Textiles in the Material Practice of Architects – Opportunities, Challenges and Ways of Stimulating Use

This dissertation reports on a design research project about textiles in the material practice of architects. Targeting practicing architects, its aim is to understand how textiles are currently part of their material practice, factors influencing their use and non-use of textiles, and how awareness of their benefits may be raised. The project’s three research questions are thus: 1) How are textiles currently used by architects? 2) Which challenges to the use of textiles in architecture can be found in the material practice of architects? 3) How can the use of textiles in architecture be stimulated? Based on Donald Schön’s view of design as reflective practice, material practice is defined as how architects work with, choose and apply materials. To reach the aim, the project integrates literature from material science, engineering design, textile engineering and design, as well as architecture, and conducts empirical studies using first hand face-to-face interviews with practicing architects and then workshop-based experiments with architecture students. The interviews were used to answer the first two research questions by analysing the current situation. This showed that architects, even though it is to a limited extent, use textiles in their designs in different ways and in their design process and an awareness of opportunities with their use in architecture. However, four dilemmas and the high integration of material considerations in the architectural design process make the use of textiles difficult. The influence of experience, cost and legislation are yet three factors that explain non-use of textiles. The analysis also pointed to the importance of material samples for the material choice, but also limitations concerning how they are used by, and presented to architects. Based on this analysis of the current situation five experiments were carried out to probe further into how awareness of the opportunities with the use of textiles may be raised, and into ways of stimulating the use of textiles in architecture. The first two experiments involved architects and other professional stakeholders in the design of more healing hospital environments using a textile design game and multi-material model making. Then, three experiments in workshops with architecture students explored the use of textiles in sketch model making, as a way of sketching ideas for how textiles can be used in office environments. The experiments show that by experimenting with representations of textiles, materials that exhibit and imitate properties of textiles, and physical samples of actual textiles, awareness and understanding increase, and ultimately stimulate architects’ use of textiles. Core contributions include discussions of the definition of textiles in the context of architecture and of the place of textiles in material classifications as well as a number of interactive experiments that may easily be conducted by architectural firms, contributing with new knowledge on how the use of textiles may be increased among architects.
A Hands-On Approach for Exploring Textiles and Daylight in Architecture

General information
Publication status: Published
Organisations: Department of Mechanical Engineering, Engineering Design and Product Development
Contributors: Heimdal, E. J., Lenau, T. A.
Publication date: 2012
Peer-reviewed: No
Electronic versions:
Materials Symposium_Poster_Elisabeth Heimdal_Torben Lenau.pdf
Source: dtu
Source-ID: u::5727
Research output: Contribution to conference ➔ Poster ➔ Annual report year: 2012 ➔ Research

Exploring Textiles in Architecture through Tangible Three-Dimensional Sketching Tools
This paper argues that tangible three dimensional sketching with textiles makes it more likely that these materials will be used when creating architectural spaces. Our research contributes to the more general idea that innovation in architecture and design can be stimulated by the exploration of new materials. With tangible three dimensional sketching, we mean an iterative process of physical model making. In two experiments with architectural students, all textile novices, spaces were modelled using a three dimensional sketching tool consisting of textiles, cardboard support and tools for giving form to and joining these materials. The chosen architectural task was how textiles could be used to regulate daylight by applying them to an exterior building skin or to interior spaces. Findings were that three different strategies were used: the tool was used to materialize, illustrate, or develop a concept. While the first two strategies use pre-existing ideas – respectively immaterialized (such as an idea) or materialized (such as an existing building or a sketch) – as point of departure, the third strategy uses the tool to develop new ideas. Our experiments demonstrate that textiles’ possibilities can indeed be explored through tangible three-dimensional sketching and that limitations and clear progression in the staging of the tool produce better models and deeper exploration. In order to extend the results to practice, a professional architect was interviewed. Based on this, we can say that the tools, though tested on students, are likely to work for professionals too.

