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# Growth Plan for an Inspirational Test-Bed of Smart Textile Services

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**Abstract**

In this pictorial we visualize the growth plan for an inspirational test-bed of smart textile product service systems. The goal of the test-bed is to inspire and inform the Dutch creative industries of textile, interaction and service design to combine their strengths and share opportunities. The pictures exemplify the characteristic tools, approaches and prototypes for three phases of growth: Incubation, Nursery and Adoption.

**Authors Keywords**

Smart Textiles; Interaction Design; Prototyping; Craft; Design Communities.

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

**Introduction**

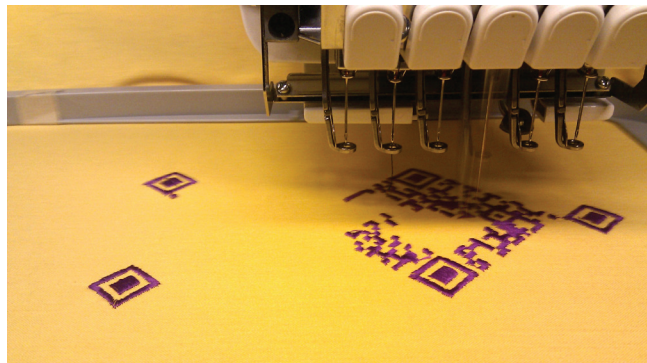
As no single actor in the field of textile, interaction or service design can meaningfully understand and realize the creation of Smart Textile Product Service Systems they need to team up with relevant partners [3]. Therefore we are creating an 'inspirational test-bed'; a platform of methods, tools, materials, partners, and prototypes where the creative industries can explore the opportunities and challenges of joining their expertise towards designing smart textile services. Three years into our project we share our design strategy and show three phases of growth: Incubation, Nursery and Adoption [8].

**Incubation Phase**

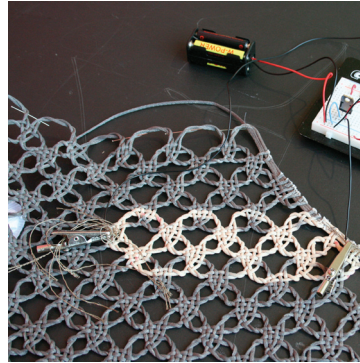
In this first phase personal creativity, material innovation and conceptual curiosity are central. The approach is characterized by 'learning through doing' and the focus is on the diversity of the design space of integrating textiles and computing. In a large open studio the facilities are characterised by tools that support both personal hand crafting and rapid prototyping. While the hand crafting supports material engagement through a slow process, the rapid prototyping allows for fast iterations of technical feasibility.

Typically, the resulting prototypes range from the productive to the pointless. They are one-offs, or one stretching meter and 'evaluated' through informal design critiques.

Starting points for the design explorations are multiple, i.e. sensing possibilities of stretch sensors (top left), a craft like bobbin lace (top right), computer controlled embroidery of QR codes (middle left) or lock-stitch machine, the interaction with the body (bottom left) or a research direction (bottom right) [4].







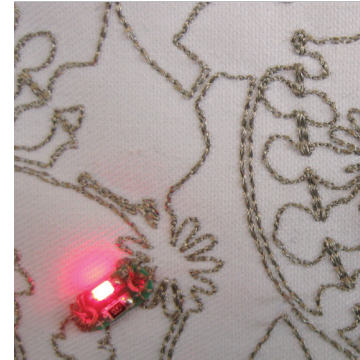
**Material Innovation:** The textile crafts of weaving (left), knitting, constructing, embroidering and lacing (right) are introduced to interaction design and to be explored with light emitting (left), conductive, and thermochromic yarns and fibers (right) to create hybrid materials.



**Conceptual Curiosity:** The concepts that are designed range from the pointless to the productive. In this phase the community is better served with a wide and rich exploration of the conceptual design space of smart textile product services.



**Embodied Wearables:** Already in this first phase are the design approach and the results grounded and inspired by notions of embodiment and phenomenology. The creation of meaning in the interaction between the body and the material is made apparent throughout.



