

Lindsay Smith
University of Hertfordshire
Title: Retro-methodology
Supervisor: Dr. Tracy Hall

The solution of a technical problem: Placing a computerised artefact in any given operational environment potentially changes that environment in unpredictable ways. Once implemented any underlying change caused has the potential to invalidate any developmental decision taken prior to that implementation. The computerised artefact is 'in situ'. The developer can attempt to anticipate change but application of developmental techniques retrospectively is problematic.

Prior research has incorporated work originating in the social sciences to improve the context in which the requirements of stakeholders are processed. This work has gone some way towards a solution of the problem outlined above. A consensus exists that a developer's interpretation of an existing environment should include stakeholder views. Less agreement exists as to how this reduces the risk of undesirable events happening after implementation, e.g. the 'system' is inadequate for stakeholder requirements.

Formalising (to make machine-executable) an informal (e.g. human-activity) system remains problematic. You cannot rule out unpredictable change even if the scenario includes correctly identified stakeholders making perfect sense of a developer's interpretation. Some people would indeed consider this 'best case' scenario highly unlikely in the first place. Certainly, the issue of *how* to include stakeholder views in requirements engineering continues to be open to argument. Interestingly the argument as to *why* include such views appears much less open.

The research hypothesis: That further work is possible on 'social issues' in requirements which can improve representation of stakeholder context in computerised solutions. A more socially sophisticated representation, of stakeholder requirements, could be used to 'off set' any negative effects of stakeholder environment change due to computerised implementation.

Sketch of proposed solution: Evaluate social science techniques that have previously been 'adopted' into the requirements engineering process. Identify 'workable' aspects of this type of technique for the requirements process. Investigate incorporating such techniques into the requirements engineering process, using existing models/methods if possible. Apply 'post-operational' requirement 'smoothing' using the 'social issues' identified during the 'pre-operational' part of the requirements process.

The expected contribution: The nature of this problem area is essentially 'paradoxical' and unlikely to be entirely resolved. The introduction of new technology has the potential to alter stakeholder environment/view unpredictably by default. That said addressing 'social issues' with such an approach should, on balance of probabilities, give further insight into stakeholders role in the requirements process.

Evaluation of results: It would be desirable to 'prove' this with a computerised solution in an operational environment. Scalability is a likely problem factor with this type of evaluation. A direct comparison, if possible, with a more traditionally developed solution could 'prove' increased compatibility with stakeholder views within the operational environment. Other methods of evaluation may be necessary for interim results etc.

Zhi Li

The Open University

Title: A Semantic of Problem Frames

Supervisors: Dr Jon G. Hall, Dr. Lucia Rapanotti, Prof. Darrell Ince

Problem Frames [3] provide a useful way for people to understand and solve software problems. They contain a concrete set of syntaxes – graphical notations (e.g., labelled boxes representing domains, annotated arcs representing shared phenomena, dotted ovals with dotted arcs representing requirements) for communication and informal reasoning in RE practice. It is a widely recognised problem in software development that a graphical notation (syntax) without an unambiguous semantics can cause difficulties in communication [5] – a typical example is UML [1]. Although graphical notations aid communication, they do not necessarily facilitate formal or rigorous reasoning. A formal semantics can help with rigorous reasoning and avoid ambiguities. As far as I know, not enough research has been focused on the rigorous reasoning from domain modelling [4] to software solution, especially in the context of problem frames. Hall et al [2] have established a semantic framework for Problem Frames – a set-based logical characterisation of solutions that map to a problem diagram, which should work in all cases in RE because it is a textual language framework that can reason about both formal and informal descriptions. However, it has not given constructive methods to find the solutions. We have begun investigating a restricted form of CSP that can provide this constructive method. I expect that my PhD will facilitate RE practitioners in representing problem diagrams, defining equivalent problems, allowing problem transformations, and underpinning correctness arguments for frame concerns. The results will be evaluated by a series of case studies.

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Waraporn Jirapanthong

City University

Title: A Rule-based Approach for Traceability of Product Family Systems

Supervisor: Andrea Zisman

Requirements Traceability (RT) has been recognized as an important activity in software system development. Traceability relations can improve the quality of the product being developed, and reduce the time and cost associated with the development. In particular, traceability relations can support evolution of software systems, reuse of parts of the system by comparing components of the new and existing systems, validation that a system meets its requirements, understanding the rationale for certain design and implementation decisions in the system, and analysis of the implications of changes in the system. However, automatic generation and maintenance of traceability relations is not an easy task. Very few approaches have been proposed in order to support automatic generation of traceability relations. The majority of the approaches assume that traceability relations should be established manually, which is error-prone, difficult, time consuming, expensive, complex, and limited on expressiveness. Therefore, traceability is rarely established.