General information
Publication status: Published
Organisations: Department of Mechanical Engineering, Engineering Design and Product Development, University of Technology Sydney
Contributors: Heimdal, E. J., Lenau, T. A., O'Mahony, M.
Number of pages: 25
Publication date: 2012
Peer-reviewed: No
Electronic versions:
Source: dtu
Source-ID: u::5227
Research output: Contribution to conference ➔ Paper ➔ Annual report year: 2012 ➔ Research

Three roles for textiles as tangible working materials in co-design processes
Textiles are increasingly complex materials used in a growing number of applications, e. g. in architecture. The textile industry must therefore engage with other professions when developing both textiles and products of which textiles are a part. In this article, we argue that tools taken from the field of participatory design represent a potential for staging such co-design situations and report on our experience from a co-design process where architects, engineers and textile experts engaged in designing future textile solutions for Danish hospital environments. During this process we used what we call tangible working materials to stage the collaboration between the stakeholders engaged as co-designers. Our experience using the tangible working materials showed us that they can be divided into three types, with different attributes and roles in the design process: real, mediating and representative materials.

General information
Publication status: Published
Organisations: Department of Management Engineering, Technology and Innovation Management
Contributors: Heimdal, E. J., Rosenqvist, T. S.
Pages: 183-195
Love Lace Exhibition

General information
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Pages: 28-29
Publication date: 2011
Peer-reviewed: Unknown

Publication information
Journal: TextileForum
Issue number: 4
Original language: English
Source: orbit
Source-ID: 317438
Research output: Contribution to journal – Journal article – Annual report year: 2011 – Communication

The making of a mock-up: A story about how ideas are framed using reality as scaffold
As part of a research project about user involvement in textile design we have carried out two Design:Labs (Binder & Brandt 2008) engaging different stakeholders in designing textile products for Danish hospital environments. In this paper we follow a mock-up session done as part of the second Design:Lab, where we meet a group working with the intensive care ward. Looking back at the video recordings from the session it became clear, that the participants continuously drew on elements from reality as they interacted with tangible materials and each other. We therefore claim that reality is an important element engaging in the hypothetical space of the Design:Lab, as it can function as a scaffold for ideas, ease the communication within the group, as well as help communicating ideas to people who have not participated in the Design:Lab.

General information
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Rosenqvist, T. S., Heimdal, E. J.
Number of pages: 432
Pages: 45-50
Publication date: 2011

Host publication information
Title of host publication: Participatory Innovation Conference
Place of publication: Sønderborg
Publisher: University of Southern Denmark
ISBN (Print): 978-87-991686-9-9
URLs:
http://pin-c.sdu.dk/assets/the-making-of-a-mock-up---a-story-about-how-ideas-are-framed-using-reality-as-scaffold---tanja-
Physical Tools for Creativity with Textile Materials
This paper seeks to develop a better understanding of how physical objects can stimulate creativity, studying the case of textile material samples employed to inspire textile designers to use new responsive materials and technologies in their designs. I show: 1) how physical objects can act both as triggers for idea generation and as solution proposals in a design process; 2) how the correlation between the developed idea and the relevant inspirational material can be of different kinds and 3) how the complexity and level of generic character of material samples influence their inspirational qualities. I finish with a brief presentation of an ongoing project investigating how architects can be inspired to use textile materials.

General information
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Pages: 34-43
Publication date: 2010

Host publication information
Title of host publication: Proceedings of DESIRE'10: Creativity and Innovation in Design
Editor: Christensen, B. T.
Keywords: Physical objects, inspiration, materials, textiles, creativity
URLs:
http://www.virksom.dk/Program_Desire.pdf
Source: orbit
Source-ID: 265428
Research output: Chapter in Book/Report/Conference proceeding → Article in proceedings – Annual report year: 2010 → Research → peer-review

Physical tools for textile creativity and invention
Two textile research projects (one completed and one ongoing) are described, where physical inspirational tools are developed and tested with the aim of stimulating textile creativity and invention, i.e. the use of textile materials in new kinds of products, thus bringing textiles into new contexts. The first research project (completed) concerns how textile designers use new responsive materials and technologies, whereas the second (ongoing) concerns how architects and design engineers can use textile materials. In both projects, the developed inspirational tool is tested through workshops with the mentioned stakeholders. In these workshops, new ways of disseminating the results from research in textiles and textile design are experimented with. The submitted contribution therefore mainly addresses the role of interdisciplinarity in textile design research as well as the impact of new materials and technologies on directions and approaches in textile design research. It presents one example of what textile design research is.

