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Renovating Traditional Craft **Exploring the Potential of Craft as Part of Research**

Abstract

This review article evaluates theories and on the entanglement of matter and meaning, elaborating and exploring the potential outcomes of craft in research processes. Exemplified through a collaborative exploration between me as a silversmith and programmers at the Mechatronic Innovation Lab (MIL) in Grimstad, Norway, I explore, through these theories, how renovation work served as a diffraction apparatus in exploring the relation between traditional craft and emerging mechatronic technologies in light of the concept of sustainability. Renovation work is, in this setting, understood as cutting, filing, grinding and polishing, often the final but nevertheless essential step in a production process. This type of surface work accentuates here how it is possible to not only see traditional crafts as carriers of intangible value linked to identity but also as a type of knowledge powerful of providing insights into the entanglement of matter and meaning. Through uniting different knowledge systems, like the subjective knowledge in the situated understanding of material, tools, setting and processes, and more objective knowledge, typically for observation, readings and purely cognitive activities, renovation work exposed, in this case, some of the limitations of automation and provided unexpected findings on the relationship between body and machine.

Keywords : Agential realism, situated knowledge, craft theory, mechatronic technology, traditional craft, silversmith.

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Introduction and research question

Several theoretical perspectives elaborate on the reciprocal relationship between cognitive and tacit understanding, materiality, space and social conditions. In this review, I assemble and elaborate on a selection of such post-modern perspectives connected to the concept of sustainability. Few of these perspectives use the term sustainability, though. Still, they share a concern for the contemporary global geopolitical problems. Throughout the Anthropocene, discussions have shifted away from human-centred and, some would say, even Western-centred perspectives. From this viewpoint, human relations, concepts and theories have never been isolated from the material world, and thus objectifying humans, land, animals or materials is fundamentally problematic.

To illustrate and reflect on the relationship between matter and meaning in light of the concept of sustainability, I relate this perspective to a seven-month collaborative exploration that took place in 2021–2022 between myself as a silversmith and the Mechatronics Innovation Lab (MIL) in Grimstad, Norway. *Mechatronics* is a field that combines mechanical machinery, electronics and computer engineering. In this case, we explored the potential of using third-arm robotics, virtual reality (VR) scanning, modelling and three-dimensional (3D) printing with precious materials, like silver or gold. Given the economic challenging conditions crafters now face (Abbing 2002; Mangset et al. 2018), we explored the potential of this technology in relation to the craft as part of the present consumption and production system. Through the practice of renovation work, understood here as the final step of surface work on the production line, the outcome and results of this comprehensive exploration were at first somewhat disappointing. The technology we tested appeared purely hypothetical due both to its cost and availability. Still, the challenge in essence a question of scale and resources. The most surprising result was how difficult it was to make the robot arm do satisfying renovation work and the amount of afterwork the print needed. The renovation work accentuated in this instance more limitations than possibilities when using and implementing this advanced technology. Due to growing awareness of social and environmental problems, stricter regulations, and generally tighter access to resources, I found it relevant to question the paradigm that solving economic challenges necessarily has to do merely developing and implementing new technologies.

A more detailed description of the research and its outcome will be presented in a separate article. So far, I have only an unpublished report provided by MIL and my own fieldnotes from the project, which I refer to here. In this case, I will elaborate on some of the theories that helped shape the project. Since this project dealt with technology and the production of knowledge, theories on the entanglement of matter and meaning became relevant because they enabled me to view renovation work as a potent component of not just gath-

ering data but also analysing and understanding the data in relation to the field of traditional silversmithing, and its relation to the system of consumption and production. – A system that are in the midst of fundamental change because of the growing focus on sustainable development.

Renovation work

Renovation work as a part of silversmithing practice is a term often used to describe the final phase of surface work, where the goal is usually to remove traces of a construction process. It can involve cutting cast tubes, grinding and polishing the surface, and so forth. Several technological inventions help make this process effective, but this type of technology only fits certain aspects of renovation work, though. Time-consuming, hands-on operations are often still required (Bratland 2023). The process objectively appears simple, and I have interpreted it as alternately an easy, tedious and almost insignificant activity and would be happy to let a machine do the work for me. The artist Barry X Bal's work, labelled an iconic example of what advanced new technology makes possible, illustrates the apparently insignificant but still vital role of this type of work. His bust, 'Envy', is an example of what 3D scanning, VR modification and 3D printing make possible. Still, the work required 2 000 hours of hand grinding to complete after the advanced technological creation phase (Bratland 2023; Johnston 2015).

