08412 Abstracts Collection
Science of Design : High-Impact Requirements for Software-Intensive Systems
— Dagstuhl Seminar —

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Abstract. Despite its undoubted success in the last two decades, requirements engineering (RE) needs a better alignment between its research focus and its grounding in practical needs as these needs have changed significantly. In this Dagstuhl Perspective seminar - part of the debate about a "Science of Design", about twenty representatives from research and industry in Europe, Asia, North and Latin America explored changes in the environment, targets, and the process of RE that influence the nature of fundamental RE questions. In a manifesto, they propose four key principles that underlie current requirements processes and influence their successful resolution: (1) intertwining of requirements with implementation and organizational contexts, (2) dynamic evolution of requirements, (3) architectures as a critical stabilizing force, and (4) high levels of design complexity and necessity to employ new ways to mitigate it. Managerial and practical implications of these principles include the effective utilization of service orientation and outsourcing in such settings, move from process-oriented to capability-based organizations around related technology platforms, and the importance of the edge of such organizations for innovation and risk containment. In addition to short abstracts of presentations by the seminar participants, this booklet also includes abstracts of discussion summaries, case studies and empirical material used, and of the manifesto.

Keywords. Requirements engineering, science of design

08412 Executive Summary – Science of Design : High-Impact Requirements for Software-Intensive Systems

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, October 8-11, 2008.

Dagstuhl Seminar Proceedings 08412
Science of Design : High-Impact Requirements for Software-Intensive Systems
http://drops.dagstuhl.de/opus/volltexte/2009/1988

Keywords: Science of design, requirements engineering

Joint work of: Jarke, Matthias; Lyytinen, Kalle; Mylopoulos, John

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1974

08412 Seminar Outline and Session Summaries

This document gives a motivation for this perspective seminar within the Science of Design initiative, as well as an outline of the participants, agenda, sessions, and presentations. Furthermore, the outcomes of the five working group sessions are summarized: multiple concepts of design, evolution and management of requirements, stakeholder issues, intertwining requirements and design, and requirements, architecture and complexity.

Keywords: Seminar outline, working group summaries

Joint work of: Jarke, Matthias; Lyytinen, Kalle; Mylopoulos, John; Kappel, Gerti; Leite, Julio; Mark, Gloria; Ramesh, Bala; Schmitz, Dominik; Sutcliffe, Alistair G.

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1973

08412 Manifesto – High-Impact Requirements for Software-Intensive Systems

Despite its undoubted success in the last two decades, requirements engineering needs a better alignment between its research focus and its grounding in practical needs as these needs have changed significantly. We identify and explore changes in the environment, targets, and the process of requirements engineering (RE) that influence the nature of fundamental RE questions. Based on these explorations we propose four key principles that underlie current requirements processes and influence their successful resolution: (1) intertwining of requirements with implementation and organizational contexts, (2) dynamic evolution of requirements, (3) architectures as a critical stabilizing force, and (4) high levels of design complexity and necessity to employ new ways to mitigate it. We make recommendations to refocus the RE research agenda as to meet better emerging and new challenges based on the review and analysis of these four key themes, and note several managerial and practical implications.

Keywords: Science of design, requirements engineering, manifesto

Joint work of: Jarke, Matthias; Loucopoulos, Pericles; Lyytinen, Kalle; Mylopoulos, John; Robinson, William

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/2028

Case Studies in Requirements Practice

Attached are two short case studies intended to encourage seminar participants to reflect on requirements questions from the perspective of the design practitioners. The case study documents summarize the experiences of project teams and other stakeholders on two existing systems development projects. Each case concludes with a series of questions that build upon discussions from the first Design Requirements Workshop 2007 in Cleveland.

Keywords: Requirements practice, distributed requirements, integration, coordination challenges

Joint work of: Hansen, Sean; Lyytinen, Kalle

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1986

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1979

Requirements in the 21st Century: Current Practice and Emerging Trends

Requirements have remained one of the grand challenges in the design of software intensive systems. In this paper we review the main strands of requirements research over the past two decades and identify persistent and new challenges. Based on a field study that involved interviews of over 30 leading IT professionals involved in large and complex software design and implementation initiatives we review the current state-of-the-art in design requirements management. We observe significant progress in the deployment of modeling methods, tools, risk-driven design, and user involvement. We note nine emerging themes and challenges in the requirement management arena: 1) business process focus, 2) systems transparency, 3) integration focus, 4) distributed requirements, 5) layered requirements, 6) criticality of information architectures, 7) increased deployment of COTS and software components, 8) design fluidity and 9) interdependent complexity. Several research challenges and new avenues for research are noted in the discovery, specification, and validation of requirements in light of these requirements features.

