EMBRACING THE DIGITAL TO THE HANDMADE

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Abstract

This report accompanies my Master project in the fields of ceramic and glass, the CRAFT! MA program, Konstfack. In this project I fuse my industrial design toolbox and my current engagement in open-source 3D printing technology with my ceramic and glass craft practice. The first pair brings in notions of innovation and an active approach towards technological change, while the second carry ancient craft methods and knowledge. I develop and make 3D printers for clay and use them as an experimental ceramic work method. In this research based practice I use ceramics as the material for 3D printed glassblowing moulds. This act represents a link between ceramic and glass crafts, one that was known to the ancient Roman craftsmen.

A view on craft and digital innovation

Although the computer is in use for several decades now, in most crafts it is still used mainly as an assistive device and we seem not to look at it as a professional tool; as a craft tool. New methods of making are out there. We need to have two toolboxes now: Our traditional one and our new digital one. We can already CAD our concepts, control CNC machines and build 3D-printers customised to our growing new practice. We share our new knowledge on open-source platforms, teach each other through the web (and around the globe) how to apply digital techniques to our craft. We now have the opportunity to join hands with the movements of democratisation of contemporary manufacturing techniques and reinvent our practice, our tools and what new-craft could be.

Technical terms

CAD - Computer Aided Design
CNC - Computer Numeric Control
3D Printing - Additive Manufacturing Technology
RepRap - Self Replicating Manufacturing Machine
FFF - Fused Filament Fabrication
PLA - Polylactic Acid, biodegradable thermoplastic popular in 3D printing
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Introduction: Bridging digital technology with glassblowing moulds crafting methods

In the course of the project I bring together glass and ceramic crafts with open manufacturing technology practices into an experimental approach towards a craft practice. The process includes making of 3D printers for clay, developing a technique to 3D print ceramic moulds for glassblowing and blowing glass in various types of moulds. The digitally crafted object is a phase in a multi stage process rather than a final ceramic piece.

This paper complements the practice. I draw my knowledge from open-source platforms as well as from traditional sources and try to formulate a contemporary context with an evident connection to crafts innovative history. I turn to the postphenomenological view on technology and human relations and conclude with a possible vision on the future of digital craft.

I have been making moulds from and for varied materials throughout the years of my practice both as an industrial designer and a ceramic and glass craftsman, and in many ways moulds have become a platform for expression and an immediate tool. Moulds are a major tool for creating complex forms in various materials. They are a specific mindset in the process that hold the ability to bring form and context into the making, therefore it was inherent to choose moulds as a central theme. The project is about the potential of mould-blown glass objects to tell the story of their own making process, as well as to reflect on their origins in both the DNA of craft and contemporary contexts. Making a mould or a 3D printer are both actions of making tools and they share a central place in the concept of ‘crafting the tools’, a key element in this project. Craftsmen had invented the pottery wheel; they created the ceramic pot and melted and refined metals and glass; they produced metal pipes to blow the glass. This innovative tool-making approach is highly relevant to how I perceive the way we, craftsmen, can innovate and apply new technology to our craft.

As so, I bring to this project my other toolbox, that of a keen open-source technology maker. Inspired by Open Source and the RepRap communities, I am developing 3D printers for ceramic craft. These printers are made as branch of the RepRap approach, where a lot of the parts are 3D printed in PLA on an open-source FFF printer, making it relatively easy for anyone to self produce. I wish to illuminate the growing community of digital craft participators, the norms that apply to this new practice and its position as a sub-field of todays craft. I see open-source platforms for sharing knowledge as autodidactic passages towards contemporary ways of innovating technology.I believe that Both norms, sharing knowledge and democratised innovation of technology can contribute to the enhancement of the craft field in the 21st century. Craftsmen practice their knowledge as a layered process where material behaviours, methods and embodied skill fuse into one action of making. Craft as a methodology of materials and techniques innovation can contribute to open-source technology in a unique manner.

