



Norddesign 2012 - Book of Abstract

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Norddesign 2 0 1 2

Book of Abstracts

Editors

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Kaj Jørgensen and Christian Tollestrup

Center for Industrial Production, Department of
Mechanical and Manufacturing Engineering,
and Department of Architecture and Design,
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Department of Architecture, Design and Media Technology, Aalborg University

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Introduction

Welcome to NordDesign2012. This conference is the ninth in a row of biannual conferences organized by technical universities in the Nordic region.

The first conference was held in Helsinki in 1996, and at this initial conference it was agreed to organize 10 conferences before deciding on the future fate of the ideas behind the conferences.

In that view the conferences have been thematically open and the organization has been tight with a limited number of participants that allows a good overview of all the papers and a lot of informal discussion between the participants.

The present conference has been organized in line with the original ideas. The topics mentioned in the call for abstracts were:

Product Development:

- Integrated, Multidisciplinary, Product life oriented and Distributed.
- Multi-product Development.
- Innovation and Business Models.
- Engineering Design and Industrial Design.
- Conceptualisation and Innovative thinking.

Research approaches and topics:

- Human Behaviour and Cognition.
- Cooperation and Multidisciplinary Design.
- Staging and Management of Design. Communication in Design.

Design education and teaching:

- Programmes and Syllabuses.
- New Courses.
- Integrated and Multi-disciplinary.

We received more than 140 abstracts and through the review process this have resulted in approximately 70 accepted papers. One of the new research fields included in this conference is the area of Biomechanics – hence the cover graphics of the conference proceedings.

With this short introduction we encourage you to study and reflect upon the topics and content of the accepted papers. And not at least to let this inspire you in fruitful discussions during the conference

On behalf of the organizing committee for NordDesign2012

Assoc. Prof. Poul Kyvsgaard Hansen
Professor John Rasmussen
Assoc. Prof. Kaj Jørgensen
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Center for Industrial Production, Department of Mechanical and Manufacturing Engineering,
and Department of Architecture and Design, Aalborg University

Wednesday August 22

10:45 – 12:00 Session 1a: Design Organisation, Management and Theory

Effect of Teamwork Modes in Distributed International Design Teams

Jeff Man, Yuan Lu, Alex Alblas and Aarnout Brombacher

Abstract: Over the past decades, the creation and development of new products has become a truly global activity. This requires people from different cultures on different locations to closely work together. This paper investigates, using actual case studies as a basis, the effect of different teamwork modes on the efficiency and effectiveness of bi-national design teams. A case study was designed and conducted to investigate the effect of three different teamwork modes in distributed bi-national design teams. In the case study, panel feedback and reflection diary were used to measure design quality and team satisfaction. Then, grounded theory method was used for data analysis of each team. In this research, it is found that different teamwork modes have effect on design teamwork in distributed bi-national teams. In addition, it is also found that different teamwork modes fit for different design teams and projects. With regard to time aspect, it is also found that different project uncertainty and team uncertainty need different teamwork modes during design process. In order to improve design teamwork, it is important for designers to be aware of culture factor and make use of teamwork modes in design process.

Virtualizing the Obeya

Knut Aasland and Detlef Blankenburg

Abstract: The Obeya is known as part of the Toyota Product Development System and Lean Product Development. Literature describes the Obeya as one of the tools of the TPDS, but rarely discusses what really makes an Obeya work, and what the critical aspects of it are.

In an EU-sponsored project on distributed, collaborative design, LinkedDesign (EU project no 284613 FoF-ICT-2011.7.4), a virtual Obeya has been identified as one of the subgoals. In order to specify such a solution, we need to examine thoroughly what Obeya is, how it is used, what functionality must be covered, and what virtualizing the Obeya concept means. This paper presents a concept for virtual Obeya

Towards a platform for New Concept Development: when kansei and design-thinking approaches meet

Alexandre Gentner, Carole Bouchard, Daniel Esquivel Elizondo and Carole Favart

Abstract: This paper, part of a PhD research, focuses on ways to improve new concept development (NCD) activities. This research is done in collaboration with the Kansei Design (KD) division of Toyota Motor Europe (TME), a team composed of designers and engineers bringing a particular dynamism to research and development activities. The paper presents a new platform for NCD aiming to assist the flow of ideas for the creation of user experience. It integrates kansei methodologies as well as more classical design-thinking approaches and uses as basis the analysis of 13 past NCD projects. The kansei approach to design pays particular attention to the different senses involved in the user experience as well as values, emotions and symbols perceived and felt. Kansei-based tools have a large scope. They can be used to provide design-guidelines but also at the creation and evaluation phases. They have also revealed themselves complementary to other approaches and in that way improve the quantity and quality of NCD methods available. These synergies are particularly useful in a context of user experience creation including concepts (function, sensory attributes, values, emotions) and also design strategies.

10:45 – 12:00 Session 1b: Design Methods and Research

How to use the degree of novelty of product ideas in idea management

Mathias Messerle, Hansgeorg Binz and Daniel Roth

Abstract: This paper aims for the development of a concept that shows how the degree of novelty of product ideas can be used for idea management. Therefore, a definition of the degree of novelty of product ideas is developed at first. The degree of novelty is divided in different dimensions regarding what aspect of an idea is new, how new this aspect is and to whom this aspect is new. Based on that, it is shown how the degree of novelty can be implemented in the stages of idea description and evaluation.

Methodical Product Program Planning within the aerospace industry

Henry Jonas, Sebastian Ripperda and Dieter Krause

Abstract: Issue of this paper is the case application of a method for Product Program Planning. The method consists of two major steps; first scenarios for the future structure of the program are elaborated and second potential carryover-candidates are conceptualised. The study is performed together with an aerospace supplier by a program of cabin interior monuments.

Product Family Models and Knowledge Transfer Support for the Development of Modular Product Families

Nicolas Gebhardt and Gregor Beckmann

Abstract: Developing modular product families meeting market demands and optimized to company processes requires extensive knowledge from many departments that needs to be communicated using product representations. In this paper an analysis of the application of a product family development method is presented and possibilities for improvements through advanced product family models and methodical knowledge transfer support are identified.

10:45 – 12:00 Session 1c: Design Processes**Co-Designing with children: Collecting and structuring methods**

Emilie Saure Hagen, Silje Mathillas Røsvik, Marikken Høiseth and Casper Boks

Abstract: Design research acknowledges the value of allowing users a direct say during product development. Hence, techniques for including users, including children are developing quickly, and children are increasingly taken seriously as a user group as well. Recognising that children are indeed the experts with regards to the products that they use, designers increasingly need to consult them. This paper is based on a literature review focusing on co-design techniques to include children in the design process. A model is presented in order to provide a holistic view of the different design approaches focusing on child user involvement. In addition, a methods matrix is presented which structures different methods that are associated with co-design in research. It presents the essence of each method and refers to relevant literature where further assessments can be found. As such, the matrix can inspire and support designers and researchers in the co-design process in general, and more specifically in such processes together with children.

Participate! A critical investigation into the relationship between participation and empowerment in design for development

Brita Fladvad Nielsen

Abstract: Participatory design methods are embraced by most design practitioners and academics working with design for development; design aiming for empowerment and poverty alleviation. That participatory methods lead to empowerment amongst the poor, marginalized participants and communities is left unquestioned by most of the literature, and there is little discussion among the practitioners undertaking such projects. When comparing design research to development research on this topic, one will come to realize that designers can benefit from a reality-check on our assumption that participatory methods and empowerment go hand in hand. An improved understanding of the effects of words on policy and research may be needed to fully understand the relationships in this debate and how design projects and outcomes are affected by the words chosen. Sufficient and transparent research to increase knowledge on this field will lead to designers knowing when and where participatory methods are appropriate and beneficial, to better understand the limitations of their methods and hopefully how they can be adjusted for the intended purpose of long term sustainable development for the communities involved. By taking a theoretical stand on a practical "design paradigm", this article discusses participatory design literature and projects in lieu of the critical discourse taking place in development theory. The discussion will conclude with further research needed and important questions to reflect upon with the purpose to improve the quality of design for development projects as well as design for marginalized and vulnerable groups.

An enhanced model for risk analysis in new product development

Marc Neumann, Tim Sadek and Patrick Labenda

Abstract: New product development is characterized by uncertainties that are a consequence of insufficient experience and missing knowledge, finally leading to risks. In literature, a multitude of different risk models is provided. However, a comprehensive risk model that is suitable for analysing different types of

uncertainties and their interdependences does not exist. In this publication we present the concept of an enhanced risk model that combines the main ideas of the Standard Risk Model with the basics of tree analysis in order to analyze uncertainties in new product development. Furthermore, we operationalize the application of the model by the use of Multiple-Domain Matrices.