**Aesthetic Clash:** The domains of interaction technology and textile are quite different in many areas. In the prototypes this becomes apparent when the initial 'hard and digital' aesthetics of interaction technology needs to be developed to match with the 'soft and analog' aesthetics of textile.



### Nursery Phase

In this phase commitment, co-crafting and confrontation are central.

The approach is characterized by 'scaling up and stepping out' to build credibility with and within a larger creative community.

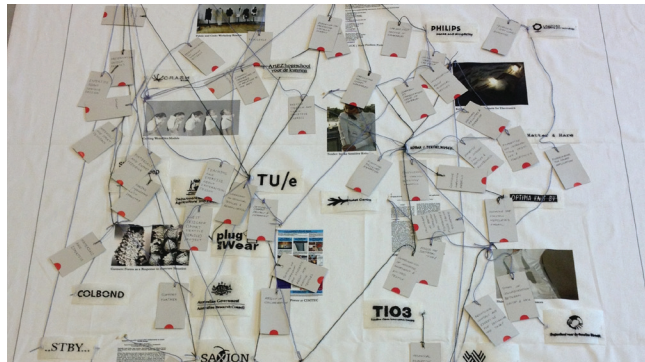
The tools in this phase are both in, and outside the open studio and support scaling up, participatory innovation, and in-situ evaluation.

The prototypes in this phase are developed to be scaled up from the one-off to multiple copies or stretching meters and tested with multiple participants. A larger creative community is built by given it access to the new materials, concepts, prototypes that were initially developed in the previous phase. Issues of sustainability, whether they are environmental, social or economic come to the foreground in this phase [7].

Top: professional weaving (left) and knitting (right)

Middle: Crafted artefact showing the network (left) used in a co-reflection session (right).

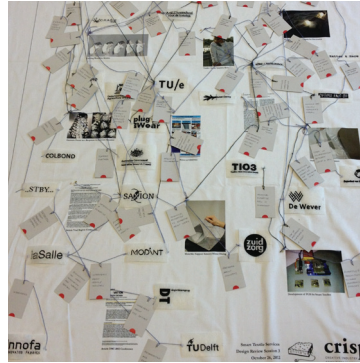
Bottom: In-situ design critique (left) and user evaluation (right)







**CRISP:** Participatory Innovation workshop to support and draw out collaboration and shared ownership between existing partners in the consortium and to attract new partners. The aesthetics of the prototype demonstrate a commitment to textiles, the community of partners and the challenges that connects them.



**Vigour 2.0:** Confrontation between a garment with knitted stretch sensors and the context of the elderly care provider. Elderly men and women and their therapist evaluate the comfort, lack of fashionability of the garment and the value of mapping body movement to direct acoustic feedback. [2]



**Bed Time Stories:** A co-crafting project between a regional weaving company, interaction design consultants and a fashion designer. The concept combines a story telling service, a woven bed sheet and augmented animations. [6]



**Beta-Textiles:** a workshop which combines textiles and coding, where previously developed smart materials are offered to a creative community of fashion designers and interaction designers. Final results were evaluated in a design critique (previous page bottom left).

