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**ENGINEERING NETWORKS: A CONCEPT FOR THE COEQUAL MODELING OF DATA AND PROCESSES IN PRODUCT ENGINEERING**Mogo Nem F., Weidlich R., Eigner M. - *Technical University of Kaiserslautern (DEU)*

849

Enterprises today have to deal with new arising challenges. Amongst other factors, the introduction of multidisciplinary products, the demand for more product reliability and increasing product liability and the globalisation result in direct collaboration between enterprises, suppliers and customers. The concept of Engineering Networks provides a means to associate the rising amount of information to the complex engineering processes they run through. It describes a meta-model, for the modelling of integrated and federated product data and engineering process models in enterprises. An extended view concept supports the presentation and management of the product data and the associated processes, within and throughout different companies.

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**THE INTEGRATION OF SYNCHRONOUS AND ASYNCHRONOUS DESIGN ACTIVITY RECORDS**Giess M. D., Conway A. P., McMahon C. A., Ion W. J. - *University of Bath (GBR)*

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With many engineering companies changing their focus from product delivery towards through-life service support, the realisation is that much of the information and knowledge being generated throughout each stage of the design process can aid in both product lifecycle support and also the development of new products. To support these activities, information and knowledge capture systems and models are required, which allow the information to be stored and used thirty years or more into the future. The dichotomy of interest in this paper is that of synchronous and asynchronous working, where engineers may work as part of a group or as individuals and where different forms of record are necessary to adequately capture the processes and rationale employed in each mode. This paper looks at each mode of working in turn and proposes complimentary approaches to information and knowledge capture. The combination of information and knowledge capture performed during both asynchronous and synchronous activities has the potential to create a significantly enhanced overall design process model and record enhancing not only the through-life support of the product but also subsequent projects.

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**DEVELOPING PROCESS INTEGRATIVE STRUCTURING OF DOCUMENTS CONTAINING PRODUCT INFORMATION**Lauer W. M., Lindemann U. - *Technical University Munich (DEU)*

817

In today's very complex product development processes, a major problem is to provide engineers with the right information at the right time. Engineers need to search for existing product information and have to evaluate its relevance. This research aims at the support of information retrieval by defining a process oriented, parameter based structuring approach of product related documents. The concept of this approach is described as dynamic linking of documents to the process. Documents are analysed and process oriented parameters are derived. An outlook is given on the definition of the value scale of the parameters, the mapping of these parameters to the product development process and the expansion of the analysed data base.

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**HIERARCHICAL DECOMPOSITIONS FOR COMPLEX PRODUCT REPRESENTATION**Ariyo O. O., Eckert C. M., Clarkson P. J. - *University of Cambridge (GBR)*

737

In many published design texts and standards, it is often advocated that hierarchical descriptions should be structured into successive levels of systems, assemblies, components and so. However, there is no one single hierarchy in a complex product. In practice, sub-units within a hierarchy are defined purely in an arbitrary manner. The lack of a structured approach to product decomposition leaves a chance of creating hierarchical decompositions with limited practical use. As a way of creating meaningful hierarchical product descriptions consistently, this paper suggests precautionary steps to aid the product decomposition process. These guidelines are based on insights gained from an assessment on decomposability of a motorcycle.

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**USER SPECIFIC SUPPLY OF DOCUMENTS FOR PRODUCT DEVELOPMENT KNOWLEDGE BY MEANS OF A COMPREHENSIVE TOPIC MAP APPLICATION**Weber H., Lenhart M., Birkhofer H. - *Technical University Darmstadt (DEU)*

877

Current books and also computer aided tools for the transfer of product development knowledge are mostly static and do not consider the user specific needs. A modular contents basis allows the composition of different but consistent documents for different users. Thereby the selection of the modules for an appropriate composition is not a trivial task. To solve this, the presented approach contains a unified description of the three fields product development knowledge domain, modular contents and users by means of adaptive topic maps. These are compatible to each other and can be integrated in a superior system. As a consequence, the original information retrieval problem can be solved by matching the different topic maps.

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**CHALLENGES WITH PRODUCT DATA EXCHANGE IN PRODUCT DEVELOPMENT NETWORKS**Jokinen K., Hajda M., Borgman J. - *Helsinki University of Technology (FIN)*

801

Collaborative product development in company networks creates new requirements for product data management (PDM). All partners need access to correct and updated data to avoid unnecessary delays and costs, and progress with tasks should be visible to others. We conducted case studies in four company networks to identify common PDM-related challenges. The results reveal several challenges with the contents of the data exchanged, the exchange processes and the tools that were used. We suggest addressing these challenges by defining and implementing PDM processes and tools that support collaborative product development. Future research in this area should address the concepts, processes, policies, and tools used in product data exchange.