I introduce my practice to digital methods and open source knowledge and norms, yet at the same time maintain a link to the past. Looking at the history of craft (material, method and artistic) is a way to recognise profound craft knowledges, and how these knowledges accumulated into ordered techniques and material cultures. The term ‘bridging’ suggests the connection between the history of vessel making and contemporary craft participation which embraces digital possibilities. Bridging refers to techniques, forms, materials, cultural heritages and related ethics; mould making is the keystone in that bridging. The project consists of two methods of creating moulds for glassblowing. Some moulds are digitally crafted with the use of my 3D printers for clay, through a digital journey of CAD translations of historical vessels, interpretation, mould design, printing and firing processes. Other moulds are hand crafted in wood, using a chosen, limited set of tools in an attempt to amplify the craft action. It is an attempt to tell the story of the making of the mould itself, as if it was a sculpture reflected in the glass object.
Glass in this project is used as a recording material. I choose this distinctive matter for few qualities: Its fluidity - to fill the volumes of my moulds, and its adhesiveness - to collect parts and particles from the moulds onto the created forms surfaces. It is an attempt to evident the mould in the glass objects skin, almost as scars of the process, but that may also look like ancient objects that had just been excavated. It is a study of the recording qualities of different mould making methods by the blown glass. I find glassblowing to be a unique practice: Working with a hot liquid requires profound skills, where heat, liquidity, gravity, centrifugal force, tooling and time all become parts of the making.

In the study of ancient glass blowing techniques and tools, the researchers depend on the marks left from the production process. In my work the marks from the digital materialisation of the mould are recorded in the glass, representing a change in the DNA of a craft process.
Key questions

Seeking to create work that both draws knowledge from the history of vessel making and amplifies the recent growing connection between craft and contemporary technology, in what ways to bring together the digital to the handmade?

Can a community of digital crafters sprout within the established craft field?

Can these currents of innovation lead to a greater involvement of craft within society?

An illustration of the project’s tools
Background and research: The past and the future of practicing craft

“... crafts bridging the gap between the past and the future. Crafts can simultaneously be a source of inspiration as well as an incubator for innovation.”

Engaging in the practice of ceramic and glass, the craftsman applies ancient contained knowledge into his work. This experience leads to the recognition that the craft practice is an ongoing continuum of embodied skills and material know-hows. Visiting the historic wing of the Corning Museum of Glass guided by William Gudenrath - a glassblowing master of Venetian and ancient techniques and a history scholar, in August 2016, deepened my awareness to the evident origins of today’s practice. Although ancient tools of glassblowing were not found (presumably because the metal of those tools was recycled), looking at ancient glassware, following the researchers I am able to realise how they were crafted and which tools shaped them. I have been looking deeply into craft-making and craft history throughout the years of my practice. I am moved by the skills of craftsmen and the methods of crafts. I find a continuing relevance in the forms and expressions of ancient pottery and glass vessels. Over the years I have been collecting books and images of chosen ceramic and glass vessels for the purpose of teaching design and craft methods. I now deepen this research in an attempt to find guiding similarities between my contemporary examinations and those capsules of knowledge in the form of ancient vessels. I recognise the precision of form that combine skill, material structure, functionality, and fine artistic balance that lays in the root of our craftsmanship.

The ceramic and glass material culture is tightly attached to the theme of vessels. The vessel has been an ambassador of human civilisation from ancient times on to the modern era. Vessels had travelled throughout the world transferring cultural heritage from one civilisation to another, conveying technology of making and materials, and spreading artistic styles and contents. They are one of human culture’s main elements of trade and contain the remains of past and existing civilisations. They are key objects in archeological researches and play a part in the dating of archeological discoveries: They hold the human timeline in their volumes.

I conduct two branches of research as part of the project. My digital journey is engaged in our contemporary reality of open-source technological advancements which I rely on for building 3D printers for clay, to be used for the printing of moulds. A second focus is a historical study of ancient ceramic and glass vessels, the story of mould blown glass from the 1st century A.D of the Roman empire and on the Roman Amphora with its Canaanite and Greek origins - over a thousand years of formation of these spectacular storage and trade jugs.

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The Roman mould blown glass

A remarkable research and revival of the techniques and moulds were conducted by the Metropolitan Museum of Art and the Corning Museum of Glass, later exhibited in Corning under the exhibition title Ennion and his legacy. This research resulted in the creation of copies of Ennion’s vessels through the revival of his workshop, tools and moulds.

