separate or replace hands-on making as a method of, and continuity to thinking. As Juhani Pallasmaa (2014) noted, ‘Computer imaging tends to flatten our magnificent, multi-sensory, simultaneous and synchronic capacities of imagination ... creates a distance between the maker and the object.’ (Pallasmaa 2014: 14)

Current craft/digital practices show that all craft-specific disciplines are changing methodologies of practice, creating applications beyond the mastery of hand-making³. Many contemporary designers are reconsidering the craft element of production, and many craftsmen have included new technologies in the process of making. For example, Michael Eden’s work is based on processes of additive layer manufacturing and explores hand and digital tools and experimental manufacturing technologies and materials; sitting between craft and design, Belgian design studio Unfold experiments with printing in porcelain by extruding ceramic materials; Zachary Eastwood-Bloom uses Rapid Prototyping and CNC milling to realise his three-dimensional designs; Shelley Dullan focuses on the application of 3D CAD modelling within a craft context; Geoffrey Mann is digitally mapping form using rapid prototyping and casting in a range of materials; Justin Marshall’s work integrates digital technologies into ‘traditional’ craft practice, in search of new aesthetic possibilities; Tavs Jorgensen investigates new computer interfaces in search of expressive forms⁴. Contemporary designers and architects also use or initiate software programmes that combine material and immaterial production; Ammar Elouin incorporated stop-motion animation to produce his furniture: CoReFab #71 Chair (2006) starts in the computer as an animated character with infinite versions of form, and ends as a digital still file transferred to a selective laser-sintering machine. Joris Laarmar adapted 3D software for automotive design and applied it to furniture (Bone Chair, 2006).

These approaches suggest a growing correspondence between digital work and traditional craft and demonstrate the current diversity of craftsmanship and highlight the possibility of a creative synthesis between digital technologies and craft practices. In this view, Matt Ratto and Robert Ree (2012) claim that digital fabrication develops an ‘increasing porosity between the digital and the material’ (Ratto and Ree 2012). As a result the “materialization of digital information” (ibid.) in most craft disciplines shifts the role of hand-skills, craft methods and processes of production. Therefore, as the process of domestication of technology takes place in different stages of adoption, craft-making becomes hybridised. In contemporary culture all forms of craft have been hybridised, and this process is in considerable part determined by integrating technological methods of production. Artist Claire Twomey suggested that ‘investigative, non-conventional approaches to clay are endemic of our time.’ (Twomey 2000: 26-9)

And, as the culture of craft practice is reshaped it changes its “language” by adopting methods of making from industry, design, fine art or other disciplines and areas of practice. Therefore, when the capacity of software to generate form is considered a craft, the possibility of developing an integrated technological approach to modelling clay opens up a hybrid kind of practicing craft.

In this context, rather than excluding digital advance in my practice, I considered modelling an open-ended process where the hand-made is not removed but complemented by technology, enabling a “different kind” of making and thinking (Metcalf 1997).

Re-MAKING PROCESSES: Re-design and Post-Production *digital craftsman*

Contemporary design methodologies based on objective knowledge, independent of any subjective considerations often follow precise methods expected to deliver a “correct” result. As Max Fraser noted, ‘Digital processes are often assumed to be too linear, rigid and mathematical to fit the more human-centred definition of craft’ (Fraser 2010).⁵ In the case of craft these precise methods, ‘do not always correspond to the rational logic of a scientific methodology.’ (Naylor & Ball 2005: 38). Rather than responding to prescribed, predefined rules and procedures craft making processes are unprecise, subjective, explorative, in contrast with scientific research. Therefore the project approached the craft/software binary from two perspectives: the integration of digital thinking into craft processes of making and the integration of craft knowledge(s) into the digitalisation of form. These intersections of digital and craft form-giving techniques created multiple points of exploration.

Since the ‘making of form’ shifted between the digital and the crafted, I considered it a practice of ‘re-design’ and ‘post-production’ – a form of editing and re-editing form-making. This process implied a hybrid forming resulted through a series of ‘translations’ from one medium to the other – involving editing and re-editing from virtual (immaterial) to physical (material). Therefore the integration of digital technologies into making ceramics could offer reciprocal “translations” – a useful concept that imply an exchange of making methods between two mediums.

The first stage of the project was based on historical research and model-making, with the scope of developing heat-releasing three-dimensional architectural components adaptable to the interior walls of buildings. Considering that people habitually lean against wall surfaces; and used to lean against the ceramic tiles that covered in the past old stoves (which provided tangible heat in rooms), I started to re-configure form. By correlating notions of form, heating, space and material, I set out to combine digital forming with traditional ceramic processes and bring about the haptic, sensorial characteristics of fired clay into architecture.

I planned to develop forms that can be adapted to vertical walls, and that could change the physical interactions between bodies and architectural surfaces, creating a connexion between people and the internal skin of a building. Such forms are intended to act as sensorial surfaces between the architectural element of the wall and the body, for leaning or resting against. The final ceramic pieces are to be integrated into the walls as heating system and subsequently filled with hot water.