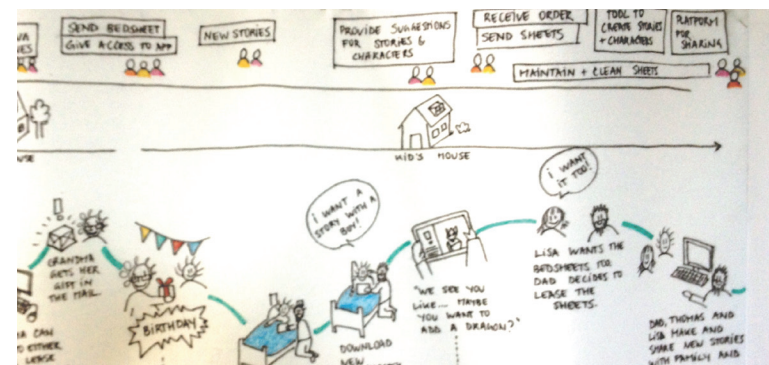
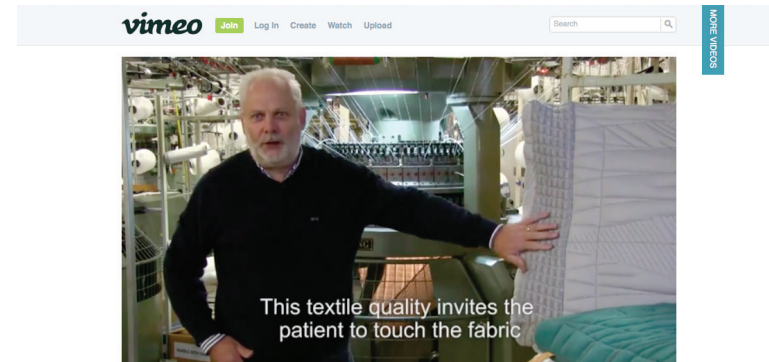
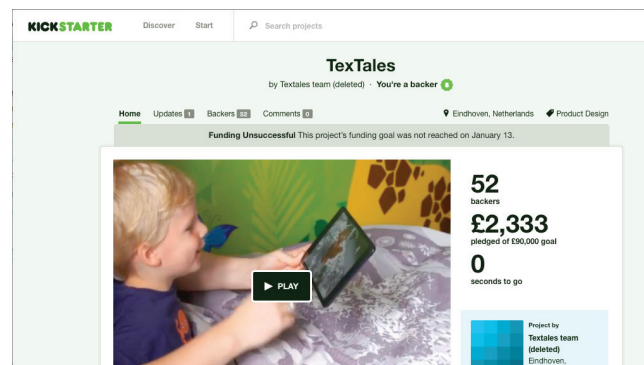


## Adoption Phase

In this phase exhibition, exposure and enterprising are central.

The approach is characterized by 'show off and tell' and 'creating value'.

The tools in this phase support documentation and dissemination for various audiences, ranging from the general public, to academia, funders and investors and companies. The goal is to show the innovative potential of the combination of textile, interaction technology and service design to the respective communities and for them to adopt the concepts and start caring for them outside the inspirational test-bed. Demonstrating the prototypes through exhibitions, videos and stories in local, national and international media is also building up societal awareness and public sensibility of what smart textiles services could mean. This is going to be a long process as often the concepts and their market are quite novel and underdeveloped.



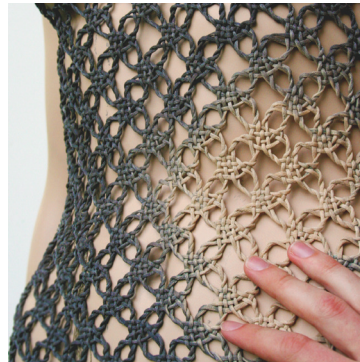




**TexTales:** what started as a personal exploration of Estonian craft qualities and involved into a co-crafted concept for a storytelling service was eventually launched at a crowd-funding platform. While not raising enough funds it did create a larger appreciative community for smart textile services.



**Vibing at the Beijing Design Week 2014:** After several iterations starting from material innovation and personal crafting to collaboration and switching from light to vibration Vibe-ing was realised. Vibe-ing is a self-care tool in the form of a garment, which invites the body to feel, move, and heal through vibration.



**Unlace:** An interactive lace lingerie garment which allows partners to connect through touch, time and warmth. The slow change in 'transparency' and warmth increases awareness of touch and creates time to explore the woman's body together. Unlace won an industry award for its re-appreciation of the old craft of bobbin lace through unconventional and smart materials.



**Tactile dialogues:** a pillow with integrated vibration elements that react to touch. The goal of the textile object is to enable a dialogue by triggering physical communication patterns between a person with severe dementia (the care receiver) and a family-member, spouse or caretaker (the care giver).

### Inspiration from Interaction Design

As our inspirational test-bed originates in a department of interaction design, and not textile design we find inspiration in Klemmer et al's [5] themes for interaction design. 'Thinking through doing' and 'performance' are quite important in the first phase. 'Visibility' or the role that artefacts play in collaboration (top), and 'Risk'; how the uncertainty, or commitment of physical co-presence shapes interpersonal interactions (middle) are apparent throughout the physical studio and in the second phase of Nursery.

