PRELIMINARY SCHEDULE

April, 2010

	Monday, May 17					Tuesday, May 18					Wednesday, May 19					Thursday, May 20					Friday, May 21	
8:00	Registration					Registration					Registration					Registration						8:30
9:00	D111 Workshop 1: Eco design implementation	D112 Workshop 2: Computational design synthesis	D113 Workshop 3: Re-considering creative thinking in design	D114 Workshop 4: Modelling and management of engineering processes	D115 Workshop 5: Managing structural complexity	Opening					D311	D312	D313	D314	D315	D411	D412	D413	D414	D415	Full day excursion (optional)	9:00
10:30						Refreshment break					Refreshment break					Refreshment break						
11:00						Plenary session D2P					D321	D322	D323	D324	D325	Plenary session D4P						
13:00	Lunch					Lunch					Lunch					Lunch						13:00
14:00	D121 Workshop 6: Engineering design research quality	D122 Workshop 7: Engineering design in mechatronics - supporting multidisciplinarity	D123 Workshop 8: Direction of research on design creativity	D124 Workshop 9: Decision making	D125 Workshop 10: Collaborative design	D231	D232	D233	D234	D235	D331	D332	D333	D334	D335	D431	D432	D433	D434			14:00
16:00						Refreshments					Refreshments					Refreshments						16:00
16:30						D241	D242	D243	D244	D245						Closing						16:30
18:00	Registration																					18:00
19:00	Welcome cocktail										Conference dinner					Farewell party						

Conference workshops
Monday – May 17th, 2010, 09:00-13:00

D111 Workshop 1: Eco design implementation
Chairman: T. McAloone

The Ecodesign workshop will focus once again on a discussion of research methods and approaches aimed to develop products whose manufacture, use and disposal have the least practical effect on the environment. We invite papers on Ecodesign implementation examples, cases and theories and will, based on the presentations of these papers, carry out a detailed discussion of the common state-of-the-art regarding Ecodesign implementation activities and research. Thereafter we will work on creating a proposal for a common Ecodesign research agenda for the Design Society, based on brainstorm, discussion and case presentation. The workshop is organized by the Design Society SIG Eco Design.

D112 Workshop 2: Computational design synthesis
Chairman: K. Shea

Synthesis is a fundamental activity in engineering design and is a central part of the early and conceptual phases. For computational design synthesis, representation is at the heart of both algorithmic approaches and commercial tools. The challenge of representation includes the theoretical decisions to adopt, for example, one that only includes geometry or formalism for defining function. It also includes challenges in how we encode these representations computationally (e.g. as graphs, shapes or strings). Representations define the expressiveness of the design spaces and languages that we can compute and reason about. The results of any computational design synthesis method are bound by these decisions. We invite participants to submit papers to the conference that focus on representations in computational design synthesis, as well as how representation impacts other aspects of computational design synthesis methods such as generation, search, evaluation, and optimization. This is the second workshop of the Computational Design Synthesis (CDS) SIG following the first successful workshop held at ICED '09.

D113 Workshop 3: Re-considering creative thinking in design
Chairmen: P. Badke-Schaub, R. de Boer

This year the workshop of the SIG Human Behaviour in Design (HBiD) focuses on the discussion of cognitive activities which are relevant for the generation of ideas. Cognitive activities dealing with any kind of problem space can be roughly described as various combinations of four basic cognitive operations, generation and exploration enlarging the problem space and comparison and selection to narrow it.

D114 Workshop 4: Modelling and management of engineering processes
Chairmen: P.J. Clarkson, S. Vajna

D115 Workshop 5: Managing structural complexity
Chairmen: U. Lindemann, S. Eppinger, M. Kreimeyer

The interest of the workshop is to explore the strengths and weaknesses of the currently available methods for the management of structural complexity. To generate a roadmap that determines the perspective thereof, the current state of the art of different means of dependency modelling, the application of such models in research and industry, and the existing pool of methods to analyze such models will be assessed as part of the workshop to build a vision about how dependencies in technical systems can be better managed. The workshop is the follow-up of a first workshop held at the ICED Conference 2009 in Stanford, CA.

Conference workshops
Monday – May 17th, 2010, 14:00-18:00

D121 Workshop 6: Engineering design research quality
Chairmen: H. Birkhofer, L. Blessing

The workshop tries to capture the different viewpoints under which research quality, and in particular design research quality, may be seen by statements of invited experts working in the field of quality definition. Enriched by contributions of the participants the workshop aims to set off to a vision of a holistic understanding of the nature of design research quality and to cover further steps of how to approach this vision. The workshop addresses everyone of our design community, who is involved in teaching, supervising and reviewing procedures and who would like to get new insights or even to contribute to these challenging questions.
The workshop idea arouse from the joint meeting of AB- and BM-members of the Design Society in March 2009 in Boston.

D122 Workshop 7: Engineering design in Mechatronics
Chairman: S. Moehringer

Mechatronics - the synergetic integration of different engineering domains such as mechanics, electronics and information technology can create new products and stimulate innovative solutions. Due to the interaction of domains the complexity of Mechatronics products is usually very high. One of the main challenges is to improve collaboration and communication across disciplines. Based on the findings of SIG workshop 2009 and the focus of interest in multidisciplinary this workshop intends to continue the discussion on multidisciplinary issues.

D123 Workshop 8: Direction of research on design creativity
Chairman: T. Taura

In this workshop it will be discussed the direction of research on design creativity. The discussion will be conducted from the theoretical and methodological viewpoints. In particular, the goal is to establish the framework for the themes and research methods for design creativity in the coming generation. The workshop is organized by the Design Society SIG Design Creativity.

D124 Workshop 9: Decision making
Chairman: S. Wartzack

D125 Workshop 10: Collaborative design
Chairmen: I. Whitfield, A. Thomson

This workshop aims to initiate a collaborative design research agenda through addressing the different research questions. The research agenda will provide the basis for considering the appropriateness of a Design Society Special Interest Group forming an international body of interest within collaborative design that possesses the desire and expertise to develop this research area.

Keynote presentations
Tuesday 18th, plenary session D2-P, 11:00-13:00

Prof. Steven D. EPPINGER, Massachusetts Institute of Technology, USA

THE FUTURE OF ENGINEERING

The engineering profession is undergoing substantial changes at this time. This keynote lecture will present some of observations of the key changes in three areas:

1. Engineering processes, which are now entirely digital and are becoming more globally distributed through outsourcing and off shoring business models
2. Engineering organizations, which are hiring younger engineers who think and work differently, and which must learn to utilize technical talent in more open and collaborative ways
3. Engineering culture, which changes slowly in established firms and is struggling to adapt to the relatively rapid changes of methods and workforce These changes have profound impact on the engineering profession, the ways we must develop engineers today, the kinds of jobs that engineers will have in the near future, and the challenges of engineering leadership.

Dr. Stefan WALLMEIER, SAF-HOLLAND GmbH, Germany

EVERYTHING IS KNOWN AND EVERYTHING IS NEW - ENGINEERING DESIGN AFTER INTERNATIONAL MERGER

Before 2006 SAF (Otto Sauer Achsenfabrik GmbH) and Holland Inc. have been two successful midsize companies. Both were supplying their products into the heavy duty truck and trailer industry. By their decision to merge a broad variety of international market opportunities arose. With a minimal overlap in their product portfolios, serving the same customers in different markets – Europe and North America - it seemed that immediately 1 and 1 equals more than 2. This is the story about the obstacles that occur on the way to become an international company from a product engineering perspective. Inch and metric is by far not the only influence that could cause a headache. After finalizing the first international projects a review allows to identify factors critical for success. Cultural differences, local market requirements, not common systems, organisational changes and the integration process are just a few of the areas to look at. It is most important for Management to always critically analyse different causes of complicacies and constantly support the organisation growing together. And still 1 and 1 can equal more than 2 but success stories require intensive work.

Dr. Hermann KLINGER, Festo AG & Co., Germany

SOLVING THE DIVERSITY-EFFICIENCY DILEMMA IN INDIVIDUALIZED LIFELONG LEARNING

As neuroscientists reconfirm again and again human learning is the most complex process humans can think of. Approaches to effectively organize this process with respect to optimizing the value for the learner directly leads into the well known efficiency - diversity dilemma. To solve this problem design methods to handle structural complexity have been used to make individual needs more transparent. With production tools from the Theory of Constraints we are optimizing the flow of knowledge between knowledge sources and knowledge applicants. As human beings are the most essential parts of learning new roles for all participants have been invented and successfully implemented. Experiences and outcomes for new Master Programs at University level and a learning system for science and technology at secondary school level are discussed.

Keynote presentations
Thursday 20th, plenary session D4-P, 11:00-13:00

Prof. Yoram REICH, Tel Aviv University, Israel

DESIGN RELIGIONS

The term 'Design religions' could be deconstructed at least in two unconventional ways: 'designing of religions' and 'religions in design'. The words design and religion appear so disconnected that none of these combined concepts seems worthwhile to explore. Indeed, none of them is a topic studied in design research or that could interest design professionals or researchers. Despite that, sometimes such odd marriages lead to striking offspring. Similarly here, from a seemingly superfluous mental exercise that examines these interpretations, we find interesting common threads that lead to several observations about design practice and design research. These observations could have concrete positive consequences to design thinking and the way we practice design and design research.

Prof. Jivka OVTCHAROVA, Karlsruhe Institute of Technology (KIT), Germany

VIRTUAL ENGINEERING: PRINCIPLES, METHODS AND APPLICATIONS

Virtual Engineering involves the early, continuous, interconnected (process view) and integrated (system view) support of the development process with respect to coordination, evaluation, and ascertainment of the development results of all partners with the help of Virtual Prototypes. The use of Virtual Reality as a visualization and validation environment allows developers, distributors, manufacturers, and customers alike to virtually handle the future product from its specification to service and recycling and to realistically assess it with regard to features and performance. The subject of Virtual Engineering not only affects processes on the operative level but aspects of corporate and managerial development in particular, as well as the planning, development, implementation, utilization, and customization of IT systems. The accomplishment of this comprehensive interdisciplinary task requires new approaches that allow the integration of the dimensions methods, organization, and technology within the entire company.

Mr. Gareth JONES, United Kingdom

PRACTICAL INNOVATION IN ENGINEERING DESIGN

Focus of the lecture will be on the practical issues that companies face when trying to introduce innovation in their product development process, i.e. an industrial perspective rather than an academic analysis. The lecture will illustrate this theme with examples of current work of the lecturer as a design consultant for companies such as BP, J&J, and P&G, and from work as Head of Development of Dyson.

201 *Inoue M., Lindow K., Stark R., Ishikawa H.*

APPLICATION OF SUSTAINABLE ASPECTS TO THE SET-BASED DESIGN METHOD

The University of Electro-Communications Japan

sustainable product development, set-based design method, sustainable life-cycle scenario

Decision-making at the early phases of design is important for a sustainable product life cycle. The proposed preference set-based design (PSD) method can generate a ranged set of design solutions that satisfy multi-objective performances while incorporating the designer's preference structure at the early phase of design. This paper discusses the ability of the PSD approach for sustainable product development by applying it to a multi-objective design problem including technical performances and sustainable issues.

287 *Efkolidis N., Kyratsis P., Dinopoulou V., Asimopoulos N.*

CONCEPTUAL DESIGN WITH EMPHASIS ON THE SOCIAL IMPACT OF SUSTAINABILITY PRINCIPLES

TEI of West Macedonia Greece

eco push, product design framework, sustainability

Designers can influence the decisions that people make, on what they purchase and why they do so. These decisions reflect their perception about lifestyle. The current paper presents an alternative eco tool, based on the principles of Design for Sustainability, but the emphasis is given on the social impact, that a product might have, when it is promoted in the market. Additionally, the customer involvement during the design process is considered crucial. The conceptual design of the Eco-toy is an example towards a cultural transformation that promotes a sustainable lifestyle.

288 *Fargnoli M., Bisillo S., Costantino F., Geraci D.*

ECO-VIRTUOSITY: MANAGEMENT OF ECODESIGN ISSUES

Ministry of Agriculture Italy

eco design, ecological profile, EuP directive, product development and management, eco-virtuosity

Customer awareness of environmental problems is following an upward trend these days, pushing companies to put on the market an ever larger range of "green products". This aspect is also underlined by the recent extension of the scope of the so-called "EuP" Directive. The research work investigated how to combine environmental mandatory issues with traditional EcoDesign tools efficiently. The results obtained allow designers to shift from control to management of the design activities, increasing their awareness about the way they are paying attention to environmental issues while designing.

322 *McAloone T.C., Mougaard K., Restrepo J., Knudsen S.*

ECO-INNOVATION IN THE VALUE CHAIN

Technical University of Denmark Denmark

eco-innovation, value chain, innovation space, life cycle thinking, competencies, value star

It is well known that companies face challenges integrating environmental considerations into their product development processes and there is an established body of research focusing on ways and means to aid this. The approach for integrating environmental considerations into product development processes is often reactive, resulting in a retrospective and insufficient approach. This paper describes the mechanisms, opportunities and barriers for the actual realisation of value chain based eco-innovation, together with a first indication of a methodical approach to realising eco-innovation.

361 *Sakao T., Hjelm O.*

SERVICE AS A MEANS OF COMMUNICATING USER VALUE AND ENVIRONMENTAL BENEFITS IN ECODESIGN

Linköping University Sweden

customer, persuasion, rroduct-service system, new technologies

The paper aims at proposing an extended ecodesign framework by incorporating a service aspect in addition to customer, value, system, function, component, and environmental characteristics. It attempts to highlight the importance of an aspect of service: communication for customers or users. The framework is applied to a commercial toilet product that is combined with a service analysing and communicating about the product usage. It is followed by implication to design and management. Note that much insight in the paper can be applied to product design in general, not only to ecodesign.

371 *Hanusch D., Birkhofer H.*

CREATING SOCIALLY SUSTAINABLE PRODUCTS – EXAMINATING INFLUENCE AND RESPONSIBILITY OF ENGINEERING DESIGNERS

Technical University Darmstadt Germany

social sustainability, design for sustainability, engineering design, social responsibility

The present paper shows a research approach for the identification of responsibilities for the implementation of social sustainability in the product creation process in order to develop socially sustainable products. For this, it gives an overview of the research on the field of sustainable products. Subsequent it describes the evolved approach. This approach consists of three main steps: collection of criteria catalogue, property related analysis of these criteria and process-oriented analysis for the identification of responsible company departments and external institutions.

129 *Schotborgh W.O., Kokkeler F.G.M., McMahon C.A., van Houten F.J.A.M.*

TOWARD A PRACTICAL GUIDE TO KNOWLEDGE ENGINEERING FOR PARAMETRIC ROUTINE DESIGN

University of Twente Netherlands

knowledge engineering, design automation, method

This paper proposes a methodological approach to knowledge acquisition and modelling. The source of the knowledge is considered to be an expert designer. The content of this paper focuses on the knowledge acquisition phase, which includes a method to interview an expert to obtain a model of his/her experience-based knowledge in a systematic manner. A model of the design process and synthesis knowledge is used as guideline. The scope is parametric design with available knowledge: routine variant and adaptive design.

321 *Helms B., Shea K.*

OBJECT-ORIENTED CONCEPTS FOR COMPUTATIONAL DESIGN SYNTHESIS

Technical University Munich Germany

computational design synthesis, graph grammars, object-oriented programming, implementation

The aim of the research in the area of computational design synthesis is to automatically solve design problems. Due to the increasing complexity of products and processes, research in this area faces multiple challenges, such as an extension of scope or an increase of efficiency. This paper draws an analogy to object-oriented programming, identifies concepts and benefits that respond to these requirements and depicts their application and implementation. The beneficial methodological extensions are presented based on a strict separation of definition and application of a formal graph grammar.

367 *Rihtaršic J., Žavbi R., Duhovnik J.*

SOPHY – TOOL FOR STRUCTURAL SYNHTESIS OF CONCEPTUAL TECHNICAL SYSTEMS

University of Ljubljana Slovenia

structural synthesis, physical law, technical system, design knowledge

The paper describes a method and a tool to support concept generation and its structural synthesis. The method includes automated generation of conceptual technical systems and their semi-automated structural synthesis. In the structural synthesis phase, the emphasis of the research is on structural visualization of automatically generated conceptual TS. Physical laws are used for description of automatically generated technical systems while the relations between parts of structure that contribute to realization of the functions are defined by basic schemata.

375 *Stankovic T., Bojcetic N., Marjanovic D.*

DEVELOPING COMPUTATIONAL TOOL FOR GENERATION OF OPERAND TRANSFORMATION VARIANTS IN TECHNICAL PROCESS

University of Zagreb Croatia

technical process, grammatical evolution, computational design support

Aim of this paper is to present a grammatical evolution based tool for generation of operand transformation variants in technical processes. Such tool can be used by designers to consider different product realization possibilities based on existent technological principles in respect to customer needs, requirements and constraints. Engineering knowledge about the transformations and technological principles is formalized within a set of production rules. For computational implementation, it is proposed to use a double-pushout approach for graph grammar transformations.