In this work, we propose a rule-based approach to allow automatic generation of traceability relations between documents created during the development of product family systems. These traceability relations can be used to facilitate identification of *common* and *variable* functionality in the product members of the family, and to support reuse of core assets that are available under the product family architecture. We are interested in creating traceability relations for documents generated in feature-based methodologies. We also believe that object-oriented methodology is important to support product family development and we concentrate our work in an extension of the FORM methodology that combines object-oriented documents and documents proposed in the FORM methodology.

Our work focuses on eight different types of documents and assumes the documents represented in XML, in order to allow interchange of documents produced by different tools. We have identified nine different types of traceability relations between these documents. We propose to use XQuery to represent the traceability rules. Currently we are developing a prototype tool for enabling automatic generation of traceability relations for product family systems. We plan to evaluate our approach in real case studies in terms of recall and precision of the traceability rules.

Paul Arkley
University of Newcastle
Title: Traceable Software Development
Supervisor: Dr S Riddle

The Technical Problem: Modification of complex computer based systems requires a detailed understanding of their functionality. To gain this understanding it is necessary to traverse the development artefacts looking for common threads of development reasoning. Requirements Traceability is a technique which helps the engineer to find these threads. Previous requirements traceability research has concentrated on structuring information, rather than considering how traceability relates to the main development process. In practice, traceability is performed as a separate quality-proving process by a different set of engineers to those who developed the product.

Thesis Hypothesis: We argue that the lack of direct benefits to main development process from traceability is the cause of the above problem, leading to information that is incomplete, inaccurate and out of date. Integrating traceability into the development process will significantly improve the quality of the information. To succeed, this integration must provide immediate, tangible benefits for the main development process.

Proposed Solution: We propose an inter-phase Traceable Development Contract in order to provide these benefits. The TDC defines the actions to be taken by related development phases, such as requirements definition and software design, in response to changes to their common information artefacts. The TDC will consist of three parts: the common information artefacts; traceability information structures which record how the common information artefacts are related to the development phases; and a behaviour protocol. The protocol will define the behaviour of each development phase depending on changes in the common information artefacts and traceability information structures. The TDC is beneficial to the development process as it, improves the quality of traceability information, coordinates inter-phase development and provides a means of assessing and negotiating development changes.

Contributions of PhD: This thesis builds upon previous work by establishing a means for the integration of traceability techniques into the main development process. This integration and the formalisation of the relationship between development phases will result in an increased level of traceability information correctness. This will, in turn, result in greater product understanding and reduced upgrade costs.

Evaluation of Results: The thesis hypothesis will be tested by:

- Determining the empirical evidence from traceability practices that supports or denies the hypothesis.
- Determining a theory from the empirical evidence that describes the factors involved in the recording of traceability relationships.
- Conducting experiments where student teams apply either an integrated or separate traceability recording process to a simple development case study. Comparison of the results from these groups will show whether that an integrated method produces a richer set of recorded relationships.
- Implementing the TDC in an industrial setting and recording the observation of the engineers taking part in the development process.

Yun Chen

Salford University

Title: Designing the User-Interface for Effective Interaction with E-planning Systems Using Human-Centred Approach

Supervisor: Andy Hamilton

With the development of Information Technology, more and more digital systems are applied in urban planning process, which refers to e-planning systems. Although the usability of products developed for e-planning use has improved immensely in recent years, they still require users to have or acquire considerable technical knowledge to operate them. The major obstacle to non-expert users is navigating an interface that embeds a language, world view and concepts that support the system's architecture rather than the user's work view. Human Computer Interaction (HCI) received attention in the first part of the 1990s to solve this kind of problem; however it seems that within urban planning research, little attention has been paid to the influence of HCI on research and practice. And, furthermore, the type of current users that are being exposed are very different from those who have been at the centre of the earlier research on HCI issues, who are specialists using the system to accomplish a specific work-related task. With the varying level of computer skills and literacy, general public may use the e-planning system in one of a large number of application areas. Accommodating such a wide spectrum of needs is a challenge and the interface is generally the key. A Human Centred Approach (HCA) opens new avenues for understanding users' expectations from an e-planning system, the ways in which they use, understand and value the system, and the role of e-planning systems within the wider societal context, so that it can provide valuable information in the designing of effective user interface architectures. As a result, HCA is supposed to be a proper way to make a complex computer technology accessible to a wide range of users, who are bringing a diversity of knowledge, technical capabilities and cultural perspectives. In addition, finding an appropriate balance of theoretical rigour and practical applicability in HCA is also worth to be addressed, which will benefit future researchers in related field, as well as contribute to the reality of the Inclusive Knowledge Sociality in 2010.

