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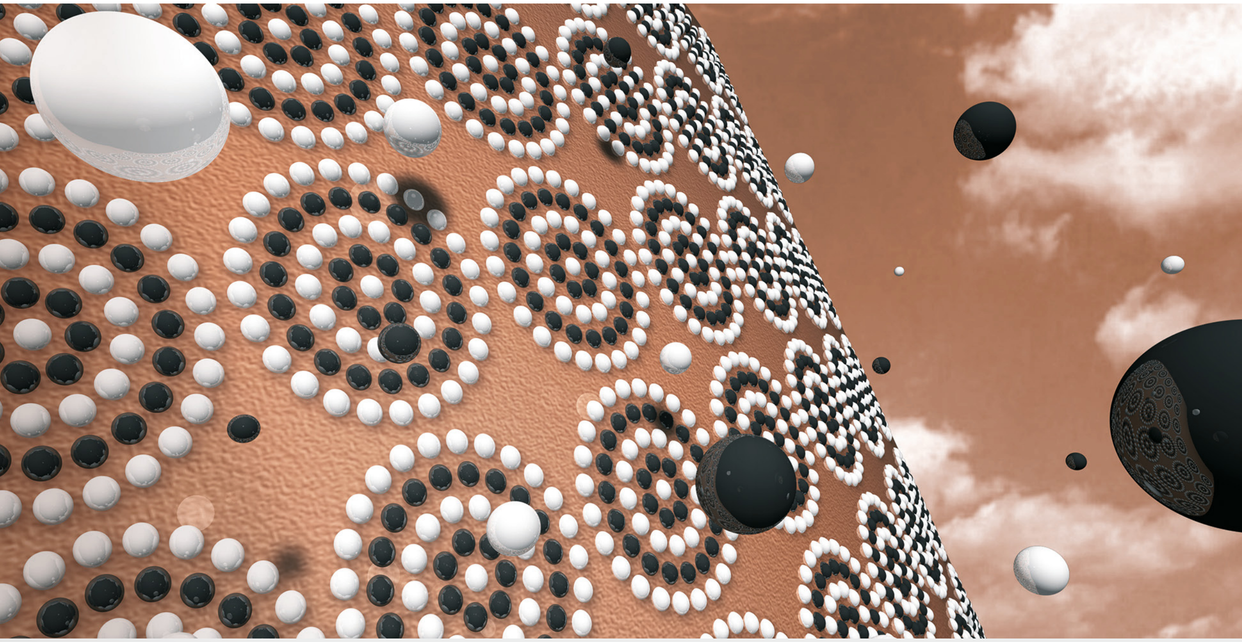

Reducing risk in innovation

Proceedings of the 15th International DSM Conference
Melbourne, Australia, 29 – 30 August 2013

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Product Development

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Scheurmann, Maurer, Schmidt, Lindemann
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Foreword

Welcome to the 15th International DSM Conference in Melbourne, Australia.

Complexity is perceived as an ever-present challenge in almost every business.

The increasing complexity and the need for integration of systems and processes and their components in an increasingly complex, risky and globally distributed operating environment drives the search for simpler, leaner and low risk product, process and organizational architectures.

Especially the design of highly integrated systems, the management of process focused organizations and the adaptation of new products to different markets require robust approaches to the smooth and efficient modelling, analysis and synthesis of appropriate solutions to working with such complexity that work at the front end of innovation.

The understanding of dependencies in complex systems early in the innovation phase can lead to the generation of better, unique and copy-proof product architectures and intelligent management of innovation risk. This enables and drives innovations otherwise not possible. Therefore, if managed the right way, working with complex systems provides many opportunities to a business that cannot be realized otherwise.

Over the last couple of decades Dependency and Structure Modelling (DSM) methods have found their entry as mainstream applications in many corporations in many industries around the globe.

The formation and consolidation of the DSM industry Special Industry Group (DSMiSIG) as a supporting mechanism for DSM users in industry has proven itself over the last 12 months.

However, a strong scientific basis and continuing testing of new DSM methods and applications by scientists and industry practitioners alike is required to ensure that new systems and processes in industry are fulfilling the expectations of industry in improved system and process performance.

With an original strong homebase in the US and Europe the DSM community expanded its range significantly. After an outstanding event in Japan 2012, this year the community meets in Australia for the first time.

The two days of this annual conference are designed to act as a catalyst and forum for scientific discussion, interaction with industry and the members of the DSMiSIG and as a springboard for framing the scientific direction of DSM methods for the next few years.

Elke Scheuermann, Mike Stowe and Maik Maurer

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The International DSM Conference is an endorsed event of the Design Society.

