Editorial Message: Special Track on Inter-disciplinary Approaches to the Design of Dependable Computer Systems

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This track emerged out of the UK Engineering and Physical Sciences Research Council, Dependability Interdisciplinary Research Collaboration (DIRC). Its focus is on outlining and discussing what lessons can be garnished from inter-disciplinary investigation and approaches to the design of dependable computer systems.

The theme of dependability reflects wider concerns about the reliability, security and trustworthiness of computer systems. As society's dependence on computer-based systems expands, while the systems themselves have become increasingly complex. These trends coincide with pressure for systems to be brought to market faster and at lower cost. Achieving sufficient dependability in these systems and demonstrating this achievement in a rigorous and convincing manner, is of crucial importance to the fabric of the modern Information Society.

The emphasis on inter-disciplinarity reflects our interest in taking some initial steps towards developing improved means of specifying, designing, assessing, deploying and maintaining complex computer-based systems in contexts where high dependability is crucial. Today, this includes not only conventional safety-critical applications, but also an increasingly wide variety of contexts where human activity is now effectively dependent on computer-based systems for its timely and orderly performance.

Much progress has been made in achieving high dependability in computer hardware and software but wider systems involving computers, people and organisations are often unsuccessful and the cause of financial or human loss. It is evident that satisfactory resolution of such concerns demands major breakthroughs in understanding the development of complex systems. Satisfactory resolution of this situation may also require an inter-disciplinary approach to understanding the fundamental problems that arise in attempts to build systems involving complex interactions amongst computers and humans. Inadequate understanding of the organisational and cultural context of use is often a significant cause of lack of dependability of major new computer-based systems, and is a major focus of this track. By bringing together academics and practitioners from a variety of disciplines and working contexts, who share an interest in the problems of dependability, the track makes an important contribution to fostering an inter-disciplinary approach.

The papers in this track cover a number of broad themes including: the architecture and organisation of systems; reasoning about dependability attributes; work and its relationships with technological systems and artifacts; and socio-technical approaches to systems design and development. The papers also collectively present reflections from those engaged in, or affected by, the design, development or implementation of computer-based information systems and provide an improved understanding of the complete organisational and cultural context of complex systems of which computers are a part.

Professor Kirsten Nygaard of the University of Oslo is recognised internationally for his outstanding contribution to the field of Informatics. Among the many awards that Professor Nygaard has received for his work is the 2002 IEEE John von Neumann Medal. We are honoured, therefore, that Professor Nygaard has accepted our invitation to give the track's opening address. The title of Professor Nygaard's talk is "The Best Strategy in Democratic Problem Solving Is a Common Understanding of the World".

Massimo Felici and Juliana Kuster Felipe address the problems of modelling computer-based systems where requirements are subject to constant change, or evolution. They use a case study of o a complex, distributed system to explore the limits of one particular modelling technique, based upon UML. They conclude by arguing for the need for a modelling framework that can support an inter-disciplinary perspective.

In addressing similar issues, Mark-Alexander Sujan, Antonio Rizzo and Alberto Pasquini turn to Activity Theory, arguing that this provides a particularly useful framework for addressing the problem of systemic evolution and dependability. As their specific analytical tool, they use the concept of 'contradictions', which, in the broadest sense, reflect incompatibilities between human and technological systems. They illustrate their approach through the analysis of a rail traffic control system in which they identify a number of contradictions inherent in the introduction of a new system for communication between train drivers and line supervisors.

Corin Gurr and Gillian Hardstone describe an inter-disciplinary approach to tackling the issues of modelling of user requirements for information systems in complex organisations where high dependability is a significant requirement. Their paper focuses on the knowledge of system users (domain practitioners) and designers, and the potential use of diagrammatic representations of that knowledge during the implementation process in order to support communication between the two groups, and to serve as tools in assisting system reconfiguration to user requirements during implementation.

Neil Pollock and James Cornford consider the issue of how generic computer systems may be adapted and customised for use in particular organisational settings, an important problem as organisations become intent on capitalising on the benefits of standardised software. They argue that generic systems may require substantial customisation and 'translation work' to achieve a fit with an organisation's needs, and with the specific work practices of its members, illustrating this with a case study of an Enterprise Resource Planning system. It exemplifies how mundane dependability issues have become significant as systems become increasingly organisationally embedded.

Luciana D'Adderio's paper examines the impact of Integrated Enterprise Software Systems on an organisation's ability to create, store, retrieve and reuse knowledge. Drawing on case studies, she argues that while such systems are implemented with the aim to improve communication and the integration of knowledge and activities across organisational domains and cultures, their introduction of results instead in highlighting existing conflicts. This has important implications in terms of dependability intended as the outcome of complex socio-technical, organisation-embedded and artefact-mediated interactions.

Denis Besnard and Anthony Lawrie present the case for using design practices from other engineering disciplines to inform software engineering. Arguing that the problem solving behaviour of the individual remains an important factor in software development work, they examine design from a cognitive perspective, looking at the design problem as an optimisation problem within a potentially large solution space. In particular, they focus on the manipulation of design constraints within a three-dimensional framework of identification, optimisation and reuse.

Shamus Smith and Michael Harrison make the case that qualitative approaches for requirements identification, such as scenario analysis, are deficient in that they do not provide the designer with an accurate and effective way of determining the impact of design options on safety and reliability. They explore the possibilities of complementing qualitative methods with quantitative approaches, illustrating what can be achieved through an example in which they combine well-established qualitative and quantitative methods to rank design recommendations in terms of their safety impact. They conclude by outlining further refinements to the method.

Finally, Salem Aljreh and Nick Rossiter argue that security problems in a number of important areas of collaborative work, such as medicine, are not very well understood. They develop a perspective for policies and models that is task-based on a need-to-know basis and demonstrate the use of Petri nets to identify the functions and states involved. They conclude by presenting a general architecture for a secure collaborative environment.

The various accounts of computer-based systems and their deployment documented in these track proceedings present a persuasive case for a movement beyond the pure engineering mentality to attend to some of the everyday realities of organisational life. They provide further support for the view that computer-based systems failures are often associated with inadequate attention to the social context of work. As systems design processes attempt to accommodate some of the complexities of organisational working, so new challenges appear involving attending to the lived reality of organisational work. Computer-based systems designers, implementers and users all suffer from difficulties in initially adequately characterising the nature of organisational work, and subsequently tracking how work may change in when a new system is introduced. As computer-based systems and artefacts penetrate more and more into people's working lives, the 'design problem' is not so much concerned with the creation of new technical artefacts as it is with their effective and dependable configuration and integration with work practices. We believe that this track will make a useful contribution to furthering understanding of how this might be achieved more successfully.

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