13:30 – 15:00 Session 2a: Design Organisation, Management and Theory

Design for Value Chain – An Integration of Value Chain Requirements into the Product Development Process

Max Brosch, Gregor Beckmann, Marc Griesbach, Jörg Dalhöfer and Dieter Krause

Abstract: Various factors like an increase of the product variety lead to an increase in complexity both at the level of product and the level of the value chain design. A study has identified the need to integrate the supply chain requirements into the product development process. This paper will describe the Design for Value Chain method as well as the findings by applying the approach at Dräger. From the analysis of the value chain, the identification of complexity and its drivers, individual requirements to the requirements engineering

Creativity on demand

Charlotta Linse, Anna Jerbrant and Mats Engwall

Abstract: The purpose of this paper is to analyze how designers perceive that managerial structures affect creativity and efficiency in the design work. The findings indicate that the designers think their creativity is enhanced rather than hindered when each step of the design process has a standardized purpose of what should be achieved.

On Managing Innovation by Design: Towards SMART Methods

Pieter E. Vermaas

Abstract: In this paper innovation by design is characterised schematically and methodological with the aim of analysing how projects of innovation by design can be managed. First, I approach innovation by design from an engineering perspective, and show that the incorporation of innovation into design projects has complicated their management by making these projects less SMART (Specific, Measurable, Assignable, Realistic and Time-related). Second, I consider methods for innovation by design and propose that innovation-by-design projects can be made better manageable, not by making the projects themselves SMART, but by formulating the methodological phases these projects have to go through in a SMART manner.

13:30 – 15:00 Session 2b: Design Methods and Research

An Approach for reducing Variety across Product Families

Sandra Eilmus and Dieter Krause

Abstract: Reducing internal variety in a company needs to move beyond the focus of development of product families, as industrial case studies have shown. To systematically achieve this, a methodical approach is needed to support product designers. Steps and tools from methods for product program planning and product family design as well as basic ideas of modularity, commonality and platform thinking are integrated into an approach for the Development of Modular Product Programs.

Grafimedia sector trembles: can future telling help?

Hanna de Bruin, Jeroen Snoek and Rianne Valkenburg

Abstract: Future telling is a method to help SME's prepare for the future. SME's generally have little time to spare for investigating the future or to formulate viable strategies. This article describes an application of the future telling method. The aim is twofold: first to determine if we can sketch an adequate image of the future in a specific sector, using the future telling method. The second aim is to evaluate if we can help entrepreneurs prepare for the future using scenarios. The future telling method was applied in the Grafimedia sector whose market is changing rapidly and enormously: printed communication is being replaced in an astonishing speed by

digital forms of communication. Some 65 trends were discussed and selected together with some ten SME-entrepreneurs from the Grafimedia sector. Additionally, a literature study on scenarios was carried out. After consolidating the entrepreneurs' visions on the future, a coherent view on the future of the Grafimedia sector emerged. This view laid the foundation for four different scenarios; short stories about four plausible futures. The benefits of the future telling method for the SME's in this case lie in several effects it has shown. The future telling conversations made the future more tangible to the Grafimedia entrepreneurs. The resulting scenarios laid the basis for new future-proof business ideas; cooperation with other companies and facilitation of the interchange of ideas. The evaluation of the future telling method suggests that the method itself is useful and valid. The resulting scenarios help entrepreneurs prepare for the future. To optimise this preparation, literature suggests that varying the form of scenarios could be an interesting next step. The more powerfully scenarios can enhance the participants' empathy for future events, the more relevant the business ideas could be.

Methodical approach for an efficient transition from development to production

Steffen Elstner and Dieter Krause

Abstract: Shorter product life cycles and increasing market competition forces companies to accelerate the introduction of new products into the market. The ability to realize an efficient transfer from development to production is an important factor in the success of a company. The aim here is to develop a methodology for the early identification and minimization of ramp-up risks with the help of response strategies from product development.

13:30 – 15:00 Session 2c: Design Processes

Understanding users in product development

Birgitte Geert Jensen and Helle Antvorskov

Abstract: The consumers expect the packaging to be functional and to fulfil their specific needs in every way. A Danish survey showed that at least 40 per cent experience difficulties, when handling and opening packaging at least once a month, and as a consequence, 16 per cent of the consumers refuse to buy the product next time they go shopping [1]. The issues are worsening due to the expansion of the elderly population in the upcoming decades all over the world. In Denmark the amount of people in the age more than 65 years old will rise to index 170 in 2050 compared to 2010 [2]. It is also noticeable that 680,000 people in Denmark have difficulties and feel pain using their hands, which account for 17 per cent of the adult population [3]. Therefore, the chance of excluding a part of an enterprise's target group is very likely, making easy-to-open packaging more relevant than ever. The project "User-driven Guideline for the Industry: Accessible Packaging for Elderly and Disabled" seeks to address these issues. The main deliverable is a web-based guideline. The guideline contains collected knowledge regarding the attitudes of the consumers and issues to address about packaging design, also, the guideline contains a step by step process to develop easy-to-open packaging. The guideline is constructed in a way that allows the enterprise to pick and choose in respect to the enterprise's needs and competences. The main focus in the development of the guidelines has been to produce a tool that functions in a practical manner instead of communicating the absolute scientific truth. The paper outlines, the user-centred approach taken to address better packaging design and explores the potentialities to deliver innovation from the user's perspective. A concrete case from Tulip Food Company shows that video observations is a tool for user understanding and that the first step towards better packaging, goes through consensus in the organization regarding the need for more easy-opening packaging.

Integrated use of scenario planning and strategic early warning systems to support product engineering processes

Ben Meyer-Schwickerath, Andreas Siebe and Albert Albers

Abstract: In this paper the application of scenario planning and strategic early warning systems is analyzed in the context of product engineering processes (PEP). A review of current literature shows different approaches for the support of certain PEP activities. However, a lack but also a demand for an integrated, overall approach to support PEP is identified. Based on a descriptive case study in four medium sized companies we propose a first prescriptive model for an integrated approach in PEP. The validation of this model is subject to further research and not part of this paper.

Evaluation of Setup Procedures on Mobile Devices based on Users' Initial Experience

Patrick K. A. Wollner, Tanya Goldhaber, Anna Mieczakowski, Patrick M. Langdon, Ian M. Hosking and P. John Clarkson

Abstract: Users' initial perceptions of their competence are key motivational factors for further use. However, initial tasks on a mobile operating system (OS) require setup procedures, which are currently largely inconsistent, do not provide users with clear, visible and immediate feedback on their actions, and require significant

adjustment time for first-time users. This paper reports on a study with ten users, carried out to better understand how both prior experience and initial interaction with two touchscreen mobile interfaces (Apple iOS and Google Android) affected setup task performance and motivation. The results show that the reactions to setup on mobile interfaces appear to be partially dependent on which device was experienced first. Initial experience with lower-complexity devices improves performance on higher-complexity devices, but not vice versa. Based on these results, the paper proposes six guidelines for designers to design more intuitive and motivating user interfaces (UI) for setup procedures. The preliminary results indicate that these guidelines can contribute to the design of more inclusive mobile platforms and further work to validate these findings is proposed.

15:30 – 16:45 Session 3a: Design Organisation, Management and Theory

A literature review of idea management

Anna Vagn Jensen

Abstract: The objective of the paper is primarily to conduct a state-of-the-art literature review of Idea Management and secondary to point out unanswered questions which are left behind in the reviewed literature. Scientific knowledge is primarily represented in innovation management literature but also considerably in literature on software and IT. On the background of the literature review, there are some weaknesses in the literature to be considered. These weaknesses concern the understanding of how people interact with idea management in their daily work practices and how different types of ideas are included or excluded in the idea management processes.

Product Value Metrics and Value-Characteristic Modeling

Chathura Withanage, Taezoon Park, Truong Ton Hien Duc and Haejin Choi

Abstract: The mainstream product value-attribute models can be categorized in to two types, according to exclusion or inclusion of product price in the product attribute/characteristic vector. The characteristic price trade-off is included in popular preference/choice analysis methods, such as random utility analysis and discrete choice analysis, where price is considered as a controllable design variable. The other type of models, customer revealed value models, is focused on modeling a pure characteristic value. Product prices are used as an indicator of value, which is governed by competition and other exogenous factors. The both approaches can be used for the design decision support at the front-end product development. In the presented research study, partial least square path modeling (PLSPM) is used to get simplified meta-models of value-characteristic relationships to compare these two approaches. A data set containing US Sedan market 2008-2010 specifications, prices and sales was used to conduct the case study. The key findings of the research study are 1) using price as a value indicator is suggested in situations where customer attributes are unavailable, and 2) revealed value is a valid overall product value metric for the US Sedan market segment.

