Future Master craftsmanship:

Where We Want Electronic Textile Crafts To Go

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ABSTRACT
Craft, both as process and resulting artifact, implies notions of care, foresight, human skill and investment. In this paper we examine the practice of creating E-Textiles as a contemporary craft, and we ask ourselves what will become of this craft when the first fully automated machine for E-Textiles production hits the market. Will the craft in E-Textiles survive, and why do we care that it does?

INTRODUCTION
Researchers, engineers, educators, artists and designers combine electronics and textiles for different reasons, to produce seamlessly integrated artifacts known as E-Textiles. While E-Textiles are produced for different reasons, the individuals involved in the process of making them, all benefit from exercising E-Textiles as a craft.
Researchers and engineers are looking to make electronics smaller, more flexible, stretchable and washable. Finding reliable and durable ways of creating electronic textiles is one of the most immediate research goals in their field [1]. Educators are introducing e-textiles into the classroom as a means of situating electronics and computation in new, attractive and more accessible contexts [2]. Designers are conceiving garments, accessories and furniture upholstery that incorporate sensors, actuators and computational power into soft, comfortable, wearable experiences in order to demonstrate the possibilities of future textile technologies [3]. Artists are producing work that combines electronics and textiles as an expressive medium, often using E-Textiles as a vehicle for other content [4,5,6].
While their motivations and goals my be different, craftsmanship is exercised throughout all of these disciplines. The researcher, the engineer, the educator, the artist and the designer are all capable of creating work in their field with attention to the craft quality of their work. As we continue to talk about E-Textile craftsmanship, we are not referring to a specific discipline or application, instead we refer to the skilled craft of individuals experienced in the use of the materials and tools involved.

THE CRAFT IN E-TEXTILES

We consider E-Textiles to be a contemporary craft, not only because it combines novel materials, tools and techniques with those associated with traditional crafts, but the process of creating functional, reliable and aesthetically pleasing E-Textile results relies heavily on the manual skill and technical expertise of the maker - one of the defining notions of what constitutes craftsmanship. An end in mind, workmanship of risk [7] require one to pay attention to details, the use of appropriate materials and tools in order to achieve the quality of work that the best one can do.

"(I shall say as a first approximation that) it (craftsmanship) means simply workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgement, dexterity and care which the maker exercises as he works" [7].

In his term, we can think that craftsmanship is a process of making, in which the quality of the result is continually at risk. When we use the term craft, it does not exclude the use of hand operated machines. Drawing with CAD system, programing with computer can be also considered as craft, as long as it involves human skills and judgement in its process. The balance between the difficulty of the required task and the skill one possesses determines the size of a risk. The bigger the risk you take, the bigger the accomplishment and the reward it becomes.

"Craftsmanship names enduring, basic human impulse, the desire to do a job well for its own sake" [8]
The results of this contemporary craft process are unique and novel artifacts, they are inventions, innovations, artworks and personal accomplishments. While some of these artifacts remain strictly decorative, others fulfill specific purposes. Craftsmanship itself is not an indicator of good research, engineering, education, design or art, it can be applied and appreciated for its own sake. As automated machine production process become capable of doing what we currently do "by hand" or "operated by hand", the question presents itself: what will happen to the craftsmanship in E-Textiles?

WHO ARE WE, AND WHY DO WE CARE

Now that we have established E-Textiles as a contemporary craft, we want to introduce ourselves as E-Textiles craftspeople. We are individuals from different disciplines who have a stake in the craftsmanship associated with E-Textiles.
Currently, production of textile circuitry relies heavily on skilled work, mostly executed by hand and semi-automated machines, simply because automated manufacturing methods for combining textiles and electronics do not yet exist. As the field develops and demand for mass-produced soft, textile and wearable technologies increase, it will not be long before the processes that currently involve human skill, can be replicated by automated machines.

If the industrial revolution defined craft from industry [9], maybe we are now in a position to launch the “craft revolution”, in which we seize the opportunity to situate our practice as contemporary and progressive, adjectives not normally associated with craft. Progress is a big word, that often seems to stand between industrial production and craft, and is one of the first things that needs to change in this craft revolution we envision. Progress does not imply quantity as much as it implies quality. Quality, individuality, uniqueness, are becoming important social values, as movements such as slow food, slow life and DIY practices demonstrate.

