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### **From Business to Buttons**

This paper describe a practitioner's tool called Goal Cards. The aim is to bridge the gap between the expected business values when investing in the product and the actual design of the product. Goal Cards describes the product at three different levels of detail: Business Goals, Usage Goals and Steps taken to ensure Usage Goals. Together they formulate a hypothesis stating: Why? (Business Goals), How? (Usage Goals) and What?" (Steps) of the product. The hypothesis is evaluated, reformulated and refined as the design process progresses. Goal Cards have so far been used in two project and have are showing promising results in practical use.

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### **Expert Procedures Implementation in Software Catalogues**

The development of expert systems, implemented in software catalogues, was taken into consideration in this paper. The need of simplifying the choice process requires the assessment of simple rules to organise the parameters characterising the system or the mechanical component to be chosen. Nowadays the designer, when the aim is to choose a component, usually prompts up a wide search, maybe by using web-internet devices and search engines or simply directly contacting some resellers. Aim of this paper is to develop a procedure, implemented into a software program, that enables to build software mechanical components catalogues by using an expert system. The schematic representation of the components enabled to obtain a simple and useful tool to solve the choice problem.

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POL

### **Exemplary Applications of the Reverse-Engineering Method in the Process of Extending Service Lives of Aircraft in Operation in the Polish Air Forces**

The paper has been intended to provide several examples to illustrate how the reverse-engineering method is applied to the process of extending service lives of aircraft in operation with the Polish Armed Forces. The exemplary issues of concern are: evaluation of stress in the structure after modification, estimation of how failures (corrosion) affect the stress distribution, and estimation of fatigue life. Numerical calculations were carried out using the finite element method (FEM). To build a computer model, a manually operated scanner 3D or a photogrammetric method were used.

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### **A Design Process for Complex Mechanical Structures Using Property Based Models, with Application to Car Bodies**

The design of complex mechanical structures is multi-objective and includes the treatments of a wide range of requirements such as quantitative, qualitative, subjective and objective. An example of this type of structure is a car body, where design has a long tradition from which valuable experience can be drawn however fixation to old practises has to be avoided. The design process described in the paper aims to reduce lead time while not excluding innovative solutions. By representing all concepts on a common base as a property based model and use optimisation, an objective analysis can be done early thereby only viable concepts will emerge to further selection. The data gained at early phases is used as input to detail design reducing iterations.

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### **A Review of Product Development Performance Metrics Investigations with Emphasis on the Designer Level**

The study discussed in the paper is a review of the outstanding literature on Product Development (PD) metrics (both theoretical and practical), and also on our own industrial experience on the subject of choosing and implementing PD metrics. The objective is to provide the basis for further research on metrics implementation in industrial environments, with especial emphasis on the designer level.

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### **Bottom Structure For DutchEVO Car: Formulation Of The Problem And The Adjustment Of The Optimization System**

The optimization problem of the DutchEVO car bottom structure was formulated with respect to the minimum mass under the constraints revealed from bending load case. The Multipoint Approximation method with Response Surface fitting and MSC.Marc FEA code was applied. The mechanistic approach was used to define the buckling constraint approximation function. The possibility to use conventional structural materials and two composites with synthetic and natural fibres was evaluated. Under the given formulation of optimization problem the bottom structure made of a wrought aluminium alloy resulted in 46% less weight than a steel structure. The other considered materials also showed a potential to be used in given structural application.

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### **Identifying the Best Overall Solution by Team Based Evaluation and Decision Tactics in Conceptual Design**

In this contribution, evaluation and decision tactics to be applied in early phases of innovative and interdisciplinary product development projects are presented. As an example, a workshop series held during conceptual design phase in the development project "proportional water valve" at Robert Bosch GmbH is taken. With the help of evaluation matrixes, the conceptual solution area is discussed in teams and narrowed down step by step. The last workshop of the series results in combining the selected sub solutions and deciding upon the final overall concept. The coordination effort invested during the workshops pays for itself in the pursuing months many times over. The solutions are thought over carefully from each discipline's angle and furthermore represent a decision which is supported by each individual team member.

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### **Modularity and Distributed Product Development**

The paper describes the introduction of an architectural phase aiming at defining product modules at the Danish Company Bang & Olufsen. The result of the process has been a product with 10 well-defined modules. Three of these have been fully developed by external partners. External partners produce seven of the modules. The product can be assembled manually without use of any specialized tools.

Bang & Olufsen is so convinced about the power and the way of handling the architectural phase that they have launched a training program aiming at training a new category of employees: Product Architects.

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#### **Application of ICDM for the Conceptual Design of a New Product**

ICDM is an Integrated, Customer Driven, Conceptual Design Method for the entire conceptual design process. ICDM is briefly presented in this paper and demonstrated with a detailed case study.

The objective of this study is to bridge the gap between the theory of ICDM and the industrial practice of a high-tech company and to evaluate the applicability of ICDM for an industrial system development.

A multi disciplinary team of six senior engineers was nominated to perform the case study. The team was instructed to apply ICDM step by step. The paper describes the stages of product definition and conceptual design for the LF100 system whose goal is to help parents to take care for their children in public areas, like playgrounds or shopping centers.

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#### **Safe Steering Wheel Airbag Removal Using Active Disassembly**

Active Disassembly is a well researched technique for creating assemblies or casings that can break themselves apart for recycling using a thermal trigger.