The Roman mould blown glass is a rare example of the highly advanced glass practice of those times. Craftsmen developed glassblowing moulds and used very similar procedures as we do today. The moulds were probably made in Terracotta and had multiple parts. The vessels were added handles and finished in complementary techniques that all highlight the impressive innovative approach of developing the then young glassblowing field towards a comprehensive mastership. Ennion was the craftsman or the manufacturer of glassware who’s work represents the highest standard, in comparison to other mould blowing makers that were discovered. He carved his trademark in a ‘Tabula Anasta’ (tablet with handles in Latin), along with various motives of decorations telling stories from the Greek mythology. It is presumed that Ennion’s workshop was located in Sidon (nowadays Lebanon) but his vessels were found in far corners of the Roman Empire, manifesting the vast trade system of those days.2

i1. Ennion, Cup, 1-50 AD
i2. Ennion, Ewer, 1-50 AD
i3. Unknown, Two-handled Amphora

The Roman amphorae

In 1899, archeologist Heinrich Dressel published a pioneering documentation on the diversity of the Roman amphorae. Studying findings from excavations in Castro Pretorio, Rome, he assembled a synoptic table of 45 distinct forms of amphorae. Since then the research of the forms, origins, content and trade is constantly introducing a bewildering variety of amphorae. The origins of the amphora as a container for the trade of agricultural produce is found in the Lebanese Mediterranean shore and is dated back to the 15th century B.C. In the first Millennium B.C the amphora was widely adopted by the Phoenician and Greek trading systems. The early Roman amphorae seem to have evolved from the Hellenistic forms, around the 3rd century B.C. Those were developed further to various forms and sizes during centuries of usage as the main maritime trade vessel of the ancient world. The forms’ characteristics are thought to derive from their functions, mostly apparent in their notable spikes; enabling to stack the amphorae in ships as well as serving as a handle for pouring the content.

The vast distribution of Roman amphorae, to all corners of the empire, military camps on the borders and beyond, indicates qualities of mass production and sophisticated trading system; the amphora was, undoubtedly, the most common trade packaging of the era. An impressive example of their extensive consumption can be found in Monte Testaccio, Rome, an amphorae artificial hill which served as a dumping site for olive-oil amphorae (mainly Dressel 20 and 23).³


The amphorae and the Roman mould blown glassware are impressive examples of supreme craftsmanship, embodied skills and an inherent material culture and knowledge that lay in the roots of todays craft techniques. The migration of knowledge through trade of vessels and goods demonstrates the idea that knowledge is borderless; this is a key motivation in open-source ethics.

I choose to quote and interpret Roman Amphorae from Dressel’s synoptic chart, hoping to refer to the innovative and culturally engaged spirit that those craftsmen held, thus superimposing the historical image with contemporary digital technology.
Theory and context: The digital revolution as a crossroad of change for the innovative craftsman towards the implementation of digital fabrication methods and tools

This project embraces contemporary methods of making that derive from the digital revolution. That is the title often given to the massive change in which new digital technologies alters the way knowledge is being generated and objects are being materialised in all fields from science to technology, from product manufacturing to arts and crafts. Concepts such as knowledge, information and data are widely discussed in both practical and theoretical contexts, as described in the recent work by Andreas Nobel:

_The digital revolution has really turned things upside down in the realms of knowledge and information. We can no longer be sure of everything except, perhaps, that the way in which digital technology deals with information and knowledge has radically changed and will, in the future, fundamentally change our view of knowledge and how we use, store and evaluate it._

During the 1980’s and 1990’s new digital possibilities of production became accessible to makers due to the digital revolution of CAD. This enabled the outsourcing of a design to advanced industrial methods directly from the maker’s computer. The emerging 3D printing technology represents another step towards a new practice, in parts alternative to the established industry. The innovative fields of digital technologies are divided to two genres - the established centred power structures on one hand, and the Open Source and Maker sub-cultures and movements on the other. While the established industry embraces the digital developments as intellectual property, the Open Source and Maker Movements are developing technologies through the use of a new set of ethics: Openness and sharing of knowledge and code, no copyright on developments, free publishing of innovation and even open hardware, all are accessible to personalising and hacking by independent developers. Richard Stallman, an American free software activist, states that “‘Free software’ is a matter of liberty, not price. To understand the concept, you should think of ‘free’ as in ‘free speech’, not as in ‘free beer’.” The vision as I see it, is to allow the democratisation of knowledge and of technological means in order to enable programmers, engineers, designers, artists, craftsmen and makers to have a fair share in the world’s technological innovation, production and trade which is nowadays dominated by multi power economical structures. This possibility of change is well elaborated by Claire Warnier and Dries Verbruggen from Studio Unfold, highlighting the connection between toolmaking, free knowledge and production alternatives:

_From knife to hammer to 3D printer, the influence of tools on a design is not to be underestimated. Yet for a long time the instruments of production were closed systems. This is now changing. Following the personal computer and a range of digital advances, the advent of the personal fabricator has provoked a revival of the idea of “making your own things.” There is a new species of design, semi-industrial craft, and although the definition of craft often refers to work by hand, in this context it reflects a renewed interest in building knowledge through repetition and practice of a skilled trade using the aid of tools._

In recent years a significant change is taking place as makers, artists and craftsmen begin to embrace digital technologies to their work, particularly 3D printing. As manufacturing machines can produce copies, the qualities of handmade and the norm of uniqueness blur, to the extent that some would argue if this kind of work is beyond the definition of craft. The question whether digital fabrication technology can be regarded as craft often rises; nevertheless the community of digital crafters is constantly growing. In my view, the attempt to define such borders to the field of craft is not relevant to todays currents of change and contradict the notions of open embracement of technological innovation for and within craft.

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Some craft artists use 3D printing in plastic to create models to be casted in metal, ceramic or glass. To highlight some active craftsmen and artists to contextualise my work, I wish to refer to Daniel Clayman, who’s work is a pioneering example of engaging 3D printing for the creation of spectacular casted glass sculptures. Other craft artists started to 3D print clay on open-source printers that they developed themselves. Among them studio Unfold, the first to print clay on an open-source printer in 2009 and who make printed ceramics and blown glass hybrids; Jonathan Keep creates his printers in a DIY approach which anyone can embrace; and Olivier Van Herpt, the large vessels he generates suggest a new ceramic aesthetics.

My own work broadens the practice of 3D printing clay to a process where 3D printed ceramic shells are designed as glassblowing moulds. Keeping in mind the revival of Ennion’s Terra-Cotta glassblowing moulds, I set on a process of developing 3D printed ceramic mould for glassblowing. The moulds are printed with the use of dramatically large nozzles that crate surfaces with strong evidence of the 3D printing action. I hope that I have attained an outcome in which the digital process of planning and materialising is manifested in the final glass objects.

i7. Studio Unfold’s Original printer, 2009
i8. Studio Unfold, Form Language Experiments, 2009
i10. Olivier Van Herpt’s 3D printer
i11. Olivier Van Herpt, Adaptive Manufacturing, 2014 and ongoing
i12. Daniel Clayman, Circular Object One, 2003
Postphenomenology and craft

In order to understand the significance of skill and material knowledge to the perception and critical development of the work, I turn to the phenomenological view of embodiment. The notion that ones craft knowledge derives profoundly from the experience of analysing material behaviour and from the body memory of skill, leads to the recognition of the importance of embodiment to the production of craft knowledge, as well as personal language. That embodied knowledge is important in fields that rely on the body and tools for centuries. It may be that the awareness to the act of embodiment originally arose in the ancient crafts. Andreas Nobel addresses that idea in his book:

In professions that use tools and physically cultivate materials an awareness of the significance of the body and the senses to acquiring knowledge has probably always existed. It is reasonable to suppose that it is from these craft professions that the phenomenological impulse first arose. To make the experience of the body importance to knowledge an aspect that can be traced to one or more text sources is to reject both phenomenology and its sources. Phenomenology cannot have arisen out of itself. The phenomenological theory of knowledge comes from the phenomenon, and not from phenomenology. If one fails to register these pretextual practical physical sources one risks ending up in a paradoxical situation which, contrary to one’s actual aims, often signals a low valuation of the body, the senses and those professions in which one makes full use of the body in producing knowledge.7

The Postphenomenology approach was introduced by Don Ihde in the early 1980’s as a fusion between central-European phenomenological approaches (mainly Heidegger’s) and aspects of American pragmatism. Among other ideas, it contains also his variational theory of multi-stable perception and the human-technology relationships theory. It is a rationalist doctrine, proposing that technology, us and the world are taking shape through four distinctive relations: embodiment, hermeneutic, alterity, and background. In one of his late books, Postphenomenology and Technoscience (2009), Ihde beautifully explains the major aspects of the postphenomenological philosophy. I bring here the concepts of ‘embodiment’ and ‘technoscience’ to later try and suggest that, like science, craft is depended on tools and technology for the creation of knowledge.

The term ‘embodiment’ that was introduced by Husserl, later extended by Merleau Ponty, is developed by Ihde to a significant context as the first relationship in the postphenomenological I-technology-world relationships. This is a relationship where one becomes unified with technology during a mutual action. The technology extends one’s abilities and perception, like using an axe, driving a car or observing the stars through a telescope.