From an etymological standpoint, renovating means making new again or restoring to a good condition (Etymonline 2021). The use of renovation work in the case described above and my experience with how this apparently insignificant part of the practice became a significant part of the research project ultimately changed how I approach and execute this type of work. My awareness of the activity was conceptually changed, or renovated, in the more etymological sense of the word. In this sense, renovation work became both a pragmatic and conceptual red thread in this research case.

The merging of theoretical perspectives and practice is grounded in my experience of working as a silversmith for more than twenty years. The general approach to understanding and using the different theoretical perspectives therefore necessarily had a subjective side to it. I found it impossible to overcome the fact that my personal engagement with and experience as a practitioner and my network in the field influenced my take on this case. Considering this situated perspective as fruitful and not an obstacle became crucial. I therefore searched for a way to unite the knowledge system of the craft with the more objective and systematic knowledge system typically pertaining to doing research in a conscious manner. The effort has been guided by the following questions:

How is it possible to unite theoretical perspectives on the entanglement of matter and meaning and the practice of traditional silversmithing in research?

What are the implications of involving the craft for understanding the relationship between traditional craft and emerging mechatronic technology?

The effort at unifying the different knowledge systems and theoretical perspectives will be the main focus of this article. However, first I will elaborate on how traditional craft, emerging mechatronic technologies and the concept of sustainability are understood in this setting.

Craft and technology

Scholars have recently expanded on the term craft to mold it into a more inclusive term, understanding as more than just the trade-oriented systemisation of special competence bound by strict law and regulations on how, where and by whom it is performed (Gamble 2001). Richard Sennet (2008) uses the term in his influential book *The Craftsman* as a way of explaining how it is possible to invoke reflective-making and creating principles for everything ranging from music and software development to art, handicrafts and more established activities associated with the term. To specify what I mean by craft in this setting, I add the word 'traditional' to help narrow the scope to just the type of craft that the United Nations Educational, Scientific, and Cultural Organization (UNESCO) specifically classifies as old and endangered practices, like woodcarving, blacksmithing, shoemaking tailoring, and so forth (UNESCO — Traditional Craftsmanship 2023). Due to my experience as a silversmith, which they also classify as one of the endangered crafts, I relate specifically to this field. However, it is possible to make associations between the theories addressed here and other types of crafts.

The relationship between art and craft is closely connected, with the meanings of the words often overlapping and used interchangeably. Several examples can be cited of how art, with an emphasis on creativity and originality and as a way of expressing and presenting meaning, plays a role in academic research (Loveless 2019; Lund 2021; Stewart 2010; Withagen & van der Kamp 2018; Ørbæk 2021). The concept of research creation especially accentuates this approach to science and emphasises the potential of letting research and art work in tandem (Candy & Edmonds 2018; Chapman & Sawchuk 2012; Loveless 2019). Still, despite the effort to expand scholarly understandings of practice, the systematic literature review 'Please stay, don't leave!' (Wahed et al. 2021) reveals how strong the focus on safeguarding intangible cultural heritage, including traditional crafts, remains. Although information technologies are considered a resource for 'educating' the perceiver and conveying and safeguarding the aesthetics of traditional crafts, proponents often view mechatronic technologies as a threat to traditional crafts (Wahed et al. 2021, 1731). UNESCO and official understandings of what is meant by traditional

crafts encourage practitioners to safeguard their activities because such activities help preserve intangible aspects linked to identity (UNESCO — Traditional Craftsmanship 2023). Since the official definition of traditional craftsmanship focuses on preserving and safeguarding, associations with a de-activated objectification of craftsmanship, where the focus is *on practice* rather than *in practice*, and suggestions that this type of activity is passive and defined by others are at the heart of such understandings.

As a silversmith, I feel that many of us operate in a landscape existing between art, design and production, with as many variations in how the craft is executed as there are silversmiths. Still, throughout my years of practice, I have encountered how differently the activities are considered depending on the setting. I often emphasise work where I develop independent designs and focus on individual concepts and ideas rather than create something that is more or less standardised, like traditional brooches for folk costumes, standard wedding rings or making what someone else has designed. Like renovation work, the part of our craft where I have to set my own agenda aside and submit to something or someone outside my self seems an insignificant part of our craft, even though in my experience it is often as challenging as working in more individualistic ways, not only technically but also in terms of reflections and communication. Whether I have considered some parts of my practice as not equally potent of generating insights touches on the question of whether intellectual knowledge always takes place before action (Blackman 2012; Kuijpers 2019; 2023) and how we rank body and mind in contemporary Western society. The case that I elaborate on in this article demonstrates how various perspectives on material agency and agential realism, with its focus on relationality between matter and meaning, enable a view of the crafting process not only as an object or a neutral tool for conveying concepts and ideas but as an intra-active subject in the generation of knowledge.