141 *Zeiler W., Savanovic P.*

SUPPORTING DESIGN BY MEANS OF MORPHOLOGICAL OVERVIEWS AND C-K THEORY IN BUILT ENVIRONMENT

Technical University Eindhoven Netherlands

integral design, morphological overview, C-K theory

Collaboration within design teams is the key to improvement of the building design process. We use the morphological overview as a tool for visualization the interaction between designers as an reflective element of the Integral Design approach. To be able to look into more detail what actual happens in the design process with the morphological overview we use the C-K theory of Hatchuel and Weil.to visualize the (relations between) contributions within a design team. Morphological overviews in combination with the C-K theory can show how (integral) design concepts are emerging within design team setting.

207 *Watty R., Kreimeyer M., Hoffmann-Berling P.*

ASSESSMENT OF THESES IN ENGINEERING EDUCATION

Baden-Wuerttemberg Cooperative State University Germany

design education, assessment, thesis, evaluation criteria

Professional engineers do not only require technical knowledge but also the ability to apply it successfully to design problems in the “real world”. The necessarily required skills can be acquired by solving realistic design problems in order to cope with for example holistic technical tasks as well as work organisation or conflicts in design teams. Project-based learning is often implemented for this purpose in theses at the end of undergraduate courses. The main objective of this paper is to compare and discuss actual approaches to the evaluation of such theses in German universities.

335 *Kain A., Kirschner r., Gorbea C., Kain T., Gunkel J., Klendauer R., Lindema*

AN APPROACH TO DISCOVER INNOVATION POTENTIAL BY MEANS OF DELTA APPLICATIONS

Technical University Munich Germany

user-centered design, customer integration, product application

Although several approaches exist to integrate the customer in new product development, industrial small and middle sized enterprises do not apply these methods comprehensively. In order to overcome existing barriers the authors suggest a product based approach for customer integration. An example illustrates delta applications, which differ in their characteristic attributes from the product use case defined by the company. The approach of Delta Applications provides a neutral platform for exchange between customers and the company and overcomes existing barriers.

338 *Schroeer B., Kain A., Lindemann U.*

SUPPORTING CREATIVITY IN CONCEPTUAL DESIGN: METHOD 635-EXTENDED

Technical University Munich Germany

brain writing, early prototyping, method 635

Different idea generation methods find application in conceptual product design to support creativity. While these methods are applied successfully on lower levels of product concretization, not many of them find application in the development of shape and form concepts. Based on Method 635 a new method is presented in this paper that tries to combine the powerful heuristic of Method 635 with physical 3D illustrations in form of early and rough (manual) prototyping. The application of the method is depicted by means of a case study before various means of further adaption are discussed.

370 *de Boer R.J., Badke-Schaub P., Santema S.C.*

EMOTION ELICITATION DURING A COGNITIVE TASK

Delft University of Technology Netherlands

emotion, mental models, cognitive tasks

This paper presents intermediate results of research into the role of emotions in the preservation of Mental Models when challenged by contradictory stimuli. This investigation is inspired by the practical experience of one author in industry. In this paper we will show that an in itself fully rational interaction will give rise to emotions when feedback is not in line with the subject’s existing mental model. We have classified the resultant emotions and their effectiveness to preserve or maintain the mental model. We discuss these findings in relation to the functionality of mental models.

225 *Zafirov R., Kiefer J., Eigner M.*

FUNCTIONAL MODELLING FOR EFFICIENT GENERATION OF MECHATRONIC DESIGN AND VALIDATION MODELS OF AUTOMATED PRODUCTION INSTALLATIONS

Technical University of Kaiserslautern Germany

mechatronic design, cross-domain engineering, mechatronic validation, digital factory, functional modelling

This paper describes a new approach for the generation of mechatronic validation models of automated production installations. It points out the function structure as a possible reference model for domain-specific engineering and analyzes the use of function structures not only in the concept phase but throughout the engineering phase. With electrical and software engineering being component/object oriented and mechanical engineering leaning onto process planning this paper presents ideas on accomplishing cross domain communication through function modeling based on process planning.

281 *Catic A., Malmqvist J.*

REQUIREMENTS MANAGEMENT WHEN INTRODUCING NEW MECHATRONIC SUB-SYSTEMS - MANAGING THE KNOWLEDGE GAPS

Chalmers University of Technology Sweden

mechatronics, requirements management, knowledge gap

This paper describes an empirical study of a driveline development project, featuring a new mechatronic sub-system, aiming to investigate the effect of knowledge gaps regarding the new sub-system on the development process. Findings indicate that knowledge gaps regarding interfaces and suppliers of the new sub-system and a lack of appropriate processes, methods and IT-tools have negatively affected requirements management. A set of recommendations on likely knowledge gaps when introducing new mechatronic sub-systems and how to bridge them prior to development project initiation are presented.

283 *Möhringer S., Stetter R.*

A RESEARCH FRAMEWORK FOR MECHATRONIC DESIGN

Hochschule Ravensburg-Weingarten Germany

mechatronics, design theory and research methodology

Since ICED 2007 the special interest group (SIG) “mechatronics” is discussing research of mechatronic design. At ICED 2009 it was decided that the results up to this points should be summarized to a research framework in order to give structure to further activities. This paper presents a proposal for such framework which is intended to be discussed in detail at the SIG session at Design 2010. A research framework is a structure which allows researchers with different focus and approach to locate their work in a larger picture and to contribute to an overall advancement of a field of science.

333 *Metzler T., Shea K.*

COGNITIVE PRODUCTS: DEFINITION AND FRAMEWORK

Technical University Munich Germany

cognitive products, cognitive technical systems, cognitive capabilities, mechatronics, new product development

Cognitive products offer great potential to satisfy new user needs and desires through cognitive capabilities. This paper provides a review of related product types, e.g. mechatronic and "smart" products, and presents a definition of cognitive products derived from reviewing cognitive technical systems. Based on this definition, a framework for cognitive functions is developed and evaluated using a set of example cognitive products developed in student, project-based seminars. This framework enables the categorization of cognitive products through their functions and gives insight into future research directions including developing design catalogs for developing cognitive products.

379 *Šimunec Z., Banov R.*

MECODES – MECHATRONIC COLLABORATION DESIGN SOLUTION

CADCAM Group Croatia

mechatronics, PLM

Today Mechatronic PLM solutions need new software applications and new standards in order to give development companies better and more efficient tools in multidomain collaboration. Based on our PLM knowledge in implementation of CATIA as MCAD and ALTIUM Designer as an ECAD solution, we developed together with Dassault Systemes a new generation of software application tools and methodologies called MECODES – Mechatronic collaboration design solution for CATIA and ALTIUM integration.

135 *Kreye M.E., Goh Y.M., Newnes L.B.*

INFORMATION DISPLAY FOR DECISIONS UNDER UNCERTAINTY

University of Bath United Kingdom

forecasting, decision making, uncertainty, through life costing

In the early product design stage, considering the Through Life Cost and uncertainty are important. However, the information given to the decision maker is often limited, resulting in a large level of subjectivity. This paper introduces experimental research exploring different information displays and their subjective interpretation by cost forecasters within the defence and aerospace sector. Three different kinds of information display and different levels of detail of contextual information were tested, showing that they impact the decision making process and subjective interpretation.

211 *Jensen A.R.V., Ahmed-Kristensen S.*

IDENTIFYING KNOWLEDGE IN DECISION-MAKING PROCESSES: A CASE STUDY

Technical University of Denmark Denmark

innovation processes, front-end product development, knowledge processes, decision-making processes, portfolio management, empirical study, coding scheme

Managing knowledge reflects the innovation capability of a company. Mapping decision processes and links to knowledge is a way to learn more in structuring knowledge in innovation processes. Through an empirical study the paper aims to identify knowledge in decision processes using known theory. Analysis results show dependency of decision processes on knowledge and the effect by knowledge processes. The paper supplies understanding of knowledge processes impacting decision processes and motivates further investigation aiming at structure knowledge to support decisions in innovation processes.

255 *Erbe T., Stroehla T., Theska R., Weber C.*

DECISION-AID FOR ACTUATOR SELECTION

Ilmenau University of Technology Germany

decision-aid, requirement management, knowledge-intensive design, actuator-selection

The generation of motions is a crucial task of technical systems. Depending on the application, these requirements can constitute a large variety of barely comparable criteria.
Currently, the actuator selection is based on design-catalogues and product-catalogues of individual manufacturers. Most of them are specialized on particular active principles and drive system solutions. So far, there is no general support for the actuator selection task.
An decision aid for actuator selection based on a database using arbitrary parameters will be presented.

349 *Ahmad N., Wynn D.C., Clarkson P.J.*

DEVELOPMENT AND EVALUATION OF A TOOL TO ESTIMATE THE IMPACT OF DESIGN CHANGE

University of Cambridge United Kingdom

information structure framework (ISF), design change

Engineering change can occur at all stages of the product development. It can take the form of change in the requirements, functions, component(s), iteration during detail design, or correction of errors discovered after delivery to the customer. Despite an increase in the understanding of changes there is still need to provide support for designers to manage changes across different stages of the design process. This paper presents and evaluates a tool to represent design process information and for using it to estimate the impact of change on different stages of the design process.

348 *Le H.N., Wynn D.C., Clarkson P.J.*

RE-DESIGNING PD PROCESS ARCHITECTURE BY TRANSFORMING TASK NETWORK MODELS INTO SYSTEM DYNAMICS MODELS

University of Cambridge United Kingdom

process architecture, model transformation, applied signposting model (ASM), system dynamics

Managing product development processes is complex due to the many factors from different process abstraction levels that influence process behaviour and performance. In this paper, an integrated simulation and analysis framework is proposed to combine the detailed process-architecture view of task network models with the high-level perspective of the system dynamics modelling approach. Through an illustrative example the feasibility and usefulness of our approach is demonstrated. In addition, a simulation-and-selection method is applied to show how managers can be supported in decision making.

305 *Albers A., Muschik S.*

THE ROLE AND APPLICATION OF ACTIVITIES IN THE INTEGRATED PRODUCT ENGINEERING MODEL (iPeM)

Karlsruhe Institute of Technology Germany

iPeM, modelling, activity

To depict all sorts of possible design situations while providing detailed support on operative work level is one difficulty of current modelling approaches. The Integrated Product Engineering Model (iPeM) bases on a systemic comprehension of engineering processes from an abstract meta model to application in practice. This paper investigates the course of the transformation from meta to implementation model and elaborates ideas for an approach on how to improve the applicability of the iPeM. The development process of systems of objectives is used as exemplary implementation case.

331 *Petetin F., Bertoluci G., Bocquet J.C.*

A VALUE APPROACH IN INNOVATIVE PRODUCT DEVELOPMENT: ARE CONVENTIONAL METHODS AND TOOLS SUFFICIENT?

Ecole Centrale Paris France

innovation, value chain creation, value management

Innovation is acknowledged in today's literature as being crucial for the subsistence of companies. But is it always good? How can we evaluate new values created for the firm and its partners considering the risks related to its development? In this paper we study the different kinds of values that can be created by an innovation. We introduce methods commonly used to drive the value created by products and supply chains and show that they are not sufficient when the innovation is too different from the original product. Finally, we present the approach we promote for a new system conception.

142 *Quanjel E., Zeiler W.*

COLLABORATIVE ACTIVE ROOF DESIGN

Technical University Eindhoven Netherlands

collaborative design, integral design, roof design

Roofs play an essential role in buildings however the development of innovative more sustainable active roofs is difficult. In the Dutch Building Industry sub optimal use of knowledge by participant during the design- and engineering phase causes building damage and hinders innovative designs and solutions. During the period of 2006-2008 a workshop as tool was developed. The development of the concept of the Collaborative Design Workshop is explained and discussed by the different set-ups and insights gained throughout, focusing on the development of the model of the workshop as a method for knowledge management aspects and aspects of innovation.

242 *Roelofsen J., Lindemann U.*

A FRAMEWORK FOR SITUATION SPECIFIC PLANNING OF PRODUCT DEVELOPMENT PROCESSES

Technical University Munich Germany

design situation, process planning, process framework

This contribution deals with the interaction of previously presented approaches towards situation specific process planning and integrates these approaches into one general framework. The relevant aspects are the development process model, the definitions of roles and levels of process planning, the design situation, the procedural model for process planning as well as the general framework and its implementation. It is discussed how the single aspects of the framework work together. The evaluation of the framework, its results and future work to improve the approach are shown and discussed.

158 *Cash P.J., Hicks B.J., Culley S.J.*

AN INFORMATION REQUIREMENT STRATEGY FOR CAPTURING AND ANALYSING DESIGN ACTIVITY AND BEHAVIOUR

University of Bath United Kingdom

empirical issues, research methods, capture framework

This paper forms part of the wider ongoing discussion on the issues and possible mitigating techniques present in empirical design research today. There are many methods which aim to develop rigour, validity and replicability. This paper brings these discussions together, drawing out a number of fundamental similarities in addressing the key barriers to success. These fall into an overarching theoretical framework from which common factors and issues can be identified. Finally an strategy is proposed for improving the standardisation and appropriateness of empirical information capture.

368 *Jensen T.E., Andreasen M.M.*

DESIGN METHODS IN PRACTICE - BEYOND THE 'SYSTEMATIC APPROACH' OF PAHL & BEITZ

Technical University of Denmark Denmark

design methods, Pahl & Beitz, etnomethodology

The paper challenges the dominant and widespread view that a good design method guarantees a systematic approach as well as certain results. It explores the differences between the dominant view (exemplified by Pahl & Beitz), micro-sociological studies (ethnomethodology), and a series of case studies of method use in Danish companies. It argues that Pahl and Beitz's implicit view of methods is misleading in several respects, and that we need to understand method use as situated, social interaction if we are to describe it realistically and appreciate it properly.

206 *Geis C., Birkhofer H.*

CLASSIFICATION AND SYNTHESIS OF DESIGN THEORIES

Technical University Darmstadt Germany

design theories, design models, design, methods

Models and methodologies for designing are numerous nowadays and no holistic approach, which combines all models, exists so far. Nonetheless, all of these models were developed with specific intentions which justify their existence, as they portray design from different perspectives and focus on varying elements or actions in designing. In our paper we classify these models and present a new integrated approach to support designers in understanding and in creating a kind of roadmap for designing, giving him access to the relevant theories and procedures he uses in certain stages of designing.

301 *Mahut S., Eynard B., Merlo C., Minel S., Beaujon T.*

METHODOLOGICAL TOOLS INTEGRATION FOR ENGINEERING DESIGN

University of Technology of Compiegne France

integrated design, value engineering, system engineering, design support tool

This paper focuses on the different phases of the implementation of methodological tools. Thus, it aims at characterizing the appropriation process. For that purpose, this work presents three integration processes that should be taken into account. Those processes are linked to three groups of actors. That should lead the company to appropriate itself methodological tools and to improve its performance while doing engineering design. Finally, this paper presents first elements about how to take appropriation elements into account in exogenous innovation tools integration.

267 *Zier S., Kloberdanz H., Birkhofer H.*

INVESTIGATING ELEMENTARY DESIGN METHODS: A PROCESS-ORIENTED AND MODEL-BASED APPROACH

Technical University Darmstadt Germany

elementary methods, design methods, design processses

Nowadays most of the design methods introduced in literature are not new but rather modifications or further developments of existing methods. Therefore the system of methods has an evolutionary grown character. Hence the aim of investigating elementary methods is to develop a systematic approach for the deduction, description and improvement of design methods.
This paper shows a systematic approach for investigating elementary design methods. Thus, a system of model spaces in product development was created, which is the basis to review the sub-processes within product development.

Session number **D233**

Title of the session: **Clarifying needs, requirements and specification in general**

Tuesday , May 18, 2010. **14:00 - 16:00**

174 *Sudin M.N., Ahmed-Kristensen S., Andreasen M.M.*

THE ROLE OF A SPECIFICATION IN THE DESIGN PROCESS: A CASE STUDY

Technical University of Denmark — Denmark

specification, design process, design tasks

The role of design specification in the design process is recognised as significant because it helps design engineers to proceed from the abstract to the concrete solution so as to fulfill the aim of the product. Thus to obtain insight about the role of design specifications during the design process, a case study was carried out in a consultancy company. The interview was chosen as a data collection method and the transcription of the interviews was indexed against a predefined coding scheme. The study found the specification has multiple roles in the product development environment and the company, product and project was very much influencing the development of a specification.

197 *Eben K.G.M., Daniilidis C., Lindemann U.*

INTERRELATING AND PRIORITISING REQUIREMENTS ON MULTIPLE HIERARCHY LEVELS

Technical University Munich — Germany

requirements elicitation, requirements prioritisation, MDM

Requirements management is crucial task regarding a company's ongoing success. Particularly in the environment of small and middle-sized enterprises methodologies supporting this task have to be available, which support this task efficiently without unnecessarily committing resources. In this paper the Multiple-Domain Matrix methodology serves as means to guide and support identification and prioritisation of requirements. Moreover, its application leads to an extensive understanding of dependencies between the requirements over all hierarchy levels in a complex product system.

