CAx/EDM INTEGRATION - ENABLER FOR METHODICAL BENEFITS IN THE DESIGN PROCESS

Burr H., Vielhaber M., Deubel T., Weber C., Haasis S. - *DaimlerChrysler AG (DEU)*   833

Although functionalities of engineering systems are rocketing, they currently cannot cope with the development of new engineering methods. Additionally, the data management systems and concepts of today fail to adequately support these innovative functionalities. The integration of new methods into existing and new system environments are often not taken into account. In addition to the optimisation of individual tool functionalities, integrated system architectures are needed. This paper will take a look at today's and tomorrow's engineering practices, showing that major benefits can only be achieved if based on a thorough concept of engineering system integration.

TRACEABILITY IN PRODUCT DEVELOPMENT

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The main factors that make traceability difficult in designing are: complexity of design objects representations; multirelations and dependencies between design objects; fuzziness of design and designing; lack of formal models of design objects; heterogeneity of design object sources. The meta model of product development context for achieving traceability is described. The implementation framework based on product development ontology is proposed, as solution for traceability difficulties: formal syntax and semantic; multilevel abstraction; semantically rules and deduction mechanisms for resolving complexity of traces among design routes; semantic interoperability as a communication medium between heterogeneous design object sources.

INTEGRATED MODELLING OF CONCEPT SYNTHESIS AND EARLY CALCULATIONS USING EXCHANGEABLE PRINCIPLE SOLUTION ELEMENTS

Wilhelms S. - *Linköping University (SWE)*   959

In conceptual design, concepts are synthesised and their essential properties determined quantitatively. The ability to quickly change solution elements facilitates exploring the solution space and reaching the best qualitative principle solutions. This article presents a parametric support for integrating qualitative concept synthesis and early calculations using function/means tree and a parallel constraint network. The focus is on how principle solution elements should be modelled in order to facilitate easy exchangeability of their quantitative models. A strategy and methods for principle solution elements permitting to be changed by a single operation and no additional manual corrections are presented.

PRODUCT LIFE CYCLE MANAGEMENT IN A SERIAL PRODUCTION

Tavèar J., Duhovnik J. - *Domel d.d. (SVN)*   925

The development of information technologies enables one to regard a product's life cycle as a unified process from idea through development, manufacture and distribution to servicing. The transition to e-business within companies contains great potential for increasing their productivity and competitiveness. This paper analyses the idea that a company should first be capable of doing e-business internally, before it can start efficiently operating with external clients. The paper analyses product development and engineering change processes in detail. An example from Domel presents a solution for product documentation management using a SAP information system and PLM (Product Life cycle Management) module.

ENHANCED ENGINEERING DESIGN PRACTICE USING KNOWLEDGE ENABLED ENGINEERING WITH SIMULATION METHODS

Bylund N., Isaksson O., Kalhori V., Larsson T. - *Volvo Car Corporation (SWE)*   841

The objective is to present how Knowledge Based Engineering combined with simulation methods is a development step for the product development processes. In the presented work the authors discuss the actual state of industrial applications, with challenges, at Volvo Car Corporation, and Volvo Aero Corporation. Systems that combine synthesis and analysis continue to be developed and increasingly deployed and used in the entire design - evaluation loop allowing faster design iterations. The challenges of introducing these systems are seen on three different levels; technically oriented, methodological, cultural and social. Best practice is yet to be seen, and a new way of work is the probable result of introducing simulation supported KBE.

SHARING NEW KNOWLEDGE: NEW FORMS OF RESEARCH

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This paper examines how knowledge derived from practice may be viewed as a valid form of research in the architectural profession, and questions how this knowledge is disseminated. Barriers to the promotion of research within the profession will be identified and discussed. The architect Greg Lynn will be presented as an example of a practioner that views new knowledge and technical innovation as something to be shared within and beyond the profession rather than retained within the confines of the practice. The paper concludes with a series of suggestions as to how practice based knowledge as a form of research might come to be utilised by a profession that is generally reluctant to share knowledge.

RATIONALE AS A LINK BETWEEN INFORMATION AND KNOWLEDGE

del-Rey-Chamorro F. , Wallace K. M., Bracewell R. - *University of Cambridge (GBR)*   847

The process of transforming information into knowledge can be investigated by observing designers progressing a design using information. This paper presents three real examples from the transcripts of an experiment based on the detail design of a military aircraft flight control surface. These examples show how designers develop a capacity to design, or design knowledge, by linking pieces of information to their background knowledge through design rationale. The authors conclude that information systems are more likely to be more effective and efficient in transferring knowledge if they also provide a description of the design rationale.