In the second stage the project involved digital form-generation based on the use of the Rhino programme whereby the modelling process was considered centre-stage in ‘begetting’ and ‘thinking form’, translating forms into digital samples. This stage was key in investigating the visual potential of digital technology for thinking form and explored the relationships between the two and three dimensions. The exploration of form-giving as visual material in a virtual medium makes possible the direct manipulation of and understanding of spatial dimension and allows experimentation through visual-spatial structures.

In order to translate digital-making into hand-making I did draw similarities between Rhino modelling and traditional modelling of clay: for example curves or surfaces generated by algorithms are mimicking curves obtained by hand; like hand-modelling, on-screen three-dimensional models can be controlled by rotating and modifying each aspect of the form, dimension, proportion, curvature.

Also, like casting, Rhino modelling leads to repetitious tasks and the generation of cloned forms like the replication of the factory machine: on-screen forming follows “additive” or “subtractive” processes resembling traditional ceramic craft. Digital and hand-modelling require backward and forward sequences of adjusting form, therefore manual, mechanical, tacit skills and the “know-how” of hand-modelling are directly connected to the conceptual and evaluative skills of on-screen modelling. Although “automated”, the digital enables the transfer of a hand-modelling technique; and form-giving processes shaped by hand-and-digital modelling become hybrid crafting.

The transition from virtual to physical form relates the visual language of the digital to that of the physical; at this point making centred on the concept of translation of form. Within this dynamic translation from virtual image to physical manufacturing and back, the on-screen models were milled into “negative” forms (in plaster) or “positive” form (in Styrofoam), and related back to materiality. The milling process represents an important transition in the process of forming, making possible the transfer of on-screen programmed virtual representations into solid forms.

The third stage of the process focused on the form and surface fabrication of three-dimensional models using a digitally driven production. The programmed three-dimensional forms were transferred through milling into physical prototypes. As the form-giving processes shift between tools, methodologies, hand-and-machine methods of production (Rhino digital manipulation and milling), the domestication of digital–crafting becomes a set of translations that initiate changes in the semantics of form.

The samples and trials of possible forms were tested in a number of moulds, and the clay was morphed into three-dimensional solid objects. Clay changes materiality from a plastic to a hardened shape; as such, the form permutations performed in Rhino and clay represent negotiations between inside and outside form, between plasticity and solid.

The textured surface ensued in the first milling was preserved since heating is released at a greater rate when surface is multiplied, and this surface became the outer “skin” of the forms. In this view digital and hand-crafting (press-moulding) alternate in redefining form.

Thus the visual/physical making developed through a language translation of form on virtual and physical levels, shifting between the contexts of hand and digital making in terms of visualisation, formatting, materialisation-dematerialisation (which are mirrored in ways of engaging and disengaging with the physicality of materials and processes). Although considered as different stages in a fluid making process, these processes were interrelated, since one outcome traces into the following one – a hybrid symbiotic relationship of craft and digital continuity. As modelling was relocated within digitally-driven making process, it redefined connections between digital and craft possibilities of practice. The resulting collection of prototypes re-considered the use of ceramics in opening up sensory and aesthetic expressions for the interior design of architectural spaces.

Project Evaluations

The evaluative methods used to make decisions between the type of forms during the stages of production and post-production were based on one hand on the visual blue prints of the Rhino drawings (in the second stage) and the physical models resulted (in stage three). This interpretive rather than scientific method permitted alterations from one medium of production (two-dimensional, of visual dominance) to another (three-dimensional, sensorial) throughout the making process. In this view testing was an analytic, generative and evaluative method.

The initial generation of forms in digital image format was used as a tool for thinking and evaluating form, and in this sense the Rhino drawings became a visual type of testing structural, technical, proportional elements. Generally the ability to judge a product at the prototype stage is focused primarily on objective, structural or technical aspects, and less on the “quality-in-use” and the social aspects of an artefact (although objects will need to fit into pre-existing object-human relationships).

However, because the forms were developed in relation to users and space, this project considered the anatomy of the body as central to the development of form solutions throughout all stages of the making processes. For example, the paper-printed Rhino drawings became points of reference for the development of shapes to be related back to the body anatomy. Once the physical Styrofoam “positive” or the plaster milled “negative” models emerged, what was evaluated visually (on-screen) became evaluated haptically, in a physical dimension.

At the same time digital intervention was a method of testing and evaluating form solutions and was used to relate, respond, adapt and accommodate making techniques, re-tailoring and redirecting the making process toward alternative solutions. At this point the role of visual and physical testing (on-screen and in the form of three-dimensional material prototypes) was to analyse and appraise options, proposing a new generation of design solutions. Also, the ensuing three-dimensional prototype forms became “bearers of knowledge” and containers of ideas and were useful in evaluating physical qualities and in furthering postproduction. Once these visual “blue-prints” (patterns) are printed and then milled in Styrofoam, the responses from users’ engagements with every series of forms becomes a basis for re-evaluation.