Sustainability

According to the United Nations, sustainable development goals (SDG) concern social, economic and environmental issues and actions taken in one area will affect outcomes in others (United Nations Development Programme 2023). This definition corresponds to what several scholars highlight as the risk of solving isolated problems when striving for sustainable development. Philip Kitcher, in his book *The Ethical Project* (2011), argues that objectivity and striving for the betterment of humanity often benefit individual nations or those in power at the expense of others, noting that we often, by isolating and solving one problem, create numerous of others. This complex dilemma makes navigating the SDG a balancing act between often contradictory elements,

and successfully managing them can appear impossible. Several scholars concerned with perspectives on sustainability in art, design and craft, encourage us to focus on the interrelationship between nature and the environment as a means of managing this balancing act (Clarke 2013; Kjetil Fallan 2019; Papanek 1985; Joey Graceffa Vlogs 2012).

Throughout the Anthropocene, which illuminates the totality of human impact on geologies and the ecosystem as a whole, it is easy to consider humans, the *Anthropos*, as the cause of all the problems we face today. Donna Haraway, though, introduces a sense of hope to this understanding by suggesting the use of terms like *Chapitalocene* and *Plantationocene* to point to the fact that humans as a species have not caused all the world's problems. Although we are all part of the Anthropocene, we are not all experiencing it or engaging with it in the same way. Several examples exist of humans living in more dynamic relationships with their surroundings. It is rather the systems of capitalism and objectification of humans, land and materials as merely resources for human prosperity that cause the problem (Haraway 2016, 30–57, 99–103).

This ontological baseline for the relationship between the human and more-than-human world affects our approach to research and what researchers consider fruitful perspectives on knowledge and knowledge production when employing the concept of sustainability. Theories questioning various perspectives on knowledge, the distinction between object and subject as well as the distinction between culture and nature become a part of the logic of sustainability because of the need for fundamental change, namely change in how we do research, and an awareness of the potential for making valuable contributions in other systems of understanding and ways of relating to materials and the environment (Finstad & Skjølvold 2015; Grant Glass 2020; Haraway 2019; Hofstad & Delsett 2020; Krukhaug 2007; Lutnæs & Fallingen 2017; Sencindiver 2019; Stakemeier & Witzgall 2018; Sundby 2017; Ingold 2015; Smith 2012).

Theoretical building blocks

The perspective on relationships lends itself to an interdisciplinary approach that considers the practical knowledge of a craft, like silversmithing, as equal to knowledge of mechatronics, culture and even philosophy. Scholars like Tim Ingold and Bengt Molander point to how it is inevitable then to consider practical or embodied knowledge and theoretical knowledge not as the same but as equally valued knowledge (Ingold 2013; Molander 2015). As Ingold poetically notes, 'We must tip the hourglass on its side; knowledge does not necessarily run top-down' (Institute for Northern Culture 2013).

In this manner, I draw from scholars like Bruno Latour, Tim Ingold and, more specifically, Donna Haraway and Karen Barad, as they explicitly describe how art and craft carry a potential to close the gap between science and the material world. They suggest implementing other types of knowledge to empower a sensibility to the entanglement of matter and meaning in research (Barad 2007; Haraway 2016; Ingold 2013; 2015). Such perspectives accentuate how we are in a symbiotic relationship with the more-than-human world, with living, breathing organisms, minerals, elements and plants, whether in the form of robotics, software, wild wolves, domesticated dogs, refined silver sheets or a tree in the forest. Donna Haraway, from the field of biology and technoscience, has adopted the notion of ‘companion species’ in arguing for the value of tuning in to our relationship with ‘species’ of the more-than-human world in research and how they work in companionship with us (Haraway 1985; 2003; 2007). In relation to the project at MIL that I referee to here, I have therefore considered the tools, technologies, materials and settings as not just research objects but as companions in the project.

Situated knowledge

As a crafter, I find it easy to grasp arguments emphasising the potential of building craft knowledge into academic research. I have therefore tried to figure out a way to find and make use of the symbiotic relationship that Latour, Haraway, Ingold and other scholars talk about when screening and testing robotics and 3D technology in relation to traditional craftsmanship. The goal was to build on their holistic encouragement to shift perspectives on knowledge creation and not merely fall into the trap of solving isolated problems ‘inside the box’. Still, I have tried to keep Donna Haraway’s warning in mind. She calls attention to the risk of romanticising the ‘otherness’ of knowledge creation when conducting research based on such a perspective. She therefore encourages researchers to consider subjective knowledge in research because of the potential for unexpected openings and connections made possible by what she calls situated knowledge (Haraway 1988, 590). I find this warning highly relevant since it is crucial to remember that the research case I deal with here is not a study of traditional craft, like silversmithing, for its own sake. The focus is on change in the field of silversmithing in relation to complex systems involving technology, innovation and policy.