The whole research will follow the 'activity line' as 'Investigate – Generate –Develop – Test – Evaluate'. After the literature investigation, a conceptual model will be generated based on HCA, which involves two ideas, i.e. 'User as Nucleus' and 'User as Refiners'. This model will provide a sound base for developing a prototype interface in a project called 'IntelCities'. During the process of IntelCities project, the prototype will be tested repeatedly and redeveloped. And finally, evaluation methods will be adopted to evaluate four aspects of the research, i.e. using Cognitive Dimension Framework (CDF) to evaluate HCA theory applied in urban area (theoretical evaluation), using HCI usability evaluation to evaluate the final prototype developed (prototype evaluation), using comparative methodology to evaluate whether or not HCA could increase the interactivity with e-planning systems (hypothesis evaluation) and using triangulation methodology to evaluate whether or not research methodologies adopted is correctly used (methodology evaluation).

Mark Elkins

Southampton Institute Faculty of Technology

Title: Can Marketing methods be of significant use for organizations in the identification of initial needs for software for internal use?

Supervisors: Professor Margaret Ross, Geoff Staples, and Ian Tromans

Technical problem to be solved: Marketing is concerned with the identification and satisfaction of customer needs. Therefore can the methods that it offers be of significant use for [large UK*] organizations in the identification of initial needs for software for internal use? Identification of initial need is the foundation on which all software projects are based and hence the importance this has on the quality of software produced. An extensive literature review has revealed that there appears to be no previous research on this specific problem.

Research hypothesis: Marketing methods are of significant use for [large UK*] organizations in the identification of initial needs for software for internal use?

Sketch of the proposed solution: This positivistic study intends to use survey questionnaires and interviews to gather quantitative and qualitative data from a sampling frame of [large UK*] organizations [, which have over 1000 employees*]. [The population sample being chosen by taking a quota of one, by computer programme generated random selection, from each county within the UK where such an organization exists.*] Sample size will be decided by considering what is achievable within a research project being undertaken by a PhD research student over 3 years within given resource and time constraints. Collected data and variables will be analysed using statistical methods in an attempt to disprove the hypothesis. There will be an ongoing search and review of secondary data to provide information on and keep up to date with external research within the problem boundaries.

Expected contributions of this research: To add knowledge that improves the quality of software used and produced through the better identification by [large UK*] organizations of initial needs for software for internal use.

Explanation of planned evaluation of results: Respondent validation, Negative case analysis, Reflexivity and Replication. Such methods to be used to attempt to check the Reliability, Validity, and Generalisability of the research.

* Provisional Research Boundaries

David Nutter

University Of Lincoln

Title: A Self-Organising Awareness System for Distributed Software Engineering

Supervisor: Cornelia Boldyreff

Software engineers and other collaborative disciplines rely on informal “out-of-band” communication for effective coordination of their activities, especially in agile methods. This type of communication is lost when development is distributed, with consequent deleterious effects on engineer effectiveness. In order to effectively support distributed software engineering, a replacement for this informal communication must be found. Much previous research focussed on either synchronous awareness such as radar views and shared editors, where participants were distributed in space not time, or asynchronous awareness such as change notification, which did not explicitly support concurrent activities. A unified approach is necessary to support software engineering. Furthermore, requiring co-location of engineering teams is not possible in today’s marketplace where development is often outsourced, consequently a definite requirement for awareness tools to replace informal communication exists. To implement an awareness tool capable of providing awareness of activities distributed both in time (asynchronous awareness) and space (synchronous awareness). The tool will not rely on a centralised reflector; instead information will be distributed over a peer-to-peer network arranged using a self-organisation algorithm. Consequently awareness information need not travel more than a few hops from its originating peer, reducing network load and increasing relevance of information received. Unlike reflector-based CSCW systems, the network will scale and will not have a single point of failure in the reflector. Furthermore, without the need to setup a reflector, there is the capability for ad-hoc awareness, using low-complexity peer discovery by local broadcast for example. The tool will be integrated with the Eclipse development environment. The files a user is currently editing will determine the data they are interested in and fuzzy similarity metrics will be used to compare the collections of each peer in the network in order to drive the self-organisation process. To evaluate the success of self-organisation, a simulation approach will be used before deploying the algorithms in the wild. To evaluate the effectiveness of the awareness provision, initial deployment and controlled experiments will be conducted within the Distributed Software Engineering group at the University of Lincoln and a later version of the tool will be trialled with existing Eclipse users.