237 *Brace W., Thramboulidis K.*

FROM REQUIREMENTS TO DESIGN SPECIFICATIONS - A FORMAL APPROACH

Aalto Universoty School of Science and Technology — Finland

requirements, requirements checklist, design specification, requirements formalization, model-centric requirements engineering

System development activities such as requirements and design specification, implementation and verification are well defined in software engineering. Model driven engineering and SysML may result in significant improvements in engineering design. In this paper, a model-centric approach to formalize requirements expressed in narrative format is presented. An integrated framework that adopts the requirement checklist concept and utilizes logical reasoning and incidence matrix operations is described. An underground work machine is used as a case study to illustrate the proposed approach.

299 *Hosnedl S., Dvorak J., Srp Z., Kopecky M.*

DESIGN SPECIFICATION AND EVALUATION TOOL FOR DESIGN ENGINEERING AND ITS MANAGEMENT

University of West Bohemia — Czech Republic

competitiveness, specification, tool, quality, evaluation, properties, life cycle

The presented paper includes the TTS background and a substantially innovated software management and engineering design tool for support of Product Design Specification (PDS) & Evaluation which has been implemented in MS Excel. The role of PDS is spread to an explicit (leading) and implicit (embedded) management tool for a continuously property driven and evaluated engineering design process. This new concept has been utilized and validated in a number of interdisciplinary engineering and industrial design projects which have arisen in cooperation with prominent Czech industrial companies.

359 *Cascini G., Fantoni G., Montagna F.*

REFLECTIONS ON THE FBS MODEL: PROPOSAL FOR AN EXTENSION TO NEEDS AND REQUIREMENTS MODELING

Polytechnic University Milano — Italy

FBS, functional modelling, user needs, design requirements, new product development

The paper proposes an extension of the Gero's Function-Behaviour-Structure (FBS) framework aimed at representing Need and Requirements and their relationships with the Function, the Behaviour and the Structure of an artefact. Needs and Requirements can be modelled as further types of variables to describe with the same formal approach of the situated FBS model the transformation processes which occur in the earlier stages of design, when the requirements still need to be specified.
The proposed model is clarified through a simple, but comprehensive example related to the design of a kettle.

160 *Gausemeier J., Dorociak R., Pook S., Nyßen A., Terfloth A.*

COMPUTER-AIDED CROSS-DOMAIN MODELING OF MECHATRONIC SYSTEMS

Heinz Nixdorf Institute, University of Paderborn Germany

design methodology, mechatronics, principle solution, requirements tracing, computer aided conceptual design

Mechatronics – the symbiotic cooperation of mechanics, electrics/electronics, control engineering and software engineering – opens up fascinating perspectives for the development of future products. Still, development of mechatronic systems remains a challenge. Software support is a prerequisite to cope with this challenge.
This contribution presents a software tool, which provides means for managing the complexity and intuitive modeling of the principle solution of advanced mechatronic systems. Its advantages are demonstrated in a case study from the development of a miniature robot.

223 *Michaelis M., Wahl A., Johannesson H.*

INTEGRATING PRODUCT AND MANUFACTURING SYSTEM PLATFORMS – EXPLORING A CONFIGURABLE SYSTEM APPROACH

Chalmers University of Technology Sweden

platform description, configurable component, concurrent engineering

While platform strategies are not the silver bullet to the development of products and manufacturing systems, they might at least yield some benefits. This paper explores a specific platform approach looking at products and manufacturing units as configurable systems. It reports an explorative empirical study identifying issues in integrated development. These issues are matched with the capability of the chosen approach to help solving them. Expressing information on appropriate levels of abstraction and illustrating interconnections of the systems are concluded to be two of the benefits.

240 *Reitmeier J., Paetzold K.*

PROPERTY AND BEHAVIOUR BASED PRODUCT DESCRIPTION - COMPONENT FOR A HOLISTIC AND SUSTAINABLE DEVELOPMENT PROCESS

Universität der Bundeswehr Munich Germany

product data model, multidisciplinary product development

Innovative products require a close collaboration of different technical disciplines as well as manifold functional areas of a company. This means that different perceptions of the product and different requirements concerning product information are existing.
Therefore, it is necessary to provide a common basis that serves all needs of information in order to purposefully involve all participants into the development process. A property and behaviour based product description provides such an adequate tool to sustainably improve the product development.

110 *Midžic I., Stankovic T., Marjanovic D.*

CONTEXT-FREE GRAMMAR BASED RULES FOR COMPONENT-LEVEL PRODUCT STRUCTURE MODELLING

University of Zagreb Croatia

chromosome product model, function-means tree, product sub-functions, product component structure, context-free grammar

This paper introduces a rule formalization paradigm where according to Function-Means tree and Chromosome Model principle, Product-Function-Component model is developed and facilitated for demonstration of context-free grammar implementation to support concept generation. Function-component relations from the Product-Function-Component tree substitute the “Corresponds To” relationships between Function-Means tree and Chromosome Model domain constituents. Production rules derived from tree structure are intended for product variants derivation.

159 *Eigner M., Gerhardt F.J., Gilz T., Handschuh S.*

PROPOSAL FOR A GUIDELINE TO INTEGRATE KINEMATICS WITHIN LIGHTWEIGHT FORMATS

Technical University of Kaiserslautern Germany

product lifecycle management, simulation, neutral data formats, JT, kinematics

Over the past years, we have been engaged in defining requirements towards application of lightweight data formats in the product lifecycle. As of today, formats like JT do not provide containers to store joints, fixes and relevant attributes, all of which are used e.g. in multibody-simulation (MBS) and installation feasibility analysis. We present a guideline and implementation that maps such data in the product structure of these formats. We have then exported new contents to Physical Modelling XML as an intermediate solution to bridge from CAD to CAE, giving an exemplary proof of concept.

152 *Meiwald T., Petermann M., Lindemann U.*

CONCEPTUAL DESIGN OF A PROCESS STANDARD IN ANTI-COUNTERFEITING

Technical University Munich Germany

product piracy, anti-counterfeiting, IT-security, international standards, case study

Based on the state of the art in anti-counterfeiting and six own case studies this paper will propose goals for a potential process standard in anti-counterfeiting. Established IT-security standards will be reviewed. It will be discussed which aspects can be transferred to a potential process standard in anti-counterfeiting in order to propose an outline for such a standard.

214 *Goikoetxea N., Sierra E., Larrakoetxea I., Gorozika J.*

GOOD PRACTICES TO TRANSLATE CORPORATE STRATEGY INTO DESIGN STRATEGY

University of Basque Country Spain

corporate strategy, design strategy, alignment
Design Strategy
Alignment

Translating the corporate strategy into the project is the most successful way for achieving corporate benefit. This is sorted out by selecting the right project at the aligning initiation phase and in a second aligning phase definning the right project strategy. This paper focuses the second view. Some good practices are enumerated, selected out from some SME´s pitfalls. Any alignment methodology should contemplate these practices.

226 *Vianello G., Xie Y., Ahmed-Kristensen S., Culley S.J.*

HANDLING OF IN-SERVICE SUPPORT: COMPARISON OF TWO CASE STUDIES FROM COMPLEX INDUSTRIES

Technical University of Denmark Denmark

service, knowledge management, procedural knowledge, aerospace industry, oil industry

This paper compares the strategy towards in-service support from contrasting sectors of industry, describing two case studies of companies developing complex products and servicing them throughout their lifecycle. The analysis of the cases focuses upon how knowledge generated during in-service support was reused within the service phase in terms of : (1) the process that led to the identification or to the validation of a solution; (2) the solution itself.

280 *Petersen S.*

DEVELOPING AN INSPIRATIONAL DESIGN BRIEF

ingomar&ingomar United States

inspirational design brief, design proposal, design brief, design quality criteria

Design research has identified a set of Design Quality Criteria, which provides lead indicators for products' market success. Mapping success criteria from business and design literature to the Design Quality Criteria reveals major gaps in the briefing process. Opportunities for improving the design briefing were explored by auditing design proposals from industry. Findings showed significant difference between proposals' Design Quality Criteria content and project control. Based on the findings, an Inspirational Brief was developed improving concepts synthesis performance.

345 *Hepperle C., Langer S., Scherer A., Schwetz P., Lindemann U.*

CONSIDERATION OF FACTORS INFLUENCING THE TIME OF LAUNCHING NEW PRODUCTS

Technical University Munich Germany

innovation, strategic planning, temporal behavior

This article is embedded in the context of researching cycle management of innovation processes and in particular addresses the cycle of launching new products with the goal of increasing the planning reliability. Manifold factors along the product lifecycle – possibly influencing the market launch intentionally or unintentionally – have been identified based on existing literature in innovation management and literature dealing with the customer's technology acceptance. The identified factors are further assigned to according categories and structured within a corresponding framework.

140 *Aryana B., Boks C.*

CULTURAL CUSTOMIZATION OF MOBILE COMMUNICATION DEVICES' COMPONENTS

Norwegian University of Science and Technology Norway

culture, object oriented design, mobile communication devices, mass customization

Modularity of products and using a configuration system are two characteristics of mass customization, which has gained importance in contemporary industries. Culture is among those user characteristics which could affect product specifications. This paper aims to propose an approach for cultural customization of mobile communication devices based upon two elements: the Object Oriented structural design (which is compatible with configuration systems) and an integrative approach of culture oriented design. Experiments illustrate the validity of the proposed approach.

310 *Parmar V., Keyson D., de Bont C.*

ANALYSING ICT PROJECTS FROM A DESIGN PERSPECTIVE: A CASE OF RURAL INDIA

Delft University of Technology Netherlands

information poverty, user participation, ICT adoption, integral design appraoch

To reduce information poverty, several ICT based interventions have been implemented in rural India. Despite huge investments, the user acceptance of information systems at societal level has been limited. This paper analyses four case studies of existing ICT interventions deployed in rural India including the degree to which and how users and other stakeholders were involved in the design. Results indicate that issues of user participation, information exchange, stakeholder involvement, and ICT adoption are critical in design of ICT interventions aiming for high societal impact.

337 *Kirschner R., Kain A., Fischer J., Gunkel J., Klendauer R., Lang A., Lindem*

AN APPROACH TO SUPPORT THE SELECTION OF STAKEHOLDER INTEGRATION METHODS IN NEW PRODUCT DEVELOPMENT

Technical University Munich Germany

customer integration methods, stakeholder, new product development

The selection of appropriate customer integration methods for specific product development projects lacks of a comprehensive model. In this contribution, we propose a model that relates the number and the expertise of involved stakeholders with different integration methods and the projects result quality. The results base on (1) primary sources, such as interviews, innovation process observations, an expert workshop and (2) tight assumptions. The model provides a deeper understanding of the factor's relations and facilitates the selection of optimal stakeholder integration methods.

362 *Chamberlain P.*

HORSES, ELEPHANTS AND CAMELS..CHALLENGES AND BARRIERS TO INTERDISCIPLINARY USER-CENTRED DESIGN RESEARCH

Sheffield Hallam University United Kingdom

industrial design, user-centred, interdisciplinarity

User-centred research methodologies are often adopted to inform design practice. This paper proposes a case for the key role of design practice, and the value of artefacts, as a fundamental methodological approach to user-centred research. Three design case studies highlight the value of interdisciplinary collaborations and the challenges and limitations of more tradtional user-centred research methods. The paper helps define the role of design as research, and the key role of artefacts as tools to access tacit knowledge and as tools to aid communication in the context of research.

222 *Feldhusen J., Nagarajah A., Schubert S.*

A DATA MINING METHOD FOR SELECTING THE SUITABLE EXISTING PRODUCT VARIANT AS A DEVELOPMENT BASE FOR A NEW ORDER

RWTH Aachen University Germany

adaptable products, automotive supply industry, self organising maps

This paper describes an approach to apply self organizing map (SOM) for the support of the developer to optimize the design process of adaptable products in the automotive supplier industry. The SOM is able to asses the similarity of requirement lists. Assuming that similar requirement lists lead to similar products, the SOM is able to identify the existing product variant, which has to be changed least to fulfil a new order. A prerequisite for using SOM is to formalise the requirements.

251 *Mieczakowski A., Langdon P., Bracewell R., Clarkson P.J.*

TOWARD A MODEL OF PRODUCT-USER INTERACTION: A NEW DATA MODELLING APPROACH FOR DESIGNERS

University of Cambridge United Kingdom

modelling approach, inclusive interaction, mental models

There is strong evidence of the importance of good interaction design to intuitive use of products. However, the underlying issue is that designers get little support in adequately representing, analysing and comparing design and user information. This paper proposes a new data modelling approach for designers, which in four distinct stages enables to assess and compare designers and users' understanding and usage of everyday products. The preliminary results indicate that it can contribute to the design of more inclusive products but its usefulness in industry is yet to be properly evaluated.

285 *Arikoglu E.S., Blanco E., Pourroy F., Hicks B.J.*

AN EMPIRICAL STUDY TO MEASURE THE EFFECTIVENESS OF SCENARIOS TO AID SHARED UNDERSTANDING OF FUNCTIONAL REQUIREMENTS

University of Grenoble France

scenarios, shared understanding, functional requirements, empirical study

This paper presents an empirical study, which is conducted to test the effectiveness of scenarios and personas in order to develop and improve shared understanding of functional requirements between design actors. The study focuses on the comparison of two design meetings: the experiment group (asked to use scenarios and personas) and the control group (does not use these methods). It follows that the contribution of this paper is to present and evaluate the protocol of this study and discuss the primary analysis of the results.

312 *Yilmaz S., Seifert C.M.*

COGNITIVE HEURISTICS IN DESIGN IDEATION

University of Michigan United States

design heuristics, creativity, design methodology

This paper explores the use of design heuristics as cognitive strategies in the creation of innovative products. Design heuristics are guidelines that help the designer to consider areas of possible designs that may not otherwise come to mind during the idea generation stage. Current design theory lacks a systematic methodology to identify the strategies used in the creation of innovative products. The methodology presented in this study provides designers with a set of heuristic principles and a process by which they can be applied to create new designs.

164 *Stuppy J., Meerkamm H., Wartzack S.*

STATISTICAL TOLERANCE ANALYSIS AND RESULT VISUALISATION FOR SYSTEMS IN MOTION

Friedrich-Alexander University Erlangen Germany

statistical tolerance analysis, Monte Carlo simulation, contributors analysis, joint clearance, elastic deformation

Small geometrical deviations, which originate from manufacturing discrepancies and from elastic deformations, can degrade the motion accuracy and, consequently, can influence the functionality of systems in motion. The goal of tolerance analysis is to ensure product functionality and to reveal potentials for an optimized tolerance allocation. In this paper, an integrated procedure for statistical tolerance analysis of systems in motion is presented by means of a crank mechanism. Beside the integration procedure, the focus is on an appropriate visualisation of the dynamic analysis results.

243 *Menzel S., Olhofer M., Sendhoff B.*

A METAMODEL-DRIVEN INTERACTIVE FRAMEWORK FOR A DESIGNER ASSISTANCE SYSTEM

Honda Research Institute GmbH Germany

designer assistance system, interactive design, free-form deformation, metamodel, neural network

The design of innovative products in the automotive industry is influenced by multiple criteria dominated by both human creativity and technical requirements. Thus the generation of a prototype is an adaptive process which iteratively integrates the needs of various disciplines, working on different timescales. This paper proposes and evaluates a styling design framework which introduces the application of neural networks for fast estimation of technical performance. Accurate model feedback enables the designer to include predicted responses in the styling process, especially in local areas.

332 *Matthews J., Hicks B.J., Medland A.J., Mullineux G.*

CONSTRAINT-BASED MODELLING: A PARADIGM FOR SUPPORTING DESIGN IN PRACTICE

University of Bath United Kingdom

constraints, design process and models, modes of change

This paper explores the potential of constraint modelling as a paradigm for supporting design in practice. It identifies that there are core similarities between design models and in particular McMahon's four modes of change. This is shown by the way of case study examples. The wider capability of constraint modelling as a paradigm for supporting design in practice is also explored through consideration of how it supports the four dimensions presented by Hicks et al. namely, discussion making, problem solving, information transfer and collaboration.

236 *Vajna S., Kittel K., Bercsey T.*

DESIGNING THE SOLUTION SPACE FOR THE AUTOGENETIC DESIGN THEORY (ADT)

Otto-von-Guericke University Magdeburg Germany

autogenetic design theory, solution space, evolution

The Auto Genetic Design Theory (ADT) uses analogies between evolution and activities in the design processes. The ADT interprets the product development as a continuous improvement process.
This paper presents an approach for a solution space definition for the ADT, which aims to generate no limitations for the product designer. This shall ensure that the achievable solution quality is not limited by an insufficient or incomplete solution space definition. Another important feature is, that the solution space dynamically changes as a reaction on external events.