In order to remove potentially explosive airbag devices from vehicles; an active disassembly demonstrator has been produced to easily remove automotive steering wheels from vehicles at their end of life. By removing the steering wheel assembly from the car, the high-value instrument panel becomes easier to remove for recycling and recovery. The first demonstrators utilise a shape memory alloy clip and a cylindrical hot probe. Although the solution was successful, optimisation of the heating system is required.

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SVN

#### **Application of Damage Model for Numerical Determination of Carrying Capacity of Large Rolling Bearings**

An exploitation of large axial bearings includes some load peaks, which cause permanent deformation of rolling contact. The plastic strain of base material under the hardened rolling layer starts to grow. The consequence may be micro cracks on the edge of the hardened layer or also peeling of the hardened layer. Because of that we have used in our computation a damage model, which includes isotropic and kinematic hardening and growth of damage. Damage model allows us to follow the variation of elastic and plastic stress and deformation as a function of the number of cycles. The article shows how the described model can be used for the determination of the actual carrying capacity of the rolling contact in low speed axial bearings.

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#### **Numerical Simulation to Study the Influence of the Thickness of Canopy at a Bird Strike**

The paper has been intended to present some considerations on how to determine the relationship between thickness of an aircraft canopy and stress tension during a collision with a bird. The finite element method (FEM) is to be applied. Dynamic pressure is supposed to simulate a bird-impact load. Load distribution in the course of such a collision will be assessed using test data taken from the literature of the subject. Calculations were applied to the Su-22 canopy.

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### **The Innovation-Styling Spectrum: Factors Constraining the Design Ambition of UK SMEs**

This paper describes the development of a framework depicting a spectrum of approaches to managing industrial design. This framework is based on literature and case examples, and four representative cases are described in detail. The concept of design ambition is defined and preliminary findings indicate that companies which display higher levels of design ambition that their competition can gain significant commercial advantage. There is some evidence to suggest a connection between technology maturity, design orientation and design ambition, but further data is needed to draw firm conclusions.

In addition, a range of barriers to improving design ambition have been identified. Further work will focus on the development of a practical approach to overcome these barriers, in the form of a decision support tool to assist in the valuation of industrial design involvement.

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### **Concurrent Decision Making for High-Tech Products and Supply Systems**

The ability to meet the market window is often described as a key factor for successful companies. The pressure to meet the market window has put demands on many companies to shorten the time from idea to a ready product. The company that succeeds to do this more effectively will take the lead in their market and become dominant players.

This paper will focus on a model for requirement driven concurrent engineering. The model will capture the dynamic aspects from reality and the context of the design environment to give information for the decision-making. The model will provide the knowledge and guidance for when, how and why decisions should be made in an innovation process for product and supply system.

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### **Finding Tomorrow Today**

In spite of the importance of a long-term view having been promoted in the literature, very little research has been undertaken to identify which companies are doing it. Even less research has shown what these innovative companies do or what similarities they have in the way they structure this. Long-term innovation is characterised by a complex divergence of possible opportunities and developments, which occur either through great foresight or a great deal of luck. However, this research has begun to show that there are a basic set of rules which can be followed in order to maintain some degree of success and can be built upon. These basic activities can form a 'long-range' funnel in which projects can be guided through and adapted from.

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### **Increasing Load Capacity of Splines due to Design**

Splines are common used shaft-hub-connections with high performance in torque transmission. There are several national and international standards (e.g. ISO 4156, ANSI B92, DIN 5480, DIN 5466) containing information about the teeth geometry, the basic use particularly for the calculation and dimensioning of spline fit connection. But for special applications that require the increase of load capacity the designers are free to adjust the splines design in detail. In this context some industrial application examples of modified splines are described.

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### **Designing 2D and 3D Textiles Using Yarn Engineering and VR**

Virtual reality presents a promising technology that can be treated as a potential enrichment of conventional computer aided technologies. The contribution gives an overview of the application of yarn engineering and virtual reality for designing linear and flat textile structures, as well as clothing products. The possibilities are explored for setting-up the complex system for virtual fabric and garment development, which, together with the intelligent textile and garment manufacture, can be treated as the most important parts of the Global Retailing Concept with the aim to strengthen the producers' position on the market building a completely new electronic-business offer.

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### **Vibration Analysis of Vacuum Cleaner Motors**

Once a product is developed and its manufacture begins, its level of excellence immediately starts decreasing due to other competitive products on the market. Its life on the market can be prolonged by continual product improvements. A longer product lifetime also increases its profitability, because the development of a new family of products is associated with considerable costs. The paper presents product re-engineering using an example of a vacuum cleaner motor and its positioning in the product development cycle. The development of vacuum cleaner motors (motor and turbine assembly) is progressing in the direction of increasing the number of revolutions and decreasing their mass and volume. The performed analysis of vacuum cleaner motor construction indicated several possibilities for increasing the number of revolutions. The basic problem concerns the influence of individual components on critical speed. The paper assesses the applicability of individual methods for the analysis of natural frequencies; the results are summarized in the form of engineering design rules for vacuum cleaner motors. The analysis was performed for an example from current manufacturing practice.

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### **Developing Doublecurved Architectural Glass**

This paper describes the making of a twisted façade, including glass. Its materialising has great similarities to that of freely doublecurved glass. The various encountered problems were approached integrally. Possible uses of prototypes are illustrated with building models. The study of twisted buildings leads to a process in which concrete moulds are used to produce doublecurved panels of glass and metal.