Amit Thakur

Thames Valley University

Title: Perception of image by its sense in Content based image retrieval

Supervisors: Dr. Lynee Dunkley Dr. Amer Salman

This is one of the most important investigation areas in different aspect e.g. senses, computer vision technology, image database, image segment. This research is on developing intelligent system of retrieving and storage images with reference to their sense into database. The sense is by which system is able to distinguish between the different objects and find the one in which user actually interested. This can be achieved by getting the objects from the image and system is capable to recognise object and system creates their own virtual sense based on object. This process fulfills the user request. The research area used to combine colour, shape and spatial features of the image to index and measure the similarity of images by developing a computer vision technology (to be able to recognise and retrieve the objects from the images). As a technical contribution, need to use algorithm that could extract the shape and spatial relationship feature of images is proposed. Due to the difficulty of determining how far objects separate, we use qualitative spatial relations to analyse object similarities and hypomony is maintained in that. Also, the system is incorporated with a visual interface which allows the users to express the query and also give the options to user regarding its query .Those options can be in the form of sketch images, textures and image examples conveniently. Besides, the feedback learning mechanism enhances the precision of retrieval. Need to develop a schema in multimedia database in which user define datatypes are define so that classification is done on the basis of prototyping for storing or retrieving the image. Indexing technique is applied to retrieve or storing the image. We strongly believe that the system is able to retrieve image efficiently and maintaining the perception in content-based retrieval by the proposed approaches.

Marco Lormans

Delft University of Technology

Title: Structuring Requirements Evolution in Embedded Systems Development

Supervisor: Arie van Deursen

Current requirement engineering tools support the evolution of requirements insufficiently for embedded systems development practice. The multidisciplinary environment (ranging from mechatronics to human machine interfacing) and the ongoing evolution of these systems cause inconsistencies in the set of requirements, which in turn lead to error-prone, time consuming, and costly repairs. An explicit requirements management environment incorporating both structured and semi-structured data, supported by tools, and tailored towards the embedded systems domain, is needed to improve requirements evolution with respect to 1) the interaction with stakeholders, 2) the presentation of the requirements and 3) the processing of changes in the set of requirements. A Requirements Engineering System (RES) is a conceptual framework that provides a structured requirements management environment, which explicitly defines the process of evolution by identifying all three important aspects of requirements evolution. Our RES captures the needs of the embedded systems domain, characterized by its multidisciplinary nature, product families, and product evolution. It provides a metastructure (RE meta-model) incorporating both structured and unstructured requirements data which supports reuse of requirements for different product families as well as processing changes to the set of requirements consistently. Furthermore it provides flexible interaction between the various stakeholders involved in developing embedded systems making it easier to tailor it for a specific industrial situation. Finally, it provides a set of guidelines to set up a RES in practice using state-of-the-art RE technologies, improving the adoption of these technologies in practice [1].

The RES framework will be applied in a number of industrial and academic case studies. In each case study selected aspects of the framework are investigated, resulting in improvements for the meta-structure and prerequisites for successful tool application. In [2] we investigated the complete process of requirements evolution in an outsourcing context. Other case studies include the generation of forms and views from a semi-structured set of requirements and the recovery of traceability links from an unstructured set of requirements. The latter in the form of a structured view.

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Paul Adams

University of Lincoln

Title: A Collaboration Environment to Support Distributed eXtreme Programming

Supervisor: Professor Cornelia Boldyreff

The Problems Posed by eXtreme Programming: The combination of a lightweight process and important interactions in XP creates a strong implication for the requirement of collocated collaborators. This is not always practical, in particular the end-user may not be located near the software engineering team. Previous attempts to distribute XP have failed to adequately solve the problem in one of two ways. Some systems, such as MILOS [1] have failed because they are based as an ad. hoc. integration of existing tools rather than a system specifically designed for the purpose. Other systems, such as Joto and Rito-Silva's "adaptive workflow" [2] have failed because they do not support all the crucial features of XP, such as pair programming.

Hypothesis: The key principle of this research is that it is both desirable and possible to create a system to support the distribution of XP so that there is no degradation of productivity.

Proposed Solution: The proposed solution for this problem shall be based on development of support for the key interactions within distributed XP: daily meetings involving the customer, pair programming and continuous integration. The solution must also support the communication and awareness overheads created by distributing XP. The entire support environment for distributed XP shall be developed as a plug-in for the Eclipse IDE.

Evaluation: The goal of this research is to develop a system that allows the distribution of XP without a degradation of productivity. Within XP the best metric for productivity would be project "velocity" (the rate of conversion from desired features to delivered features). The two key areas of success for a system of this nature are communication and awareness, both of which are quantifiable and whose contribution to project velocity can be assessed.

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