252 *Follmer M., Hehenberger P., Punz S., Zeman K.*

USING SYSML IN THE PRODUCT DEVELOPMENT PROCESS OF MECHATRONIC SYSTEMS

Johannes Kepler University Austria

SysML, product development process, system-level modelling, system-level models, system models, mechatronics, systems-of-systems

Mechatronic products consist of solutions from disparate engineering disciplines. As a consequence, the respective “mechatronic design process” has to comply with the integration of these disciplines. However, there is a critical lack of tools supporting the interdisciplinary aspects during the development process of mechatronic products, especially in the conceptual design phase. System-level models can remedy this unsatisfactory situation and allow for a holistic view on complex systems. The graphical modelling language SysML offers the possibility of developing useful system-level models.

261 *Gausemeier J., Brandis R., Reyes-Perez M.*

A SPECIFICATION TECHNIQUE FOR THE INTEGRATIVE CONCEPTUAL DESIGN OF MECHATRONIC PRODUCTS AND PRODUCTION SYSTEMS

University of Paderborn Germany

conceptual design, mechatronics, principle solution, process planning, production system development, specification technique

Within the scope of the cooperative project “VireS” an instrument for the integrative development of product and production system is developed considering the aspects costs and robustness at an early design stage. In this work we present a specification technique for the description of the principle solution of a production system based on the principle solution of the product. This describes the manufacturing processes (operation sequence) and the allocated resources which are used. Furthermore the proposed approach maps the relationships between product and production system.

334 *Willems B.*

DESIGN MANAGEMENT FOR COMPANIES FROM THE MECHATRONICS SECTOR

Agoria Belgium

design management, mechatronics, branding, communities, perceived quality

Companies from the mechatronics sector are in continuous search for new methods and tools to differentiate their products from the competition. Increasing the quality and performance or reducing costs is no longer sufficient. In this regard the use of design as a strategic instrument gains interest. However tools and methods designed for the specific needs and characteristics of the mechatronics sector are not widely available yet. This paper reports on the research done to translate generic tools and methods on design management into specific ones for the mechatronics sector.

170 *Vielhaber M., Bergsjö D., Catic A.*

MECHATRONIC SYSTEMS ENGINEERING - THEORY AND AUTOMOTIVE PRACTICE

Daimler AG Germany

mechatronics, systems engineering, automotive industry, PLM

Over a century, automotive engineering was a mainly mechanical discipline. Mechanical engineering has a much longer history, with methodology research coming up around 150 years ago. Only in recent years mechatronic thinking has been entering the scene, leading to first mechatronics-focused process models, which are however not consistently applied in industrial practice, yet.
This paper investigates how state-of-the-art systems engineering methodology can be brought closer together with automotive practice. It proposes steps towards a better theory/practice fit of engineering methodology.

196 *Aasland K.E.*

MULTI-PROFESSIONAL PROJECT AS FINAL MASTER PROJECT FOR DESIGNERS

NTNU Norway

team education, student competition, comprehensive project

Industry requires ever more of the candidates coming out of design educations in universities. They expect them to be able to perform productively in a development project from day one. This requires new and additional knowledge and competence building in the study programs. As an experiment, our university has introduced a comprehensive, multi-professional design-build-test project as an alternative to the traditional master project. The experiment has run over 2 years, and the results so far are reported.

238 *Arikoglu E.S., Bonvoisin J., Bouznif M., Cheriti S., Hachani S., Izadpanah H*

DISTRIBUTED COLLABORATIVE DESIGN: ANALYSIS OF A STUDENT EXPERIENCE

University of Grenoble France

functional spaces, distributed design, heterogeneous design team, competition "24h de l'innovation"

"Les 24h de l'innovation" is a design competition during which student teams have to innovate on industrial problems within a 24h timeframe. This paper analyses the participation of two student teams which took place in a distant collaboration context. A reflexive study on the course of action helped to identify eight obstacles generated by the given conditions and that hampered the design activity. These items have been analysed within the scope of two theoretical frameworks which are presented: distributed design and collaboration functional spaces.

271 *Calderon M.L.*

APPLICATION OF REVERSE ENGINEERING ACTIVITIES IN THE TEACHING OF ENGINEERING DESIGN

Polytechnic University of Catalonia Spain

engineering design education, design research methodology, reverse engineering, hands-on activities

Existing studies show that D/A/A (Disassemble, Analyse, Assemble) activities can become a popular pedagogy to provide engineering design students practical hands-on experience in the classroom, however, there are no standardized guidelines on how to make the most out of these activities leaving this task to the experience of the professor at work. The experiences in developing a guiding manual for the implementation of these activities adapted to the specific requirements of a curriculum in engineering design considering its learning objectives and fundamentals are presented in this paper.

315 *Gu N., Gül L.F., Williams A.*

METHODS FOR EVALUATING 3D VIRTUAL WORLDS IN DESIGN EDUCATION

International University of Sarajevo snia-Herzegovina

3D virtual worlds, evaluation methods, design education, collaborative design, creative design

Design education is concerned with learning theory and its applications in the design of artifacts that are essential to our society. 3D virtual worlds have the potential to make a major contribution to design education as a new teaching and learning environment, supporting synchronised communication and 3D modeling. This paper presents three categories of formal methods we have adopted for evaluating 3D virtual worlds in design education. The paper concludes by evaluating the effectiveness of the different methods through comparison and discussion.

356 *Wynn D.C., Maier A.M., Clarkson P.J.*

HOW CAN PD PROCESS MODELLING BE MADE MORE USEFUL? AN EXPLORATION OF FACTORS WHICH INFLUENCE MODELLING UTILITY

University of Cambridge United Kingdom

design process model, process model utility, cybernetics

In any process modelling exercise, questions arise regarding how to maximise the utility of that intervention. This paper describes the utility of modelling as the quality of process regulation it enables and, drawing on established principles of cybernetics, analyse the concept of modelling utility to explain the role of modelling in regulating PD processes. We use this analysis to identify opportunities for researchers and practitioners to improve PD process modelling practice.

162 *Elezi F., Graebsch M., Lindemann U.*

REDUCING WASTE IN PRODUCT DEVELOPMENT BY USE OF MULTI-DOMAIN MATRIX METHODOLOGY

Technical University Munich Germany

lean, waste, product development, complexity, multi-domain matrix, value stream mapping, design structure matrix

This paper investigates an alternative methodology for waste reduction in Product Development (PD) projects which utilizes a Multi-Domain Matrix (MDM). Waste in PD processes originates from different domains. On the other hand, MDM are considered a potential tool for inter- and intra-domain analysis. In order to explore the potential of MDM in waste elimination, the relation between complexity and waste is first established. This relation is taken into account to develop an MDM waste reduction methodology. Lastly, the impact of the proposed methodology on different types of waste is explored.

347 *Wynn D.C., Caldwell N.H.M, Clarkson P.J.*

CAN CHANGE PREDICTION HELP PRIORITISE REDESIGN WORK IN FUTURE ENGINEERING SYSTEMS?

University of Cambridge United Kingdom

engineering change prediction, process simulation

As a result of easier and faster iterations during the design process, the management of design changes, their propagation and their impacts are likely to become increasingly important in future. This paper uses a simulation model to investigate whether, and to what degree, a better understanding of how change propagates could help mitigate some of the risks to project performance that will arise from the increased dynamic complexity in future design environments. We conclude that accurate prediction of change propagation only a few steps ahead could significantly reduce unnecessary rework.

180 *Engelhardt R., Kloberdanz H., Mathias J., Birkhofer H.*

AN APPROACH OF A MODEL TO DESCRIBE UNCERTAINTY IN TECHNICAL SYSTEMS

Technical University Darmstadt Germany

uncertainty, model, development process, analysis, technical systems

A complete model of uncertainties is being developed in this paper, where uncertainties can be identified on different levels of abstraction. Uncertainties have to be taken into consideration during the planning and developing process especially while building the model and forecasting the technical product and process properties. It enables the assignment of suitable models of uncertainty at different levels of abstraction. Based on this model, it is a decisive part of these models to derive suitable methods which help reducing the lack of knowledge.

229 *Paula I.C., Fogliatto F.S., Echeveste M.E.S., Cristofari C.A.*

PRODUCT DEVELOPMENT MANAGEMENT MATURITY ASSESSEMENT: PROPOSAL OF A NEW METHOD

Federal University of Rio Grande do Sul Brazil

PDP management, maturity model, problem analysis

The optimization of Product Development Process (PDP) is challenging. This paper presents an alternative approach for PDP maturity measurement, organized in two stages: stage (i) we assess the frequency in which PDP's typical problems happen in the company, and then correlate problems with a list of PDP's Best Practices. Outputs of stage (i) are a maturity score for the company's PDP and improvement opportunities to be prioritized. In stage (ii) we set up a company's profile in view of which improvement opportunities from previous stage are prioritized and consolidated in a portfolio.

377 *Birkhofer H., Zhao S.*

THE LONG-RUNNING ISSUE OF REVIEW QUALITY – FINDINGS FROM AN EMPIRICAL STUDY AMONGST INTERNATIONAL REVIEWERS

Technical University Darmstadt Germany

peer review, review quality, content and formal quality

This study was conducted in order to elaborate the degree of differing evaluations amongst reviewers by obtaining as many reviews as possible for one single paper which has been sent out to all potential referees. According to the findings, a strict objective evaluation of a scientific contribution seems to be not feasible. The review process is strongly affected by the character traits of the referee and his scientific imprint. In this sense, not the "bargaining" on the review criteria or the rating scales will be rewarding but the adequate consideration of the individuality of the reviewers.

340 *Hendriks L., Kazacki A.O.*

A FORMAL ACCOUNT OF THE DUAL EXTENSION OF KNOWLEDGE AND CONCEPT IN C-K DESIGN THEORY

Mines ParisTech France

C-K design theory, formalization, design logic, design reasoning, dual expansion

The paper presents a contribution to the formalization efforts of C-K design theory. First, we analyze the notion of "dual expansion of concepts and knowledge" in C-K design theory and we discuss how such a reasoning process can be modeled using first-order logic. Then, we present a basic formal account of this notion. This framework is complementary to previous work formalizing the interaction of concepts and knowledge. Finally an attempt is made to sketch some possible extensions of the basic formal framework.

314 *Acosta G.G., Romeva C.R.*

FROM ANTHROPOCENTRIC DESIGN TO ECOSPHERIC DESIGN: QUESTIONING DESIGN EPICENTRE

Technical University of Catalonia Spain

anthropocentric design, ecospheric design, design paradigm

This paper proposes a change of epicentre in design and product-service development areas. Reality is showing us that human life is unsustainable and that we are not aware of the total dependency of the Earth wellbeing and its limited resources, and therefore the authors believe that there is no other way than changing paradigm. The document introduces the hegemonic paradigm, the anthropocentric paradigm, pointing out afterwards approaches that move towards a different paradigm and their limits. Finally, it introduces the basic concepts and ethics of ecospheric design.

336 *Kazacki A.O., Hatchuel A., Le Masson P., Weil B.*

SIMULATION OF DESIGN REASONING BASED ON C-K THEORY: A MODEL AND AN EXAMPLE APPLICATION

Mines ParisTech France

design reasoning, simulation, C-K design theory

C-K design theory is a theory of design reasoning describing design as the interaction of concepts and knowledge. The foundation of C-K theory has often been laid out and studied in formal terms. By contrast, this study presents a simulation model allowing to investigate some design phenomenology and strategies that can be captured by the theory. To illustrate the model, two contrasting design strategies inspired by an industrial case have been proposed and implemented.

126 *Zhao S., Birkhofer H.*

REVIEW QUALITY MANAGEMENT - APPLYING ISO 9000 STANDARDS ON THE REVIEW PROCEDURE OF THE DESIGN SOCIETY

Technical University Darmstadt Germany

peer review, research quality, quality management

This paper elaborates how the ISO 9000 standards can be used to enhance the review performance of the Design Society. By analyzing the quality management principles and applying them on the review procedure, possible courses of action are derived for dealing with existing weaknesses as well as exploiting the potentials. In order to do so, the Design Society is regarded as an organization which wants to gain competitive advantage and reviewing is considered as the service provided by the organization. Objective is to provide support for improving the quality of the review procedure of the Design Society by means of the fundamentals of quality management.

234 *Loftus C., Hicks B.J., McMahon C.A.*

UNDERSTANDING THE USE OF EMAIL IN ENGINEERING: A SCENARIO BASED APPROACH

University of Bath United Kingdom

email, communication, information, re-use, scenarios

This paper is part of a research project to investigate strategies for improving the use and re-use of email sent during the course of engineering work. Using the current literature and empirical studies undertaken during this project the paper presents a non-exhaustive set of requirements for use in assessing such strategies.

This paper contributes a set of 9 scenarios that can be used to as part of a method for assessing the appropriateness and eventual success of

259 *Bertoni M.*

BOTTOM-UP KNOWLEDGE SHARING IN PSS DESIGN. A CLASSIFICATION FRAMEWORK

Lulea University of Technology Sweden

product service systems, functional product development, knowledge engineering, knowledge sharing

The paper presents an approach to visualize the knowledge sharing capabilities of Web 2.0 tools and mash-ups in the design of Product Service Systems. Drawing on data from the Swedish manufacturing industry, it proposes 12 dimensions on which bottom-up tools are benchmarked against the practical issues of working in a cross-functional and Virtual Enterprise environment. The framework has been used in the development phase of a Web 2.0 prototype, showing to enhance the common understanding on the technology capabilities and to facilitate the discussion on the requirements for the demonstrator.

130 *Eigner M., Gerhardt F.J., Gilz T., Handschuh S.*

NEUTRAL DATA FORMATS IN PRODUCT DEVELOPMENT: FROM USE CASES TO A REQUIREMENTS PORTFOLIO

Technical University of Kaiserslautern Germany

product lifecycle management, lightweight data formats, JT

The demand for integrating a neutral, lightweight format as a process-enabler along the product lifecycle rises, but so far there has been lack of a company-neutral driving force to determine and further document the full extent of exactly which processes can be supported by such a format. In this paper, we present a procedure model whose foundation was layed by conducting a comprehensive process chain analysis. Generalizing use cases were derived. Based thereon, a requirements portfolio was established, in turn allowing a judgement on whether or not a format supports a specific use case.

266 *Ammar A.A., Scaravetti D., Nadeau P.*

KNOWLEDGE REUSE : TOWARDS A DESIGN TOOL

Arts & Métiers ParisTech France

knowledge management, knowledge base, methodology, small and medium-sized enterprises

The aim of this study is to provide a methodology adapted to the small enterprises, to formalize and capitalize on knowledge with a view to designing future processes. This methodology will be built around a knowledge based system. The basic input element into the database is the elementary function, expressed in the form of a verb and complement. Both bases of verbs and complements are decomposed into four classes, of more and more precise semantic level. Based on a verb-complement association, the system provides output of all the possible technical solutions.

154 *Pavkovic N., Bojcetic N., Vadla I., Rohde D.*

EMBEDDING DESIGN RATIONALE CAPTURING IN PLM SYSTEMS - A CASE STUDY WITH IBIS-BASED DIAGRAMS

University of Zagreb Croatia

IBIS diagrams, design rationale, PLM systems

The aim of the proposed approach is to provide an interface for creating and manipulating elements of captured design rationale in the environment of PLM system. Elements of IBIS diagram are stored as class instances, and are treated in PLM system as any other class of document. Benefits of this approach could be shown in usage of existing "standard" PLM team communication, storage, maintenance and search capabilities. To efficiently use PLM storage and search capabilities, “intelligent” links between IBIS elements are required. Here “intelligent” link refers to a link created as an object.

157 *Stockinger A., Wittmann S., Martinek M., Meerkamm H., Wartzack S.*

VIRTUAL ASSEMBLY ANALYSIS: STANDARD TOLERANCE ANALYSIS COMPARED TO MANUFACTURING SIMULATION AND RELATIVE POSITIONING

Friedrich-Alexander-University Erlangen Germany

relative positioning, manufacturing simulation, tolerance analysis,tolerance visualization

Tolerance analysis methods are used in design to prevent a loss of profit caused by geometric manufacturing deviations. Main drawback of these methods is their high level of abstraction and simplification. Therefore, we propose a method to include manufacturing deviations of parts by means of variational Finite Element Analysis and to perform a simulation of the assembly process. The proposed work methodology is explained and compared with state-of-the-art methods of statistical tolerancing. A case study of a deep-drawing assembly is presented to outline the benefits of the presented approach.

212 *Gül L.F.*

STUDYING EMBODIED INTERACTION WITH THE DESIGN ENVIRONMENT: WHAT IS THE ROLE OF PRESENCE IN DESIGN?

International University of Sarajevo snia-Herzegovina

designing in 3D, affordances of design environments, presence, protocol analysis

This study characterizes the changes in designer's perception of space and interaction within the design environment while they are moving from sketching to non-immersive to immersive 3D designing. The designer's actions and speech are videotaped and analyzed using protocol analysis method. The analysis of the protocols shows that the types of representation afford different perceptual focus on the spatial properties of the design solution. This finding indicates that the designers developed a sense of presence in the the 3D immersive VE that have an impact on visuo-spatial reasoning.

