MULTIOBJECTIVE OPTIMISATION IN INDUSTRIAL DESIGN

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Since the mid-1980s, there has been a growing interest in solving multiobjective optimization problems using genetic algorithms because they process a set of solutions in parallel allowing to obtain the Pareto Frontier through a unique run. We propose a new genetic algorithm for multiobjective optimization, named SPLSDCAS, which uses a geographical selection schema integrated with an innovative fitness assignment and an Additive-Sharing technique. The results obtained on a simple test as well as on a complex design problem, the multiobjective shape optimization of a lenticular wheel, suggest that SPLSDCAS can be very effective in sampling the entire trade-off surface, also outperforming the other algorithms involved in the comparison.

TOWARDS A SYSTEM MODEL TO IMPROVE THE QUALITY OF DECISIONS

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For the evaluation of components in the design of complex systems, it is hard to determine both the evaluation criteria and their importance correctly. The paper introduces a new approach to determine the importance of component's evaluation criteria that bases on a particular description of the technical system. Furthermore, a concept is integrated to recognize component's evaluation criteria, even if they are not directly linked with the development goals. It is also shown, how this approach can be applied to products as a part of a superordinate system. The approach is illustrated with the application on a new elevator technology.

DEVELOPING DECISION COMPONENTS MODEL FOR ANALYSING DESIGN
DECISIONS IN MONO-DISCIPLINE DESIGN TEAMS

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An empirical research is conducted in order to understand the details of the design decision structures and formation; and to determine the components of the design decisions that are produced by the industrial design teams in the design process. The method of protocol analysis is used to determine the cognitive process of the members of the design team and to analyze the details of the design process. Empirical study is conducted with a mono-disciplinary design team,worked on a product design task, and is recorded by a video camera and the verbal protocols are transcribed. Verbal transcriptions are segmented and the protocol is coded by decision components coding systems. In the results section of the research, the evidence obtained from coding system developed in the study is presented in graphics and discussed the performance of the coding system in analyzing decisions.

DECISION SUPPORT FOR STRATEGIC PARTNER SELECTION IN COLLABORATIVE
DESIGN AND INNOVATION

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Strategic partner selection in collaborative design and innovation is an issue with currently high demand from industry. Our project partner is seeking for operational assistance and decision support in finding a suitable partner for collaborative R&D in a future technology. A software tool for providing operationalized decision support has been developed. Each employee will work with the tool until dana will be consolidated within a coaching process, defined by an integrated model. The theoretic foundation for the theory model is based on a survey on success determinants in collaborative design and innovation. With a variety of output mechanisms, the tool provides a multi-perspective overview of potential partners to the decision-makers.

A MAPPING OF DESIGN DECISION-MAKING

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In this paper we present the decision score, which is a model of decision-making seen in the engineering designer's perspective of the design process dynamics, where a decision has multiple objects and where it is based on earlier decisions, prediction of consequences and design process progression. The model is based on four observations: the engineering designers do not see a neat string of distinct and explicitly made decisions, there are several decision-makers during design, a design decision is not made at a distinct moment in time, and the decision object is evolving in time and changing in context. We have successfully made an attempt to justify the model by confronting it with several empirical studies of design decision-making.

TREATMENT OF DECISION SITUATIONS IN THE DESIGN PROCESS

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During the design process different decision situations arise at planning, managing and problem solving procedures. The aim of this contribution is to characterise the content and the characteristic of decision situations supporting decision making in product development process. A model of a generalised problem solving procedure is established which distinguish two main types of decision situations at the beginning and the end of the design operations. The model describes in particular the relationship between problem solving operations and both types of decision-making, which helps the designer to come to a flexible design procedure.

MULTIPLE ATTRIBUTE DECISION MAKING TOWARDS MOST ACCEPTABLE VARIANT SOLUTION

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Modern product development concept is based on the product as a technical system. Developed model in this paper connects the product as a technical system and designer. Different models of decision making with different level of procedure formalizing for the choice of an acceptable conceptual engineering design are analysed and presented. Proposed multiple attribute decision-making models based on the mathematical formalisms analyses the acceptability level of n variant solutions. Through this analysis it is possible to rank particular variant solutions and determinate which solution is most acceptable.

NUMERICAL EXPERIENCE WITH TWO-POINT ADAPTIVE NONLINEARITY APPROXIMATION FOR DESIGN OPTIMIZATION

MagazinoviæG. - *University of Split, FESB (HRV)* 1431

In this paper, an extensive numerical examination of the Two-Point Adaptive Nonlinearity Approximation, TANA-3, is provided. This function approximation method is tested against a set of 18 real-life design optimization problems. A complete set of 97 cost and constraint functions and 7049 function approximations were performed and compared with exact values. Majority of approximations performed by the Two-Point Adaptive Nonlinearity Approximation algorithm possess high accuracy and low computational cost. Therefore, this method is highly appropriate for application in design optimization. However, some 15% of the performed approximations exhibit significant inaccuracy.

EVOLUTION OF A COMPUTER EVALUATION TOOL IN CONTEXT WITH SCOTTISH INDUSTRIES

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This paper presents the current status of a research project that aims at implementation of computers in evaluation of Concept designs. A Questionnaire was sent to a range of Scottish industries. In one of the questions, an assumption is made of the availability of a design evaluation tool embedded in conventional CAD packages. The industries were asked if they would use this CAD tool, aim being to determine the latent need for such a tool. The answer to the question was received on a fuzzy scale ranging from 1 to 10. The companies were classified into various types and statistical analysis made of their responses. The paper concludes with a statement of future work towards the creation of a computer supported evaluation tool.

USER-CENTRIC EVOLUTIONARY DESIGN

Parmee I. C., Abraham J.A. - *University of the West of England (GBR)* 1441

The paper provides an overview of interactive evolutionary computing and describes aspects of user-centric evolutionary design systems relating to multi-objective satisfaction. Such systems generate high-quality design information that improves understanding of the design domain. Knowledge gained from this information, when combined with the experiential knowledge of the designer, can support a reformulation of the design problem to better satisfy emerging requirements, improve definition and provide greater confidence in the problem representation. An iterative designer/evolutionary earch process resulting in both a better understanding of the problem and improved machine-based representation of the design domain an thus established.

APPLICATION AND EVALUATION OF A METHODOLOGY FOR CANDIDATE TECHNOLOGY SELECTION IMPROVING PRODUCT DESIGN PROCESSES

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1447

Engineering Knowledge Management has proved to be a key enabler to reducing lifecycle costs and time, improving quality and helping to ensure safe products. Two issues have to be considered for the adoption of new EKM methods and tools within the product lifecycle: 1) how to select appropriate and effective methods and tools; and 2) how to estimate benefits and impacts before adopting and/or integrating those methods and tools. This paper presents a possible validation of a methodology for the selection of new EKM technology, through its application in an industrial case for improving product development processes.

PRODUCT DESIGN SCHEMATICS: STRUCTURED DIAGRAMMING FOR REQUIREMENTS ENGINEERING

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1453

The authors have developed a systematic diagrammatic approach to represent design problem requirements as part of a larger project on visualising design information. Product design schematics (PDS) are based on concept maps but also draw from other research efforts in design problem analysis. PDSs distinguish between product characteristics, functional requirements, constraints, and performance metrics. The approach is explained with examples. The authors are currently developing a computer-based tool to support PDS creation and use. Anecdotal evidence suggests that the PDS approach can help designers reach a deeper understanding of design problems more quickly and easily than other approaches.