Donna Haraway describes how drawing insider–outsider boundaries as a means of understanding knowledge are really only theoretical power moves and not moves towards truth. She asks how we may find fruitful ways to integrate subjective knowledge based on bodily experienced understanding without entering the trap of focusing on the binaries of objectivity versus

subjectivity, outsider versus insider and so forth (Haraway 1988, 576–578). Bodily experience-based knowledge and its relation to space and materiality are what she describes as situated knowledge — a type of knowledge that is about communication and relations and not about isolated individuals. For Haraway, this type of knowledge does not stand in opposition to science. Still, situated knowledge requires picturing the object of knowledge as an actor and agent in the social relationship of conversation; consequently, it must also play an active part in research (Haraway 1988, 592–593). I have found Haraway’s use of the term situated knowledge relevant for this case because it works as a model for thinking about traditional craft and the entanglement of matter and meaning as well as the social and material aspects of the trade, in a project like the exploring, screening and testing mechatronic technologies. Since situated knowledge is subjective, Haraway describes how it is necessary then to find what she calls our own ‘semiotic technologies’ (Haraway 2019, 60). By ‘semiotic’, she means, from an etymological standpoint, the systems of signs and symbols that comprise both artificially constructed and pragmatic issues (Merriam-Webster 2022). With respect to the semiotic technology used in the analytical phase of the project at MIL, I have found Terje Planke’s use of the term theory in relation to craft useful.

Craft theory

Terje Planke writes about theory in relation to craft to describe the combination of thinking and making and the symbiotic relation between such activities in the craft itself (Planke 2001; Planke & Lorentzen 2022). I find his description of the knowledge *in* craft serves as a bridge between Haraway’s perspective on situated knowledge and the particular project of silversmithing and mechatronic technology. Planke has written extensively about how knowledge for a crafter exists and changes in close relation to, for instance, processes, materials, tools, the society of crafters, laws and regulations, customers and economic actors. He calls this entanglement of process, material and meaning “*the crafts theory*” (Planke 2001; Planke & Lorentzen 2022, 250–257). However, use of the term theory in this respect also blurs the distinction between empirics and theory. Planke draws from Michael Polanyi and Bertel Rolf, but also from independent writers like Jon Bojer Godal (Godal 2021; Godal et al. 2018), to develop and describe his perspective on the knowledge system used in craft by focusing on a community of boatbuilders in Norway (Planke 2001). Planke expands here on Michael Polanyi’s term tacit knowledge (Polanyi 1966). Tacit knowledge is, in the Scandinavian countries, often translated as ‘taus’, an unspoken knowledge connected to the tactile sensorial understanding of process and materials and *how we* know just as much about *what* we know. He

emphasises how Polanyi's term builds on an understanding of language as a tool and that our knowledge does not exist in the tool alone. The scope of our knowledge always exceeds what we express verbally or symbolically (Planke 2001; Polanyi 2000, 10). Still, in much the same way as Haraway describes situated knowledge, Planke also includes the craft's subjective social component. Together with the tactile side of knowledge, this perspective accommodates the connection of craft not just to materiality but also to location, tools, mentors, customers, colleagues and other relations that influence and shape understandings and execution of the practice.

Planke discusses the subjective social component of the craft by referring to how the boatbuilder must understand both the materials and the tools he uses to build the boat, but also the sea, the fisherman, who is the customer, as well as his tools, needs and desires, and the economy, not to mention the society of other boatbuilders and so forth. He also explains how this complex understanding of several aspects, *the crafts theory*, is communicated through a mix of stories and key statements spoken and conveyed in an interdependent relationship with process and materiality, as something that becomes situated in each individual and only fully understood when the actors have a type of shared understanding of the setting. Traditional craft, from this perspective, is about product, shape and functionality, but it is also about understanding context and relations (2001, 2, 307–312). Planke underscores this point by describing how boats, taken out of context, are often only judged by their aesthetics and visual beauty and how such an understanding of a boat is not only insufficient and deficient but outright dangerous and, in the worst case, even fatal. Like Haraway, he therefore encourages shifting focus from the safeguarding and conservation of processes as objects to the potential of incorporating analytical practice *in* the craft rather than *on* the craft (Planke & Lorentzen 2022, 249).