Keywords: Requirements, modeling, specification, validation, verification, change, large systems, complexity, stakeholders, field study

Joint work of: Hansen, Sean; Berente, Nicholas; Lyytinen, Kalle

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1989

See also: Hansen, S., Berente, N., Lyytinen, K.J. (2008). "Requirements in the 21st Century: Current Practice & Emerging Trends". In: Lyytinen, K.J., Loucopoulos, P., Mylopoulos, J., Robinson, W. (eds.): Design Requirements Engineering: A Ten-Year Perspective. Springer LNBIP 14, pp. 44.87

Making sense of Design & Requirements Perspectives - & their Inter-relations

Liam Bannon (University of Limerick, IE)

I see myself as a commentator or discussant at this workshop as my research interests are on the "edge" of the RE area. Thus, for me, the question of what perspective we bring to bear on the issues we are debating is paramount. What I find interesting in some of the recent discussions is to what extent the issues and problems we are facing today are novel and distinct from those we were facing 10 or even 20 years ago, and how these are being discussed nowadays and heretofore. I provide some personal context for these remarks and show both some similarities and possible differences over the years in the ongoing discussions.

Keywords: Perspectives, evolution, process, iteration, prototyping

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1975

'A Science of Design' is a Misled and Misleading Goal

Frederick P. Brooks (University of North Carolina - Chapel Hill, US)

Simon, in advocating for a Science of Design, proposed a linear Rational Model of design as his science's central concept. Such a model occurs naturally to engineers. Indeed, it has been independently formally set forth several times: e. g., by Simon, by Paul and Beitz, and by Royce.

Having a visual, geometric representation of a design process model is crucial, for designers are spatial thinkers. We most easily learn, think about, share, and talk in terms of a model with a clear geometric picture. But the linear, step-by-step Rational Model is misled in goal and approach. It does not accurately reflect what real designers do, nor what the best design thinkers identify as the essence of the design process. Science and design are fundamentally different activities.

The goal of a Science of Design is also misleading. Its Rational Model leads to the too-early binding of requirements, leading in turn to bloated products and schedule/budget/performance disasters. The Rational Model has persisted in practice despite its inadequacies and plenty of cogent critiques. This is because builders and clients need contracts. Several alternative process models have been proposed. I find Boehm's Spiral Model the most promising. We also need to develop alternative contracting processes, perhaps adapting those from the building community.

Keywords: Science of design, rational model, spiral model

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1976

Requirements Engineering for Social Software

Anna Glukhova (RWTH Aachen, DE)

Social software bears some special characteristics for requirements engineering (RE) like user-centeredness, self-organization and voluntarism. No concrete formalization of the RE process for social software has been established so far. In this position paper, important aspects of social contexts will be considered in order to define requirements, referring to the previously identified four key requirements principles.

Keywords: Social software, web 2.0, requirements engineering, collaborative systems, communities

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1977

Distributed Cognition in the Management of Design Requirements

Sean Hansen, Kalle Lyytinen(Case Western Reserve University - Cleveland, US)

In this position statement, we outline a new theoretical framework of the distribution of design requirements processes. Building upon the Theory of Distributed Cognition, we characterize contemporary requirements efforts as distributed cognitive systems in which elements of a design vision are distributed socially, structurally, and temporally. We discuss the various forms of distribution observed in real-world systems development projects and the processes by which representational states are propagated through the system. We conclude with a brief discussion of the implications of the framework for requirements research and practice.

Keywords: Distributed cognition, distributed requirements, COTS software, IT architecture

Joint work of: Hansen, Sean; Lyytinen, Kalle

Full Paper: http://drops.dagstuhl.de/opus/volltexte/2009/1930

RE in the Age of Software Platform Strategies

Matthias Jarke (RWTH Aachen, DE)

The bottom-up evolution of information and communication standards (T.L. Friedman) enables increasingly powerful software platform strategies by organizations and partner networks.