Investigating elementary design methods – using pattern recognition methods to define method modules

Sebastian Zier, Nicolas Reiss, Herbert Birkhofer and Andrea Bohn

Abstract: The aim of investigating elementary methods is to increase the acceptance of methodical working in practice by developing a systematic approach for the deduction, description and improvement of design methods. The purpose of this paper is to give an overview about the goals and modularization methods of design methods with the Genome Approach.

15:30 – 16:45 Session 3b: Design Methods and Research

Design for Adaptability – Identifying Potential for Improvement on an Architecture Basis

Maximilian Kissel, Phillip Schrieverhoff and Udo Lindemann

Abstract: Adaptability provides additional value to stakeholders over the whole life-cycle. But the systematic design of product life-cycle properties into complex systems constitutes an ambiguous task. Design for Adaptability (DfA) is an evolving topic in both science and industry. However, the transformation of a system to a desired “amount” of adaptability is impeded by lack of transparency of dependencies among system elements and their vague influence on the properties. Therefore, we present methodology, which allows improving systematically the adaptability of a system. The first step clarifies of the adaptability business case. Then, the system model is generated and analyzed. Dependent on the business case measures for improvement can be derived. At the example of an automotive braking

system for an electric vehicle, we demonstrated the application of the methodology.

A Shared Basis for Functional Modelling

Boris Eisenbart, Kilian Gericke and Lucienne Blessing

Abstract: The presented research aims at contributing to a better understanding of the diverse functional modelling approaches proposed across disciplines, often involving more than one function model. The paper presents a review of 41 systematic design approaches from different disciplines, analysing what is addressed by functional modelling at which point in the proposed development process, i.e. in which sequence, if any. The analysis aims at deriving potential commonalities across disciplines, which could support the development of an integrative functional modelling approach. Finally, the results of the analysis are discussed, concluding that while there seems to be no shared sequence in functional modelling across disciplines, a common base can be derived, with regard to what is prominently addressed by functional modelling in the different disciplines.

Reflective Practice in Design Thinking, Learning and Performing Product and Process Development

Annika Henrich, Anders Wikström and Mats Jackson

Abstract: The entire school system of today has programmed our students to find the only answer that solves the problem. However, we all know that there is more than one solution to a problem. Now we have to relearn how to explore ideas as we did in preschool in order to create different solutions to a problem. Industry realizes that it is becoming more and more important to build bridges to other disciplines as “innovation” and “design” and to build “multidisciplinary” environments to be successful in business and in research. Today’s education in engineering design needs to correspond to the industry need to develop new products and services where innovation and creativity is central. In three cases describing different courses at Mälardalen University a comparison has been performed focusing on educating students for the changing demands within industry today. The results suggest complementary courses in project management with a focus on design thinking.

Interactions for Design - The temporality of the act of use and the attributes of products

Rubén H. Jacob Dazarola; Manuel Martínez Torán, M^a Consuelo Esteve Sendra, Andrés Conejero Rodilla

Abstract: Commonly, and since its inception, the methodology of Industrial Design has considered the “use” of goods as a unique and timeless dimension when seeking to define the characteristics of products, this means that the requirements, features and functions of the products (tangible or intangible) raised in the design process, focus on the main person-object interactions, omitting secondary moments of interaction, such as maintenance, installation, removal, etc.. This work proposes a way to address the interactions between users and objects and provides a theoretical proposal for a classification based on “situations and events of interactions” that are inserted and repeated throughout the life of objects, and so possessing both such importance to the user as the same primary function, and thereby becomes a key to control the definition of the attributes and functions of all kinds in the products.

15:30 – 16:45 Session 3c: Design Processes

Towards describing co-design by the integration of Engineering Design and Technology and Innovation Management literature

Pedro Parraguez Ruiz and Anja M. Maier

Abstract: The purpose of this paper is to provide an overview of the available literature concerning the understanding and improvement of co-design processes. The most pertinent aspects of such processes are presented through an interdisciplinary analysis incorporating contributions from literature in the fields of Engineering Design (ED) and Technology and Innovation Management (TIM). Interactions between design and third parties in a range of co-design situations are examined via a targeted literature review, and a map is developed containing a network of keywords. As a result of this review, key aspects from the literature are summarised and connected through an initial framework characterising the what, when, who, how and why of co-design. The research motivation arises from the Danish Industry Complex Cleantech Solutions initiative and its need for a conceptual background that integrates the multiple perspectives addressing co-design.

Design Thinking and Aesthetic Meaning-Making: Interlaced Means to Engage in Collaborative Knowledge-Building

Mithra Zahedi, Tiitu Poldma, Ehsan Baha and Tim Haats

Abstract: Engaging in knowledge building that is collaborative and that integrates design thinking among interdisciplinary teams is increasingly a means to innovate in product and service design and in business. However, the actual ways this might be accomplished are challenging. These questions are important ones for design educators, researchers and practitioners. This paper studies the question from an educational point of view. It examines what happens when two design researchers and educators, one from an industrial design background and the other a design process oriented background, animate a workshop and how the participants roleplaying various stakeholders engage in design thinking, both as a discovery strategy and through the concept of 'aesthetic meaning-making'. The workshop aims were to improve collaborative design thinking skills and to explore how a team of experts and non-experts interact within a design project to achieve consensus on goals. During the workshop participants became at once users and makers of emergent results. Two of the participants add their perspectives on how, in this scenario-based workshop project, the exchange of knowledge and learning occurred through both their phenomenological experiences and the collaborative inquiry. They also explain how collaboration among their respective teams resulted in their innovative propositions. Design thinking, complex project scenarios, and collaborative inquiry within interdisciplinary teams, in the context of design education, form the framework of this paper. The process is described, both in terms of the theoretical framework that underlies the concepts of meaning-making with users and as a form of engaging in experiential knowledge generation. The theoretical framework and workshop description introduce these concepts and the workshop engagement and results are presented, with perspectives from the workshop creators, the animator and the participants themselves.

Open Source Development of Tangible Products

Asta Fjeldsted, Gudrun Adalsteinsdottir, Thomas J. Howard and Tim McAloone

Abstract: This article's objective is to set up some foundational theory and practices for Open Source Development (OSD) of tangible products, a novel and emerging approach derived from the well-known open source software movement. As a contribution to the first steps of research in this discipline a clear definition for OSD is proposed and used to describe the key elements of a suggested OSD Process model. Several case studies are analysed to create an Archetypal Business Model characterising OSD of tangible products and the possibilities and delimitations within. Furthermore, strategic tools are suggested for companies that wish to explore the potentials OSD brings which form a so called OSD Method. The result of the method is the OSD Strategy and implementation thereof. This is done with the objective of determining the potential profitability that lies within OSD of tangible products and how companies can utilise this new approach to improve their business models and capture value in innovative ways.

17:00 – 18:15 Session 4a: Design Organisation, Management and Theory

Mapping the added value of design thinking in social entrepreneurship

Brita Fladvad Nielsen and Jonas Asheim

Abstract: Social designers and social entrepreneurs aim at improving life quality locally and globally. As research on social entrepreneurship is intensified in the Nordic countries, it is important also for designers to understand what their role is and can be compared to the social entrepreneur; as well as for social entrepreneurs to understand the value of design thinking in their efforts. This article extracts an updated portrait of the social designer based on interviews, before it compares it with the image of the social designer. A central finding is that social design adds a sustainable, less resource demanding orientation to the equation. Finally it reflects upon how this companionship could be improved.

An Architecture Framework for Multi-Product Portfolio Management in the Commercial Vehicle Industry

Simon Plaikner, Maximilian Kissel, Matthias Kreimeyer and Udo Lindemann

Abstract: In the field of commercial vehicle manufacturing, the functionality and complexity of products rises steadily while innovation cycles become considerably shorter. In addition, customer orientation causes rising external complexity of product portfolios. Without the moderating and managing role of an architecture department within a corporation these diversified markets drive a multi-product development towards increased inner complexity which cannot be handled efficiently anymore. In this paper, we address the role, necessary tasks and methodologies of a product architecture department at a commercial vehicle manufacturer. A so called Architecture Framework is presented that helps to cope with the organizational complexity in the field of product development by structuring work processes and assigned tools. For that, we reflected the requirements of a commercial vehicle manufacturer towards an Architecture Framework to existing solutions in literature. The advantages of each concept were consolidated. The suggested framework was prototypically tested in an industrial environment.