Though how we make and create jewellery is not as directly fatal if we do not understand context as that of a boat, our crafts' connections to the system of consumption and production are real. When the 'waves' of this system change fundamentally in light of the concept of sustainability (Pedersen & Jørgensen 2018) Planke's emphasis on understanding context becomes relevant. Planke's use of the term theory in this setting works as a semiotic technology that enables a consideration of the knowledge in the craft as an equally valued building block with which to build new knowledge. In combination with Haraway's erasing of the distinction between subjective and objective knowledge, it is also possible to build this type of knowledge into activities like reading, observation, reflection and writing, those aspects of research that I am conventionally more used to calling theoretical knowledge.

Agential Realism

Together with Planke's 'Craft theory', I find Karen Barad's notion of 'agential realism' a useful semiotic tool for seeing the potential of a craft like renovation work in particular. Barad elaborates on the relationship between human and more-than-human by introducing the term intra-action (Barad 2007). She hyphenates the word to both elaborate on Bruno Latour's Actor-Network Theory (ANT) (Barad 2003; Latour 2005) and describe what she means by actors as not just being preset separate entities interacting with one another but as participating in a constant dialectical remaking process in the void that exists between actors (Barad 2007). Barad talks in several of her publications about 'the void' being at the centre of the process and how it is never empty (Barad 2003, 2007). It is relevant to remember that Barad is a physicist, and so her understanding of the void is shaped by such a scientific perspective. The field of physics generally focuses on such building blocks of materiality as the atom and the void, where the void is the nothingness between components. She exemplifies the potential of the void as concept by referring to the splitting of the atom and how the void can also represent more than just nothingness. It creates room for numerous possibilities (Barad 2003, 806; European Graduate School Video Lectures 2018). Barad uses Donna Haraway's 'diffraction pattern' metaphor (Jamison & Haraway 1992, 300) to explain how scholars need to rethink 'the geometry and optics of relationality' (Barad 2003, 803). A diffraction pattern describes what happens when waves of light pass a corner, an opening or a slit, hindrances of a sort that she refers to as 'the apparatus', which changes the formation of the waves (see Abramowitz & Davidson 2022). In the metaphor, 'the apparatus' may just as easily be a philosophical idea as a material tool. Just as the atomic bomb would not exist without the theory on the splitting of the atom, neither would such a theory be conceivable without the physical possibilities of the atom. The material and meaning — the thinkable theoretical concept — 'intra- acts' and create the phenomenon. Relationality in this case may be the relationship between matter and matter. However, it may just as well be the relationship between matter and meaning, as concepts influence material processes just as material phenomena influence concepts.

In this manner, Barad's connection to Niels Bohr and quantum physics (Bohr 2005) blurs the line between mind and matter and renders her theories materially visible mechanisms as well as philosophical ideas in such a manner where matter becomes concept and concept becomes matter. Barad calls this process 'the entanglement of matter and meaning' (Barad 2003, 802). Her theories accentuate in this manner how a holistic perspective on culture and nature is both physical reality and abstract theory, and her use of the term 'ap-

paratus' makes it possible to think about renovation work, in my case, as both a physical and conceptual part of my research. Thinking of and working with renovation work in this way is what enables me to find new perspectives and relational outcomes rather than adhering to the binaries of traditional craft and technology, and it likewise enables me to find other findings that I would not have discovered if purely focusing on isolated processes and objective analysis.

Another voyage through matter and meaning

Karen Barad's theory of agential realism and her attention to 'the void', the space between actors, and the relation between the material and the thinkable (Barad 2003, 2007) creates an awareness of the relationship between technology craft and meaning. If what and how we think talk, or write about the notion of intra-act in relation with the craft, and the action itself, what we do in direct entanglement with the materials and the tools, informs how we think, write and talk, then neither of these activities is neutral. Knowledge is then not only based on theoretical, abstract intellectual activities, like observation, measuring, reading, thinking, analysing and writing, but also on physical engagement with the materials. Consequently, an awareness of *what* material is involved in such intra-actions and *how* it is implemented becomes relevant.

Based on this perspective, I found it possible to cut through the prejudices that thought always take place before action and that parts of the practice consist of mindless activities, like tools solely capable of canalising my predetermined concepts and ideas. I became open to the possibility that something exists in the processes, in the relationship between me, the tools and the raw materials, that is unfeasible through purely focusing on intellectual, conceptual work and objective studies. Letting go of the prejudices made me consider renovation work similar to the 'apparatus', which Karen Barad calls the opening that diffracts mind and matter in the research process. I therefore made room for this activity throughout the exploration of mechatronic technologies at MIL through the idea that it would contribute to the research outcome, even though I had not determined what role it would play on beforehand. However, finding this model for thinking with and through the materials in this research project grew out of being open to the unexpected, to use Haraway's term (Haraway 2016). I had to experience it to truly understand and become aware of such actions in an intra-action sense.

