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Perspectives Workshop: Science of Design – High-Impact Requirements for Software-Intensive Systems
Executive Summary

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Abstract. This document gives a brief motivation for and summary of the perspectives workshop "Science of Design – High-Impact Requirements for Software-Intensive Systems". The workshop was held in Schloss Dagstuhl – Leibniz Center for Informatics from October 8th until October 11th, 2008.

The NSF-funded Science of Design (SoD) Initiative in North America has tried to establish principles of a science of design between the traditional natural science and social science methodologies. This is highly relevant in a scientific climate whose publications tend to accept formal results or formally conducted empirical studies of existing systems much more easily than design- and innovation-oriented research. It is therefore necessary to define more clearly what is "good" design research and, in particular, to align better the research strategies and the current and future needs of practice.

Within the design science initiative, two workshops in the US and Europe discuss the relationship between the practice and the research in *requirements engineering* with the aim of identifying "high impact requirements" research, i.e. areas which have high importance and relevance in current and future practice but have received little research interest in the past. Another goal is to bring together representatives of the broad variety of fragmented disciplines in which requirements play an important role, but where little communication exists.

The starting point of the workshops was a large-scale empirical study in over thirty organizations concerning the present relationships between research and practice in RE. The results were in part quite encouraging: Many RE research results have found their way at least partially into practice. But while uptake of scientific RE results has been more successful than often perceived, the transfer of new practice problems to research has been less successful. While the above-mentioned RE results were derived from problems of the 80's, many new challenges have arisen in the meantime for which relatively little RE research exists. Moreover, isolated ideas from different disciplines have not yet found their way into coherent theories. It is in these areas, where RE research with high impact could emerge in the next few years.

As a result of the first workshop held in Cleveland, Ohio, June 3-6, 2007, four key requirements principles have been identified that need deeper investigation: intertwine

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requirements and contexts, evolve designs and ecologies, manage through architectures, and recognize and mitigate against design complexity. These issues have been used as anchors for the second workshop held in Europe, namely Dagstuhl. The idea was to deepen the discussion on some particularly important challenges, but also to include more strongly the perspectives of European companies and researchers, such as the stronger focus on enterprise software architectures and formal semantics of service-oriented business software architectures, but also inter-cultural management aspects ranging from eInclusion aspects to offshoring. Accordingly, the Dagstuhl workshop has again brought together 22 representatives from research and industry with various different backgrounds in requirements engineering, software and IS development, human computer interaction (HCI), computer-supported cooperative work (CSCW), organization science, business processes, and service orientation. The program has interleaved a number of plenary keynotes and panel discussions from various disciplines (including case studies from industry) with working groups dedicated to five special topics including, but not limited to the ones mentioned above: “multiple concepts of design”, “evolution and management of requirements”, “stakeholder issues and economics of requirements”, “intertwining requirements and design”, and “requirements, architecture, and complexity”.

While the details of the results of these working groups are given in a more detailed document of its own, from an overall perspective the following conclusions can be drawn. We argue that current and future design requirements are shaped by the rapid change in implementation capabilities and platforms, new application demands, and rapidly evolving environments. Over its thirty-year history, the idea of design requirements has changed from single, static and fixed-point statements of desirable system properties into dynamic and evolving rationales that mediate change between the dynamic business environments and the design and implementation worlds. As Fred Brooks noted in the Dagstuhl workshop: “Design is not about solving fixed problems; it is constant framing of solution spaces”. This evolution has now probably reached a new turning point characterized by unprecedented scale, complexity, and dynamism. This calls for new ways to think about requirements and their role in the design. Like earlier turning points, such as the software crisis in the 1970s, it will demand a resolute and careful intellectual response. The four requirements principles have numerous implications for research questions of which only a minority has been addressed yet.

Overall, the good news is that the importance of RE continues to grow as the arguments for it are broadening. But the bad news is that besides the need for making a business case for a decent return on investment within a shorter time frame, in the future RE we need to consider additional arguments such as the need for the alignment with business process, understanding your own capabilities, systematizing the customer expectation managements, ensuring legal protection against IP loss or contract violation suits, creating user buy-in, and minimized training costs when justifying your next RE project. We need to therefore expand RE research into new fields—including complexity science, industrial design, organization design, and economics, among others. One challenge is the void of interdisciplinary intellectual exchange between diverse communities that have a stake at software requirements given the observed need for increased diversity in the design of software-intensive systems.