Postphenomenology is active in its observation and analysis and so is the act of embodiment, where body-technology practice, alongside reading the data, are becoming knowledge when embodied. By examples Ihde investigates, from the ancient stone-age axe to antique archery, from Galileo’s telescope to postmodern computer assisted imaging, it is clear that the act of embodiment enables the formation of knowledge to both create the technology and to evolve the skill of mastering it. In the conclusion of the antique archery comparison, Ihde writes:

7. Nobel, Andreas, Shady Enlightenment, Konstfack Collection, Stockholm 2016, p. 39
...I am not claiming here to have exhausted the variations, but these three are enough to show that the phenomenological variations that now include considerations of the materiality of the technologies, the bodily techniques of use, and the cultural context of the practice are all taken into account and demonstrate again the importance of variational theory with its outcome in multistability, the role of embodiment, now in trained practice, and the appearance of differently structured life world relative to historical cultures and environments.\textsuperscript{8}

According to Ihde, science is based and dependant on technology, on revolutionary innovation of technology, therefore technology preceded science. Galileo’s telescope is a well known example from the early days of modern science. Technology, when embodied, serves as an extension of the scientist’s senses and capabilities. Astronomers today are using imaging-technology and can “see” a multi layered image fused from various technologies of imaging; from radio waves to a broad light spectrum on to gamma rays. The data is transformed and composed to a visible image by computers and so the scientists can create the knowledge by active embodiment. Ihde named this dependence of scientific evolution on technological revolutions ‘Technoscience’.

Now allow me to reverse the narrative. Instead of looking forward from antiquity to the present, what if we look backward from the present to antiquity? Looking backward, retrospectively, what I draw from this history is that what I have described as “revolutions” are revolutions precisely related to technologies, instruments. In astronomy, these may be thought of as instrumental embodiments. Human perception is transformed in each new technological development... In the end, that is why I now call the phenomenon that includes postmodern discovery technoscience.\textsuperscript{9}

Following Ihde, I wish to suggest that craft - as a sphere of human creation and innovation - is also dependant on technology and tools innovation. In its pure form, craft is an embodied practice of material-technological processes, and therefore, just like science, it is a part of human culture that leans on technology to develop. At the same time, pre-modern craft (similarly to modern science) participated as a core innovation pot for those tools, materials and techniques that we call technology. I wish to draw from Ihde’s term and name the possible evolution of crafts ‘Technocraft’.

\textsuperscript{8} Ihde, Don, \textit{Postphenomenology and Technoscience}, State University of New York Press, 2009, p. 18-19
\textsuperscript{9} Ibid, p. 61
Methods

Through the course of the project I view my own processes as study-cases of combining digital technology with a craft practice. A layered logic structures the work, layers of both time and content that together construct the research body as a whole. In addition, layered structures echo from the logic of 3D printing and from the revealing of an archeological dig. What fuses those layers, for me, is the notion of ‘crafting the tools’, which all enable the blowing of a glass bubble in a mould.

Project layers:
1. **Hand sculpting moulds as a way to explore recordable crafted qualities by the glass**

I have been sculpting wooden moulds with the use of a chosen, limited set of tools to emphasise the craft action. As I limit the carving tools to just a chainsaw or one chisel and hammer, I can only work the wood to the extend of the tools’ resolution, thus the outcome expresses the craft action.

2. **An autodidactic journey into open-source, building 3D printers**

An additional layer is extending my work on 3D printers, designing and constructing 3D printers for clay and glass. Developing my own 3D printers for ceramics to use in the project, and continuing the development of a boron-silica glass printer. It is an attempt to expand my craft practice towards innovation and take part in the sub-field of digital craft.
3. 3D ceramic moulds

The 3D printing of moulds for glassblowing in clay enables me to introduce technological innovation to the work, as well as historical and contemporary contexts. I am implementing various digital technologies such as CAD planning and 3D scanning along with the process of 3D printing. As 3D printed surfaces bear the marks of digital coiling (which I keep unpolished), the moulds carry an expressive evidence of their making process. The formative subjects are Roman amphorae and my interpretations of them; the outcomes are hybrid objects that hope to capture the past with the contemporary.
4. Glassblowing - investigating glass as a recording material of forms and textures and its potential to tell the story of the process