The insignificant becoming significant

Since many production processes in my practice have been automated, renovation work is an activity I spend much of my time doing in the workshop. To begin with I viewed the activity much like a 'walk in the park', as an easy distraction, when I needed a break from theoretical reflections, writing and

reading. As the project grew, however, it became clear that the hours of distraction did in fact influence the research process and my understanding of it in specific matters, and vice versa. The perspectives affected my consideration of the process that we were testing in the lab facilities at MIL. Perspectives on the entanglement of matter and meaning caused me to open myself to the possibility that activities I had considered less significant might have to do with the society that I am part of and not the action itself. As a result, I began working on renovation work that naturally followed the situation of running a small-scale craft company, while making preparations, in between experiments and while doing the analysis, thus keeping the work attuned to the society of which this craft is a part. Due to variations in the research process, the flow of the renovation work was not totally systematic; rather, it followed closely alongside the research project, lasting between one and two hours every day.

When looking at the collaborative project done at MIL, it is interesting to see how this activity started to affect the direction of the process and analyses of the empirical findings. The collaborators at MIL and I, were concerned with the practical aspects of the project while doing the lab work. The testing and screening phases provided an overview and understanding of the potentiality of the selected technologies — possibilities in terms of time and rationality. However, by being open to the subjective relationship between the technology, my body and the surface of the silver, as well as the setting of doing renovation work as a crafter, I let this apparently simple process guide the experiments.

As described above, I experience renovation work as both a tedious and simple activity. Describing the process also makes it sound like a simple mechanical task. Therefore, both the collaborators at MIL and I believed at first that it could easily be done using robotic technology and considered it mostly a starting point for us to build a shared understanding of the potential of such technology in relation to the craft. Therefore, we were surprised to find that renovating a cast was a very challenging process for the robot arm. We started to rewind the process, to split it up, and ultimately started with simpler tasks, such as pick and place, to complete the task. Even then, though, it was challenging to recreate precise polishing tracks because, as it says in the report, *'these are fine movements which require a great deal of precision'* (Settedal 2022). The tests where we made VR models and 3D prints using the precious material were also somewhat disappointing. Although this technology provides an opportunity for seemingly endless visual and conceptual possibilities, our focus on the renovation part accentuated that materializing the design is far from merely a keystroke. The printed surface and the scaffolding demanded a large amount of renovation (Settedal 2022). Renovation work made me ask questions about whether the work really had the potential to benefit from less

expensive and research-demanding construction processes. I know that construction work done through hammering and chiselling, as but one example, demands hardly any afterwork. However, such processes do demand hands-on material skills rather than programming skills (Fieldnotes 2022).

It is not possible to conclude whether 'teaching' the robot to do the simplest of crafting processes is really about precision or whether it has to do with more complex issues, and whether VR modelling and 3D printing promised to be a shortcut that turned into a detour, just by looking at the cases alone. However, by attempting to find pragmatic solutions to economic issues, the theories on new materialism, agency and tacit knowledge suddenly became more than just abstract philosophical notions. The findings illustrate the potential implications of letting parts of the craft play a role in the research process. However, the principles of renovation work also intra-acted in my analysis. Analysing the lab results only based purely on economic interests in an objective and framed manner, boils down to scale and access to resources. Opening the results to broader perspectives on ecology, materiality and the intra-action of matter and meaning from an approach where there is room for more than just objective and framed measurements reveal a more complex picture. My numerous hours spent doing renovation work influenced the selection of processes and, consequently, also the empirical findings. As I started to give this activity more room and attention, I became aware of how the principle of this craft, as I experienced it, started to colour my analysis as well.

Renovation and surface work emphasise a focus on details, but also how the details also affect the whole. Every pore, hole and trace of the tool says something about the whole piece of work, and although they may appear insignificant compared to the construction and shape of it, they disturb the overall impression. Sometimes, they also indicate a weak point in the finished item. Grinding into a pore can open bigger holes and problems than what is evident on the raw surface, indicating weaknesses that can cause significant problems in the long run.