Production, formally known as craft, was swallowed by the industrial revolution, and craft became known as non-industrial production. But there is no real reason why craft has to exist as a counter movement to industry. It is not simply nostalgia for the rewarding feeling of a job well done, we also believe that our mode of production and work ethos offers benefits that industry can’t or doesn’t care to.

Craftsmanship is by no means dead, but if nothing changes, craftsmanship will most likely continue to exist alongside industrial technology. The existence of automated machinery, that replicates craft process, will not stop us from doing what we do, because we do it for different reasons. And yet, particularly at this point in time, it is a good question to ask: how would we like our practice to continue, once industrial automation kicks in? Will we become E-Texiles grandmothers, sewing LEDs onto t-shirts for our grandchildren while industry produces them in bulk? Will our grandchildren think of our creations as un-cool because they are craft-made? Will our craft become art because it becomes ever more useless [10] ? Our answer is that we would like to continue practicing our craft for many of the reasons people continue to practice it today and to shift the emphasis of the value from simply being non-industrial to being innovative, cutting edge and unique. When our skills become devalued because machines replicate the work faster, cheaper and “better”, we *will* still enjoy the craft process. But instead of sitting back to become E-Textiles grandmothers, perhaps competition from the automated machines will encourage us to move on. In accepting this challenge, as future master craftspeople, our aim is not to re-invent craft, but rather to re-invent ourselves as future master craftspeople. By talking openly and critically we hope to continuously find ways in which our practice can seek to express the advantages of man over machine.

In the remainder of this paper we discuss conventions, traditions and practices within the field of E-Textiles that support the kind of future craftsmanship we seek.

WHERE TO GO FROM HERE

In June 2011, The Swedish School of Textiles organized a week-long E-Textile summer camp with the theme of ‘*Future E-Textiles Mastercraftsmanship’* [11]. Eighteen practitioners from the field attended the camp, and actively participated in discussions, skill-shares and group projects. The camp was a platform for discussion about our current practice and about how we want to continue practicing our craft. We were concerned about finding ways of portraying and communicating our trade,

that don't just focus on the common traits associated with craft, which are: skilled workmanship, attention to detail, fulfillment and personal enjoyment.
From discussions that took place during the summer camp, and from our own experiences, we distilled a list of three practices that we believe are key to supporting the kind of future craft practice we are aiming for:

1. *Learning: acquire new skills, both knowledge (explicit) and know-how (tacit)*
2. *Community: engage with others, both online and offline*
3. *Exposure: share your results and study other people's skilled work*

Learning: Acquire new skills, both knowledge (explicit) and know-how (tacit)

E-Textiles practices involves both explicit and tacit knowledge. For example, circuit schematics or weaving patterns embody explicit knowledge, while learning how to solder and operate a weaving loom require tacit knowledge that comes from practice and experience.
When mastering one discipline, you need to learn both the explicit and tacit knowledge of the field. In E-Textiles practices, because of its interdisciplinary character, the practitioners are required to know multiple disciplines' both the explicit and the tacit knowledge. Often, one has to learn it outside of their expertise. Currently many practitioners obtain this knowledge from books, online documentations or by attending educational courses and workshops.
E-Textiles itself is also producing its own discipline knowledge. For example, weaving EL wire into textile requires explicit knowledge on circuitry connection on woven structure, as well as tacit knowledge on how to keep the thread tension when weaving the EL wires.

Example: How To Get What You Want

Since 2009 we have been documenting the materials, tools and techniques we use in our practices on our own online database, titled *'How To Get What You Want'* [12]. The database consists of knowledge in the area of : material, electronics, textiles and E-Textiles. The site posts the technique on making sensors, actuators, circuits, connections and traces with various conductive textile materials. Most of these techniques are introduced with step by step tutorials with movie showing the outcome in use. The site follows the Open source hardware policy allowing people to freely use or modify the knowledge. Circuit schematics, source code and pattern for fabric constructions used in these tutorials are provided as download files. Both conductive textile materials and non-conductive materials used in our projects are listed in the material category. The vendors of these materials are also documented so that others can purchase it for their own use. (figure 1)
This database is not meant to be an encyclopedia of E-Textiles techniques, but rather a documentation of our trade, and one of the way we pass on our knowledge.