Drawing on analogies with automotive industry, we discuss some important requirements aspects for the success of the platforms themselves, which go beyond the recent research on software product lines. But it is also important to study how the presence of such platforms, e. g. social network technology, changes the RE process for agile innovation on top of other platform, and for the user communities of these platforms. Often this changes the trade-off between non-functional requirements and introduces aspects of industrial design (aesthetics, innovativeness) or security/privacy and system function transparency at runtime to counter the ubiquitous data mining movement on such platforms.

Keywords: Platform, product line

The Importance of Change Management when Intertwining Requirements and Design

Gerti Kappel (TU Wien, AT)

One of the long lasting problems in software engineering is coping with change. This problem becomes even more important when requirements and design work intertwine, a general accepted practice today. Within change management we have to tackle (a) traceability, (b) consistency, and (c) adaptability. With traceability, we have to look at both forward and backward traceability, which might lead to very complex dependencies. Consistency is another way of looking at dependencies. Adaptability tackles the problem of changing the system on the fly. This might lead to context-aware adaptable systems. In this realm, one big question arises, namely, when does adaptation lead to a new system? To put it in other words, which requirement may not be intertwined with design easily but leads to a new design?

Keywords: Change management, traceability, consistency, adaptability, new design

Software Transparency

Julio Cesar Leite (PUC-Rio de Janeiro, BR)

Software transparency is a new concern that software developers must deal with. As society moves towards the digitalization of day to day processes, the transparency of these digital processes becomes of fundamental importance if citizens would like to exercise their right to know. Informed discourse is only possible if processes that affect the public are open to evaluation. Achieving software transparency to this level of openness brings up several roadblocks. This talk reports on initial findings on exploring the obstacles for enabling software transparency.

Keywords: Software, transparency, requirements engineering

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1929

Full Paper:
http://ftp.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-322/paper13.pdf

See also: Exploring i* Characteristics that Support Software Transparency Julio Cesar Sampaio do Prado Leite, Claudia Cappelli, Proceedings of the 3rd International i* Workshop, CEUR Workshop Proceedings, pp. 51-54

Understanding Social and Environmental Requirements

Lin Liu (Tsinghua University Beijing, CN)

Rapid changes in the social and technical environment bring about many new challenges to system requirements engineering, amongst which out-sourcing or off-shoring of certain design tasks to countries with more human resources and broader markets becomes promising business leverage. Here we report some of the result from an ongoing research project on the survey of requirements practices in China. It is interesting to understand the current status of industrial practices after years' research efforts, especially in a rapidly developing country such as the China. We perform a web-based survey of requirements engineering practices in China, focusing on the requirement elicitation techniques and requirement presentation techniques. Our study has collected data from 150+ participants from 50+ Chinese companies and education institutes. We also analyze the impact of Chinese culture on requirement engineering practices. In this report, we present the main survey results and point out their implications. We hope our results are useful for industrial practitioners and academic researchers wishing to improve current practices, and for foreign software companies wishing to better understand their Chinese customers.

Keywords: Requirements engineering, culture, environment, China

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1978

Large-scale Collaboration: The Challenge for Distributed Requirements Analysis

Gloria Mark (Univ. California - Irvine, US)

Advancement in requirements analysis processes basically follows two interrelated steps: 1) utilizing and enhancing methods and tools and 2) improvement in the understanding of requirements analysis practice. In this talk I will describe some of the challenges for distributed requirements analysis, based on a perspective grounded in the field of computer-supported cooperative work.

Increasingly more, we are seeing a trend towards the globalization of software-intensive organizations. Along with this we are also seeing the emergence of large-scale collaboration and design both within and across organizations and national boundaries. The development of new technologies and infrastructures to enable such large-scale collaboration and design is occurring at a fast rate. Cyberinfrastructure to support scientific collaborations and the Access Grid, designed to provide high capacity networks to aid science and engineering collaborations, are two prominent examples. Global software development is another example. This globalization and large-scale of collaborations are having an effect on how products are designed and produced, and importantly, on how requirements are determined and incorporated into designs. However, despite the technological enabling of such global and large-scale collaborations, requirements analysis is faced with major social and organizational challenges. I will describe some challenges through a field study of a large-scale engineering design team composed of collocated teams distributed at different sites. The study shows how teams face an inherent tension balancing demands of their collocated environments with those of distributed teams. These tensions are manifest in the teams' abilities to develop and adopt common terms and methodologies, to negotiate and adopt hybrid solutions, to overcome misattributions, and to establish appropriate social networks across distance. I will discuss the implications of these tensions between collocated and distributed demands in impacting distributed requirements analysis.

