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A20 - SUMMARIES OF SOME SELECTED PAPERS FROM STREAMS 5

GLOBAL DESIGN TEAMS AND PROFESSIONAL DEVELOPMENT AND ISSUES IN ENGINEERING EDUCATION

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Despite the broad scope of the areas covered in this summary, the papers are remarkably cohesive. Three papers in the set give overviews of these topics, each from a different perspective. [Devon *et al.*] identify the elements of global design and discuss their implications for design education. [Sheldon] reviews the design research literature, studies its relevance to industrial practice, and identifies areas of critical importance to industry. [Torlind *et al.*] present a series of case studies and develop a list of findings and research challenges for collaborative design. Each paper presents a list of research areas and challenges. I have combined the lists and organized the discussion of the papers around the integrated list. Many of the papers overlap several categories. For example, almost all the papers on global design teams address educational issues and professional practice.

GLOBAL DESIGN TEAMS

The critical elements for global design teams identified by [Devon *et al.*] include the need for global benchmarking, the 24 hour clock, as well as accounting for cultural diversity, for different national standards, and for the global economy.

Collaborative Environments

From their case studies, [Torlind *et al.*] identify the need for support of social connectedness, informal communication and awareness of other users. Problems include the complexity of tools, the lack of true collaboration and the need to share artifacts in distributed environments. Many ICED authors are addressing these issues.

[Larrson *et al.*] present the design for a flexible collaboration space in which they will be able to study designers working in collocated and distributed teams. Their goal is to create an environment which can continue to evolve as more is learned and needs change. [Holmdahl *et al.*] look at both the mental and technical problems to web-supported design collaboration and present the results of an experiment designed to reveal the issues. To address the need to share artifacts, [Bergström and Törlind] have developed a virtual reality-like system that enables remote collaborators to interact with physical objects at remote sites. [Ganser *et al.*] have developed a system that enables simultaneous work in a common interaction space, so that a distributed team can write, speak and see as if they were in the same space.

[Wodehouse *et al.*] and [Finger *et al.*] each present a case study on a collaboration tool developed for students design teams. While the first is Wiki-based and the second is discussion-based, both focus on enhancing knowledge sharing and learning by the students. [Dong and Moere] use semantic analysis to develop representations of the patterns of design team communication. They use information visualization tools to show the patterns of emergent idea cohesion in very large design teams. [Kleinsmann *et al.*] study the barriers and enablers to the development of shared understanding in a multidisciplinary design project in industry. In their paper, they discuss the managerial implications of the findings of their study. [Grieb and Lindemann] discuss the development of tool that enables a distributed design team to tailor their communication media and design tools to the characteristics of their design situation.

Knowledge Capture and Use

The automatic capture and reuse of knowledge generated during the design process continues to challenge design researchers. [Jaime *et al.*] study the use of archival knowledge in industrial projects. They present the design for a tool using UML that capitalizes on the available knowledge from bibliographic research. [Zhu and Xie] present an XML-based method to integrate multiple intelligent knowledge services for internet-based product design. [Eynard *et al.*] apply a UML-based specification for the product development process within a Product Lifecycle Management (PLM) system. They identify the shortcomings of the current PLM systems and discuss the research needed to make them suitable for controlling the workflow in the design process.

ISSUES IN DESIGN EDUCATION

Design education philosophy

Five papers in this set take a philosophical position on design education. In a speculative paper, [Dowlen] discusses the role of change, progress, belief systems in how we think about design education. [Grimheden and Hanson] propose a didactic approach to teaching design engineering and show how it has been used in the creating of the Master of Science program at KTH. [Fargnoli *et al.*] argue that design education can be improved through the study of technical history. [Anderson and Jackson] and [Vidovics and Bercsey] argue that engineering and industrial design courses should be integrated.

Enhancing Creativity

[Taura *et al.*] propose a method for enhancing creativity. In a sequence of experiments, they show that the highest creativity is achieved when designers must blend highly dissimilar concepts. [Pahl] presents a preliminary report on a study exploring using meditation as a means to increasing team creativity. [Dowlen] describes the systematic use of creativity tools in a design course for first-term students. The course provides them with a toolkit of methods for use in later courses, an understanding of the theory behind the methods, and the opportunity to practice the methods in an authentic design context.

Outcomes Assessment

Several papers discuss outcomes assessment for students in design classes. [Redelinghuys] discusses the changes that must be made in an engineering design courses to account for the differences in preparedness among students. [Field *et al.*] looked at the effect of spatial abilities on the comprehension of design drawings and discuss the implications for graphics education. [Churches and Magin] report on the Warman Student Design Project and Competition and present results of self-reported learning by students. [Tsai *et al.*] outcomes-based assessment of student learning in a mechanisms course. Based on the observation that efficiency and effectiveness differentiate the expert from the notice, [Motte *et al.*] focus their teaching on embodiment and detail design. They have some interesting preliminary results; for example, students liked having a specific process to follow, but the quality of the process had no correlation with the quality of the result.

[Andersson *et al.*] have developed a procedure for the systematic design and implementation of design-build-test project courses. They address issues such how to develop learning objectives, select teaching methods and assess procedures. [Shah] identifies the basic design skills that students need to learn and develops methods to evaluate these skills within the context of a larger problem. In ongoing work, [Eris *et al.*] present a thorough assessment of the Project Oriented Learning Environment and use the results of the assessment to substantiate the theoretical framework for the environment.

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