After the lab period, I kept returning to small details that we had ignored as we conducted the screening and testing phases, re-reading notes from my logbook that were not a part of the test report. One such note said that we were supposed to test a more advanced robot, but did not have access to it, followed by a comment on the outdated robot arm (Fieldnotes 2022). Much in the way that we often do renovation and surface work without paying too much attention to them, I kept returning to the seemingly minor observations not deemed relevant enough to include in the findings put in the report. With respect to Karen Barad's notion of agential realism, the entanglement of matter and meaning, and her focus on the void (Barad 2003; 2007), such 'insignificant' moments appeared interesting as an alternative perspective on

analysing the lab work. Although Barad applied her theory to an analysis of nuclear test bombing and quantum field theory (European Graduate School Video Lectures 2019), entirely different empirical material than the robotic, 3D scanning and printing of jewellery, her ideas made me aware of the entanglement of matter and meaning as somewhat relevant in terms of analysing 'the in-between moments' encountered during the lab work. If the void, the space in between, is a potent space, then the apparently insignificant parts of the lab work may still carry the potential for insight.

Time and materiality

The MIL lab's explanation for why we did not gain access to the robot arm that we had first wanted to implement in the tests was due to a global lack of the material silicon (Fieldnotes 2022). Silicon, processed and used in semiconductors, is vital to all digital equipment; still, the global situation does not allow for limitless technological expansion. Software development blurs the line between our virtual and physical reality, and it is easy to ignore the fact that this development is at the mercy of materials and the possibility and knowledge of mining, refining and processing the material to make the components used in microchips in everything from Tesla cars to virtual glasses and smartphones (Bratland 2023). I find it easy to consider the old-school tools connected to the holistic perspective on culture and nature. However, Barad's perspective on time and representation, nature and culture highlights how an understanding of the connection between artificial intelligence and materials also makes it possible to relate this technology to the bigger picture.

Having an understanding of what tools are made of, how they are made and how long they might exist in the form of a tool before they return to being just materials is different than just knowing about the technical aspects of low-tech tools. Some of my oldest tools, for example the chiselling hammer that I inherited more than twenty years ago, are simple constructions made from wood and steel. I can understand how the hammer is made; I have repaired it occasionally, and if it breaks, I am able to make a new one myself out of scraps from the local garbage dump.

As previously mentioned, one of the implications of Barad's perspective is that it affects how we may consider time, representation and questions of identity. I am not a silversmith; it is just a practice that I perform. Barad's perspective on performance emphasises that identity is not something fixed, something that one is, but rather, it is something transformative (see also Butler 2004, 204–205), I *am* not a traditional silversmith, but I work in a dependent relationship with the raw materials and the tools, just like my collaborators at MIL, although the tools are different. It is easy to think of traditional craft and mechatronic technologies as existing in a dichotomous

relationship. Being a silversmith comes with a strong sense of responsibility, as the history of the craft tends to focus on the loss of something valuable from the past that we must preserve (UNESCO — Traditional Craftsmanship 2023; Wahed et al. 2021).

Still, Barad's perspective shows how 'traditional craft' and 'technology' can be considered multifaceted, intertwined and constantly transformative terms. The tech developers and programmers at MIL who I collaborated with in the experimentations have a similar understanding of advanced technology as I have of my low-tech tools, like the old hammer. They also work in a dependent relationship with materials and sociocultural conditions, though they are encouraged to develop rather than preserve. Situated knowledge does not necessarily have to do with low-tech craft. However, 3D scanning, printing and robotic technology are more dependent on the global market of material supply.

In another note from my logbook that I kept returning to, the lab workers explained the third-arm technology to me, with one of them saying the following about the robot arm in the lab: 'This is from 2018, but that is okay (apologising it for being old and outdated at this point in February 2022) — it is with the software the development happens rapidly' (Fieldnotes 2022). The statement was at first difficult for me to relate to, as I have an almost personal relationship with my tools; they even gain in value as our 'relationship' grows.

To think of a phenomenon as transformative, via Barad's perspective, interferes with the most common linear perspective on time as well as identity and representation. Through this lens, it is possible to consider technologies not necessarily as emerging. From an etymological standpoint, transformation relates to the term change, and change is slightly different from the term develop. From a linear and representative perspective on technology, it is easy to think in dichotomous terms, as in something emerges and something else becomes 'outdated'. We can laugh now at those who considered the spinning wheel demonic and dangerous when the technology was new (Hoffman 1991, 68), because now we see the technology as traditional. Rosi Braidotti and several other scholars from the field of technology studies warn about engaging in nostalgia when it comes to technological developments (Braidotti 2017, 23–24). Still, I find that the linear perspective on technology makes it hard not to engage in nostalgia at times. Even Braidotti often refers to how the 'human' gets 'wiped out' in relation to what she calls 'Zoe' — a short-hand term for the more-than-human world in the form of artificial intelligence, robotics and machines (Braidotti 2017, 28). Still, I do not experience this idea as something new.