The process consists of transformations between several steps of materialisation while glass is dedicated to the final object and is left as a reflection of the process. I choose to dedicate the blown glass to the final objects of this multi stage process initially because it is the practice and material that fascinates me the most and my recent embodied craft skill. The exceptional qualities of glass, its fluidity, adhesiveness and transparency support the idea of capturing the making process.
5. Historical Research

A historical research on one of glass and ceramic’s most innovative and engaged points in the history of the Roman world guides me as a source of knowledge and inspiration. Having collected images and books of historical and ancient vessels over the years, I now deepen the research and use it as a data source of form, material structure, making processes, vessels uses and artistic styles. I regard to craft history as a formalistic reference, where I quote from, re-design and mix new stories and volumes, and also as a methodological source of the wisdoms of craftsmanship.

As part of the research, a proposal for a performance event in Marabou Parken turned into a personal lab of 3D printing historical iconic vessels.

6. Theory building

The theoretical layer of the project formulates the motivations for the material processes and structures the connection between embodied skill and knowledge of making; open source knowledge and norms; and the new sub-field of digital craft with its visionary innovation.

7. Web platform documentation

In the sharing consciousness of the open-source movement, the project is being documented on an open platform, where printers parts (stl. files and plans), data, CADs, historical research and process documentation are freely shared on www.technocraft.xyz
Conclusion

This work deals with linking the fields of established glass and ceramic crafts with new open-source technology and norms of sharing knowledge. The new ways of working in ceramics and glass that derive from the ability of 3D printing clay (and a variety of other materials) have the potential to broaden the methods of the practice.

The work hopes to tell a story about the process of making itself, its contemporary and historical contexts and knowledge sources and the change that the digital component has in my own craft practice. To do so, the moulds are displayed along much of the experimental blown glass objects. These are presented to resemble an archeological research into my own pursuit. Those glass objects also represent a journey to the embodiment of skill and serve as reflections of the mould’s negative void form. Some of these glass objects suffer from unskilled work problems like deformed handles and rims. Questions arose regarding the place of such glass work in the context of skilled craft, yet I feel that it tells a relevant story about the journey of the embodiment of high craft skills, the potentials of 3D printing to change mould making and glassblowing practices, as well as the ability of digital tools to bring in new contexts and forms into traditional glassblowing. From the large number of experimental glass objects I elevate few that are exhibited as finished pieces.

After practicing and exhibiting my work in various countries, it seems to me that craft orbits as a ‘satellite’ the fine art realm or the design scene. This regards to the platforms of exhibiting the work. International craft fairs (such as ‘Collect’ in London) and influential centres for the teaching of crafts (e.g. The Studio at the Corning Museum of Glass) influence the craft communities by setting a high level of craftsmanship, conceptual and critical approach and broadening learning possibilities of skill. Yet I feel that craft - as a platform for innovation and high engagement with society - had more glory days. There is no question about the boundaries of craft; in my view, craft is, in it’s essence, the persistent embodiment and sharing of skill and knowledge of making. Craft was, and still is, a unique ground for material and technology innovation. Todays open-source and maker communities are ever more open to craftsmen, artists, designers and other kinds of new defined makers, all are involved with open technology innovation. New practices are engaged in developing tools and techniques as new work environments for the creation of objects. Embracing open sharing values can alter the way craftsmen participate and share their work and knowledge. An emerging subculture of 3D crafters is already active in the field of ceramics and glass and our work represents the potentials of applying digital techniques and tools to the craft field; with this project that knowledge hopefully grows further.
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i5. *Monte Testaccio, the Amphorae Artificial Hill in Rome*. Image from [https://www.archaeological.org](https://www.archaeological.org)
i6. Heinrich Dressel, *Synoptic Table*, 1899. Image from [http://archaeologydataservice.ac.uk](http://archaeologydataservice.ac.uk)
i10. Olivier Van Herpt, *Ceramic 3D Printer*. Image by Olivier Van Herpt, taken from [http://oliviervanherpt.com](http://oliviervanherpt.com)
Appendix

This extension of the projects paper contains a reflection of the graduate exhibition, a conclusion on the topics of colorless glass, a summery of the 3D printed mould making method that I developed throughout the project and future intentions for this body of work and my own practice.