Part I: Application of DSM and Matrix Methods

15TH INTERNATIONAL DEPENDENCY AND STRUCTURE MODELLING CONFERENCE, DSM 2013
MELBOURNE, AUSTRALIA, AUGUST 29 – 30, 2013

Three Examples of how DSM Enhances Engineering Design Automation

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Abstract: Since the automation of engineering design activities through increasingly complex computer systems is a big trend among manufacturing companies the need of supporting the maintenance of such systems now quickly emerges. In this short paper, we show how DSM has been used in three different automation projects, targeting the design of engineer-to-order-products, in order to ensure that the knowledge automated by the systems is consistent and easily accessible to engineers. The DSM was used to varying extent both during the development of the systems and in runtime of the resulting design automation systems. Three levels of usage of the DSM within the design automation systems were identified: “visualization only”, “static execution sequencing”, and “dynamic execution”.

Keywords: Automated Engineering Design, Inference Engine, Knowledge Object

1 Introduction

Knowledge based engineering (KBE) aims to automate engineering tasks by means of knowledge based systems (a branch of computer science). The fact that the concept of KBE has many definitions might be due to the wide area of knowledge-based systems and their many sub-categories. One widely used definition of KBE, that is adopted here, is the one stated by Stokes (Stokes 2001): “The use of advanced software techniques to capture and re-use product and process knowledge in an integrated way.”

A general structure of a knowledge based system is shown in Figure 1, adapted from (Hopgood 2001), and as seen in that figure, the two keystones in a knowledge based system are the knowledge-base and the inference engine. The knowledge base is comprised of facilities to store knowledge in the sense of information in context, here referred to as automated knowledge. This means that structuralized data is stored with its context in a way that makes it possible for the inference engine to make use of it. Hence, the knowledge is separated from the routines (the inference engine) that make use of the knowledge.

It is possible to define the knowledge base in different ways, using different knowledge representations. The knowledge base must of cause be machine-readable, which means that the knowledge base is designed to make the computer system able to automatically reason based on the automated knowledge. It would of course be highly beneficial if a machine-readable knowledge base was also human-readable, and much effort has been put to achieve this. One big problem with the KBE-systems is that the jungle of relations of different types grows very quickly over time and it becomes hard to navigate through it. The use of DSM to bring structure to the knowledge base at design time of the system and during run-time has proven to be successful in three design automation projects. The scope of these projects and how they were supported by DSM is outlined in this paper.

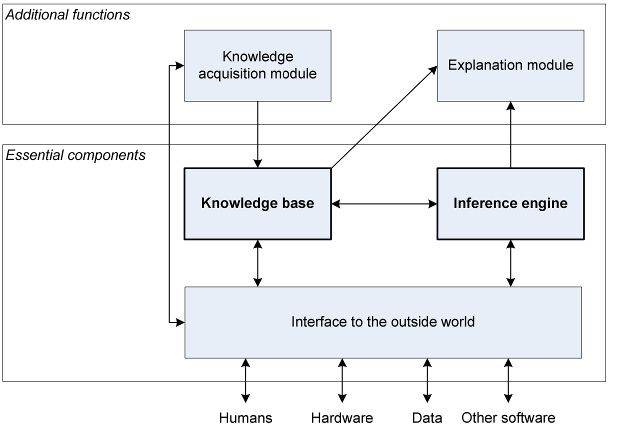

Figure 1. The main components in a knowledge-based system are the knowledge base and the inference engine.

1.1 Related work

The usage of DSM to manage engineering design knowledge has gained attention during the last few years. Sharif *et al.* studied how to use DSM to support the acquisition and management of knowledge for customer order driven engineering (Sharif and Berman 2007). Hung *et al.* studied how to make use of DSM to control product knowledge stored in a database (Hung et al. 2008). In that case, the focus was on how to integrate DSM and Quality function deployment (QFD) and how to plan the design process of developing new products. Tang *et al.* investigated how to structure captured knowledge through DSM in order to retrace design history, rational, decisions and assumptions (Tang et al. 2010). Bhaskara also showed how to use DSM for capture and reuse knowledge, but also how to use DSM to analyze the impact of design changes and for managing the requirements and design rules (Bhaskara 2010).

2 Case one: CoRPP – Knowledge processing with predefined static flow

The primary purpose of the CoRPP (Coordinated Realisation of Products and Processes) system was to support the company in its effort to gain design solutions with enhanced producibility through studies of variations in cost, weight and operation time, as described by Elgh and Cederfeldt (Elgh and Cederfeldt 2007).

The main element of the bulkhead is a circular plate with vertical structural members, which consist of cut, rolled and welded steel plating, as shown in Figure 2.