Enablers & Barriers for Realizing Modularity Benefits

Simon Haahr Storbjerg, Thomas Ditlev Brunoe, Jesper Thyssen and Steffen Nordahl Joergensen

Abstract: Although modularization is becoming both a well-described domain in academia and a broadly applied concept in business, many of today's firm still struggle to realize the promised benefits of this approach. Managing modularization is a complex matter, and in spite of this, a topic that has received far less attention compared to the theories and methods concerning modularization of technical systems. Harvesting the full potential of modularization, particularly in relation to product development agility, depends on more than an optimal architecture. Key enablers in this context are the organizational and systems related aspects. Recognizing the need for guidance to realize the benefits of modularity, the purpose of this study is through a literature study and a case study to improve the insight into the organizational and systems related enablers and barriers with regard to obtaining the full potential of modularization in terms of product development agility.

17:00 – 18:15 Session 4b: Design Methods and Research

Most Advanced Yet Acceptable, but don't forget

Ehsan Baha, Yuan Lu, Aarnout Brombacher and Koert van Mensvoort

Abstract: Radical product and/or service innovation can ideally benefit all people and firms, and society as a whole, but pose risks in regards to technology-, industry chain-, market-, and project- uncertainty. In this paper we focus on addressing market uncertainty and argue that this uncertainty affected by the meaningfulness of radical product and/or service innovations due to meaning gaps created during the innovation process. We investigate and suggest ways to bridge such gaps through theory inspired research using a design case study. Results show that in addition to introducing new meanings next to existing meanings, one should also select what meanings to dispose and which (lost) meanings to potentially re-introduce. With this work we hope to inspire design and innovation thinking on how to improve radical innovation adoption by addressing meaning gaps caused during the radical innovation process.

A shape grammar approach for automotive styling: the case of the French cars

Jean-Bernard Bluntzer, Egon Ostrosi and Jean-Claude Sagot

Abstract: Today, an important quality of a brand or a strong family is its clear and precise identity. Moreover, in order to obtain a winning brand, the company managers should continuously be innovative without forgetting the product history of the brand and should use the culture of the country like a value system and as inspiration background. In this paper, we analyze a selection of French cars from the Peugeot, Citroën and Renault branch. The proposed methodology is based on the extraction and the analysis of characteristic styling lines of the cars. We deducted from this approach that a French identity is available. With the comparison with the German lines, we exposed that specific lines are particular to French car. We have considered that the characteristic lines of the car, the joint elements and the connection elements formalize a French language. The finite generic description of this language was done by a car grammar. To maintain and develop the French identity of a brand or a family brand, a computer based system of future lines based on elementary primitives reflecting the car identity is under development.

Opportunity Design: what, where and how?

Louise Møller Nielsen, Astrid Heidemann Lassen, Christian Tollestrup and Suna Løwe Nielsen

Abstract: Creating and growing new businesses is fundamentally about turning good ideas into future business. However, this requires an entrepreneurial opportunity to be exploited via a valid strategic and organizational design. So far, literature has mainly focused on identifying approaches and methods for the strategic and organizational design, whereas the emergence of opportunities has mainly been of a descriptive character. Even if, some of the central characteristics of the opportunity recognition process have been identified, there is still a lack of approaches, methods and tools, which can support new entrepreneurs discovering the great entrepreneurial opportunities. By looking at industrial designers working with entrepreneurial opportunity recognition, it becomes evident that there is a set of approaches, which can turn the opportunity recognition into an intentional and proactive process. We name this intentional and proactive approach to the opportunity recognition process: opportunity design. In this paper, we make an initial effort to define opportunity design, and identify some of the specific approaches applicable to the design of opportunities.

17:00 – 18:15 Session 1d Design Processes and Knowledge

Modelling and using product architectures in mechatronic product development

Hans Peter Lomholt Bruun and Niels Henrik Mortensen

Abstract: The objective for the paper is to determine the role of a product architecture modelling tool to support communication and to form the basis for developing and maintaining product structures for improving development practices of complex products. This paper contains descriptions, observations, and lessons learned from a case study in which the author tested a modelling tool to represent a product's architecture during product development in a larger Danish company. The reasons leading to the use of the specific model and its terminology is described and illustrated. The paper supports two fundamental theoretical viewpoints; Theories of technical systems and theories of design processes. In this framing, the paper addresses the engineering activity of developing products supported by product architecture representations. The paper includes the description of a visual architecture representation, experiences by using the architecture representation in a mechatronic development project, and the scope of using the architecture model as a skeleton for a data structure in a PLM system. The fundamental idea for planning and modeling holistic architectures is that an improved understanding of the whole product system, will lead to better decision making. Moreover, it is discussed how the sometimes intangible product structures within a architecture can be visually modeled based on the assumption that knowledge about a product's architecture has to be tangibly instantiated, in order for people and decision makers to successfully share it and use it.

Integration of aerodynamic simulation and design in conceptual automotive development

Mario Hirz, Martin Prenner and Severin Stadler

Abstract: Conceptual automotive development processes are characterized by a wide range of different working fields and influencing factors, which leads to the participation of diverse departments and disciplines. An optimized interaction of the involved parties based on efficient collaborative development processes, using computer aided tools, methods and strategies states an important factor for a successful development. The present publication focuses on the optimization of aerodynamic investigations in conceptual vehicle development. The main characteristics of aerodynamics are determined during initial development phases, because the early vehicle styling process defines the general shape of the car's outline. An early optimization of the vehicle main shape by use of computational simulation methods enables the effective consideration of aerodynamic requirements during the exterior styling development phase. This procedure enables a reduction of modification effort in subsequent engineering processes.

A process model for the design analysis clarification task

Håkan Petersson, Martin Eriksson, Damien Motte and Robert Björnemo

Abstract: Many product development projects nowadays use computer-aided engineering systems in the analysis of product proposals. It is therefore important to appropriately integrate the analyses activities in the product development process. One important aspect of this integration is how to handle the initiation of the task: identifying the need, planning the task and its monitoring, and communicating it to the analyst. To that end, this paper proposes and illustrates a product development process model that aims to efficiently and effectively prepare a design analysis task.

Thursday August 23

10:30 – 12:00 Session 2d: Design Processes and Knowledge

Knowledge-based geometric modeling in construction

Martin Bonev and Lars Hvam

Abstract: A wider application of IT-based solutions, such as configuration systems and the implementation of modeling standards, has facilitated the trend to produce mass customized products to support inter alia the specification process of the increasing product variety. However, not all industries have realized the full potential of using product and process modelling tools as well as the implementation of configuration systems to support their business processes. Especially in the building industry, where Engineer-to-Order (ETO) manufacturers provide complex custom tailored products, up to now, often a considerably high amount of their recourses is required for designing and specifying the majority of their product assortment. As design decisions are hereby based on knowledge and experience about behaviour and applicability of construction techniques and materials for a predefined design situation, smart tools need to be developed, to support these activities. In order to achieve a higher degree of design automation, this study proposes a framework for using configuration systems within the CAD environment

together with suitable geometric modeling techniques on the example of a Danish manufacturer for precast concrete elements.

Investigating the importance of sustainability information in Product Development and Design

Silje Helene Aschehoug, Geir Ringen, Casper Boks and Knut Einar Aasland

Abstract: To further improve the sustainability performance of products, a sustainability information framework beyond mere product and process data has been developed. This was done under the assumption that access to and use of such information may increase firm knowledge on sustainability issues as well as firm ability to develop sustainable products, and thus enhance competitiveness by adding value to products beyond functionality, quality, and cost. The present article reports the results from two case studies in the Norwegian furniture industry. Categories of sustainability information which firms find most important and relevant to product development and design has been identified, as well as factors influencing accessibility of such information. Systematically identifying and compiling sustainability information in the way proposed by the framework is suggested useful for developing requirements and specifications, for general decision support, and for generating knowledge that may inspire entirely new product meanings

Definition of comfort in design and key aspects- A literature review

Stavros-Konstantinos Stavrakos and Saeema Ahmed-Kristensen

Abstract: Comfort, is an important issue in the design of many consumer products, in particularly those with physical contact with the consumer, e.g. headsets or chairs. In the scientific literature the definition of comfort is under debate. Comfort and discomfort are terms widely used and specifically understood but lacking generally acceptable definitions that make them easy to account for in the design process. (Vink, 2005) Comfort composes of physiological, physical and biological factors (Looze et al, 2003). The research aims to understand the factors that constitute comfort (within the context of product design), and understand those that can be influenced by the design of a product. An attempt will be made to set a general framework towards the definition of comfort and identify the different dimensions strongly linked to comfort. This paper describes a review of literature from the fields of design, experience design, applied ergonomics, human factors and human - machine interaction. The paper reviews definitions of comfort, from the absence of discomfort to the enhancement of comfort as a result of an interaction with a product. The paper proposes a definition and some key concepts of comfort that can inform designers to products with higher levels of comfort. A literature review has been carried out to investigate comfort. Two, possibly contradicting, views towards the definition of comfort are expressed: comfort is seen as the absence of discomfort (Hertzberg, 1958), and comfort is enhanced by using a product. From the literature review it can also be seen that comfort is an interaction between the user, the environment and the product. Investigating those three dimensions in a combination with a generally accepted notion of comfort could provide a general assessment of comfort at the early stages of the development phase.