TOPOLOGY OF MODULAR KNOWLEDGE STRUCTURES IN PRODUCT DEVELOPMENT

Weiss S., Berger B., Birkhofer H. - *University of Technology (DEU)*   943

The topical subject is modularization of knowledge. A modularization approach is described, that works on a separation of contents and their presentation. To implement the modularization approach in computers a formalization of the data and structure of contents is necessary. Aspects concerning different kinds of linkages between the modular knowledge units, such as the integration of semantic networks, simple links or content structure have been considered within the model. This respects the following points: constitution of modular contents based on the modularisation approach, threads of implementation, structures of memorization, appropriate exploitation and direct processing with no complex transformation algorithms.

DRIVERS FOR MODEL BASED DEVELOPMENT OF MECHATRONIC SYSTEMS

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The vehicle industry is experiencing an increased product complexity based on the development of electronics. Systems that earlier were stand-alone are now dependent on each other and design changes in one system are therefore reflected and must be considered in other systems. One trend in the development of embedded and distributed systems is model based development (MBD). MBD through the use of CAD-tools permeates most organizations nowadays, but MBD of multi-disciplinary systems like distributed control systems is less common. The use of MBD is unequally utilized in different organizations. Three drivers for introducing MBD are discussed and suggested: maturity, standardization and complexity of the product.

COMMUNICATION AND KNOWLEDGE SHARING IN DISTRIBUTED ENGINEERING DESIGN

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This paper deals mainly with the problems of sharing and managing knowledge in distributed engineering design processes. The paper presents a review of the evolution of engineering design work, and state-of-the-art of knowledge management, and brings out the important role of communication. A distributed engineering design project has been realised by the collaboration of five German universities. During the project the communication of participants has been analysed. Based on these results of this study, on the state-of-the-art and problems of knowledge supporting, new directions and accents of knowledge-based engineering will be defined.

HANDLING UNDESIRED FUNCTIONS DURING CONCEPTUAL DESIGN - A STATE - AND STATE -TRANSITION - BASED APPROACH

Bruch C. - *University of Karlsruhe (DEU)* 827

This paper presents a concept for identifying and processing undesired functions, originating from principle solutions, during conceptual design. Undesired functions affect a product either by reducing its intended input or by producing undesired outputs and can be processed either by determining and optimizing their distribution function or by finding inverse, consecutive or compensation functions to them. The process of handling undesired functions is modeled by its states and the according state transitions. Object patterns and process patterns are used for representing the declarative and the procedural knowledge respectively.

INCREASING THE EFFICIENCY OF DESIGN CATALOGUES BY USING MODERN DATA PROCESSING TECHNOLOGIES

Franke H.-J. , Löffler S., Deimel M. - *Technical University Braunschweig (DEU)* 853

Design Catalogues are a helpful method to assist designers by reusing existing solutions. The key to success when working with Design Catalogues is a funded database of catalogues. This paper describes basic functions and applications of the computer aided tool "eKat". It bases on modern data processing technologies and facilitates to access a large number of Design Catalogues via internet. The system makes designers able to explore alternatives and can be helpful for the embodiment design phase. Currently, the system contains 30 Design Catalogues and it will be expanded continuously in future. The access to various catalogues at any time makes this system attractive for engineers.

METRICS FOR THE PDM FUNCTIONALITY OF ERP SYSTEM

Kljajin M., Galeta T. - *University of Osijek (HRV)* 859

In a recent development of the Enterprise Resource Planning (ERP) systems, there is tendency of implementing the Product Data Management (PDM) functionality. To estimate a success of implementation, developers but also users, need metrics. Therefore, in this paper are proposed appropriate metrics. Between major criteria are nominated: level of the core functionality; level of the extended functionality; level of the integration of PDM functionality inside ERP system; level of the achieved product data integrity and level of the achieved product data security. Levels are quantitatively enumerated and tested in a purpose to evaluate criteria's convenience.

"SYMBOLIC DESIGN": A UML BASED ENVIRONMENT FOR INTEGRATED PRODUCT DEVELOPMENT

Liverani A., Amati G., Pellicciari M. - *Universita; di Bologna (ITA)* 871

In this paper a novel approach to PPD (Process and Product Development) through a UML (Unified Modelling Language) has been investigated, with the primary objective to setup a functional and resource optimization and providing a strong connection with standard CAD tools. Specifically created for an object oriented approach in designing, we propose an OOAD framework with the aim to define classes of objects which describe all entities involved in the PLM, setting all constrains necessary to a concurrent and collaborative activity. In order to demonstrate the power of this approach a custom software and GUI, named SF-CAD (Symbolic Functional CAD), have been programmed and an application example has been provided.