Keywords: Large-scale collaboration CSCW

The Logic of Requirements

John Mylopoulos (University of Toronto, CA)

Requirements consist of (a) domain assumptions, (b) hard goals, (c) quality constraints, (d) possibly prioritized preferences. The very core of Requirements Engineering consists of the following problem: given a set of (a)-(d), generate specifications that fulfill hard goals and quality constraints, assuming that domain assumptions hold, and satisfy maximal sets of preferences. We are working towards tools that solve this problem for expressive modeling languages in terms of which one can represent domain assumptions, goals, etc. Such tools can be used as basis for exploring requirements by varying preferences and priorities, or weakening/strengthening goals.

Keywords: Domain assumptions, hard goals, qualitz constraints, prioritiyed preferences

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1980

Co-Design of Business Processes and Business Information Systems

Andreas Oberweis (Universität Karlsruhe, DE)

My field of interest is at the borderline between software engineering and business process engineering. Business information systems (should) support business processes in an organisation. There are requirements related to business processes and requirements related to the software. However, there is usually no integrated view on both issues. Typically, information system life cycle and business process life cycle are only loosely coupled to each other. We need some kind of co-design of both artefacts. Different levels of linking business process life cycle and information system life cycle are discussed in my position statement.

Improving the Quality of Requirements Engineering Processes

Barbara Paech (Universität Heidelberg, DE)

This position paper is based on the assumption that descriptive and prescriptive research on IT is important. In particularly this means that IT research should try to understand the state of the practice and try to improve it through relevant research results. On the basis of my experiences with software engineering processes in industry and application domains such as hospital information systems I highlight the main challenges for improving the quality of requirements engineering processes. The key underlying trend in software engineering is the increasing intertwinement between development time and run time of software. Requirements engineering has to enhance its mechanisms for communication, knowledge management, process fitness, dealing with complexity and the continuous evolution accordingly. This requires empirical studies e. g. wrt the usage of models or the role of values, as well as innovative methods and tools, e. g. for mining requirements repositories, traceability or the use of models during run time for monitoring.

Requirement Definitions and Processes for an Enterprise Wide Information Technology System

Sasi Kumar Pillay (NASA Glenn Research Center, US)

This presentation will cover the necessary steps that are integral in establishing an enterprise wide Information Technology system. A team needs to be established first to gather requirements. This can be done a number of ways, such as surveys and/or interviews with a focused user community to understand and document key requirements, issues, barriers, and the like. These surveys could

easily be done using the Web; however, we found interviews are an essential part of gathering and clarifying input. Next, focus groups need to be formed, whereby what-if scenarios and rapid prototyping can be used to better understand requirements and create potential solutions with the groups. The next step is to determine if a commercial off-the-shelf (COTS) program or a custom program needs to be written which addresses all the requirements. Preferences should be challenged and a final decision as to include them as requirements or not need to be addressed and dispositioned with the customer focus groups. In the end, a decision whether to use COTS or custom programs need to be made if the remaining requirements can be met while considering all alternative solutions using a life cycle costing model. An example of providing a collaborative source at NASA using this process will be discussed.

Change Management in Agile Requirements Engineering

Balasubramaniam Ramesh (Georgia State University, US)

Based on an analysis of data collected in sixteen U.S. software development organizations, we identify six agile RE practices. We also identify seven challenges that are created by the use of these practices. Problems with customer inability and a lack of concurrence among customers significantly impact agile development. Also, risks associated with neglecting non-functional requirements also necessitate changes during development. Using a system dynamic simulation model we evaluate the impact of agile RE practices on cost of making changes to requirements. The smaller range of cost of requirement change makes the iterative development a feasible approach. However, the effectiveness of this approach relies on the refactoring effort.