IMPLEMENTING THE PRINCIPLES OF SET-BASED CONCURRENT ENGINEERING IN CONFIGURABLE PRODUCT PLATFORMS

Dag Raudberget, Peter Edholm and Magnus Andersson

Abstract: This paper describes a new design approach that implements the three principles of Set-based Concurrent Engineering by using the concept of Configurable Component modelling. Several case studies has proven the efficiency of Configurable Component modelling as well as the Set-based philosophy, and by combining these two research areas, a computer based modelling of Configurable Component objects is used to support the Set-based philosophy. The approach is demonstrated by a case study that indicates a promising future of combining Set-based Concurrent Engineering with Configurable Component modelling for re-design problems.

10:30 – 12:00 Session 1e: Design Methods and Systems

Using the Contact and Channel – Model for the methodical development of lightweight solutions

Benedikt Posner, Hansgeorg Binz and Daniel Roth

Abstract: In literature there are several lightweight approaches, such as conditional, conceptual or material lightweight design. But the challenge for the designers is to use the suitable lightweight approach and to develop a lightweight solution for their product. In this paper, an approach for a method which supports the designer in a systematic finding of lightweight solutions will be presented. In order to realise a method for developing lightweight solutions, the Contact & Channel - Model will be adapted.

Towards a Process Model for the Development of Light, Mechatronic Products

Abstract: Existing process models for the development of mechatronic systems do not consider the task for weight reduction and its positive effects for the manufacturing and usage phase of systems, e.g. savings in resources and energy. Lightweight design only often represents an optimization step after the product development which leads to problems like restricted functionality, increase of development costs and development time or quality. In this paper, a process model on the basis of the known V model of the guideline VDI 2206 is developed whereas weight reduction is no longer seen as optimization task at the end of product development. Instead, it will be integrated into the process itself and will be evaluated within several analysis steps which are distributed over the design procedure.

Reliability-Based Optimal Design of Thermal Actuated Compliant Valves

Masakazu Kobayashi, Yamato Fukui and Masatake Higashi

Abstract: In recent years, compliant mechanisms have been paid to attention as new mechanisms to replace traditional rigid link mechanisms. Compliant mechanisms achieve a specified motion by deforming the structure elastically instead of relying on joint movements. Compared to traditional mechanisms, compliant mechanisms have several merits due to their monolithic structure without joints. Thus, the use of compliant mechanisms in mechanical products, medical instruments and MEMS can be expected to increase. For such promising compliant mechanisms, although many design methods have been developed, their reliability is not sufficiently considered. Since compliant mechanisms are quite different from traditional mechanisms, it is difficult to configure safety factor empirically. Thus, in this research, optimal safety factor, one of reliability-based design optimization (RBDO), is introduced into compliant mechanism design. In compliant mechanism design, there are two important criteria: output displacement and stress, but traditional OSF considers only single reliability. Thus, existing OSF is extended to allow for considering multiple reliabilities. In the case study, the proposed method is applied to a design of a thermal actuated compliant valve used for a micro water cooling system.

Design, analysis and testing of a 5-axis solution for water jet cutting

Kjell Andersson, Asim Kutlu, Markus Langenoja, Jonas Rosengren and Mario Sosa

Abstract: Abrasive water jet cutting is a technique which utilizes water mixed with abrasives, projected at high velocities to cut a wide range of materials. With a 5-axis solution for angled cutting chamfered cuts of material e.g. for parts that later are going to be welded and thus reducing one manufacturing step can be performed. This paper reports project work made in the MF2004 Machine Design advanced course at KTH. It describes the design and analysis of a first prototype (alpha prototype) of a 5-axis solution as well as the design of a second prototype (beta prototype). The selected concept is a tool center point (TCP) solution where the chamfer angle is realised by two rotations and the TCP position is independent of these rotations.

10:30 – 12:00 Session 1f: Design Support Tools and Human Behaviour

Tolerance analysis of mechanism taking into account the interactions between deviations using meta-models

Michael Walter, Tobias Sprügel and Sandro Wartzack

Abstract: A product's functionality depends largely on the interaction of its components and their geometries. Hence, tolerance analyses are used to determine the effects of deviations on a functional key characteristic – also for mechanism. However, possible interactions between the different deviations and the resulting effects among themselves as well as on the functional key characteristics are not considered yet. This paper considers the extension of an existing "integrated tolerance analysis of systems in motion" approach in detail: The integration of meta-models, which represent the interactions, into the system's functional relationship. Therefore different meta-modeling techniques as well as validation techniques are used. Consequently a recommendation can be derived, how the product developer can achieve a high prediction quality of the meta-models and therefore a reliable tolerance analysis of mechanism taking into account the appearing interactions.

Architecture and realization of a self-learning engineering assistance system for the use within sheet-bulk metal forming

Thilo Breitsprecher and Sandro Wartzack

Abstract: Substantial efforts have been taken in the past to integrate manufacturing related and design-relevant knowledge into the product development process. A common approach is to provide this knowledge to the designer by implementing a knowledge-based system (KBS), an expert system or, as it is referred to in this submission, an engineering assistance system. Keeping the knowledge base of this KBS up to date is a central issue and the necessary knowledge acquisition the

bottleneck within the development and maintenance process of a KBS. This applies especially for KBS applications where the knowledge can be considered as dynamic, that is the design- and engineering-relevant knowledge changes within short periods of time. In this paper the emerging manufacturing technology sheet-bulk metal forming (SBMF) is taken as the background for the development and application of an engineering assistance system. To overcome the bottleneck of knowledge acquisition the architecture of the presented assistance system is equipped with a self-learning component, based on knowledge discovery in databases applications.

Towards Life-Oriented Evaluation Support of 'Interface Concepts'

Lawrence Farrugia and Jonathan C. Borg

Abstract: The evaluation of design concepts is a critical early design stage with potential ramifications on subsequent lifecycle phases. During this stage the engineering designer is typically required to evaluate multiple concepts with respect to conflicting criteria. Over the years academic research proposed numerous concept evaluation techniques in order to support the user at this critical stage. Yet this has yielded an additional problem in which the inexperienced user needs also to be guided in the selection of the appropriate concept evaluation technique. The research presented in this paper has the long-term objective of providing computer support to the user on 2 levels: the evaluation of design concepts and the selection of the appropriate concept appraisal technique. The research, presented in this paper focuses on the development of an approach for the evaluation of module interface design concepts.

Project methodology for elaborating a Spatial Augmented Reality tool for acting as a creative resource for designers and artists

Vicente Chulvi, Francisco Felip, Carlos García, Diego Díaz, Julia Galán and Elena Mulet

Abstract: The objective of this work is define a framework in order to raise a methodology for analyzing the effect of Spatial Augmented Reality (SAR) in the creation of indoor spaces, both at creative and emotional level in designers and artists, as well as in the design itself obtained. The potential of the SAR as a tool for designers and artists requires of rigorous analysis to demonstrate that the use of new and innovative applications of Augmented Reality in the creation of an indoor space is useful as an element of expression and it enriches the creative capacity of the designers and artists. The initial idea is based on building a 'white box' cabin, in which the user is placed. On its walls and primary volumes we will project images with which users can interact by using their own body movements. In this way, the communication with the virtual environment could be carried out in an intuitive and gestural way, allowing unspecialized users to interact with the environmental elements and removing any technological constraint. Also, to be immersed in a physical space where the environment itself acts as a tool will clearly change the concept of 'workplace' by eliminating everything that could cause problems for the creative task. This paper defines the framework for studying the effect of the SAR in the design of indoor spaces. This definition includes identifying the phases of the study and selection of the most appropriate technologies for the development of the experimental prototype.

13:30 – 15:00 Session 3d: Design Processes and Knowledge

Cognitive Problem Solving Behaviors of Design Teams In Different Tasks

Ayhan Ensici, Prof. Nigan BAYAZIT

Abstract: In this research, the design processes employed in three different design tasks that are undertaken by a design team are analysed. Cognitive behaviors of the design team have been observed in an experimental environment to fix individual and environmental factors. The team problem solving behaviour is also put under scrutiny in the context of the decision making cognitive acts that are displayed during the design processes. TCTA (Team Cognitive Task Analysis) approach has been utilized in order to ensure the applicability to practice and validity of the results of the study. The design processes employed in the Routine, Innovative and Original design tasks by design team are observed to be able to describe the effects of the various design tasks over the problem solving behavior and cognitive decision making processes.