General information
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J., Lenau, T. A.
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Duck Journal for Research in Textiles and Textile Design
Volume: 1
Issue number: 1
ISSN (Print): 2042-0854
Original language: English
URLs:
http://www.lboro.ac.uk/departments/ac/mainpages/Research/staff%20groups/DUCK%20(Website)/volumes.htm
Source: orbit
Source-ID: 265432
Research output: Contribution to journal → Journal article – Annual report year: 2010 → Research → peer-review

Textile Architecture: How to Dress Buildings Up
Textiles can be used as building skins, adding new aesthetic and functional qualities to architecture. Just like we as humans can put on a coat, buildings can also get dressed. Depending on our mood, or on the weather, we can change coat, and so can the building. But the idea of using textiles to create human habitation is not new. As Diether S. Hope phrases it, referring to tents: The history of development of humanity would be barely conceivable without free spanning textile membrane structures.

General information
Publication status: Published
Textiles as Tangible Working Materials in Participatory Design Processes: Potentials and Challenges

Participatory design (PD) methods are currently of little use in the textile industry, even though the need for multiple stakeholder involvement in the industry is growing. In this paper, we argue that PD represents a potential for innovation in the textile industry, due to PD’s collaborative nature facilitating dialogue between different stakeholders and its ability to move stakeholder participation to the early stages of the design process. We have explored PD tools in a design process engaging architects and textile designers in designing textile products for Danish hospitals. From this we have realized a potential in dividing the materials into three types with different attributes, which should consequently be staged differently in a PD process. We have thereby seen that exploring PD in a textile design process improves the understanding of the role of tangible working materials in PD processes. We believe that the application of PD to the textile industry will enrich the theoretical foundations of PD in general.

Dynamic light transfer: The textile that sees you and blinks back to you

Knitted products have a flexibility that offers many attractive possibilities. Combined with technical fibres, this gives interesting and innovative possibilities. Many technical fibres and yarns has however properties such as high stiffness and...
brittleness which are difficult to process in the practice of weft knitting. This paper is about the experimental product development of a light radiating textile lamp in which optical fibres are used as the only illumination source. The lampshade is produced on an electronic flat knitting machine with special equipment suitable for the feeding of yarn with high stiffness. The work was divided in two parts: exploring the possibilities to knit the desired shape on one hand and experimenting about knitting with optical fibres as a weft insertion on the other hand. The method is an inductive approach; a literature survey, information from suppliers of knitting production equipment and experimental work on a flat knitting machine at The Swedish School of Textiles, Boras, Sweden. Results show that the diamond shaped structure can be knitted in one piece with transparent monofilament yarns. Furthermore it also shows that difficulties occur when knitting with stiff and brittle optical fibres therefore the paper ends with a discussion with suggestions of how to overcome these challenges.

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Pages: 61-65
Publication date: 2009
Peer-reviewed: Yes

**Publication information**
Journal: AUTEX Research Journal
Volume: 9
Issue number: 2
ISSN (Print): 1470-9589
Ratings:
Scopus rating (2009): SJR 0.786 SNIP 0.851
Original language: English
Keywords: flat knitting technology, knittability and handability of brittle fibres, Optical fibres, light radiating, shape knitting

**Intelligente tekstiler**

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Pages: 48-49
Publication date: 2009
Peer-reviewed: Unknown

**Publication information**
Journal: Ansa Nytt - Magasinet for norske studenter i utlandet
Volume: 38
Issue number: 3
Original language: English
Source: orbit
Source-ID: 253003

Research output: Contribution to journal › Journal article – Annual report year: 2009 › Research › peer-review