Spring Exhibition

I chose to design the exhibition through two main concepts as a double purpose space. The first is my view of the work as a last workshop or a “sorting-out lab” in this multi-stage process, where the act of observation on the finds from the dig in my own process takes place. This is a hindsight observance of the process as an outcome, that enables the needed inquiry for further realization of the work. The floor piece ‘Embodying Amphora’ and the ‘Moulds Facade’ reflect each others existence and role. On the immediate view the glass Amphorae were blown in the moulds and their forms are a result of the moulds constrains, which is the tool of fabrication. In a different angle of observation, it is the blowing process of numerous Amphorae in moulds, during the process of developing the method for 3D printed glassblowing moulds, that brought the ‘Moulds Facade’ to existence; a coherent new method of making. The second concept of the exhibition design is an invitation for a tour in my practice. The “lab” was cleared out of any unnecessary elements, to allow quiet observation. The connections between the different elements become evident as the space transforms into a white-cube, floating the notion of bridges between ceramic and glass, open digital technology and craft, innovation as a bridge between the past and the contemporary. I believe that an intimate encounter with this body of work can influence craftsmen and related audience to embrace innovation into their practice.

‘Embodying Amphora’ is an installation that holds the different layers of the project. They are revealed as the process of sorting-out the narrative within the pile of vessels occurs: The story of the process, innovation in craft, the journey to embodiment and the sharing of the knowledge. It spreads along as a timeline and a path that leads into the space.

‘Moulds Facade’ is a unification of 19 moulds from my process, all positioned open to reveal their inner volumes. The installation brings in the methods in use and the notions of innovation, that 3D printing as a craft method suggests, as well as historical contexts of innovation which derive from the ancient Roman Amphorae forms, highlighting an era of tremendous innovation in crafts.
6 chosen pieces allow a detailed view on some of the forms, textures, volumes, and stories that I quoted, recomposed and sculpted. In an intimate space behind the ‘Moulds Facade’ a 1:2 scale Roman wine Amphora (Dressel 1) suspended in the air, is the largest quote I revived from Dressel’s synoptic chart. It shares my pursuit after the embodiment of that ancient craft knowledge. Altho the Amphora was a common form for glass vessels, most of it’s appearance is as Earthen-ware enormous jugs. Dressel’s chart encompass some of those ancient ceramic vessels. The realization of those Amphorae in glass, through the use of Earthen-ware made moulds, emphasizes this ever old connection between the fields of ceramics and glass.

The group of three Amphorae interpretations tell my own stories and reflections on this act of connecting the timeline of craft from antiquity to contemporary. Their morphology is a bridge between the possibilities of CAD and ancient forms.

The last pair are clear and black vessels from a hand sculpted mould that explore the notions of light explosion and three-dimensional shadow as a recording method in glass. The world of glass art is one of extensive use of colors in a verity of old and newer techniques, yet I have been blowing, in this project, only clear and black glass. This method is derived from the attempt to use the glass as the recording material of the process. Clear is the basic appearance of glass, when not added extra pigments. When clear, glass is transparent and light penetrates the surface to reveal the mass of the glass as well as the inner volume. A textured surface of the glass causes the light beams to “explode” to countless directions. In that clear state the blown objects record the forms and textures of the moulds as a celebration of flickering light.
Black however is the absence of reflective light. The light beams are trapped in the glass and can not reflect back or illuminate the inner mass. The outcome object is a “3-dimensional shadow” of the clear one, where a focused reading of the form and texture takes place. Together they emphasize the nature of glass as a frozen crafted moment that holds the memory of the process.

During the Spring Exhibition I received few comments regarding future exhibiting ideas. Some mentioned that my display and the story of making is evident and intriguing, and that an exhibition in a gallery would be a natural next step for this body of work. As it is my own wish to see this project displayed elsewhere, beyond the next exhibition in ‘The Glass Factory’ in Boda, Sweden, I hope to find a future context for exhibiting the work.
Future intentions

In this project I had the opportunity to bring together and further develop few parallel paths of my practice. This regards to the glass and ceramic crafts and the engagement in 3D printers for craft, as well as the development of a new way to 3D print glassblowing moulds in clay, a journey to digital open fabrication techniques. I feel this dramatic progress in my craft practice is a beginning of several routes of work, as I return to the studio:
- Making 3D printers for clay and pushing forward the new Digital-Craft sub field.
- Continuing the work on 3D printed ceramic glassblowing moulds as a method to create volumes that contain different contexts and enable a new engagement with production and society.
- A route of reviving the complete Dressel’s chart as 3D printed ceramic Amphorae, a performance in the spirit of the suggested ‘Minitime-Maxitime’ project. (pics. page 17)

Thanks

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