In general, digital input was useful in thinking, testing, analysing and evaluating structural and proportional elements of form; it re-directed the making process, permitting alterations from one medium of production to another. Digital modelling facilitated a new type of creative exploration and experimentation, an accurate translation from virtual to material form. Another important element related to digital manufacturing was the exploration of material qualities through fabrication.

The first prototypes designed to fit in between the body and flat architectural surfaces were installed as warm components against the wall, offering a haptic, physical interaction with the body in terms of sensory experience.

Conclusive Reflections

The development and integration of digital technologies into design and craft through interfaces that convert the digital into physical permeate reciprocal translations characteristic to contemporary hybrid practices. CAD/CAM innovations, 3D printing and Selective Laser Sintering allow the rapid-prototyping of complex objects made from resin, plaster, nylon or metal. Such technologies are increasingly applicable due to new developments of materials and larger scale production possibilities. Since in the contemporary Western culture material and immaterial methods of production interchange with advances in computation, the possibilities offered by digitalisation indicate that technology may dominate and overtake traditional handwork, diminishing or eliminating the place for the handmade. Yet the latest developments in digital fabrication show that the digital revolution creates a space of juxtapositions of methods, tools and techniques, creating mixed models of practicing craft, where each discipline is transformed through the other (craft becomes a continuation of technology and design as an extension of a craft. This inter-disciplinary overlap enables a convergence of practices as well as an adoption of each other’s tools and techniques of fabrication, extending the possibilities of craft production.

As the separation between the types of production (and methods of generating form) developed by industry, design, and craft is decreasing, the element of making in ceramics needs to be re-valued within a culture of mass-produced-and-consumed products. The integration of the above groups of techniques, skills and methods of production (hi-tech performance/ low-tech making; tradition/ innovation; old/ new manufacturing; matter (ceramics, hardware) and information (software)) also re-position the value of the hand-made and the use of hand tools as evidence of human skill and expression. If technological advance and industrial processes have generally dominated the production of objects as everyday commodities, craft and the handmade embedded different kinds of values in objects. Yet approaches that use technologies that are new to ceramic practice validate the co-existence of craft and digital technology and redefine craft and consumer products in the digital revolution. In reflecting on the role of craft in the twenty-first century, Gerard Briscoe (2014) observed that craft contributes to the re-defining of objects’ value in a culture of increased production.⁶

In this view, the project was embedded within the contemporary debate on the nature of craft as it examined the intersection of traditional ceramic techniques and digital processes. In aiming to create connections between craft-and-digital making, the project focused on the fabrication of form by considering a (digital) modelling technique to mediate between craft and digital production. Therefore it was relevant to evaluate how a digitally-aided production becomes a craft, and how engagements with the processes of making are influenced by technology from a maker's perspective. Furthermore, since digital technologies require an appropriation, manipulation and a change of production and fabrication methods and tools, it is important to learn how this adoption of thinking in a different medium makes digital craftsmanship relevant in the contemporary culture of studio ceramics.

The final digitally-crafted prototypes developed through a hybridised crafting reflect the integration of materials, craft processes and knowledge(s) belonging to two mediums of production. The hybridity of the making process is reflected in the exploration of form-giving (the modelling and crafted prototypes, the milled models) where the digital is revealed as a crafting process. As such, contemporary ceramic craft skill involves a concomitant (craft)-deskilling and an adoption of new skills (a re-skilling), resulting in a hybridity of practice (changing the notion of craftsmanship). However, although software became part of the making process, the translation of form was rooted in a traditional understanding of craftsmanship (software being an intellectual construct based on handmade); therefore craft and materials remained the basis of making.

In re-positioning the handmade in relation to the digital the project evidenced the influences of technology on my own experience of making and thinking. The ways in which the digital fits within the history of craft has great implications for craft practice and its relationship to modern culture: new technological tools, methods and processes of production evidently alter profoundly the ways in which makers produce work. In adopting new, hybrid practices that enable different engagements with craft, makers are challenged in accepting new values and perceptions, new types of products and new applications - otherwise unachievable in traditional craft production.

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1 EKWC, the European Ceramics Working Centre, 'Den Bosch, The Netherlands

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2 The Rhinoceros ("Rhino") programme is a software 3D modeling tool for designers and architects programmed to create, edit, analyze, render and manipulate curves, surfaces and solids. Any geometric model constructed in Rhino can be exported to laser cutters, milling machines or 3D printers for manufacturing.

3 Notably 'Lab-Craft' (2010), 'Make: Shift: Do' (2014), 'Power of Making' (2011)

4 Tavs Jorgensen is a freelance designer and research fellow at the Automatic Research Group, University College Falmouth.

5 Max Fraser curated 'Lab Craft: Digital Adventures in Contemporary Craft' (2010)

6 Speakers' Corner: Making, materials and tools at MAKE:SHIFT Conference exploring craft and innovation (20 & 21 November 2014 at Ravensbourne in London.