221 *Husung S., Kästner T., Weber C., Höhne G., Brix T.*

SIMULATION OF ACOUSTICAL PRODUCT PROPERTIES IN EARLY PHASES OF THE DESIGN PROCESS

Ilmenau University of Technology Germany

virtual reality, machine acoustic, auralisation, simulation in design

This paper deals with introducing extended audio-visual VR technologies into product development process. It will be shown that, in order to provide product models fit for design purposes, first some intensive basic research questions have to be solved. This contribution discusses the use of a VR-system and the simulation meth¬ods and models required for product development. This is explained via the example of a pick-and-place unit. The task of the specific design process is to develop a two-coordinate pick-and-place unit for assembling purposes with short cycle times and a low noise level.

239 *Leino S.P., Lind S., Heikkilä J., Uuttu O.*

INTEGRATION OF MANUAL WORK RELATED INFORMATION TO PLM

VTT Technical Research Centre of Finland Finland

PLM, virtual environments, manual work

Virtual environments (VE) are seen as potential means for improving efficiency of product process, and decreasing amount of spent time, and money. VE has also proved to provide effective product development, and analysis tools. However, adopting a VE to a company's product processes and PDM/PLM is a challenge. This paper aimed to propose how manual work design supported by novel VE can be integrated into company product process and PLM. The proposed procedure enable better information flow between product lifecycle stages, e.g. feedback from a maintenance worker to design engineers.

328 *Gausemeier J., Rammig F., Radkowski R., Krupp A., Müller W.*

VIRTUAL AND AUGMENTED REALITY FOR TESTING OF SELF-OPTIMIZING SYSTEMS

Heinz Nixdorf Institute, University of Paderborn Germany

self-optimizing systems, systematic testing, virtual & augmented reality

This paper presents the use of Virtual Reality (VR) and Augmented Reality (AR) for the analysis of systematic tests of self-optimizing systems. Self-optimizing systems are advanced mechatronic systems, which react autonomously and flexible on changing operation conditions. These systems demand formal methods for the test of the controlling and self-optimizing information processing. One method is the so-called systematic testing, which tests the behavior of a system on basis of a formal method. VR and AR are necessary for planning, analysis and evaluation of systematic tests.

319 *Vint L.A.*

THE ROLE OF THE DESIGNER WITHIN SUSTAINABLE ENVIRONMENT: PART OF THE SOLUTION OR PART OF THE PROBLEM

Griffith University Australia

design, sustainable design, climate change, global warming, education

Designers are considered as an integral part of the creative industry; however, in reality they represent the consequence business. Designing involves problem solving and improving people's lives; thereby, what designers create with every decision has an environmental price. The dilemma many designers are facing is seeking an internalised balance between readiness to make informative decisions to incorporate sustainable practices and constraints of being engaged in a commercial project, run by profit. Thus, ethical design with its degree of sustainability forces designers to make a choice.

202 *Beier F., Maier T.*

HOW TO DIGITIZE ANALOG INDUSTRIAL DESIGN ENGINEERING

University of Stuttgart Germany

digital design process, industrial design engineering, product development process, work flow, designing methodology

In engineering research and development, technical progress indicates important changes. For example, product engineering without help of modern technologies got unthinkable within the last decade. This contribution discusses the challenge of integrating modern media in the development process of traditional industrial design engineering. Whereas, the focus doesn't only concentrate on presenting new software or hardware tools but also take a big view on the process itself. This is due to the fact that a wise integration of modern media cannot be equal to ordinary implementation of these tools.

187 *Kim K.M., Lee K.P.*

TWO TYPES OF DESIGN APPROACHES REGARDING INDUSTRIAL DESIGN AND ENGINEERING DESIGN IN PRODUCT DESIGN

Korea Advanced Institute of Science and Technology Korea

design approach, design process, product design

This paper introduces a new perspective to product design approach. Two disciplines involving in product design process, engineering design and industrial design are reviewed. They are characterized as 'Inside Design' dealing with Product-working Functionality and 'Outside Design' dealing with Human-using Functionality respectively. Two distinctive design approaches are drawn out by reviewing product design processes; 'inside-out approach' by which the inside design is defined before the outside design and 'outside-in approach' by which the outside design is defined before the inside design.

364 *Skarka W.*

USING KNOWLEDGE-BASED ENGINEERING METHODS IN DESIGNING WITH MODULAR COMPONENTS OF ASSEMBLY SYSTEMS

Silesian University of Technology Poland

knowledge based-engineering, generative model, CATIA

The paper presents the system for designing with modular fast assembly componets. The system uses Knowledge-Based Engineering methods based on Generative Modeling. Proces of knowledge management starting from knowledge acquisition and finishing on integrating knowledge in CAD tool (CATIA) is discribed. In process of building konowledge base and transfering knowledge ontology elaborated especially for this purpose and PCPACK5 as software tool was used. Elaborated ontology is developed from MOKA ontology.

111 *Bernardes M.M.eS., de Andrade M.B.*

PROJECT MANAGEMENT PROCESSES IN BRAZILIAN DESIGN COMPANIES: RESEARCH BASED ON CASE STUDIES

Federal University of Rio Grande do Sul Brazil

project management, design management, design companies

Project management it is not mentioned very often on the majority of studies on design management. In this context, this research aims at guiding future actions to stimulate the use of consolidated management practices in design offices. The article presents the main result of a year-and-a-half research based on case studies in design offices located in the city of Porto Alegre, Brazil. This study was an attempt to verify how offices develop their project management process, since a gap in the state of the art of design management research was identified.

Session number **D321**

Title of the session: **Modelling and optimisation of engineering design processes III**

Wednesday, May 19, 2010. **11:00 - 13:00**

194 *Stöber C., Westphal C., Krehmer H., Wartzack S.*

INTEGRATION OF CUSTOMERS' REQUIREMENS AND DFX-APSECTS AND THE DEGREE OF MATURITY IN A PROPERTY BASED FRAMEWORK

Friedrich-Alexander-University Erlangen — Germany

properties, characteristics, requirements, degree of maturity, DfX

The co-operating of the different mechatronic domains can detect synergies for the specification of the product properties. However by the manifold requirements the product development process gets more complex. All kinds of requirements and interdependencies have to be considered and translated in properties. Therefore a property based framework is developed to combine the detailing of customer requirements down to technical properties and to characteristics under consideration of the so called DfX-aspects with an integrated monitoring of a degree of maturity and iteration management.

241 *Eriksson P.E., Eriksson Y., Swenberg T., Sverrisson A.*

NEW DESIGN PROCESS MODELS FOR THE AUDIO VISUAL INDUSTRY: A DESIGN SCIENCE APPROACH

Mälardalen University — Sweden

distributed creativity, design models, audio-visual design, film/TV-production

Industrial design processes have several common denominators regardless of the actual design. This is to say that the production of moving images is a kind of design process. Even though every single film- or TV-production is unique, the production processes as such are often similar. Therefore we suggest that a Distributed Creativity Workflow Model will be useful in film- and TV-production. This model will facilitate the design process and make the production of contemporary audio-visual material more cost effective. Hopefully more time can be spent on creativity within the process.

341 *Herberg A., Langer S., Lindemann U.*

ONTOGENY AND TRANSFORMATION OF PRODUCT MODELS – ANALYSIS BASED ON DEVELOPMENT PROJECT DOCUMENTATION

Technical University Munich — Germany

dynamics of product models, product model transformation, product model ontogeny, iteration

The synchronization of activities still comprises a major difficulty for the management of simultaneous engineering processes. Aiming at intensifying the consideration of product-related cycles in process planning, the temporal dynamic behavior of product models (PM) is being addressed in this paper. An analysis of established process models reveals the deficiency of dynamic aspects of the representation of PM. A development project has been conducted serving as data basis for the currently ongoing analysis of the used PM. The potentials of this analysis are outlined by initial results.

354 *Wyatt D.F., Wynn D.C., Clarkson P.J.*

CHARACTERISING THE IMPACT OF LEGACY ARCHITECTURES ON COMPLEX PRODUCTS

University of Cambridge — United Kingdom

product architecture, incremental design, constraints, computational design synthesis

The architecture of a product is important for its lifecycle performance, but incremental design is often practised to limit the duration, costs and risks of product development. Using computational design synthesis to simulate real design, it is demonstrated that incremental design can reduce achievable product architecture quality compared with original design, but that the effect can be mitigated by allowing modifications to the carried-over architecture. The results quantify the tradeoff between quality and reuse in design, leading to more informed decision-making during product planning.

369 *Mathias J., Kloberdanz H., Engelhardt R., Birkhofer H.*

STRATEGIES AND PRINCIPLES TO DESIGN ROBUST PRODUCTS

Technical University Darmstadt — Germany

robust design, design tools, uncertainty, robust design strategies, robust design principles

In this paper, a catalogue of tools is developed in order to support the design of robust products. Here, disturbances are considered which arise from the environment and have an impact on the product. Three strategies for the controlling of disturbances are presented, "Eliminate disturbance", "Reduce / eliminate disturbance influence" and "Reduce / eliminate disturbance impact". For each strategy, a catalogue of tools is developed in which rules, principles and instructions are assigned to each disturbance. From this catalogue the designer gets possible tools to design his product robust.

132 *Edholm P., Johannesson H., Söderberg R.*

GEOMETRY INTERACTIONS IN CONFIGURABLE PLATFORM MODEL

Chalmers University of Technology Sweden

geometry interactions, geometry interfaces, platform model

Geometry interactions between geometry interfaces (locating schemes and mating geometries) of parts in a platform environment composed by Conifgurable Components, CCs, are defined and tested in this paper. The interactions are defined as sub-objects within the already defined CC-object. A case study is performed where these CC-objects, with their geometry interfaces and geometry interactions, are defined in a PDM and CAD environment where the functionality has been defined using separate objects exposed in the PDM-structure.

275 *Cameron B.G., Rhodes R., Boas R., Crawley E.F.*

DIVERGENCE IN PLATFORM COMMONALITY: EXAMINATION OF POTENTIAL COST IMPLICATIONS

Massachusetts Institute of Technology United States

platforms, commonality, cost

Platforming has become an important means of cost-sharing across industrial products. Among many benefits, platforming enables cost savings. Recent work by Boas [2008] has shown that products built sequentially often exhibit decreases in commonality. We discuss some of the findings from case studies of divergence, and their implications for the management of design. Further, we examine in detail one potential detrimental effect – cost growth. Several metrics for tying divergence to cost effects are discussed, as well as the associated mechanisms which could link divergence to cost.

166 *Hansen P.K., Sun H.*

A COMPREHENSIVE VIEW ON BENEFITS FROM PRODUCT MODULARIZATION

Aalborg University Denmark

modularity, product platform, supply chain platform

In most product modularization cases the companies have only weak initial estimations about both the type and the magnitude of the potential benefits. This indicates a need for more precise perceptions of the challenges of managing product modularization efforts.
This paper deals with three challenges according to the outset as described initially. First, we will unfold a company neutral empirical based way of how to understand and manage product modularization. Secondly, we will classify and conceptualize the various product modularization benefits. Thirdly, we will evaluate a number of individual industrial product modularization cases according to the conceptualized model of

265 *Abdullah M.F.A., Marshall R.*

A RESEARCH OVERVIEW OF INDUSTRIAL DESIGN FRAMEWORK FOR MODULAR PRODUCT DESIGN

Loughborough University United Kingdom

industrial design, modular product design, design process, design process application framework

Industrial design has a potential to support development of modular product. This research aims to develop a systemic approach to optimise industrial design in modular product design. A new framework called the InDFM (Industrial Design Framework for Modular Product Design) is developed based on industrial design surveys conducted with British and European based companies involved in developing modular products. A model of the InDMF will be presented to the participating companies and retrospectively applied to their existing product development process. A qualitative evaluation is performed.

138 *Borjesson F.*

A SYSTEMATIC QUALITATIVE COMPARISON OF FIVE APPROACHES TO MODULARITY

Modular Management USA, Inc. United States

modular function deployment, design structure matrix, heuristics, design for X, qualitative comparison

An approach to modularity is used to mean the method by which a modular architecture is defined. This paper presents a method by which such approaches can be compared, incorporating both academic and experience-based criteria. The proposed method, based on dendrograms, is applied on MFD, Component-based DSM, Heuristics, and two derived approaches. Derived approaches seem to offer improvements, but also introduce new disadvantages which are absent in the methods on which they build.

274 *Peralta C., Moultrie J.*

COLLABORATION BETWEEN DESIGNERS AND SCIENTISTS IN THE CONTEXT OF SCIENTIFIC RESEARCH: A LITERATURE REVIEW

University of Cambridge United Kingdom

design, science, collaboration, interdisciplinary, scientific research, design research

This paper examines literature about collaboration between product/industrial designers and scientists in scientific research. The paper suggests that differences between design and science are greater than commonalities, and that design is not a form of science. It claims that the research that designers do while designing has similarities and differences with scientific research. It also explains that further empirical study is needed to understand collaboration between product/industrial designers and scientists, and that studies in interdisciplinarity can be used as the framework for it.

372 *Rasoulifar R., Zolghadri M., Eckert C.M.*

THE NEED FOR A TOOL TO EXCHANGE INFORMATION IN NON-HIERARCHICAL NETWORK OF THE ELECTRTONIC INDUSTRY: AN EUROPEAN PROJECT

Bordeaux University France

product development, non-hierarchical network, information sharing

This paper reports on the early stage of an EU FP7 project,CONVERGE, which addresses the efficiency and agility of the supply network of Electronic industry in the EU market. The final objective is developing a collaboration platform for supply network actors. To understand the requirements for such a tool, it is critical to understand what it means to exchange tactical and strategic information in non-hierarchical networks. As people interpret information in different ways, tools needs to help people to recognise the significance of the information as having tactical and strategic importance

199 *Elgh F.*

TOWARDS AN INTEGRATED SYSTEM FOUNDATION FOR QUOTATION PREPARATION

Jönköping University Sweden

cost estimation, design automation, quotation preparation, system foundation, variant design

Subcontractors are frequently involved in quotation processes and the main objective of this work is to provide an integrated system foundation for quotation preparation that enables detailed analyses of product, process, and cost information. The technology, models and principles for successful system realization are described and a case example illustrating system functionality and utilization introduced. The system foundation enables flexible access to stored information supporting analyses across orders and product variants as well as on a more detailed level for individual product items.

290 *Masclet C., Boujut J.F.*

USING SITUATED FBS TO MODEL DESIGN INTERACTIONS IN A DISTANT SYNCHRONOUS COLLABORATIVE SITUATION

University of Grenoble France

collaborative design, synchronous collaboration, mediated collaboration, situated FBS, serious game

In this paper we present an approach based on a the Delta Design serious game, that proposes a versatile design scenario. We focus on the modelling aspects of the design situation and particularly we pay attention to interaction modelling. The situated FBS model is used as a basis for building our descriptive model and we show how we can propose a model of some key interactions and help to understand the mechanisms of the process of creating a shared understanding. In order to study more deeply this process we have built a collaborative platform, implementing the delta design situation.

124 *Hansen Z.N.L., Ahmed-Kristensen S.*

THE IMPACT ON THE PRODUCT DEVELOPMENT PROCESS WHEN OFFSHORING OR OUTSOURCING

Technical University of Denmark Denmark

product development, design, knowledge, offshoring, outsourcing

This paper investigates the impact on the product development process when a company offshores or outsources a part of it abroad. Data was collected through interviews conducted in five companies. The study showed that the impact can be both negative and positive. The key impact was the possibility of a more complex development process due to cross-cultural virtual communication and collaboration. This meant a spiral development process is harder to offshore or outsource than a generic one. However, this complexity can be lessened by making the process or product simpler and by codifying and documenting processes and tasks to provide a common frame of reference.

360 *Kreimeyer M., Wynn D.C., Clarkson P.J., Lindemann U.*

PROFILING PD PROCESSES BY COMBINING STRUCTURAL ANALYSIS AND SIMULATION

University of Cambridge United Kingdom

process, structure, metric, simulation, case study

This paper shows how two approaches to PD process analysis – structural metrics and simulation analysis – can be combined. Structural metrics can be used to provide a high level analysis of an existing network of tasks. Stochastic simulation can be used to obtain an overview of how tasks interact over time. Both approaches are applied to a process model that originates from the body-in-white design process of a premium class sedan as used in a major German automotive manufacturer. We demonstrate and contrast the analysis approaches, individually and in combination.

224 *Bergsjö D., Almefelt L., Malmqvist J.*

SUPPORTING REQURIEMENTS MANAGEMENT IN EMBEDDED SYSTEMS DEVELOPMENT IN A LEAN-INFLUENCED ORGANIZATION

Chalmers University of Technology Sweden

embedded systems, automotive, mechatronic design, company culture, product performance, requirements management

This study has been conducted at Scania CV in Embedded Systems Development. It was performed with a focus on systems architecture and support for requirements engineering. The study has focused on assessing the company culture and legacy in order to establish the need and benefit of increased formalization.