My saw, and the two pliers that I bought as an apprentice, feel like extensions of my arm when engaged in such practices as renovating a cast. The saw has always been a little crooked, so it draws slightly to the left, but I am so



The renovation work at MIL. Photo: Gudrun Semons.

used to it that I am only aware of the quirk when I occasionally use an unfamiliar saw that happens to cut straight. When aware, I can feel the surface of the silver through the tool. In such instances, it is also hard to draw a line between me as a human and the technology, although the technology is old. To consider technology as transformative and not necessarily as evolving,

I find it easier not to become caught up in nostalgia and wish for a return to some unfeasible glorious starting point, losing myself in the sense that something is constantly slipping out of my hands — or, on the other hand, just mindlessly celebrating innovation for innovation's sake.

Barad (2003, 808) suggests that performativity is linked not only to the formation of the subject but also to the production of the matter. In this case, it is possible to use Barad's perspective to let go of the mental effort of seeking either to preserve or to develop. Her perspective makes it possible to consider technology as a phenomenon in constant flux regardless of our back-and-forth efforts at categorising it. Letting go of the binaries enables a sharper focus on some key values regarding sustainability and striking a balance between the economic, ecological and intangible aspects of the technology.

Even though we were not able to make the robot arm cut and grind the cast tubes, and even though the latest printing technology did not deliver a perfect surface, eliminating the need for any after-work, we could not conclude that the effort was wasted or that fully automate renovation work will never be possible (Settendal 2022). Still, in light of Barad's perspective on the entanglement of matter and meaning and how such a relationship is always transformative, the question is, just what is being transformed here? Yes, we can develop technology in a laboratory, technology that may save some time and effort, but at what cost? What are the implications outside the laboratory?

If programmer at the MIL lab, which is part of the national infrastructure of innovation, pilot testing and experimental development of industrial production systems in a country like Norway, had a difficult time getting access

to the type of technology we tested because of tighter regulations and accessibility, then I find it less likely that a traditional silversmith would have access to such technology. Accessibility might be a contemporary problem. Still, Professor of African Politics Evaristo Benyera (2021), amongst others, has described how the fourth industrial revolution works as a recolonisation of the Global South. He elaborates on how the rapidly growing demand for technological development creates new ways of looting this part of the world for its resources, with humanitarian costs. Like the former colonial period, the Global South is again fuelling technological development, but it has no control over the distribution of or take part in the wealth (Benyera 2021). The world situation and the growing need to implement the concept of sustainability in decision-making processes make the fourth industrial revolution and its potential to electronically and digitally transform industry slightly different than the previous industrial revolutions since the SDG makes the paradigm of limitless growth, exploitation, and expansion problematic.

Even though we in wealthy Western societies may not see the fourth industrial revolution as a recolonisation of the South, rapid technological development involves the rapid consumption of resources (Pitron 2023). Renovation work, accentuated in the case described that technological expansion is not a quick unproblematic and easy fix.

Closure

The research case at the MIL lab serves as an example of how craft can play a fruitful role in research. As the project grew, it became clear that the hours of work that I first considered a mere distraction actually intra-acted with the different perspectives proposed by Haraway, Barad and Planke and created a conceptually and pragmatically red thread throughout the project. My perspective on the activity was conceptually renovated, as the numerous hours spent at the workbench caused the activity to grow in importance and ultimately become a significant part of the research.

Karen Barad's (2003, 2007) theory of agential realism and her attention to the void, the space between a phenomenon and the relationship between the material and the thinkable, has offered another way to view the relationship between technology and traditional craft that does not resort to binaries and dichotomies. The 'renovated' perspective on technology, craft, materiality and meaning accentuated the fact that less resource-demanding technologies and hands-on material skills are not only valuable as carriers of the cultural components linked to identity. The perspectives of agential realism gave me opportunity to consider surface work as an apparatus through which the exploration of mechatronic technology was diffracted. Still, this initial awareness of how mind and matter interact and have the potential to work in unity

and generate new insights and understanding only came about through being open to the possibility that situated knowledge has the potential to lead to unexpected outcomes that are not possible to foresee or discover purely through intellectual cognitive and visual work, with the crafts role as predetermined.

Although the research case findings are multifaceted and it is difficult to draw any specific conclusion from them, I have, through this work, nevertheless come to reflect critically more often on what technology I can do without, whether from a business standpoint or in relation to building new knowledge and understanding.

AUTHOR

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Unpublished lab report provided by Halvor-Dag Settendal for MIL, 2022.

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