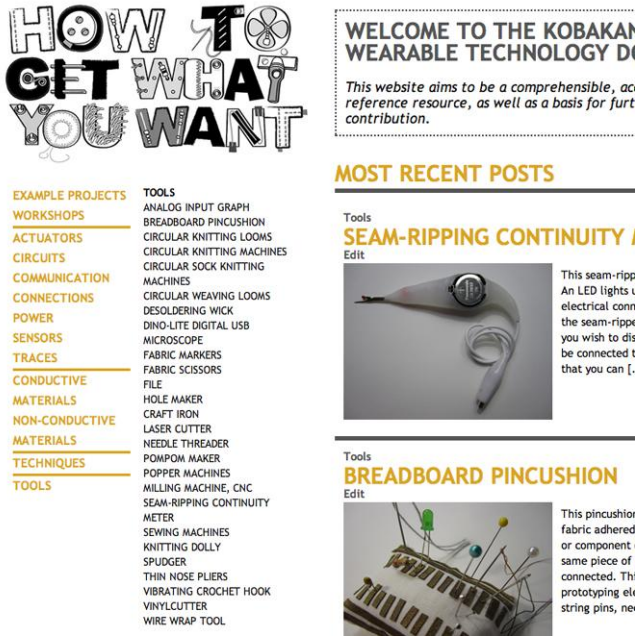

Figure 1: screenshot from '*How To Get What You Want'* *(www.howtogetwhatyouwant.at) online database.*

Community: Engage with others, both online and offline

Many practitioners in the field of E-textiles participate in the DIY community, by documenting their techniques online on various platforms [13, 14, 15]. Some of them hold workshops or teach in educational institutes. These workshops and face-to-face meet-ups encourage collaborative learning and working models, demonstrating a share and receive attitude. Also physical meetings foster discussions and healthy critiques of work, something which the anonymity of the Internet often lacks. Forming loosely connected DIY (Do-It-Yourself) or DIWO (Do-It-With-Others) communities serves as a platform to exchange explicit and tacit knowledge, motivate their creative process and to encourage collaborative works.

Example: Workshops

Since 2008 we have held over 20 workshops in many countries, hosting between 5 to 20 participants each time. The participants' background is various, from beginner in electronics to trained engineers and designers. During the workshops, we demonstrate or display our own technique on E-Textiles. Participants are then asked to create their own projects using the introduced materials and techniques. Often these techniques are modified for their skills and applications creats new versions of it. These workshops provides the chance to physically observe the techniques you see on online documentations, get in touch with actual materials as well as to see how the others work with it. It also serves as a place to start a community among the practitioners in local area. (figure 2)

Figure 2: workshop participants discussing over their textile circuit design.

Example: Summer Camp (skill share and experts meeting)

The E-Textiles Summer Camp gathered experts in the field to share and collaborate in intermediate-expert level. Participants were asked to share skills through hands-on workshops, where they showed particular E-Textiles technique they have developed. Participants had one day to work in collaborative group project. One of the outcome was a tablecloth filled with different kind of embroidery exploring various hand-craft techniques you can employ in E-Textiles. (figure 3) There were involved discussions on the topics of online documentation and open source issues, expert level of skills in collaborative works and starting a community among distanced practitioners which we hope to continue the exchange in future.

Figure 3: Summer Camp participants collaborating on their embroidery circuit project.

Exposure: Share your results and study other people's skilled work

Exposing ourselves to others work, by visiting exhibitions, fairs and conferences gives us a chance to study other people's skills and trades. Since E-Textiles is a young craft, there are no standard definition for "good" or "mediocre" yet. By observing others work, as well as your own, we as craftspeople need to negotiate one's own standards and nourish the judgement skill to distinguish a "good work". This "ability to judge" is crucial in order to develop one's own critique standard for their practices.

Medieval time craftsperson traveled around during their apprenticeship called "journey man" to learn skills outside of their local community. Artist-in-residence programs allows practitioners to travel and collaborate with local practitioners. We could consider this as a modern apprenticeship model.

CONCLUSION

E-Textiles is a contemporary craft practiced across many disciplines. As E-Textiles craftspeople we envision that this craft will continue even when automated machines are able to reproduce our work. We seek for the "craft revolution", which associates the word "progress" with quality, individuality and uniqueness. In this future society, We will simply create new work that relies on our individual skills and human ability to think independently. Moreover, to maintain the relevance of E-Textiles, passing on one's knowledge and trade, engaging with others, exchanging ideas and exposing yourself with works of others is necessary. We need to keep our practice alive, but also insure that it grows to meet future challenges, that is why we talk about "future master craftspeople".

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