The paper concludes that formalized requirements management does not exist at Scania today, however a majority of the key informants express a

329 *Holley V., Yannou B., Jankovic M.*

TOWARDS THE PREDICTION OF MULTIPHYSIC INTERACTIONS USING MDM AND QFD MATRICES

Ecole Centrale Paris France

inter-business, multiphysics, interaction, MDM, QFD

In view to customer demand, today products are multifunctional. Soon in the choice of concept, these new integration needs lead to entangled and complex collaboration for the project team.
To achieve the analysis of multiphysic interactions, the AID matrix based method has been developed. Several different design matrices (DSM, DMM and QFD) are evaluated and used to determine appropriate mappings between architecture alternatives, functions and performances. Using indicators and heuristics, the voice of design departments and the complexity of collaboration can be integrated.

248 *Marini V. K., Restrepo J., Ahmed-Kristensen S.*

EVALUATION OF INFORMATION REQUIREMENTS OF RELIABILITY METHODS IN ENGINEERING DESIGN

Technical University of Denmark Denmark

robustness & reliability, assessment methods, information requirements

Current methods for assessing reliability require that designers have access to information that is only available when the product is almost completely developed (e.g. manufacturing data). Current methods for assessing robustness relay excessively on engineers experience. This results in longer development times, as robustness and reliability (R&R) assessments result in the need to review the design. This paper aims at characterising the information needed to perform the most used R&R assessments, and to suggest how to improve them in order to make them applicable during conceptual design.

247 *Parvan M., Maurer M., Lindemann U.*

SOFTWARE WIZARD DESIGN FOR COMPLEXITY MANAGEMENT APPLICATION

Technical University Munich Germany

software wizard, assistance system, user interface, complexity management, multiple domain matrix

Application systems are characterized by a continuous increase of complexity and address users with different levels of experience. The design of assistance systems, so called “wizards”, which support the analysis and handling of complex application systems, is the research subject of this paper. The wizards are customized regarding the specific design and methodology of LOOMEO, a tool for dynamic visualization, analysis and optimization of system structures. The user can apply the wizards to achieve solutions for stated problems and to reduce and control the overall system complexity.

195 *Fasiha M.Y.N., Sakayama Y., Yamamoto E., Taura T., Nagai Y.*

UNDERSTANDING THE NATURE OF DEEP IMPRESSIONS BY ANALYZING THE STRUCTURE OF VIRTUAL IMPRESSION NETWORKS

Kobe University Japan

deep impressions, human preference, structure of impressions, latent impressions, virtual impression network

We focus on deep impressions, which defined as the impressions that are related to the deep feelings towards a product and lie under the surface impressions. We aim at understanding the nature of preference that an individual may have with regard to a product. For that purpose, we developed a method for constructing 'virtual impression networks' and analyzed the structure. As the result, the difference appeared between the structural characteristics of 'like' and 'dislike' networks. We suggest that the understanding of the deep impressions may be the clue in understanding human preference.

353 *Nijs G., Vermeersch P.W., Devlieger P., Heylighen A.*

EXTENDING THE DIALOGUE BETWEEN DESIGN(ERS) AND DISABLED USE(RS): FROM CONVERSATION TO EMBODIED SKILL

Katholieke Universiteit Leuven Belgium

architectural design, disability, use

This paper considers how through dialogue the relationship between architectural design and disability can yield opportunities instead of constraints. Two cases drawn from ongoing ethnographic design research show possibilities and the potential of dialogue for design practice and design research. Dialogue is said to amplify silent realities—things that exist either in user, object, or use, but that stay unaccounted for. However, following the discussion of the cases, it is deemed necessary to extend the notion of dialogue from conversation to embodied skill.

344 *Jun T.G., Hinrichs S., Jafri T., Clarkson P.J.*

THINKING WITH SIMPLE DIAGRAMS IN HEALTHCARE SYSTEMS DESIGN

University of Cambridge United Kingdom

diagrams, systems design, healthcare, modelling language

In order to explore the applicability of diagrammatic representations for healthcare systems design, this paper aims to investigate the roles of different diagram types in various healthcare systems design cases: medication management process; medical device purchasing process; patient diagnosis process. It mainly examines how healthcare workers perceive various diagram types in terms of ease of understanding and utility. In conclusion, it provides insight into how to use various simple diagram types for healthcare systems design.

282 *Gual J., Lloveras J., Puyuelo M., Romero F.*

A PROPOSAL OF AN EVALUATION MODEL UNDER THE PRINCIPLES OF UNIVERSAL DESIGN

JAUME I Spain

universal design, wheelchair, model assessment

In this paper, we propose a model of evaluation in accordance with the  seven principles of Universal Design (UD). This model integrates the analysis and breakdown of the critical elements of the product; the identification of direct and indirect users; and the principles of UD as questions about all the critical elements of a product. We also study a real case of a user of a home wheelchair in order to show the utility of the proposed model.

284 *Labenda P., Sadek T.*

"DESIGN FOR TRAFFICABILITY" OF KINEMATICALLY REDUNDANT LOCOMOTION SYSTEMS

Ruhr-University Bochum Germany

trafficability, locomotion systems, kinematic redundancy, environmental considerations, mobile robots, analysis and evaluation

Building collapses are frequently accompanied by the entrapment of humans buried alive. The victims have to be localized and rescued. Here, mobile robots can act as mobile sensory units navigating through a field of debris transmitting important data to the rescue staff. The robots' abilities of locomotion and their mobility and trafficability, respectively, are of major importance. Here, kinematically redundant locomotion systems possess high potentials. The paper deals with the conceptualization of such robots for urban search-and-rescue under the demand of an effective trafficability.

256 *Gramlich S., Kloberdanz H., Birkhofer H.*

A CONCEPT FOR A STRUCTURED DESCRIPTION OF PROFILE-STRUCTURES OF BRANCHED SHEET METAL PROFILES AS BASIS FOR AN AUTOMATED DESIGN PROCESS

Technical University Darmstadt Germany

design methodology, linear flow splitting, profile-structures, topology, design automatisation

The product development process is shaped by manual actions and decisions. A concept for a structured description of profile-structures (assemblies of branched sheet metal profiles) is needed as basis to automate the design process. The high object complexity requires a three-step approach (topology, geometry, technology). Structural as well as cross-sectional properties have to be set in each step. The topological, geometrical and technological properties are strongly linked. This is a great challenge and the reason why iterative loops have to be integrated in an automated design process.

357 *Eckert C.M., Alink T., Albers A.*

ISSUE DRIVEN ANALYSIS OF AN EXISTING PRODUCT AT DIFFERENT LEVELS OF ABSTRACTION

Open University United Kingdom

product analysis, functional product models, design cognition

This paper analysis how one designer approached the analysis of an existing product, He was part of an experiment with 20 engineers, who were given a hydraulic pump and ask to summarise their findings in a function tree. He produced a comparatively systematic and complete analyses with comprehensive drawings. He started by indentifying abstract functions, then analyse the role of components and then match the two. In doing so he was looking at the product essentially at three different levels of abstraction: the whole product a sub-system level and a single element level, e.g. sealing rings. He changed the level of abstraction as he came across particular issues or problems in his understanding.

297 *Langbein S., Sadek T.*

DESIGN FOR FUNCTIONAL INTEGRATED SHAPE MEMORY ALLOY SYSTEMS

Ruhr-University Bochum Germany

shape memory alloy, actuator, functional integration, partitioning of components, interface analysis

Actuators based on shape memory alloys are today developed to be used only in special applications. Therefore solutions cannot be transferred to other tasks. The focussing has important disadvantages. Firstly the effort and costs reach a high level and secondly the development of complex SMA-actuators turns out to be an insuperable barrier for many companies. As a result there is significant interest in providing standardized and integrated SMA-actuator systems. The aim of this study is to provide methods and the knowledge to support the development process of such SMA-actuators.

373 *Hansen C.T., Andreasen M.M.*

ON THE CONTENT AND NATURE OF DESIGN OBJECTS IN DESIGNING

Technical University of Denmark Denmark

design objects, conceptual design, total design

Often the physical product is seen as the design object. Many properties, which are important for the potential customer or user, are not carried by the product in itself, but by activities and systems brought into relation with the product. Thus, in modern industrial product development and from a methodical point of view it is necessary to expand the focus in order to take activities and other important, but soft properties into account. We see a challenge to develop the idea of ‘design objects’ as a means to broaden engineering designers’ understanding of what they are designing.

304 *Neumann M., Sadek T.*

SCALABILITY OF MECHATRONIC SYSTEMS

Ruhr-University Bochum Germany

scalability, modular design, type series, methodology, similarity

Scaling products by the development of type series and construction kits are established methods to meet the demands of mass customization and well understood for conventional mechanical engineering. In comparison the investigation of mechatronic systems with respect to scalability only takes place in an inadequate manner. Until now no common understanding of scaling exists between the participating domains mechanics, elctronics and software technologies. This article tries to generate a common view and shows how domain allocation can extend the limits of conventional product families.

151 *Diepold K.J., Biedermann W., Eben K.G.M, Kortler S., Lohmann B., Lindem*

COMBINING STRUCTURAL COMPLEXITY MANAGEMENT AND HYBRID DYNAMICAL SYSTEM MODELLING

Technical University Munich Germany

structural complexity management, hybrid dynamical systems, design structure matrix, complex system analysis

This paper presents an approach, which combines structural and dynamical models to form a unified system model. Thereby, both dynamical and structural complexity can be analysed simultaneously. First, a short review on current research in structural and dynamical modelling is presented. Major interfaces between structural and dynamical modelling are shown and used to generate a new modelling process. A new hybrid modelling paradigm is introduced. Finally, a simple example is shown, in order to highlight the approach and thus the potential of combining structural and dynamical modelling.

262 *Nicquevert B., Boujut J.F., Yami S.*

DESIGN PROCESS MODELLING AND COMPLEXITY: WHICH KEY SUCCESS FACTORS FOR THE IMPLEMENTATION OF A PDM TOOL?

CERN Switzerland

design process modelling, project management, complexity, product lifecycle management

Starting from the observation of an implementation project of a Product data management tool (PLM) in a context of large scientific collaborations, this paper focuses on the organisational process leading to the design process modelling and the capture of users' needs. Using a qualitative case study method, this descriptive study shoes the complexity in action, and claims that this complexity is an additional key success factor, as long as the technical manager, a central character of the projects, is taking into account the recursive loops of relationships between the various stakeholders.

292 *Fathallah A., Stal-Le Cardinal J., Ermine J.L., Bocquet J.C.*

USING PRODUCT DESIGN METHODS IN DESIGNING AND VALIDATING ENTREPRISE MODELS

Ecole Centrale Paris France

enterprise model, model design, model validation, model function

Many managers use models to understand the main processes of their companies but also to take the right decisions to enhance the performances. Numerous researches have been carried out on enterprise modeling through the last decades. Most of the times, they propose several modeling techniques making it difficult for managers to choose the suitable model for their enterprises.
In this paper we analyze the design of an enterprise model to set up the characteristics it should have to meet the modeler needs.
The functional analysis is an important step of the design process of new products. The objective is to determine the elements of the product

351 *Kreimeyer M., Lindemann U.*

A GQM FRAMEWORK TO GUIDE PROCESS IMPROVEMENT USING STRUCTURAL ANALYSIS

Technical University Munich Germany

product development, goal-question-metric (GQM), framework, process improvement

In process management, manifold perspectives onto an existing process can be taken when analyzing it. However, there are few frameworks that combine the different interests of process management with existing analysis approaches. This paper suggests a framework based on the Goal-Question-Metric approach to link common goals and concepts of process analysis to the currently available means of analyzing the structure of dependency models such as process maps or flowcharts. Using a case study from automotive body design, the use of the framework is exemplified.

355 *Wadell C.J., Ölundh Sandström G., Janhager J., Norell Bergendahl M.*

EARLY STAGES USER INVOLVEMENT AS A PRODUCT INNOVATION CAPABILITY IN THE MEDICAL TECHNOLOGY INDUSTRY - A LITERATURE STUDY

KTH, Royal Institute of Technology Sweden

user involvement, product innovation capability, medical technology

The article is presents a literature study related to user involvement in the early stages of the product innovation process in the medical technology industry. Five fundamental capabilities in early stages user involvement are presented and reasoned about. The capabilities are identification of users, acquiring, assimilation, and transformation of user knowledge as well as exploiting. The result of the article contributes to future research in an action research project with the medical technology industry and the public healthcare sector in Sweden.

294 *Albers A., Ebel B., Sauter C.*

COMBINING PROCESS MODEL AND SEMANTIC WIKI

Karlsruhe Institute of Technology Germany

semantic, wiki, iPeM, process, documentation

Increasing product complexity, gobal markets and shorter product life cycles are only a few reasons why the development of new products is a challenging task. A lot of knowledge is needed for and generated in product development processes. In this paper an approach is presented which suggests a combination of the integrated product engineering model (iPeM) and semantic wikis for supporting knowledge management in product development. To receive a valid statement of the practicability and usability of the approach the implemented wiki-system was used during an industrial predevelopment project.

171 *Galea A., Borg J., Grech A., Farrugia P.*

INTELLIGENT LIFE-ORIENTED DESIGN SOLUTION SPACE SELECTION

University of Malta Malta

design decision support tool, product life-cycle specifications, DFX, proactive design support

Traditional CAD tools tend to provide support for the solution phase of the design process, with the design specifications being overlooked. This is a major limitation given the vital importance of considering design specifications. This paper describes ongoing work to develop a design support tool aimed to meet this limitation. The tool, apart from assisting designers to take into account product life-cycle specifications also aims to merge the specification space with the solution space, thus making it easier for the designer to realize when a design specification is going to be violated.

307 *Hacker W., Melzer M., Debitz U., Stelzer R.*

HUMAN-CENTERED SUPPORT OF EDUCATION IN DESIGN PROBLEM SOLVING

Technical University Dresden Germany

design problem solving, non-technical skills, education in engineering design

The integration of teaching non-technical (“soft”) skills in engineers’ initial and further education is important, but widely disregarded (e.g. Crawley, Malmqvist, Östlund & Brodeur, 2007). Therefore a balanced set of support techniques and tools for the decisive creative early phases of product development as well as for subordinate aspects of the design process (planning and documenting; working as a design team) was developed, integrated in engineering students´ regular curriculum, and evaluated. The results are not contrary to the potential utility of the suggested support system.

374 *Rasoulifar R., Zhang X., Zolghadri M.*

A DESIGN SUPPORT TOOL FOR INTEGRATING EXPERT-USER IN THE DESIGN PROCESS: CASE APPLICATION ON SURGICAL INSTRUMENTS DESIGN

Bordeaux University France

user centered design, collaboration, design support, surgical instruments

The majority of design support tools focus on technical and managerial aspects of design. User integration in design process is an emerging dimension for the design of innovative products, particularly in innovative design of specific and expert usage product. The present paper explains the expert-UCD method and addresses the specification of this method. Then the main architecture for a software tool with the roles and use cases are presented. Based on this structure, a software tool prototype is developed and used for an application, the design process of an innovative surgical instrument.

327 *Eigner M., Faißt K.G., Hollerith T., Mogo Nem F.*

A VIEW-BASED MODELING APPROACH FOR REPRESENTING MULTIDISCIPLINARY FUNCTIONS IN PDM SYSTEMS

Technical University of Kaiserslautern Germany

view-based modeling, mechatronical function modeling, product lifecycle management

The challenges of today’s competitive business contexts drive enterprises to guarantee their customers permanent product innovations which is nowadays stimulated by the application of multidisciplinary solution principles. Therefore, means have to be provided to cope with the associated complexity. From a PLM perspective, the most troublesome gaps to bridge are the synchronisation of disparate product data and related processes. This paper outlines concepts for a view-based modelling approach using the example of multidisciplinary product functions as well as their prototypical implementation.

122 *Solaberrieta E., Arias A., Barrenetxea L., Etxaniz O., Minguez R., Muniozgu*

A VIRTUAL DENTAL PROSTHESES DESIGN METHOD USING A VIRTUAL ARTICULATOR

University of Basque Country Spain

dental virtual articulator, collision detection, dental CAD/CAM

The following paper is a research project in which a Virtual Articulator which allows for the simulation of mandibular movements has been developed. By using this articulator, kinematic analysis can be taken into account in the design of dental prostheses, which constitutes a significant improvement in this field.

The main practical implications of this paper are, on the one hand, the improvement in dental CAD/CAM systems by adding the kinematic

244 *Lenau T., Dentel A., Ingvarsdóttir Þ., Guðlaugsson T.*

ENGINEERING DESIGN OF AN ADAPTIVE LEG PROSTHESIS USING BIOLOGICAL PRINCIPLES

Technical University of Denmark Denmark

biomimetics, biological principles, idea generation, engineering design, biological literature, shape adaption

The biomimetic design process is explored through a design case: An adaptive leg prosthesis. The aim is to investigate if the biomimetic design process can be carried out with a minimum of biological knowledge and without using advanced design methods. In the design case biomimetic design was successfully carried out using library search resulting in 14 biological analogies for the design problem 'shape adaption'. It is proposed that search results are handled using special cards describing the biological phenomena and the functional principles.