Decision making is accepted as the most critical step in the problem solving process. In this research the analyses cognitive processes have been done by defining cognitive decision components and the actions appeared under these components. Design team developed different numbers of design decisions during the three tasks although they have spent similar amount of time for each of the task. Every verbal utterance produced by design team members in three design processes has been transcribed and coded by pre-defined decision component categories and cognitive actions. The results posit that there is not any regular relation between design tasks and decision components. Designers in the team were more satisfied from design process and the decisions they made with decrease of their familiarity to the tasks. If the team design processes in all design tasks are considered, it is obviously could be seen that design team tend to be more 'solution oriented' when the design problems' solution space gets wider. In other words design team focuses to the solutions more when solving problems with wider solution spaces.

Bringing Knowledge Oriented Engineering to Design Practice

Michael Vielhaber and Jonas Haupenthal

Abstract: The significance of knowledge in the process of engineering design is often underestimated, disregarded in methodologies or neglected due to operational constraints. This paper presents knowledge oriented adaptations to the scientific engineering process model of VDI 2221 as well as a knowledge oriented reengineering approach to be applied on real industrial design processes.

The Influence of Design Reasoning towards Business Strategising and Innovation

Andre Liem

Abstract: The objective of this article is to reflect six models of “Design” reasoning against the four generic perspectives of business strategising. The selection of these six models was based upon their relevance for design practice. The models are: Problem Solving, Hermeneutic, Reflective Practice, Participative, Social and Normative.

Through heuristic comparisons of Business Management and Design Thinking literature, similarities can be found among “Business Strategising”, “Design Strategising” and “Designing Thinking”. Furthermore, it can be concluded that from an “Innovation mode of thinking”, typical models of design thinking and reasoning show similarities with the four strategic perspectives as illustrated in Whittington’s matrix.

The relationship between strategy perspectives and models of design reasoning can form a reference for business managers, design managers and designers on how to plurastically develop innovation strategies. In this context the term “plurastic” should be interpreted from a more nuanced perspective, considering short-, and long term, as well as “egoistic” and “altruistic” ambitions of the organisation.

Finally this article aims to argue for connectivity among “Business Strategies”, “Philosophical Worldviews” and “Models of Design Reasoning” through narrative methods, such as story telling.

A sustainable, industry-oriented Concept for an integrated Project in Bachelor and Master Education in Mechatronics

Peter Leibl, Albert Seemüller and Alexander Steinkogler

Abstract: The paper describes the differences in the theoretical background, methods and steps during the project works and the differences between the bachelor and master projects in the field of mechatronics. Moreover, the application and the results of the projects are discussed, with emphasis on the link to actual engineering environments in the engineer's world outside the University. Furthermore, the different size of the groups, structures and substructures of the teams, as well as the according assistance of the lecturers are explained. Furthermore concrete examples are explained and discussed in this paper.

13:30 – 15:00 Session 2e: Design Methods and Systems

Design and evaluation of a concept for storing thermal energy

Kjell Andersson, Kaviresh Bhandari, Simon Chamoun and Katrin Engel

Abstract: Thermal energy storage technology is a promising power source for peak-power requirements in automotive applications as well as for small-scale combined heat-and-power generation. This paper reports project work made in the MF2004 Machine Design advanced course at KTH and describes the design, realization and experimental testing of a concept for storage of thermal energy. The test results were compared to the theoretical model described in the patent application of a steam buffer [1] as developed by RANOTOR AB [2] in Sigtuna, Sweden. The experimental results proved to be in correspondence with the predicted behaviour, which indicates proof of concept.

Nature-inspired Process Model for Concept Selection and Evaluation in Engineering Design

Manuela Iulia Parvan, Florian Miedl and Udo Lindemann

Abstract: A main challenge in engineering represents the evaluation and selection of concepts in the early phase of product development. This decision making process is highly complex due to the various influence factors that have to be considered simultaneously. Actual methods used involve much know-how and experience and often imply an increased work effort and costs. To overcome these challenges a more effective concept selection process is needed. In this paper an intuitive and easy to apply method for concept evaluation and selection in engineering design is presented. The method is based on selection mechanisms found in nature and can be used in engineering and other related disciplines for concept development and information filtering. The collected and adapted selection

mechanisms from nature and engineering are embedded within an application process. The user can apply the nature-inspired process model to evaluate the designed concepts by using tailored K.O.-criteria. The functionality of the process model is tested within two scenarios.

Assembly Target specific Structuring of modular Product Families

Niklas Halfmann and Dieter Krause

Abstract: The structuring of products is awarded the highest potentials for assembly effort reduction of variant product families. A research in corresponding literature in the field of engineering design shows deficits of the approaches regarding systematic applicability, consistency and validation of the proposed structuring measures. In this paper a methodical procedure is presented that intends the application of measures based on an analysis of the actual design for assembly targets. These measures are represented by a defined product model including chosen product attributes. Thereby, the impacts of the measures taken can directly be evaluated providing a validation of the initial design for assembly targets. The application to an exemplary product proves further potentials of the presented developed procedure regarding ergonomic application and significance of the results.

Factors Affecting to Exploitation of Modularity

Jouni Lehtinen, Timo Lehtonen, Tero Juuti and Asko Riitahuhta

Abstract: Utilizing the benefits of modular products is an industrial phenomenon that has emerged in second quarter of 20th century. This was made possible by developments in manufacturing technologies such as standardized quality of materials, tolerance levels and methods that enabled benefits through repetition. There are many examples in history where modular products have turned out as success stories. Equally, there are many examples of modular product that have never proceeded beyond prototype stage and have ended up as commercial failures.

In this paper we discuss the factors that affect to exploitation and success of modularity. In previous research several factors, based on business and technological issues alike, have been presented. However, these factors do not really explain the success or failure of cases presented in this paper which represent equipment in capital goods sector; locomotives with electric traction, bus manufacturing and shipbuilding. These cases are explored with two questions in mind: is the size or weight of the products limiting modular approach and are the factors effecting modularity due to internal product characteristics or external properties such as business environment?

In our conclusion we present that the ruling factor affecting modularity is the existing business environment. However, increased size of products typically has effect to manufacturing technologies due to challenges in tolerances and required investment to manufacturing facilities thus requiring manual work which hinders repetition in manufacturing and modularity benefits.

13:30 – 15:00 Session 2f: Design Support Tools and Human Behaviour

Hybrid Design Tools Intuit Interaction

Robert Wendrich

Abstract: Non-linear, non-explicit, non-standard thinking and ambiguity in design tools has a great impact on enhancement of creativity during ideation and conceptualization. Tacit-tangible representation based on a mere idiosyncratic and individual approach combined with computational assistance allows the user to experiment, explore and manifest their ideas, fuzzy notions and mental images. One of the most difficult tasks of individual users is the externalization of tacit knowing, tacit expectations, and metacognitive feelings. Simply put, to bring your imagination alive you need encouragement, nudging, decision-making and trigger intuition. In our research we focus on the metacognitive aspects of user interaction and tool use wherein the wheels of causality are set off through coincidence, unpredictability and unexpected events. The hybrid design tools we author and build are based on the human intuitive capacity and sensory abilities to immerse in physical manipulation and tangible representation to enhance creativity and ideation process. Simultaneously we embed and implement computational design tools that assist and nudge the user during the process to represent the conceptual models, data mapping and transformative information. This transformation has a consequence of exercising the full cognitive abilities and reinforces the insight in understanding and knowledge about the problem definition and solution space. Working visually and sensory is a complex process that includes spatial information, multi perception and manual dexterity.

Addressing Experience in Design Research: The case of young children as users of medical products

Marikken Høiseth

Abstract: The focus on people's experiences with products is gaining increased attention in the design research community. Currently, research and discussions on

user experience revolve mainly around everyday consumer products. However, there is a need for more knowledge about people's experiences with products that they are compelled to use for medical reasons. This paper draws attention to people's experiences with medical products from a design research perspective. It analyses experience components and concepts and relates them to the case of young children as users of medical products. The goal of the paper is to analyse and assess the suitability of these concepts for that type of products and suggest categories that support an experience-based approach when designing for young children as users of medical products.

EMOTIONAL PROSTHETICS: Artificially replacing physical manifestations of emotions to enhance Mother-Son multisensory bond inside Neonatal intensive care environments

Camilo Anabalón

Abstract: This paper present the development, application and the use of it to inform later design efforts, of a tool to assess preverbal communication between mothers and their preterm newborns.

User centred design for mobility aids

Johanna Schmidt, Marcell Illés, Kristin Paetzold

Abstract: Products for elderly people are often not very usable. In this paper a case study is described, where users of walkers were asked how satisfied they are with their walking aid and which problems they experience. The outcome of this was not only a better understanding of the users in handling their walkers, but some difficulties in using interviews as method to get requirements could be detected.