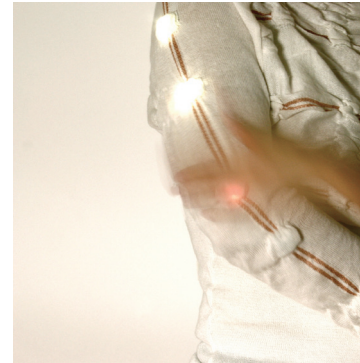
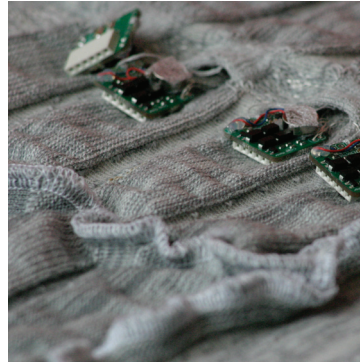
A second line of inspiration is found in craft qualities as expressed by [1], where we see the craft qualities of material engagement, self-expression and creativity in the Incubation phase. In the second phase of Nursery the positioning of creative work in relation to the community seems most relevant, while in the third phase of Adoption the aesthetic tastes (bottom), and socio-economic needs of a larger appreciative public are the main qualities that one could strive for.



### Transition between Phases

The initial growth plan was intended by [8] for Ambient Intelligence system design. They point to the main strength of the Growth Plan "that each phase ends with a prototype that allows experiential evaluation of the transformational workings." Similar, in our growth plan for the inspirational test-bed of smart-textile services the aim for each phase is to deliver prototypes that can be experienced and evaluated on how they transform the skills, knowledge and attitudes of the stakeholders involved. "Another strength of the Growth Plan approach is that it stimulates testing in real life. This is something that is often not pursued due to its complexity" [8]. In our case this means growing towards the 'real lives' of every stakeholders, whether it is educational, academic, or industrial real life, and finally to the real life of end-users. The main weaknesses of the Growth Plan as already pointed out by [8] is that each transition, from one phase to the next, carries the consequence that more time and more resources are needed. And while in each transition benefits are gained, others are also lost. In the first transition from Incubation towards Nursery more time and resources are needed mostly for technological development from off-the-shelf materials (textiles or electronics) to custom made. This technological development can be made 'in-house' to preserve conceptual coherency but it will disturb the progressivity of the project, where progress slows down and becomes irregular. Collaborating with technological experts can keep the momentum, but personal and conceptual concessions need to be negotiated. In the second transition from Nursery towards Adoption an additional increase in expertise is needed which risks additional time and resources to align academic, societal and economic adoption.





**More time and resources** are needed to transfer from off-the-shelf components to custom-made to industrialization which is essential for a concept to transfer to a next phase. Each transition therefore highlights the limits of the then available expertise and facilities within the inspirational test-bed.

**Personal and conceptual concessions:** With the inclusion of new experts concessions are being made. The concept 'Tender' used light inside knitted pockets as a medium. In the transfer towards 'Vibing', light was replaced by vibration and the entire concept changed from outside expression to inward experience.



**Too soon:** Bedtime Stories did not raise enough backing from the crowd. Fully developed concepts with smart textiles receive harsh critiques from textile developers. These disappointing experiences make the stakeholders question whether they presented too soon, the wrong message or to the wrong audience.

**Aligning adoption:** As the functionality and fashionability of the product-service has improved from Vigour 2.0 to 3.0 and societal and academic adoption is near, the stakeholders need to extend their expertise towards business modeling in order to align to economic adoption.

## Conclusion

The main contribution of this pictorial is to inform and inspire the existing cultures of textile, interaction technology, and services how to work together in an inspirational test-bed. As a methodological contribution the pictorial shows a growth plan of three phases, i.e., Incubation, Nursery and Adoption each with their own central goals, and how this plan can grow a creative and appreciative culture of Smart Textile Services.

While the future of smart textiles, especially in combination with service systems seems promising, the field is still in its infancy. Therefore, instead of aiming for short-term or individualistic scientific or commercial success, a regionally funded program allows focus on growing a slower, more sustainable innovation to create a community and foundation for future success.

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