# Material driven 3D Digital Form giving. Experimental use and integration of digital media in the field of ceramics

Research Through Design Case Study

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#### Abstract

This thesis is about the experimental use and integration of digital media in the shaping process of artifacts in the field of ceramics. The aim of the research is firstly to support the ceramicist in working experimentally and exploratively by means of digital media, and secondly to contribute to the interdisciplinary discourse about the use of digital media within the field of craft. The project focuses on 3d form; hence 3d digital graphics and Rapid Prototyping (RP). "RP" is a common term for techniques for transforming the digital form into physical form in this case by the use of 3d printing and CNC milling.

The research project is centred around two research questions:

- 1. How knowledge and experience about form-giving in the field of ceramics can be transferred to and utilized in 3d digital form-giving.
- 2.What can be gained with such use of 3d digital form-giving, and how is it utilized in a dynamic interplay with the actual shaping of ceramic artifacts.

The thesis is entitled "Material-driven 3D digital form-giving. Experimental use and integration of digital media in the field of ceramics". "Material-driven form-giving" reflects the idea of ceramic material as a generative and responding potential in the form-giving process, which contributes to unpredictable form solutions. Materialdriven form-giving is characterized by two levels; a first level which is to identify and refine a generative potential in the material; and a second level which is to transform and actualize this potential in a representative number of artifacts by interacting with the generative potential of the material. The idea of levels is inspired by Sanford Kvinter (2002), who describes how a virtual component is linked to an actual component by a dynamic and uncertain process. In this context, the virtual component can be seen as the potential of the ceramic material, which can be expressed in a wide range of artifacts.



More specifically, the idea of material-driven form-giving was explored and exemplified by means of the author's own experiments with 3d modelling and simulation software. This led to the concept of "material-driven 3d digital form-giving". The experiments explore how the ceramicist can utilize themes such as movement and metamorphosis in his work, by means of 3d digital form-giving. The point of departure for these experiments was the use of dynamics in the animation software Real Flow. In the terminology of such 3d software, "dynamics" is a common name for a number of digital tools designed for the simulation of physical phenomena, e.g. liquids, wind, and gravity.

It is argued that dynamics in this sense can be seen as a generative and responding potential, which is comparable with the role of ceramic material when used according to the idea of material-driven form-giving, hence the name material-driven 3d digital form-giving. Various artifacts were produced during the experiments by transferring digitally defined forms into ceramic materials by means of RP. These artifacts showed a potential to produce "dynamic conflicts". Such conflicts contribute to a fluid boundary between fiction and reality, reflecting the above-mentioned use of techniques and materials.

The preliminary experiments using Real Flow raised new questions and hence new parallel experiments. For example, the use of dynamics in such commercial software can be said to represent an already defined way of thinking and giving form. This issue is discussed in relation to the ideas of Manuel De Landa (2001) and others, regarding how the use of digital media can reflect and emphasize a more personal way of form-giving.

The results obtained encouraged an experimental development of a 3d digital tool named digital interactive form-giving tool (DIF) in cooperation with a computer programmer. The experiment explores an interactive 3d digital drawing, which responds visually to the movement of the hand in a virtual 3d space using a Wii remote as a device. The movement captured and digitalized by the Wii forms the basis for a 3D physical model produced by means of RP, which expresses the movement in physical form. It is argued that such an approach represents a more personal way of material-driven 3D digital form-giving, compared to the use of so-called commercial software.

Within the field of ceramics, the ceramicist often develops his own materials and techniques. Still, the resulting artifact will more or less always exhibit the "signature" of the material given by nature. In a contrast it is argued, that DIF enables an exploration of properties, which are not bound to material and by laws of physics. For example, the use of 3d digital media enables the designer to explore phenomena such as sound and movement of a hand based on his own generative and responding dynamic systems. This enables a higher degree of complexity in the form-giving process of an artifact.



Finally, it is explored and discussed how the artifact designed with DIF can contribute to interplay with the ceramic material. These experiments explore the RPproduced artifact executed in a specially developed ceramic material. This allows a physical transformation and change of the artifact in the traditional kiln firing. And this, in turn, produces a dynamic interplay between the complexity in the digital formgiving, and the complexity of the ceramic material of the artifact.

The thesis is written in Danish, but during the project period, four papers were published in English and presented at international peer-reviewed conferences. Each of these papers reflects different aspects and views, which are discussed in the thesis. Two of the papers are focusing on practical experiments in the research project, while the other two papers are focusing on the method, which is exemplified by the experiments.

## Summary of research through design activity

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## Underpinning research, context and summary of methodology

The method of research was inspired by the Ph.D. work of Dr. Katie Bunnell (2009), who proposed an open and emergent practice-based methodology for exploring the integration of digital technologies into her practice as a ceramic designer-maker. The method is explorative and experimental, which in this study means that the research questions and empirical series of experiments are produced and developed in the process of research. This approach can be seen as an instance of Schön's "reflection in action" (Schön, 1983). Furthermore, it is relevant to use the terms "practice-based design research" (Biggs, 2002) and "research through design" (Frayling, 1993), which

for the present purpose can be defined as an experimental design practice that is part of the design research and contributes empirical data. The method explores how design research that includes experimental design practice, can utilize the researcher's background as a practitioner, and make the practice central to the research.

A method of this kind was developed in the course of the present project and named the Method of Branching Experiment. It is characterized by an explorative approach based on the author's interplay with techniques and materials, and by relying on a cluster of parallel and interdependent experiments within a defined frame – rather than single experiments. The method has shown how parallel experiments can be seen as a dynamic system in which a number of unpredictable and surprising relationships emerge and are exemplary for what can be done and how within the context of the original research questions.

#### References produced by researcher from/during doctoral research

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