15:30 – 17:00 Session 4d: Design Processes and Knowledge

New Opportunities for Norwegian Wool: An Investigation of Product and Market Possibilities

Birgitte Linde Røsvik and Casper Boks

Abstract: This paper aims to provide knowledge on how Norwegian wool can contribute to a more environmental sustainable textile consumption and increase value creation in Norwegian wool production, textile industry, retailing and design. In the context of this project, the present paper reviews existing research on Norwegian wool and the physical properties of the material in order to investigate if there are other possibilities to utilize Norwegian wool. Existing research seems to focus on wool in the setting of clothes, even though the Norwegian wool is not suited for next-to-skin clothing. As the market for traditional knitted products is limited, it is necessary to differentiate Norwegian wool from the softer qualities like merino, and find areas of use that truly benefit from the properties of the Norwegian wool. The paper also addresses how some of the barriers and misperceptions facing the wool industry can be changed through marketing and product design, which is exemplified by the development of a woolen space divider, emphasizing wools acoustical properties and ability to regulate indoor air humidity.

Retrieving knowledge and information by using a systematic search interface – an industrial case study

Thomas Luft, Sandro Wartzack

Abstract: Knowledge and information are nowadays the most important factors for the development of modern and innovative products. Therefore the efficient management and contextual supply of knowledge is nowadays becoming increasingly essential because more knowledge and information needs to be considered by engineers. However, there are a variety of problems in handling and retrieving knowledge and information in particular in the engineering design process. Existing IT systems do not meet the requirements of the users or do it only in an insufficient way.

In this paper which is based on an industrial case study the identification and in particular the classification of "Knowledge and Information-Objects" of the considered company is described. These two steps are one of the most important preconditions for a holistic and computer-based knowledge management system from a management and a supply oriented view. In order to customise a systematic search interface that meets the requirements of the employees, an appropriate number of workshops with experts from different departments have to be organised. The focus of this paper is on a (combined) content- and source-based systematic search interface for knowledge and information retrieval.

Analysis and Visualization of Product Data for Decision-Making in Product Improvement

Susanne Dienst, Madjid Fathi

Abstract: Nowadays rapid growth and changes of technologies approaches particularly in product development is observed. Such movement is partially due to global need of knowledge exchange and knowledge transfer among various industrial stakeholders and organizations. In this context, feedback data (objective or subjective) from the product use phase or customer shall be utilized for improving the next product generation. Within the scope of this paper, the mentioned process is conceptually revealed and elaborated. Therefore certain phases are distinguished, which have to be accomplished towards recommending possible solutions, and providing relevant data for decision-making. The entire process supports product developer to effectively manage decision-making activities.

15:30 – 17:00 Session 3e: Design Methods and Systems

A Market Systems Analysis of the U.S. Sport Utility Vehicle Market Considering Frontal Crash Safety Technology and Policy

Steven Hoffenson, Bart Frischknecht and Panos Papalambros

Abstract: Active safety features and adjustments to the New Car Assessment Program (NCAP) consumer-information crash tests have the potential to decrease the number of serious injuries on United States (U.S.) roadways each year, according to previous studies. However, literature suggests that risk reductions, particularly in the automotive market, are often accompanied by adjusted consumer risk tolerance, and so these potential safety benefits may not be fully realized due to changes in consumer purchasing or driving behaviour. This article approaches safety in the new vehicle market, particularly in the Sport Utility Vehicle and Crossover Utility Vehicle segments, from a market systems perspective. Crash statistics and simulations are used to predict the effects of design and policy changes on occupant crash safety, and discrete choice experiments are conducted to estimate the values consumers place on vehicle attributes. These models are combined in a market simulation to forecast how consumers respond to available vehicle alternatives. The model is tested for a scenario where active safety features are implemented across the new vehicle fleet and a scenario where the U.S. frontal NCAP test speed is modified. Results exhibit evidence of consumer risk adjustment and support adding active safety features and lowering the NCAP frontal test speed, as these changes are predicted to improve the welfare of both firms and society.

Technical Evolution Process - An Approach for Product Development and Optimization

Roland Lachmayer, Bastian Sauthoff and Philipp Gottwald

Abstract: The question how to combine conceptual changes with optimization strategies and life cycle information to implement semi-automatically design changes regarding real environmental conditions in product development is still a challenge. The presented approach of an evolution-based development outlines a framework to get on step closer to computer-aided design variation. Instancing the bicycle important aspects like product representation, optimization strategies as well as the invariance of feedback variables are focused in detail.

Calculation of Complexity Costs - An Approach for Rationalizing a Product Program

Christian Lindschou Hansen, Niels Henrik Mortensen, Lars Hvam and Ulf Harlou

Abstract: This paper proposes an operational method for rationalizing a product program based on the calculation of complexity costs. The method takes its starting point in the calculation of complexity costs on a product program level. This is done throughout the value chain ranging from component inventories at the factory sites, all the way to the distribution of finished goods from distribution centers to the customers. The method proposes a step-wise approach including the analysis, quantification and allocation of product program complexity costs by the means of identifying of a number of suggested Life Cycle Complexity Factors (LCCFs). The suggested method has been tested in an action based research study with promising results. The case study shows how the allocation of complexity costs on individual product variants provides previously unknown insights into the true cost structure of a product program. These findings represent an improved decision basis for the planning of reactive and proactive initiatives of rationalizing a product program.

Cost Optimization of Product Families using Analytic Cost Models

Thomas Ditlev Brunoe and Peter Nielsen'

Abstract: This paper presents a new method for analysing the cost structure of a mass customized product family. The method uses linear regression and backwards selection to reduce the complexity of a data set describing a number of historical product configurations and incurred costs. By reducing the data set, the configuration variables which best describe the variation in product costs are identified. The method is tested using data from a Danish manufacturing company and the results indicate that the method is able to identify the most critical configuration variables. The method can be applied in product family redesign projects focusing on cost reduction to identify which modules contribute the most to cost variation and should thus be optimized.

15:30 – 17:00 Session 3f: Design Support Tools and Human Behaviour

Reduction of Uncertainty by Sensitivity Analysis and context-specific Data Processing within Virtual Property Validation

Jochen Reitmeier and Kristin Paetzold

Abstract: Particularly, in the early stages of a development project, designers have to deal with a comparatively high data uncertainty. Virtual product development is essentially dependent on simulation results, which in turn are strongly influenced by the underlying database. In this paper the utilization of sensitivity analysis in combination with a specific data processing is shown. This gives methodical support to reduce uncertainty at hand.

Computer Aided Design as an Idea and Concept Generation Tool in the Early Stages of the Design Process

Andre Liem

Abstract: This article claims that in certain circumstances digital visual representations (CAD) can facilitate a better understanding of the form than sketches and drawings, in the early creative idea and concept generation stages of the design process. Hereby, intensive reflective and processual visualization activities, which immediately renders feedback in computer media influences the designer to generate images more frequently and more precisely in his/her mind, compared to conventional media.

The above phenomenon has led to discussions around two factors, which redefine the value of CAD in an educational context. These factors are:

- Type of students admitted according to academic inclination
- Type of Design Program

Results have shown that students, who were admitted based only upon good grades, were generally poor in (manual) sketching and drawing. However, due to their solid academic capabilities, they demonstrated a strong aptitude towards learning different CAD systems. When merging these students' CAD with their analytical and creative thinking skills, it has been observed that communication and interactions among educators and students in the early stages of the idea development and concept generation stages were more descriptive and at crucial stages supported by surprisingly well developed CAD drawings / models. It is also evident that explicit iteration and gradual development of ideas and concepts supported by sketches were less prominent.

Concerning the type of design program, Industrial Design Engineering type of schools, who advocate a structured problem solving design process, based on Analysis – Synthesis, tend to also support the early implementation of CAD in their processes

Consideration of Anisotropic Material Properties in Mechanical Design within Early Design Phases

Georg Gruber, Daniel Klein, Philipp Ziegler and Sandro Wartzack

Abstract: To achieve the goal of simulating the structural behavior of parts made of short fiber reinforced polymers with satisfactory accuracy and justifiable modeling effort, a new approach adapted to the needs of the early design steps was developed at the Chair of Engineering Design (KTmfk). Hereby, the various effects of material behavior are modeled by overlapping two different material models in one finite element definition. The anisotropic material properties are determined by an injection molding simulation. The complexity of the resulting fiber distribution is reduced to just three values per finite element. The paper's focus is the introduction of an automated method supporting the determination of the numerical material parameter and a new tensor based method enabling the averaging of the complex orientation state. The benefits of the new methods and a validation are presented.