125 *Medland A.J., Gooch S.D.*

AN IMPROVED HUMAN MODEL FOR USE IN THE STUDY OF SITTING POSTURES

University of Bath United Kingdom

anthropomorphic data, constraint resolution, human to product interaction, CAD modelling, paraplegic study

A human modelling program has been extended to allow it to handle constraint rules. The improvements include those of modelling balance and posture as well as hand gripping. This model has been applied to studies of people with tetraplegia and in particular to their abilities to use a wheel chair. In this study a range of patients were investigated and significantly different postures were found dependent on the level of their spinal injuries. The models and rules can now be used to modify the individual wheel chairs to improve the posture and match the capability of the users.

101 *Sušic A., Štorga M., Majic M.*

ERGONOMIC ASSESSMENT IN CONCEPTUAL AND EMBODIMENT DESIGN

University of Zagreb Croatia

ergonomics assessment, inclusive design, user-centered design

The aim of the study reported in this paper was development of the metrics for ergonomic assessment that could be utilized by engineers in conceptualization and embodiment design. As an initial step towards enabling practitioners in engineering design to cover these issues without need of acquiring specific knowledge and measurement equipment, the list of feature groups for ergonomic assessment in early stages of the product development has been proposed and evaluation method has been presented. The medical examination table was used as a case study for illustrating proposed approach.

198 *Hareesh P.V., Kimura T., Adachi S., Thalmann D.*

AN ERGONOMIC EVALUATION ENGINE FOR CONCEPTUAL DESIGN STAGE USING ANTHROPOMETRIC DIGITAL HUMAN MODELS

Panasonic Electric Works Co Ltd Japan

ergonomic evaluation engine, digital humans, anthropometry, real-time simulation, aging simulation

This paper introduces an ergonomic evaluation engine for conceptual design stage of a product development cycle using digital humans. Using an intuitive control facility, design engineers can input a simple CAD model, design variables and human factors in to the system. The evaluation engine generates the required simulation in real time by making use of Anthropometric and Physical Characteristic Databases and Prioritized Inverse Kinematics architecture. The proposed system could be an efficient tool for helping designers for easier and earlier identification of ergonomic flaws

117 *Raudberget D.*

THE DECISION PROCESS IN SET-BASED CONCURRENT ENGINEERING - AN INDUSTRIAL CASE STUDY

Jönköping University Sweden

set-based concurrent engineering, design evaluation, Pugh matrix, industrial case study

Decision-making and selection of different design alternatives is a central activity in product development. This paper compares the decision process of Set-Based Concurrent Engineering to Pugh's method of controlled convergence in an industrial case study.

The purpose is to investigate if the set-based decision process renders different results compared to the traditional Pugh matrix selection. In the case study, Pugh's matrix promoted the development of new concepts. The set-based process offered the opposite approach, aiming at improving

173 *Yannou B., Wang J., Yvars P.A.*

SIMULATION OF THE USAGE COVERAGE OF A GIVEN PRODUCT

Ecole Centrale Paris France

constraint programming, usage, design under uncertainty, coverage metrics

In the context of the Usage Coverage Model of a product-service, design parameters are linked to expected usages that must be covered. This paper implements a physics-based model to provide a performance prediction for each usage context that also depends on user skills. The physics describing the behavior and performances of a jigsaw is established. Simulating the usage coverage is not trivial for two reasons: presence of circular references in physical relations and need to deal with usage domains. Then, we use CSP techniques to simulate the performances and the part of usage covered.

177 *Gorbea C., Hellenbrand D., Srivastava T., Biedermann W., Lindemann U.*

COMPATIBILITY MATRIX METHODOLOGY APPLIED TO THE IDENTIFICATION OF VEHICLE ARCHITECTURES AND DESIGN REQUIREMENTS

Technical University Munich Germany

concept selection, compatibility matrix, vehicle architecture

A compatibility matrix is an nxn matrix that is used to identify partial solutions that are compatible within a given choice set. This paper presents a four step methodology that is applied to find over 5451 valid hybrid electric vehicle (HEV) architecture configurations along with 91 requirement sets. The two domains are bridged using "linking selections" that allow developers of HEV architectures explore both new structural configurations and compatible system requirement parameters. The methodology aplies to any n-dimensional choice sets and is based on morphological matrix and DSM theory.

249 *Vanhatalo M.J., Lehtonen T.A., Pakkanen J.T., Juuti T.S., Riitahuhta A.O.*

TOOL FOR CONCEPT EVALUATION BASED ON THE PROPERTIES OF THE CONCEPT AND THE BUSINESS ENVIRONMENT

Tampere University of Technology Finland

concept evaluation, properties of concept, properties of business environment

Nowadays new products have to be brought to the market in frequent pace. This leads to situation where designers need a way to quickly validate their concept ideas. We present a tool for this. The tool consist properties of the concept, production network, and business environment. The principle in the tool is to link these properties by visualising the behaviour between the relations. These behaviours inform the designer about the consistency of the concept to the life cycle. The tool was tested in a specific industry area and conclusions are that it gave the information it was designed for.

254 *Punz S., Hehenberger P., Follmer M., Zeman K.*

CUSTOMER ORIENTED CONCEPT DEVELOPMENT IN MECHATRONIC PRODUCT DESIGN

Johannes Kepler University Austria

customer orientation, quality function deployment, conceptual design, house of quality, house of concepts

Especially in early product design stages, customer orientation is mandatory for product success. A method aiming at this goal is the QFD approach, which, however, does not focus on conceptual design, at least not to the desired extent. Hence, a new approach, namely the House of Concepts (HoC) is introduced offering assistance in enhanced customer orientation particularly during conceptual design, and supporting systematic concept development on different levels of abstraction. Thus, the HoC approach contributes to position products exactly in the targeted market segments.

Session number **D411**

Title of the session: **Modelling and optimisation of engineering design processes IV**

Thursday , May 20, 2010. **8:30 - 10:30**

161 *Kreimeyer M., Bradford N., Lindemann U.*

PROCESS ANALYSIS USING STRUCTURAL METRICS: A COMPREHENSIVE CASE STUDY

Technical University Munich — Germany

structural complexity, process, analysis, metric

There are numerous approaches to analyze and improve processes systematically. This paper focuses especially on the application of structural complexity metrics that assess, at a high level, how the different entities of a process interact and where, through the identification of structural outliers, there might point to possible weak spots. The paper is based on a previously published case study and compares a recent, more comprehensive set of complexity metrics to an existing analysis using a case study taken from automotive design.

289 *Högman U., Johannesson H.*

TECHNOLOGY DEVELOPMENT AND NORMATIVE PROCESS MODELS

Chalmers University of Technology — Sweden

technology development, stage-gate, spiral model

The aim of this article is to contribute experience gained from developing, implementing and using a normative model for technology development based on the stage-gate model. A modified stage-gate model is proposed where the iterative and explorative nature of uncertain technology development is considered. An empirical contribution is made regarding the dialogue that took place in the study company in question when trying to balance the management need for rationality, structure and control vs. the need of the developers for exploration and experimentation.

153 *Krehmer H., Meerkamm H., Wartzack S.*

AVOIDANCE OF UNNECESSARY DESIGN ITERATIONS BY MONITORING THE PRODUCT´S DEGREE OF MATURITY

Friedrich-Alexander University Erlangen — Germany

design iterations, product´s degree of maturity, properties, characteristics

Increasing requirements as well as product development processes getting more and more complex cause an increased likelihood of unneccessary design iterations. So, developers need a framework to avoid unnecessary and time-consuming detours by assessing effects of each possible change. Aim of this contribution is to identify key factors for the avoidance of unnecessary iterations and to present approaches for coping these challenges. Furthermore a framework for the avoidance of unnecessary iterations based on a continuous monitoring the product's degree of maturity is introduced.

350 *De Lessio M.P., Wynn D.C., Clarkson P.J.*

MODELLING THE DESIGN PROCESS PLANNING SYSTEM

University of Cambridge — United Kingdom

planning system, modelling, planning elements

This paper examines the use of modelling to analyse aspects of the planning system to minimise the potential for planning error. Using a dependency structure matrix, the relationships between multiple plans used within the planning system are analysed to identify and minimise the opportunity for planning errors to occur. Building on this example, the use of such models to evaluate the overall planning system in multiple ways is explored with the objective of defining enhanced methodologies for conducting the highly dispersed but yet very interactive planning activity amongst project actors.

343 *Langer S., Knoblinger C., Lindemann U.*

ANALYSIS OF DYNAMIC CHANGES AND ITERATIONS IN THE DEVELOPMENT PROCESS OF AN ELECTRICALLY POWERED GO-KART

Technical University Munich — Germany

change, cycles, process modeling, process analysis, empirical example

This paper aims at analyzing and characterizing dynamic changes and iterations (referred to as "cycles") within development processes. Therefore, the development process of an electrically-powered go-kart is surveyed intensely and modeled with the specific focus of describing and analyzing cycles. Subsequently, cyclic occurrences are identified and potential criteria for describing cycles are derived and defined. Finally, the applicability of the descriptive criteria for the cyclic occurrences is checked. This leads to an empirically based, more precise description of the term “cycles”.

231 *McAlpine H., Cash P., Howard T., Arikoglu E.S., Loftus C., O'Hare J.*

KEY THEMES IN DESIGN INFORMATION MANAGEMENT

University of Bath United Kingdom

information management, user requirements, design process

This paper discusses the information management (IM) requirements of a wide range of stakeholders from a typical engineering organisation. Based on multiple empirical studies undertaken at the University of Bath's Innovative Design and Manufacturing Research Centre (IdMRC), collaborating universities and partner organisations, six scenarios have been constructed. Their contents reflect the main information management challenges facing today's large engineering organisations. From these scenarios, five key themes are identified and the corresponding areas for future IM research are discussed.

203 *Roth D., Binz H., Watty R.*

GENERIC STRUCTURE OF KNOWLEDGE WITHIN THE PRODUCT DEVELOPMENT PROCESS

University of Stuttgart Germany

evaluation of knowledge, knowledge management, knowledge structuring, product development process

The resource knowledge becomes more and more important in terms of a factor of production. The intention of this paper is to develop a preferable, general structure of knowledge within the product development process to make it available to several fields of application. Theoretical results have been optimised due to first empirical studies in an academic environment. The developed structuring model represents an approach that subdivides relevant knowledge types into two categories and shows their interconnectedness, relations and significance within the product development process.

114 *Hölttä V.*

ENABLING EFFICIENT COMMUNICATION OF QUALITY DESIGN INFORMATIONIN A DESIGN PROCESS

Helsinki University of Technology Finland

information exchange, design process, communication, quality design information

Poor communication of designer-produced information can lead to mistakes and delays in the design process. The aim of the paper is to find ways to ensure efficient communication of quality design information via a communication analysis framework. Three major factors of efficient quality design information communication can be identified: teamwork, individual awareness and development, and organizational support. The results indicate that concentrating on these key concepts could help improve the quality of design information.

366 *Kjeldal-Jensen O., Ahmed-Kristensen S.*

INFORMING EARLY-PHASE TECHNOLOGY DECISIONS IN PARADIGMATIC INNOVATION

Technical University of Denmark Denmark

decision making, paradigmatic innovation, engineering knowledge management

The innovation activities of a company facing paradigmatic change with regard to both technology and business model includes many decisions, where information is limited along several dimensions.
How are decisions regarding technologies informed in the early phases of innovation, when dealing with paradigmatic knowledge fields?
To explore the question, a case study; investigating the decisions made for radical new innovations, and the knowledge needed for supporting these decisions, was carried out in an energy utilities company.

303 *Petermann M.A., Meiwald T., Lindemann U.*

TRANSFERRING KNOWLEDGE OF PRODUCT CREATION - MOTIVATIONS AND CONSEQUENCES

Technical University Munich Germany

knowledge transfer, interview study, qualitative approach, bottom-up analysis

In order to provide a more detailed understanding of the implications of transferring knowledge in product creation networks, we need a more detailed picture of motivations and consequences of such knowledge transfer for different stakeholders. In this paper we present first results of an interview study within seven industrial goods designers and manufacturers. Aiming at a description beyond the catchphrases provided by literature so far, a detailed insight into motivations and consequences of knowledge transfer for those who divulge, receive or use product creation knowledge is provided.

358 *Eckert C.M., Delamore P., Bell C.*

DIALOGUE ACROSS DESIGN DOMAINS: RAPID PROTOTYPING IN AEROSPACE AND FASHION

Open University United Kingdom

rapid prototyping, creativity, fashion innovation

This paper reports on an unusual dialogue between two designers using Rapid Prototyping (RP) technology, one from the domain of aerospace, and the other from fashion design. Both designers saw the opportunities to improve the design process through RP, while identifying challenges in persuading people to change current practice. The immediacy of interaction with physical objects affords better design communication, and decisions can be revised before significant resources are committed. Both designers were struck by the similarities in the challenges and potential across both domains.

219 *Stoeckert H., Lindow K., Stark R.*

COLLABORATIVE ENGINEERING – ISSUES AND EVIDENCE FROM INDUSTRIAL PRACTICE

Technical University Berlin Germany

collaborative engineering, process interfaces, virtual product creation, interface errors, process & methods requirements

A lot of challenges needs to be managed when it comes to Collaborative Engineering in today's product developing industries. This paper describes investigations in the field of Collaborative Engineering as well as German's automotive, aviation and plant engineering industries, regarding those special problems. After describing issues and obstacles to smooth collaboration with the according theoretical background, process and method requirements (PMR) will be introduced. Finally, the conducted empirical survey CE-Study 2009 as well as the key findings and possible interpretations are presented.

260 *Schumacher M., Stal-Le Cardinal J., Bocquet J.*

A SYSTEMIC APPROACH TO DEFINE THE HIERARCHICAL STRUCTURE OF AN AIDED COMPETENCE MANAGEMENT SYSTEM FOR VIRTUAL TEAM BUILDING

Ecole Centrale Paris France

aided system, competence management, virtual team building, systemic approach, hierarchical tree

The paper responds to the need of an Aided Competence Management for Virtual Team Building System (Aided CMVTB System). We focus on virtual teams that are active in design projects in the area of New Product Development.
Due to the systemic approach of the functional analysis the Aided CMVTB System is described by functions that are represented with the tool of the hierarchical tree. Predicated on the CEISAR Enterprise Architecture Cube the hierarchical tree is one of the reasons for the adaptiveness of the Aided CMVTB System to different needs of stakeholders.

342 *Schleidt B., Eigner M.*

A COMPETENCY MANAGEMENT APPROACH FOR CROSS ENTERPRISE PRODUCT DESIGN

Technical University of Kaiserslautern Germany

virtual product design, competency development for engineers, quality function deployment, person-environment fit, cross enterprise engineering, measuring working conditions

In the dynamic environment of Cross Enterprise Engineering and Product Design the importance of efficient cooperation and deployment of human resources is increasing. Based on the idea of Quality Function Deployment an approach for the management of competencies according to working conditions will be presented. The theoretical foundation for this approach represents the theory of person-environment fit. Also an empirically validated competency model and an index to describe working conditions in Cross Enterprise Engineering will be described.

291 *Chamakiotis P., Dekoninck E.A., Panteli N.*

CREATIVITY IN VIRTUAL DESIGN TEAMS

University of Bath United Kingdom

creativity, design teams, virtual teams, virtual design teams, globally-distributed teams, globally-dispersed teams

Virtual Teams are an increasingly seen phenomenon in the digitally-mediated global workplace. The creativity of Virtual Design Teams, a quite popular working arrangement amongst contemporary organizations, has not been researched extensively whilst creativity is seen as a prerequisite throughout the design process. This paper draws on the creativity, design and virtuality literatures and develops a model that sets the research boundaries and pinpoints some of the knowledge gaps. Specific research directions and questions are also presented based on the review.

346 *Kortler S., Diepold K.J., Lindemann U.*

STRUCTURAL COMPLEXITY MANAGEMENT USING DOMAIN-SPANNING STRUCTURAL CRITERIA

Technical University Munich Germany

structural complexity management, design structure matrix, domain mapping matrix, structural criteria, structural meanings

Manufacturing technical products implies complex design processes and complex product architectures. One perspective is to characterize products and their design processes by their underlying structures. Comparing and evaluating these structures makes it necessary to interpret underlying patterns, different structural criteria and then evaluate their impacts. There are many structural criteria describing patterns included in single domains. This paper closes the gap of interpreting domain-spanning structural criteria and complements the existing possibilities to evaluate system's structures.

273 *Platanitis G., Pop-Iliev R., Barari A.*

COMPREHENSIVE USE OF A DSM-BASED METHODOLOGY IN AN ACADEMIC SETTING

University of Ontario Canada

design, education, DSM, WTM

The process dynamics of a 3rd year design project are analyzed using DSM methodologies. First, the stability characteristics are determined. Then a sensitivity analysis is performed to compare differing design process models as provided by the students. Finally, the effect of random disturbances of varying degrees and points of occurrence are analyzed. The results will assist students with organizing and tackling tasks more efficiently, while instructors can foresee their window of opportunity in implementing design changes, as well as prepare them to mitigate project delays of unknown cause.