**Interactive Sample Book (ISB): An Inspirational Tool for Smart Textiles**
Which responsibilities do designers have? One could claim that designers have the responsibility of cooperating with persons from other fields, in order to create synergies, which can generate new product or service innovations, with high aesthetic as well as functional qualities. In this perspective, important aspects of the design process are the materials and technologies that are worked with. In relation to these, designers need to cooperate with experts from other fields, especially when working with new materials and technologies. Using new materials is a challenge, and one of the situations when cooperation with persons from other fields than the design field can be particularly fruitful. Another aspect that needs to be taken into consideration when working with new materials and technologies are environmental aspects. In relation to this, one could say that designers have the responsibility of minimizing the negative effects these could have on the environment, and of considering not only aesthetic and functional, but also environmental aspects when selecting
materials and technologies. The ISB project is an example of a cross-disciplinary project about new materials and technologies involving designers and engineers. It is carried out by Elisabeth Heimdal as her Master thesis from Design & Innovation, The Technical University of Denmark. Collaboration partners are the design bureau Diffus, textile designer Priya Mani, master student in mediaology at AAU Marija Andonovska and DTU supervisor Torben A. Lenau. Inspiration to use smart materials Interactive textiles are still quite an unknown phenomenon to many. It is thus often difficult to communicate what kind of potentials lie within these materials. This is why the ISB project was started, as a practice based research project, with the aim of exploring and communicating some of the possibilities within interactive textiles. The applications for interactive textiles range from medical applications to architecture, and from the fashion industry to costume design. In relation to the sample book, focus will be on texture, lightning and senses in relation to integrated decoration and function primarily to indoor applications. The result of the project will be a number of interactive textiles, to be gathered in an interactive sample book (ISB), in a similar way as the sample books of wallpapers one can take home from the shop and choose from. In other words, it is a kind of display material, which in a simple manner can illustrate how different techniques and smart materials work. The sample book should display a number of possibilities where sensor technology, smart materials and textiles are mixed to such an extent that the textile can react to different kinds of input from the surrounding world.

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J., Lenau, T. A., Guglielmi, M., Johannessen, H.
Publication date: 2009

**Host publication information**
Title of host publication: The 8th Nordcode seminar and workshop : Design Responsibility: Potentials & Pitfalls
Place of publication: Kolding School of Design
Keywords: Smart textiles, material samples, inspiration
Source: orbit
Source-ID: 250778
Research output: Chapter in Book/Report/Conference proceeding > Article in proceedings – Annual report year: 2009 > Research > peer-review

**Interaktiva textilier på TechTextil**

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Pages: 9
Publication date: 2009
Peer-reviewed: Unknown

**Publication information**
Journal: Struktur - Tidsskrift for tekniska textilier
Issue number: 3
ISSN (Print): 1104-6058
Original language: Swedish
Source: orbit
Source-ID: 253005
Research output: Contribution to journal > Journal article – Annual report year: 2009 > Communication

**Tekstiler og innovation på DTU**

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Lenau, T. A., Heimdal, E. J.
Publication date: 2009

**Event information**
Event: Intelligent and technological textiles
Location: Københavns Universitet
Keywords: textiles, innovation
URLs:
http://ctr.hum.ku.dk/
Textilier och Innovation - Hur kan fysisk interaktion med interaktiva textilier ge nya idéer?

**General information**
Publication status: Published
Organisations: Department of Management Engineering, Innovation and Sustainability
Contributors: Heimdal, E. J.
Publication date: 2009

**Event information**
Event: Smart Textiles - fiktion eller fakta?
Location: Swedish School of Textiles, Borås, Sweden
Source: orbit
Source-ID: 253000
Research output: Non-textual form - Sound/Visual production (digital) – Annual report year: 2009 – Research

Development of a diamond shaped light radiating textile: An experimental flat knitting process with optical fibres

**General information**
Publication status: Published
Organisations: Innovation and Sustainability, Department of Management Engineering
Contributors: Heimdal, E. J.
Number of pages: 222
Pages: 115-121
Publication date: 2008

**Host publication information**
Title of host publication: Ambience08: Smart Textiles - Technology and Design
Place of publication: Borås, Sweden
Publisher: Centre for Textile Research, Swedish School of Textiles
ISBN (Print): 978-91-9755576-3-4
Source: orbit
Source-ID: 252962