Keywords: Agile RE

Joint work of: Ramesh, Balasubramaniam; Lan Cao; Tarek Abdel-Hamid

Effectuation for Organizing Design Processes?

Isabelle Reymen (TU Eindhoven, NL)

Design Science Methodology is the title of a course I developed/am developing. It tries to bridge design in engineering and social science, with the goal to learn industrial engineering and management students notions of design.

With an engineering background (Architecture and some Computing Science), I am now Assistant Professor Design Processes in the Organization Science and Marketing group of Prof. Romme. I lecture in the Innovation Management Program of the Eindhoven University of Technology.

I am very interested in thinking about new ways of organizing design processes and about how to deal with the new challenges of design science. My

research focuses around "The design of processes for artifact creation", where artifacts can be new products, systems, discourse, businesses, markets, ...

I am also involved in a new initiative that plans to organize a workshop on Organizational Design and Engineering, which I like to share with the audience.

Keywords: Design science, design process, organization design

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1981

Requirements Monitoring

William Robinson (Georgia State University, US)

We must be vigilant that systems do not take on undesirable properties, like Shelly's Frankenstein, to terrine our cyberspace. Requirements monitoring can raise alerts should our creations fail to meet their obligations. Over time monitoring can increase trust. Requirements monitoring is no silver bullet, but is does address some essential difficulties of software, particularly invisibility that arises from its complexity and changeability.

Action Design Research – An Integrative Research Method for Studying Design

Matti Rossi (Helsinki School of Economics, FI)

It is the premise of this position paper that a combination of design research and action research can be very useful for studying high performance designs. However, there has been a separation between the two approaches. A growing body of literature is recognizing these cross fertilization possibilities between AR and DR. Researchers argue for similarity between the two (Järvinen 2007; Lee 2007; Figueiredo and Cunha 2007) as well as caution against fusion (Iivari 2007). Others suggest a middle ground stating that in some situations and contexts, the two may be integrated (Cole et al. 2005; Sein et al. 2007).

Keywords: Action research, Design research, Proactive research

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1982

Science of Design: Impact of Modeling

Bernhard Rumpe (TU Braunschweig, DE)

Models are a primary technique to capture requirements. If the modeling language is appropriate, we can use these for simulation (testing and requirements elicitation).

Complexity can only be handled through compositional modularizations of requirements and their alignment with compositional solutions. Using requirement models (e. g. data structures, work flows) to orchestrate generic components/solutions helps to make the development more agile and flexible. Restricted forms of models can even be used by end-users for customization.

Requirements Engineering for Control Systems

Dominik Schmitz (Fraunhofer Institut FIT - St. Augustin, DE)

Nowadays, more and more controllers in automobiles are realised in software on electronic control units. This contribution reports on a joined project of control system engineers and software engineers that aims at a better integration of these two disciplines. Focussing the requirements engineering part, the relevant issues for control systems are set in relation to the previously identified four key requirements principles.

Keywords: Requirements engineering, control systems

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1983

Complexity, Requirements and Design

Alistair G. Sutcliffe (Univ. of Manchester, GB)

So why do we get worried about complex systems and what can we do about it? Complexity worries us because the world is unpredictable, large scale, multi component and densely interconnected. We perceived interactions as complex since we have difficulty in generalising over multiple events especially when events are poorly ordered. However interactional complexity is tractable by mathematical modeling as (misnamed) chaos theory has shown. Interactional complexity is being modeled with increasing accuracy by computational theories and simulations of physical and biological systems, viz. the IPCC world climate model. The second form is semantic complexity which implicates the difficulties we have in understanding intent of people. Here sadly there is no short term tractable solution. The Dagstuhl process of discussion leading to incremental (maybe radical) advances in understanding is one answer.

Keywords: Interactional complexity, semantic complexity

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1985

Requirements Engineering Domain Dimensions

Alistair G. Sutcliffe (Univ. of Manchester, GB)

This doc gives my initial ideas on the dimensions/criteria for different genres of applications (or domains if you prefer), following my summary presentation at the Dagstuhl workshop.

Keywords: Domain dimensions, genres of applications, follow-up

Extended Abstract: http://drops.dagstuhl.de/opus/volltexte/2009/1984