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**INVESTIGATIONS INTO THE DATA BASIS OF DESIGN KNOWLEDGE IN INDUSTRIAL DESIGN ENGINEERING**Uhlmann J., Schulze E. E. - *Technical University Dresden (DEU)*

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The article's main topic is design knowledge within professional knowledge in design. In order to give a theoretical classification, a scheme is derived from psychology and neurosciences. Thus design knowledge is described on basis of a model of memories content for data knowledge and the action regulation theory for design activity. An application of the theoretical scheme is presented within three exemplary investigations to differentiate data knowledge into factual- and episodic knowledge: (1) A comparison between the curricula of engineering and product design, (2) an interpretation of evaluation categories for design awards, (3) an experimental approach to investigate the content of data knowledge.

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**DESIGN KNOWLEDGE INDEXING IN RELATIONAL DATABASE**Rohde D., Pavkovic N., Aurisicchio M. - *University of Zagreb (HRV)*

857

The aim of this research is the improvement of the knowledge management process for long-lasting product development projects, which repeat themselves in cycles of 3-5 years. To find and propose appropriate ways of "navigated" (suggested) knowledge capturing that would take as less designer's time as possible, this research tries to answer following questions: What kind of design information structures should be captured?, How to organize, structure and index captured information? The main advantage of proposed approach is the usage of the same relational database structure and interfaces both for process of experimental analysis used to develop knowledge indexing taxonomy and for process of future eventual practical usage.

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**CLASSIFICATION OF TOOLS AND METHODS FOR KNOWLEDGE MANAGEMENT IN PRODUCT DEVELOPMENT**Kaiser J.M., Conrad J., Koehler C., Wanke S., Weber C., - *Saarland University (DEU)*

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Knowledge management is a very important topic in engineering design and the application of information technologies is an important part in the implementation of knowledge management. The aim of this paper is to combine knowledge management tools and methods with product development. It considers the knowledge management tools from the area of business administration in the context of the product development process according to VDI 2221. Based on these considerations, this contribution identifies and proposes existing solutions for knowledge management in the different phases of product development.

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**INVESTIGATING THE STRUCTURE AND ORGANISATION OF ENGINEERING LOGBOOKS FOR MORE EFFECTIVE REUSE**McAlpine H., Hicks B. J., Culley S. J. - *University of Bath (GBR)*

841

Engineering logbooks are an important but often overlooked source of design information and knowledge, partly because their structure and organisation makes re-use difficult or impossible. To address this, a methodology for characterising the structure of logbook entries is discussed and the results of its application to a set of logbooks is presented. These findings are used to inform the development of a strategy for improving the recording and subsequent re-use of logbook information. The strategy is discussed in detail and examples are given of how the strategy facilitates more effective management of logbook information, for both the individual and the wider organisation.

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**MODULARISATION OF PRODUCT DEVELOPMENT CONTENT – PROVIDING USER-SUITABLE DOCUMENTS**Lenhart M., Weber H., Birkhofer H. - *Technical University Darmstadt (DEU)*

825

This paper introduces a procedural model for the configuration of modular content. The model helps to decrease the amount of effort necessary to generate individual documents for learning and application. It provides precise instructions and a standardised procedure for implementing user requirements as well as situation-specific document requirements. By considering a set of scenario-specific design recommendations, the described procedure enables the author to generate individual documents, even when he is not familiar with the underlying cognitive conditions. Finally, the configuration model and the modularisation approach are key prerequisites to generating user-specific documents within a reasonable amount of effort.

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**THE ROLE OF NARRATIVE IN EVOLVING ENGINEERING DESIGN DOCUMENTATION**Eng N. L., Bracewell R. H., Clarkson P. J. - *University of Cambridge (GBR)*

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Graph representations are emerging to replace more traditional narrative forms of knowledge capture. These seem to be a better fit for work with modern hyperlinked, non-linear computerized systems and design problems. The old forms, however, possessed important characteristics for effective knowledge capture. It is not exactly clear what is lost and gained in the transition. This paper explores narrative theories and examines them using the cognitive dimensions framework. A review of literature finds that deliberately constructed narrative structure is key to affording meaningful experience of representations. This suggests flaws in current documentation practice. Proposed concepts situate many new questions that will require further study.