FUZZY LOGIC RETRIEVAL OF COMPLEX ENGINEERING INFORMATION

Napalkov E., Zars V. - *CAD Center of Riga, Technical University (LVA)* 877

This paper analyses various aspects of information retrieval for design application within the common product dana model (CPDM) represented in the form of fuzzy frame-based network. The goal of research was to develop the structure of this network and to describe fuzzy logic rules used for bottom-up and top-down retrieval of design patterns in vector space. The main feature of the proposed approach is a creation of additional conditions for approximating the desirability of design functions and behaviours during the design process.

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REACHING THE COST TARGET - CURRENT STATUS IN SMEs

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Many companies apply the method of Target Costing in order to offer products with an optimal cost-performance ratio. Due to this method, every decision within the product development process has to be scrutinized with regard to the cost target. We describe an investigation of the current status of cost evaluation in SMEs. The participants were asked for difficulties in decision situations caused by a lack of cost information. Further, the survey investigates what kind of support and information the engineers require to generate the needed cost prognosis. The survey shows, that the employees need support in the evaluation of future product costs. The main reasons are insufficient methods and cost information.

DOCUMENTING TECHNICAL SPECIFICATIONS DURING THE CONCEPTUALISATION STAGES OF AEROENGINE PRODUCT DEVELOPMENT

Roy R., Kerr C., Makri C., Kritsilis D. - *Cranfield University (GBR)*   897

In order to deliver a high quality product, the stakeholder requirements have to be agreed and documented during the conceptualisation stage of product development. This is a critical step since this documentation provides the foundations for successful design. This paper provides a model of how an original equipment manufacturer documents the technical specifications of its civil aeroengines during the conceptualisation stage. The encapsulation of the external and internal stakeholder requirements will be presented. The process of how these top-level documents are decomposed and disseminated through the organisation will also be outlined. A discussion of the associated problems with the documentation process will be provided.

AN INITIAL EMPIRICAL STUDY OF USING A PRODUCT CONFIGURATOR AS A SUPPORT TOOL FOR DEVELOPING PRODUCT FAMILIES

Sarinko K., Martio A., Huuskonen T. - *Helsinki University of Technology (FIN)*   903

Configurable products are one way to carry out mass-customisation. A configurable product is described with a configuration model. A product configurator is an information system for creating a configuration model and generating product instances. We present potential benefits and challenges of using a product configurator to manage the product variety related information during the development phase. The results are derived from a focus group study in a case company. We modelled a real product and found that a product configurator seems to be a feasible tool for creating and maintaining overall and complete description of the product variety, it provides up-to-date information for everyone and helps the communication in the development phase.

A VR/KM INTEGRATED PLATFORM FOR SUPPORTING INTEROPERABILITY IN CONCEPT DESIGN

Ucelli G., De Amicis R., Conti G. - *Fondazione Graphitech (ITA)*   931

In the rapidly growing global economy car manufacturers now require quality, innovation and short time to market to win the increasing competition. This is traduced in the need for optimization of the development process that can be achieved through the maximization of re-use of data and internal knowledge of the company. This research aims at development of a platform that integrates Virtual Reality and Knowledge Management systems, within the early stages of the design process which supports information-rich contents. The system's aim is to support not only design creativity, enhancing stylers' natural capacities, but will also allow a better understanding of the creative process through its decomposition.

AUTO-GENERATION OF DYNAMIC CROSS-LINKS AMONG MODULARIZED CONTENTS

Weiss S., Birkhofer H. - *University of Technology (DEU)*   951

A main problem concerning modularization of knowledge is the huge effort to link new knowledge units to existing ones. This paper describes how to solve the problem of integrating and linking new knowledge units. A model to create the networks between contents automatically and dynamically is presented. This effects a human relief because the high number of potential links between contents were analyzed and set by a machine. Above that, contents were processed to be published in the WWW. This approach enlarges an existing modularisation approach and defines so called Self Link Objects (SLO). The paper explains the structure of Self Link Objects, its set of meta data and how the automatic linking works.

SYSTEMATIZATION OF DESIGN PROBLEMS BY GRAPH THEORY

Yoshikawa S., Minami M. - *Japan Nuclear Cycle Development Institute (JPN)*
965

A graph-theory-based systematization method of design problems has been proposed aiming at carrying over obtained engineering knowledge in constructions of large-scale systems. This method focuses on deriving decision making sequence in assigning values on specifications, rather than pursuing accuracy in each evaluation. A prototype software has been verified by comparing the derived decision making sequences from a set of equations among major specification parameters of a nuclear plant to an empirically built algorithm by experts. This method has a potential in handling non-quantitative specifications by automatically switching inter-dependency structure among the relevant quantitative specifications.

SYSTEMATIZATION OF DESIGN PROBLEMS BY GRAPH THEORY