A simplified approach towards integrating biomechanical simulations into engineering environments

Daniel Krüger, Jörg Miehl and Sandro Wartzack

Abstract: In human-centered design biomechanical simulations can be used to predict the characteristics of the interaction between the user and the product in order to optimize the design with respect to ergonomics. However since biomechanical modelling has its origin in medical applications the simulation procedure is not familiar to product designers yet. In this paper an approach towards the integration of an arbitrary biomechanical simulation system into the CAD/CAE engineering environment is proposed. The objective is to enable the analysis of user-product interaction in early design phases based on virtual prototypes. A major focus of this work is the fast acquisition of human body measures and motion sequences using an inexpensive depth imaging device originally designed for entertainment applications.

Friday August 24

10:30 – 12:00 Workshop:

The Delft Innovation Method - A Thinkers Guide to Innovation

Jan Buijs

10:30 – 12:00 Session 4e: Design Methods and Systems

Towards a Classification of Architecture Initiatives: Outlining the External Factors

Christian Lindschou Hansen, Niels Henrik Mortensen, Lars Hvam and Ulf Harlou

Abstract: This paper introduced a set of external factors capturing the contextual differences that set the stage for architecture initiatives. These are derived from a systems theoretical approach recognizing the fact that architecture initiatives should respond the challenges posed by the external environment in which the company and the future product program is operating. The outlining of the factors are based on the conviction that no one-fits-all exists, when it comes to architecture initiatives, and the notion that it is impossible to truly evaluate whether an architecture initiative is good or bad, without including the contextual differences. The purpose of the external factors is to improve scoping and goal setting of architecture initiatives, and improve comparability between- and transferability of knowledge from architecture initiatives. The external factors are a first step towards an actual classification of architecture initiatives.

Bond Graph Modeling and Simulation of Mechatronic Systems

Tufail Habib, Kjeld Nielsen and Kaj Asbjørn Jørgensen

Abstract: One of the demanding steps in the design and development of Mechatronic systems is to develop the initial model to visualize the response of a system. The Bond Graph (BG) method is a graphical approach for the design of multidomain systems. That is ideal for visualizing the essential characteristics of a system. This paper explores the BG method as a modeling approach to develop Mechatronic systems; a case study about the Radar Antenna pedestal drive system is comprehensively addressed. Flow of energy between different functional elements of the system and their causalities are analyzed. Furthermore, model is evaluated through state space equations and simulations are carried out in industrial software tool, such as 20-Sim.

Modeling and Investigation of Electromechanical Valve Train Actuator at simulated Pressure conditions

Tufail Habib

Abstract: In an electromechanical valve actuated engine, the valves are driven by solenoid-type actuators and cam-shaft is eliminated. Control of each valve provides flexibility in valve timings over all engine conditions and achieves the benefits of variable valve timing(VVT).This paper is about investigation of Electro-mechanical actuator at simulated pressure conditions for a single cylinder engine. For this purpose, a scaled down actuator with reduced armature lift and high stiffness springs are being used.Experiments are conducted to measure valve release timings, transition times and contact velocities. Furthermore, discussion about the spring, magnetic, exhausts gas forces and their ability to actuate the system as desired.

ModAn interdisciplinary approach to validate mechatronic systems in early product development stages

Maik Auricht, Boris Beckmann-Dobrev and Rainer Stark

Abstract: A fast and efficient solution for the evaluation of mechatronic systems in early development stages provides Smart Hybrid Prototyping (SHP). It represents an intermediate stage between the digital and the physical prototype. In particular, it allows multimodal experiencing of mechatronic systems, the human is better involved in evaluating the overall system. To demonstrate the concept of the Smart Hybrid Prototyping approach and to evaluate the technological feasibility an example from the automotive industry was chosen: the development of car tailgates.

10:30 – 12:00 Session 4f: Design Support Tools and Human Behaviour

Visualization of simulation-data-based metamodels during the product synthesis

Philipp Ziegler, Alwin Schummer and Sandro Wartzack

Abstract: This research work focusses on visualization techniques to support the product developer at the product synthesis, which can be implemented in a design support tool. The method uses metamodels, which predict approximatively product properties from combinations of characteristics. The metamodel is fitted to simulation data. The visualization enables a deeper comprehension of the correlations between product characteristics and product properties as well as among the properties.

Enabling simulation-based mechatronic design by shifting of activities

Fabio Dohr and Michael Vielhaber

Abstract: Simulation has been used in product development for years. Especially in mechatronics simulation is seen as a key factor due to the high complexity of both process and product. To develop a simulation-based design process for mechatronic systems it is essential to know which tools and techniques for modeling and simulation already exist. In this paper an overview of these tools and techniques is provided as well as a rating for their use in early phases. Finally some initial ideas are presented on how to integrate simulation early in the process.

Information transfer from electrical design to simulation models in Modelica for virtual commissioning

Radoslav Zafirov, Martin Eigner and Thomas Baudisch

Abstract: Objectives/focus/background:

With the industry focusing on adaptive production, the complexity of production processes and production systems is constantly growing. Therefore, efficient interdisciplinary modeling and validation within the engineering process of manufacturing plants is now as relevant as ever. One computer assisted validation method of increasing importance for plant engineering is the Virtual Commissioning. It allows for controller software code to be functionally tested and optimized utilizing a digital simulation model of the whole manufacturing plant. This validation approach is meant to be time-saving, since controller software does not have to be written and tested in the commissioning phase on the spot, after the plant has been physically built and set up. The preparation for Virtual Commissioning on the other hand is a time consuming process. It involves the generation of additional simulation models of a plant, based off of engineering results primarily from mechanical and electrical design. The generation of these simulation models is done for the most part manually in designated simulation tools, different from the typical CAD tools in mechanical and electrical design.

Methods:

Following the model based design paradigm, an approach has been developed, on how to automatically generate plant simulation models by re-using information from electrical design models. The goal of the approach is to avoid redundant manual re-modeling of aspects of the plant that have already been defined in electrical design.

Results:

The simulation models in question are discrete behavioural models created using the Modelica language. A simulation model of the plant can communicate through signal exchange with the Programmable Logic Controller (PLC) during simulations. It consists of behavior models for every relevant plant component (e.g. sensors, actuators), which are managed in internal libraries of the tools used for Virtual Commissioning. A prototype application is presented in the paper, which has been programmed to validate the approach of transferring information from electrical design (using COMOS 9.1) to models for Virtual Commissioning (using ITI SimulationX 3.4 with Modelica) with real plant data.

Conclusions:

Modeling techniques in electrical design and in multiphysics simulation are very similar due to the use of connection diagrams. The information that diagram elements hold is specific for both disciplines. Still, some information that is relevant for both can be re-used to save a great amount of modeling effort. The approach presented in this paper shows the benefit of such information re-use. A discussion on the applicability of this approach in real engineering scenarios concludes the paper.

Social Design, a New Vision for the Disabled Society in Iran. Case Study: Adaptation Of Samand Automobile for Paraplegic People

Farzaneh Eftekhary, Dr. Ahmad Nedayi Fard, Dr. Vahid Chupankareh

Abstract: Nowadays, development consists of new concepts, which are more comprehensive than economic concepts. Development means growth and change. This means that the aspects of development in different social arenas must be seen and the society must step forward as a whole unity. One of the most important aspects of development in every country, which is also one of main goals of developments as well, is to create equal opportunity for everyone in the society to reach higher scientific, cultural and social standards. For presence in the society, certain situations and equipment are needed to be developed step by step in every country. One strategic point is equalization and notice to the needs of all the groups of users of the society. This means that the local societies, small cities and rural places from one side and the disabled people from the other side should become one of the centers of attention in every country from a general point of view. Universal design began with the idea that by covering a larger group of users helps the globalization and improvement of people's life. However, what happened was the design of certain products with high technology for users with special needs. Hence the prime goal of the universal design was not fulfilled. Social design with a new view at the universal design, introduce the group of users as the most important factor in shaping different products. By entering the area of social design, disabled people, low-income communities and potential applications for designing public participatory processes with "less favorable" populations became in the center of attention of the considerable designers, entrepreneurs and social institutes to address this group of users who seemed to be neglected for years and years. Considering the primary ideology in universal design and its positive view to the society, inclusive design and social design were formed to overcome the deficiencies of the universal design and to attract the attention of the designers to the true needs and demands of the special groups e.g. the disabled people in the society. In fact the disabled group is one of the most important groups of users in the inclusive design. In Iran also, the needs of the disabled people has not been addressed and the city environment has the least facilities for their presence. One of the serious demands of the disabled people to enter the society is the lack of means and equipment of public transport. By expressing how to adapt the Samand car for paraplegic disabled people, we will present the sample of a product that has a full independence level for the presence of the disabled person in the city environment.