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**TOWARDS REPRESENTING, EVOLVING AND NETWORKING ENGINEERING KNOWLEDGE FOR COMPUTATIONAL DESIGN SYNTHESIS**Hoisl F., Shea K., Helms B. - *Technical University Munich (DEU)*

793

Current computational design synthesis methods are often based on static knowledge and restricted to limited scope tasks focusing on specialized engineering knowledge only. Based on a review of research in engineering knowledge representations, knowledge-based engineering and engineering design grammars, this paper presents an extended model for formal engineering design synthesis and defines new requirements for the knowledge representations used within to enable the integration of multi-domain knowledge that can be networked, exchanged and dynamically evolved throughout the innovation process. The paper discusses through examples the advantages of the approach for creating computational synthesis methods that support innovation processes.

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**WHAT IS DESIGN KNOWLEDGE FROM THE VIEWPOINT OF CPM/PDD?**Conrad J., Köhler C., Wanke S., Weber C. - *Saarland University (DEU)*

745

Knowledge is a very common term in engineering design and also extensively discussed. Even if it is not an explicit matter, it plays implicitly a role in the background. The Characteristics-Properties Modelling / Property-Driven Development (CPM/PDD) approach is one possibility to illustrate the product development process. This paper provides a closer look on design knowledge in the context of CPM/PDD. The description of product knowledge in CPM/PDD is thereby straightforward. The more complicated part is the description of process knowledge. Therefore, the method of reduction is transferred from theoretical computer science into the context of engineering design. The result indicates what design knowledge is, especially in CPM/PDD.

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**USER KNOWLEDGE IN A CONCEPT DEVELOPMENT PROJECT OF A BUSINESS-TO-BUSINESS DIRECTORY SERVICE**Mannonen P., Runonen M. - *Helsinki University of Technology (FIN)*

833

Existing process descriptions and methods of user-centred design emphasize the understanding of users and context of use and evaluating the usability of designed products. The descriptions of user research methods and usability evaluation techniques are rich and large in numbers. There however seems to be a lack of analysis and descriptions of what kind of role the gathered user knowledge plays in designing and what kind of impact does it have. This paper describes a concept development project of a business-to-business directory service and presents an analysis of the amount and characteristics of user related information gathered and utilized during the concept development process.

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**KNOWLEDGE ORIENTED PROCESS MANAGEMENT FOR DFX**Faerber M., Jochaud F., Stöber C., Jablonski S., Meerkamm H. - *University of Bayreuth (DEU)*

777

The development of innovative products has become crucial for companies nowadays. Engineers are facing many challenges while transforming requirements specifications into working products. Both target processes to structure the design process and the DfX approach with specific instructions help engineers with this task. However both are usually treated as separate aspects. In this paper we propose a data model to combine both the process model and the DfX approach into a single integrated data model. This data model, based on ontologies and semantic web technologies, is the basis for a knowledge base that can be used by a workflow management system to support product developers during all phases of the design process.

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**A NEW KNOWLEDGE BASED APPROACH THE REVERSE ENGINEERING OF A PRODUCT**Durupt A., Remy S., Ducellier G., Derigent W. - *Université de Technologie de Troyes (FRA)*

753

Current (RE) approaches are based on frozen models (parametric surface approaches) and are hardly re-usable. Consequently, the possibility of re-engineering or re-design does not exist. This paper proposes a new research direction taking into account product lifecycle knowledge. The research direction combines a geometric approach to a functional approach for formalizing and semi-automating the rebuilding methodology. This methodology is presented and the geometrical recognition and the knowledge identification phases are set and data are organised in a functional and structural skeleton. Finally, a use case of the journal cross of a Peugeot 403 is presented for illustrating the approach.

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**AN INTEGRATED CONTEXT MODEL FOR THE PRODUCT DEVELOPMENT DOMAIN AND ITS IMPLICATIONS ON DESIGN REUSE**Eckstein R., Henrich A. - *University of Bamberg (DEU)*

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Today's product development is characterized by cutting down product development costs and times which can be accomplished by leveraging reuse of existing knowledge in an enterprise. We propose a search approach, that incorporates a comprehensive description of the user and the document context. This description of the user leads to a better understanding of the information need. We suggest the consideration of domain specific measures to enable a higher precision in searching. The perspective behind this idea is that a user's information need is characterized by a user query and his current context. The retrieved documents are represented by their content and the document context – the creation phase or the degree of maturity for example.

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