An Urgent and Growing Problem

Leading British academics and industrial practitioners have established a national strategic coordinated research and training initiative focusing on the science and engineering of Large-Scale Complex Information Technology Systems (LSCITS). Funds of approx £10m have already been committed by the EPSRC, the main UK funding agency for computer systems research.

The motivation for the LSCITS Initiative is the on-going growth in the size and complexity of information technology (IT) systems. Our ability to develop, maintain and manage such systems is falling behind the growth in their complexity. There is a high risk that we will find ourselves reliant on IT systems that we don’t fully understand and that we cannot effectively manage.

The roots of complexity in IT systems are their increasing size; the increasing involvement of many different organisations in their construction and use; and the increasing rate of business and social change that they have to accommodate. To manage and control complexity, we need better technical tools and methods of system development. We also need a better understanding of the human, social and organisational issues that affect the procurement, development, deployment and use of complex IT systems.

The Initiative will establish a coordinated international network of researchers in industry and academia with the skills and knowledge appropriate to dealing with the problems of current and future LSCITS across their life-cycles. The Initiative’s Training Programme is intended to produce the next generation of systems engineers and technology innovation leaders.

Both the LSCITS Training Programme and the LSCITS Research Programme will bring together academic researchers and industrial practitioners. This flyer gives an overview of the Initiative’s general structure and approach. There are additional flyers giving more details of the LSCITS Training Programme and the Initiative’s Research Programme.

Overall Aim

Our aims are to improve existing technical approaches to complex systems engineering and to develop new socio-technical approaches that help us understand the complex interactions between organisations, processes and systems. We will tackle the following problems:

- **System Understanding.** The principal functional and non-functional properties of complex IT systems cannot be completely understood by our existing ‘reductionist’ approaches.
- **System Interactions.** Systems interact with their operational environments in many different ways.
- **Systems and Organisations.** Complex IT systems are specified, developed, used and maintained within organisations that may themselves be thought of as complex systems. The development, deployment, evolution and use of the IT systems is thus influenced by human, organisational, business, social and political factors.

Conceptual Framework

The inherent tension between stability and change in LSCITS requires an approach to research that includes both of these perspectives.

- **Stability:** The system’s essential properties must be maintained, its key variables kept within the limits of system viability, and its goals must be kept in step with the goals of the organisation that it serves.
- **Change:** Agile reaction and adaptation is desirable, reducing the time required to make appropriate changes in response to external pressures and perturbations, and to deploy these changes across organizations.

A key research question is then: how are essential large-scale complex IT system properties maintained in the face of change? There is no easy answer to this, but we must certainly reason at different levels. These include the detailed implementation level, the intermediate level of development and operational processes, and the higher level of organizational dynamics.
The LSCITS Consortium

A collaboration is required to tackle the problem because there is no single university in the UK which includes all of the expertise required to address issues of both stability and change.

The founding members of the LSCITS Consortium are each leading academics, internationally recognised for their research.

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A unified collaboration offers significant advantages:

• It allows each site to leverage expertise from the other sites.
• It enables us to integrate theory (Oxford, Leeds) and practice (York, St Andrews).
• It allows for the development of common perspectives on the LSCITS problem.
• It means that integration can be controlled - we are able to ensure that different streams of work remain compatible.
• It presents a single interface to industrial partners, funding agencies, and related projects.
• It provides a core of work that can be extended and complemented by new projects.

Industrial Partners

The Initiative is intended to be intimately coupled to the needs of industry, commerce, defense, and the public sector. The initial structure and content of the LSCITS Research Programme and of the LSCITS Training Programme are each the result of extensive consultation with researchers and practitioners in a wide variety of organisations. Over the lifetime of the Initiative, both programmes will be revised on the basis of feedback from ongoing consultation. It is expected that a range of companies and organisations will become involved as sponsors of research and training within the Initiative as it progresses. Approaches and offers of involvement from prospective additional industrial partners and sponsors are always welcome.

Management Steering Boards

The LSCITS International Scientific Advisory Board (ISAB) advises on the scientific quality of the Initiative’s research activities from a worldwide perspective. It is composed of leading researchers in the science and engineering of LSCITS drawn from academic and industrial organisations around the globe. The ISAB includes members from Carnegie-Mellon University, Hewlett-Packard Labs, IBM Labs, MIT, and the universities of Toronto, Queensland, and Dortmund. The founding ISAB Chair is Professor Cliff Jones, of Newcastle University, UK.

The LSCITS National Stakeholder Board (NSB) exists to ensure that the LSCITS Initiative best meets the national need, and is integrated appropriately with related organisations, programmes and initiatives in the UK. Members of the NSB include representatives from companies such as BAE Systems, British Telecom, and Rolls-Royce; from UK public-sector organisations such as the Ministry of Defence, the Department of Health, and the EPSRC funding agency; and from directors of related UK initiatives such as the two UK Complexity Science doctoral training centres, and the UK’s defence Software Systems Engineering Initiative (SSEI). The founding NSB Chair is Dr Mark Thomas of IBM UK.

UK Government Funding

The Engineering and Physical Sciences Research Council, the primary funding agency for computer science in the UK, has reserved funds of approx £10m for the LSCITS Initiative over the period 2007-2012.