213 *Helten K., Hellenbrand D., Lindemann U.*

A PROCEDURAL MODEL TO ASSESS MAIN INFLUENCES OF PRODUCTION ON PRODUCT DESIGN

Technical University Munich Germany

product robustness analysis, design for manufacturing and assembly, multiple-domain matrices (MDM)

Production as one of the main limiting factors must be considered during product design. Today product concepts need to be robust, i.e. in this context suitable for various production concepts and conditions. To understand the significant interdependencies of product concepts and production systems in early phases, we propose a procedural model including the analysis of both areas on different abstraction levels and the use of a Multiple-Domain Matrix. Especially the influence different production alternatives have on the product concept indicates key factors for a design of robust products.

123 *Karakašic M., Zadnik Ž., Kljajin M., Duhovnik J.*

DESIGN SOLUTIONS WITH PRODUCT FUNCTION MATRIX AND ITS REQUESTS

University of Ljubljana Slovenia

product development, design process, functional modeling, functional matrix, functionality matrix

This paper presents model and application of product function matrix and its requests model. Model is implemented in developed computer Web application. With connections and winning parameters relation between Blower matrix and Diffuser matrix is presented and achieved. In this way it is possible to generate complete product function structure stored in matrix structure. When complete matrix and function structure is created, it is possible to generate physical (shape) product structure.

108 *Osman K., Bojcetic N., Marjanovic D.*

MULTI CRITERIA DECISION MAKING IN PRODUCT PLATFORM DEVELOPMENT AND EVALUATION

University of Zagreb Croatia

decision making process, product platform development, analytic hierarchy process, cooling generator

This paper describes the application of two methods, and the proposed framework, with which we want to achieve optimal choice platform products, combining the following methods: Modular Function Deployment (MFD) (my previous work) and evaluation using of multicriteria decision making process, based on the method of Analytic Hierarchy Process (AHP). Here we applied computer tools "SuperDecisions" for creating a hierarchical model of AHP decision making. With this work we want to improve and accelerate the development of product platform (in this case on the example of cooling generator with air-cooled condenser with axial fan and for outdoor position of installation). According to the

147 *Uberti S., Gadola M.*

DESIGN OF A NEW HIGH-END STREET BIKE

University of Brescia Italy

motorcycle, handling, chassis, design

This paper deals with an “atypical” bike design. It can be considered atypical due to the materials used and the peculiar engine – chassis combination. The project was born as a consequence of the manufacturing company's desire to access a niche motorcycle market. The project is about a new bike with an adequate family feeling with the factory style, totally customizable; it will be a large capacity, naked sporty two-seater, with innovative design and a very good handling.
In the paper the entire design process leading to the presentation will be briefly explained.

235 *Zapf J., Alber-Laukant B., Rieg F.*

CUSTOMIZED DESIGN PROCESSES OF POLYMER PARTS BY COMPUTER-AIDED TOOLS

University of Bayreuth Germany

CAx, FEA, simulations, workflow

Complex CAE-driven product development processes need a methodical approach to handle them successfully. Using the ICROS-method (Intelligent CROss-linked Simulations) sub-processes in designing, depending on their relations, can be composed to complete process-chains. This procedure, supplying the developer on different process levels and steps, is shown by a practical example of product design, the elastomer damping elements of claw couplings. With the method presented material and part behaviour can be predicted by skilled combination of virtual product design and prototype testing.

277 *Matkovic K., Klarin B., Jelovic M., Duras M.*

INTERACTIVE VISUAL ANALYSIS AS A SUPPORT OF OPTIMIZATION AND ANALYSIS OF INTERNAL COMBUSTION ENGINES

VRVis Resaerch Center Austria

interactive visual analysis, common rail injection, chain drive, EHD bearing drive, EHD Bearing]

Multiple simulation runs, a process where many simulations with different parameters of the same model are ran, helps engine designers in getting insight. In order to cope with increased complexity and amount of results advanced techniques are needed. Interactive visual analysis can support analysis of such a data. Three projects: rapid prototyping of a common rail injection system, analysis of a timing chain drive, and analysis of an elastohydrodynamic lubrication bearing are described. All of these projects result from a cooperation between visualization experts and mechanical engineers.

316 *Pavlic D., Vanhatalo M.*

AN INFORMATION FRAMEWORK FOR ESTIMATION OF INSTRUMENT TRANSFORMER COST

KONCAR - Instrument transformers Croatia

cost, PDM, ERP, PM system, eBOM, mBOM

Managing the cost of production from the early beginning till the end of production has crucial role in competitive ability on the today’s market. Hence the challenge is to automatically estimate the cost of production. An eBOM is extended by the elements necessary for mapping with the mBOM. Those elements are Activity_id, Resource_id and Quantity_id. Extended bill of material and manufacturing bill of material, together with the integration between the BOMs, constitute the information model for estimation of manufacturing cost. A model is realized by utilization of PDM, PM and ERP systems.

352 *Tan C.F., Chen W., Rauterberg G.W.M.*

TOTAL DESIGN OF LOW COST AIRCRAFT CABIN SIMULATOR

Technical University Eindhoven Netherlands

total design, low cost, aircraft cabin, simulator

Testbed is a platform on which an assortment of experiment tools and products may be deployed and allowed to interact real-time. Successful tools and products can be identified and developed in an interactive testbed. The aircraft cabin simulator is a testbed that is developed for European project, namely SEAT. The simulator consists of a small scale cabin like testing platform, an inventory section, a simulation section, a simulation section and a control section. In this paper, we describes the application of total design in the development of aircraft cabin simulator.

145 *Uberti S., Baronio G., Cambiaghi D.*

STUDY & DESIGN OF A SPECIAL TEST BENCH FOR HYDROSTATIC SPINDLE HOUSINGS

University of Brescia Italy

hydrostatic, spindle, test bench, design

This paper deals with the study, design, manufacturing & testing of a particular scientific instrument, functional to investigate hydrostatic bushing behaviour under various experimental conditions.
Job was conducted in concurrence with one of the leading companies in rotary transfer machines business. Machining is performed by hydrostatic unit, in which spindle assembly is contained in a sliding tube supported by a set of hydrostatic bushings. In this paper we will detail the design of a "research & test" bench whose aim is to help in developing new hydrostatic bushing systems.

286 *Müller P., Stark R.*

A GENERIC PSS DEVELOPMENT PROCESS MODEL BASED ON THEORY AND AN EMPIRICAL STUDY

Technical University Berlin Germany

PSS development, generic development process model, empirical study, interviews

For the development of industrial Product-Service Systems (PSS, IPS2) generic development process models are hardly available. The definition of a generic IPS2 development process model is one aim of our research on PSS and IPS2. In our article, we elaborate on a generic process model for PSS and IPS2 development, which is part of a PSS development methodology. The process model bases on theory and empirical findings. An interview study has been undertaken to compare as-is processes in German industry in 2009 in order to compile the new, generic PSS development process model.

192 *Akasaka F., Hosono S., Nakajima M., Kimita K., Shimomura Y.*

REQUIREMENT ANALYSIS FOR THE IMPROVEMENT OF PRODUCT-SERVICE SYSTEMS

Tokyo Metropolitan University Japan

service engineering, product-service systems, requirements, improvement

Manufacturing companies are starting to recognize that services offered through a product are important. From the viewpoint of designing products in combination with services, it is important for designers to define requirements based on analysis of customer needs. This paper proposes a method to analyze the identified requirements for a strategic service improvement. By evaluating the requirements qualitatively from both the service customer's and provider's perspectives, some significant suggestions to define specific requirements which should be focus of improvement are presented.

191 *Chiba R., Akasaka F., Shimomura Y., Tateyama T., Arai T.*

CONTENTS QUARITY DESIGN CONSIDERING CORPORATE RESOURCE WITH SERVICE ENGINEERING

Tokyo Metropolitan University Japan

service engineering, genetic algorithm, resource distribution

In service engineering, the qualities of contents parameters are very important for the customer service value. However, the contents parameters cannot be designed in any values, because the providers have limited resources, which are monetary and time, for the improvements of the contents parameters. In this study, we propose the method of the resource design with the represent of sigmoid functions and Genetic Algorithm. We verify the proposed method with a certain example where CD/DVD rental service is improved. And then, we make discussion how to manage the resources in the example.

339 *Orawski R., Hepperle C., Mörtl M., Lindemann U.*

A FRAMEWORK FOR A PRODUCT-SERVICE-SYSTEM PORTFOLIO: MANAGING THE EARLY PLANNING

Technical University Munich Germany

PSS-portfolio, product spectrum, innovation process, product flexibility, integrated lifecycle

Product-service-systems consist of complex structures and dynamics. They are influenced by hardly predictable impact factors and requirements. Thus, PSS pose a challenge to companies. A PSS-portfolio is suggested to support the early planning during the innovation process. This paper discusses the various dimensions and their requirements which have to be taken into account to manage this challenge. The combination of aspects deriving from product flexibility, systems engineering and product development creates a framework which is the foundation for managing a structured PSS-portfolio.

269 *Pohlmeyer A.E., Machens F., Blessing L.*

ATTRACTIVE OR NOT – WHAT'S THE DIFFERENCE? INTER- AND INTRA-GROUP COMPARISONS IN THE KANO MODEL

Technical University Berlin Germany

methods, aging, technology adoption, satisfaction, Kano

52 younger and 52 older adults expressed their responses to fulfillment and absence of product attributes, which have been previously identified as crucial aspects of technology adoption. The aim of the study was to investigate whether older and younger adults differ with respect to their priorities concerning product appraisal. Additionally, statistical intra-group comparisons were introduced to allow the consideration of tied ranks. These equate to market segments of groups that are represented similarly often, but with different expectations. Significant age differences were found.

105 *Woolley A., Loudon G., Gill S.*

CONTEXTUAL TESTING IN THE MOBILE PHONE DESIGN PROCESS; A CASE STUDY

University of Wales Institute Cardiff United Kingdom

in-context testing, information appliance development

The case study with a Multinational Mobile phone manufacturer presented in this paper investigates the different roles in-context testing with users plays within a design process, and highlights some of the challenges faced implementing contextual approaches. This case study suggests that to add maximum value to the design process, contextual methods should be implemented early in the design process, using rapid and flexible interactive prototyping tools that support a 'toolbox' approach to usability evaluation.

220 *Wiegers T., Song Y., Vergeest J.S.M.*

SHAPE IDEATION TROUGH SHAPE METAPHORS

Delft University of Technology Netherlands

shape ideation, shape metaphor, conceptual design, ideation, creativity

Shape communication was observed in an experiment. Fourteen subject pairs explained the shape of ten objects to each other. All subjects applied shape metaphors, in particular for the five clay objects in the test. The shape metaphors enabled quick explanation of global shape, allowing the details to be explained later. We advocate the development of support systems that can recognize a number of frequently applied shape metaphors, to let human-computer interaction make more benefit of the communication skills of the users.

264 *Stößel C., Blessing L.*

TAP, SWIPE & PINCH: DESIGNING SUITABLE MULTI-TOUCH GESTURES FOR OLDER USERS

Technical University Berlin Germany

gesture-based interaction, multi-touch interfaces, aging, user-centered design

Multi-touch technology and finger-gesture interaction are becoming increasingly popular. While manufacturers advertise this new interaction paradigm as "easy" and "intuitive" to use, it remains unclear whether it indeed facilitates interaction, especially for older users with their special knowledge, needs and capabilities. The present work investigates which gestures are intuitive to older and younger users for a range of common interaction tasks on a mobile device. We found that older users are less coherent in their proposed gestures, use fewer fingers and generate more symbolic gestures.

200 *Halfmann N., Krause D.*

TOWARDS INNOVATIVE ASSEMBLY CONCEPTS: INTEGRAL PRODUCT- AND ASSEMBLY STRUCTURE

Hamburg University of Technology Germany

design for assembly, product structuring, assembly sequencing

The product development plays a decisive role in view of the coherence of the causation and the responsibility of costs along the product life cycle. Early acting is obligatory. The product structuring represents an essential part of design-for-assembly activities in general. In this contribution a systematic approach is presented to structure products on the basis of modular architectures. Therefore assembly relevant criteria are identified and integrated in the procedure. Finally the approach is exemplary applied to the design and installation process of civil aircraft cabins.

217 *Bonvoisin J., Mathieux F., Domingo L., Brissaud D.*

DESIGN FOR ENERGY EFFICIENCY: PROPOSITION OF A GUIDELINES-BASED TOOL

University of Grenoble France

ecodesign, energy efficiency, guideline, energy using products (EuP), electric and electronic equipment (EEE)

Environmental consequences and supply security of energy are currently of major concern. Inefficient energy management in electric and electronic equipment (EEE) represents a significant share of energy wasted in developed countries. Although power consumption of EEE should be addressed during design, no comprehensive method has yet been developed. This paper introduces a new Design for Energy Efficiency method, and details one of its tools. The tool uses a structured inventory of guidelines to be implemented during design and will help identify constructive design strategies for products.

250 *Fargnoli M., Laurendi V., Tronci M.*

DESIGN FOR SAFETY IN AGRICULTURAL MACHINERY

Ministry of Agriculture Italy

design for safety, occupational safety, machine directive, risk assessment, agricultural tractors

The field of machine safety has recently received new issues by the introduction of the directive 2006/42/CE in EU Countries. The impact of this novelty is significant because of the new Essential Health and Safety Requirements proposed by this directive and the extension of its scope. The research work concerned the field of agricultural tractors, which partially fall under the scope of this directive. The output of the study consisted in the development of an integrated procedure for Risk Assessment, which is aimed at supporting all stakeholders involved in the use of tractors.

293 *Hellenbrand D., Helten K., Lindemann U.*

APPROACH FOR DEVELOPMENT COST ESTIMATION IN EARLY DESIGN PHASES

Technical University Munich Germany

cost estimation, development costs, early design phases, uncertainty

A lot of methods deal with the prediction of production or life-cycle costs. At the same time in engineering design there are almost no methods available to predict development costs. These are also of relevance because they are closely related to development effort. Based on an analysis of different related classes of available methods and their adaptability to the problem an approach is presented which allows for development cost estimation in early design phases. To deal with the high uncertainty it combines a regression analysis with statistic simulation to an overall model.

136 *Kazamia K.I., Kafaridou M.O.*

HOW A DESIGNER CAN SUPPORT SUSTAINABILITY IN A CREATIVE WAY

University of Nicosia Cyprus

sustainability, design process, paper-mass, product design

This paper explores the term “Interior Design” and in particular the relationship of the interior design profession with its direct and indirect impacts on the environment. Furthermore it expands the relationship of the interior design profession to the wider scope of social and economic sustainability and suggests a strategy which leads to the involvement of community to promote the uptake of sustainability.

324 *Liem A.*

PROFESSIONAL, INDUSTRIAL AND EDUCATIONAL PERSPECTIVES ON SPONSORED STUDIO TEACHING

Norwegian University of Science and Technology Norway

sponsored studio teaching, business practice, industrial collaboration

This paper discusses how to adopt responsible sponsored studio teaching as common practice in design education, while taking into consideration the interest of design practitioners, professional organizations, unions and the Norwegian society from a social, ethical and economical context based on the Norwegian business culture. There are no clear signals that “Collaborative Sponsored Studio Teaching” undermines the growth of the design professions by means of unfair business practices. Thre 2nd level service stakeholders played a more active role in supporting educational collaboration.

330 *Fukuda S.*

HOW CAN WE SATISFY OUR CREATIVE CUSTOMERS?

Stanford University United States

creative customers, lifecycle customer involvement, process value, lifetime value, experience creation

Our product development has been product-oriented and one way from the producer to the customer. We have regarded them as mere passive consumers and failed to notice our customers are creative and active. But customer’s experience adds value in this age of great changes. We, engineers can create experience for them not only through usage but throughout the whole product lifecycle from design, manufacture, use and repair. Then we will satisfy their highest human needs of self actualization. It is service beyond product delivery and we could establish win-win relation more easily.

363 *da Silva Vieira S., Badke-Schaub P., Fernandes A.A., Fonseca M.T.*

SUBSTANCE VARIATION IN DESIGN APPROACH

Delft University of Technology Netherlands

design disciplines, design cognition, design approach, variant and invariant characteristics

The purpose of the present transdisciplinary research is to identify how designers’ characteristics and behaviour ascertain different approaches to the design process towards understand design processes underlying mechanisms and effective design practices.
The present paper reports a case study providing insights on the characteristics of designers from different disciplines that share the same working environment and contribute to the creation of interactive design solutions. The content of the designers’ statements are analyzed to identify variants and invariants of designers’ approach.

296 *Ericson A., Karlsson A., Wenngren J., Törlind P.*

WHERE DO INNOVATIONS COME FROM?

Luleå University of Technology Sweden

innovation, product development, innovation process

This paper is based on a descriptive study of two types of innovation awards within a manufacturing company. The purpose is to identify sources and understand the background of these awarded innovations. An industrial view of the concept innovation is of importance in order to support future product development processes. Based on the interviews of several team members in awarded innovation projects, some aspects can be emphasized: the importance of the exploration and knowledge acquisition phase, importance of external triggers and that innovation is not a linear process.