Requirements Engineering Group at University of Technology, Sydney, Australia

(http://research.it.uts.edu.au/re/index.html)

RE@UTS is part of the Faculty of Information Technology at UTS and was established by A/Prof. Didar Zowghi in July 2001. The group currently consists of 8 academics, 1 researcher and 7 PhD students.

Current Research Projects:

1. GONDOLA: An interactive computer game-based teaching and learning environment for Requirements Engineering
   Funded by Faculty of Information Technology ITED grant
   Principal Investigator Didar Zowghi
   Research Collaborator Yusuf Pisan
   Research Assistant Chad Coulin

2. Supporting co-evolution of business processes and Web systems
   Funded by ARC Discovery Grant 2005-2007
   Principal Investigator David Lowe and Didar Zowghi
   Research Assistant: Norazlin Yusop

3. Field investigations of requirements engineering in geographically distributed software development organizations
   Funded by Faculty of Information Technology Post-doctoral fellowship
   Principal Investigator Didar Zowghi
   Research Collaborator Industry partners

4. Qualitative Systematic Approach to Requirements Analysis (QSARA)
   Funded by UTS Research Seed Grant
   Principal Investigator Ban Al-Ani

The High Integrity Systems Engineering (HISE) Group at The University of York, Canada

http://www.cs.york.ac.uk/research/hise.htm

- Work in requirements engineering for embedded systems aims to reduce the impact of requirements change in concurrent engineering. Formal techniques have been integrated into methods and toolsets used by engineers, linking this work to safety processes.
The core activities of requirements engineering are:

- The elicitation of the requirements
- The documentation of these requirements using adequate representation formats,
- The negotiation about the requirements with the relevant stakeholders.

Therein, a high quality of the resulting requirements must be achieved, e.g. with respect to the completeness and the consistency of the requirements. Requirements management is responsible, amongst others, for prioritising the requirements, ensuring the traceability of the requirements, and managing requirements changes.

The core competencies in requirements engineering are:

- goal- and scenario-based requirements engineering method COSMOD-RE
- early quality assurance for requirements.
- product line requirements engineering

The main research areas of our group are:

- Requirements engineering
- Software product line engineering
- Software quality assurance
- Service-based Systems Engineering
Current Projects in Requirements Engineering:

- **REMsES: Guideline for Model-based Requirements Engineering and Requirements Management of Software-intensive Embedded Systems**
- **SoftWiki: User-Oriented, Distributed Requirements Engineering for Evolutionary Development Processes**

Completed Projects in Requirements Engineering:

- **Goal and Scenario Oriented Requirements Engineering**
  (Merck)
- **Requirements Engineering for Product Families with Use Cases**
  (Siemens Medical Solutions, Health Services)
- **Approach for the documentation and management of requirements for embedded electronic control units (ECUs) among different vehicle lines**
  (DaimlerChrysler)
- **Assessment of Requirement Engineering Processes (AORE)**
  (DaimlerChrysler)
- **Requirements Engineering and Management: Method-based Tool Evaluation**
  (SIZ)
- **Cooperative Requirements Engineering with Scenarios (CREWS)**
  (Esprit-Project / RWTH Aachen)
- **Novel Approaches to Theories Underlying Requirements Engineering (NATURE)**
  (Esprit-Project / RWTH Aachen)
The Software Engineering Research Group (SERG) at Lund University in the southern part of Sweden
(http://serg.telecom.lth.se)

Research focus

- Use cases: Structuring concepts and application.
- Requirements’ relation to verification and validation: Methods for integrating requirements and test specifications.
- Market-driven requirements engineering: Analysis and improvement of the RE process.
- Decision support. Visualization support to requirements prioritization. Automation support for decision-makers within RE, based on natural language processing.

Objectives

The main objective is to provide methods and models for requirements engineering, which are suited for V&V as well, and to empirically evaluate the results.

The NISE Research Group
Department of Software and Information Systems
College of Computing and Informatics
University of North Carolina Charlotte
USA
(http://nise.uncc.edu/index.html)

- Ontology-based Requirements Engineering

The Requirements Engineering Specialist Group of the British Computer Society (RESG)

Department of Computing, Imperial College London

- Requirements engineering case studies and experiences
- Requirements engineering standards
- Requirements engineering methods and environments
- Formal representation schemes and specification languages
- Descriptions of the requirements engineering process
- Requirements validation
- Requirements elicitation
- Requirements traceability
- Requirements metrics
- Requirements reuse
- Requirements prototyping
- Animation and execution of requirements
- Multiple viewpoints on requirements
- Non-functional requirements
- Acquisition of requirements through reverse engineering and re-engineering
- Domain modeling and analysis for requirements engineering
- Artificial intelligence techniques for requirements engineering
- Relevance of cognitive science and HCI for requirements engineering
- Requirements for the human-computer interface of computer systems
- Communication in group and co-operative work in requirements engineering
- Organization modeling, including identification of stakeholders
- Political and cultural issues surrounding requirements engineering
- Philosophical and social underpinnings for requirements engineering

**IFIP Working Group 2.9**

**AIMS**

- The elicitation, specification, analysis and management of the requirements for large and complex software intensive systems;
- The interpretation and documentation of those requirements in such a way as to permit the developer to construct a system which will satisfy them.

**SCOPE**

The Scope of the WG includes all aspects of requirements engineering. Some examples of areas of special interest are:

- formal representation schemes and requirements modelling;
- descriptions of the requirements engineering process;
- tools and environments to support requirements engineering;
- requirements engineering methods;
- requirements analysis and validation;
- requirements elicitation, acquisition and formalization;
- reuse and adaptation of requirements;
- domain modelling and analysis;
- requirements engineering for distributed, safety-critical, composite, real-time and embedded systems.

**Software Systems Engineering Research Group at the Cavendish School of Computer Science in the University of Westminster, England**

(http://www.sse.wmin.ac.uk)

The Software Systems Engineering Research Group is part of the Cavendish School of Computer Science in the University of Westminster
ADAORA - In this project, we are developing a semiformal specification language and a prototype tool that overcomes the weaknesses of existing approaches, in particular those of UML.

Attemtto- In this project, we develop a requirements specification language which is based on the idea of using controlled natural language for specification.

Metamodelling - Here we explore new, better ways for defining the syntax and semantics of graphic specification languages.

Scenarios - We investigate the role of scenarios in Requirements engineering and develop new techniques for representing scenarios. We also deal with scenario integration.
UML - We have contributed to a better understanding of stereotypes and have investigated weaknesses of UML.

**Formal Methods Research Group, Department of Computer Science, University of Toronto**
(http://www.cs.utoronto.ca/fm)

**Formal Methods and Tools (FMT) Research Group**
Faculty of Electrical Engineering, Mathematics and Computer Science (EEMCS) at the University of Twente

**Specification and Verification Research Group**
Carnegie Mellon

We invent new mathematically-based techniques, languages, and tools to model the behavior of systems and to verify that these models satisfy desired properties.

**AOSD Research Interest Group of Universidade Nova de Lisboa, Portugal**
(http://aosd.di.fct.unl.pt/aosd-group)

Current research topics include:

- Aspect-oriented requirements engineering
- Aspect-oriented business modeling
- Aspect-oriented components
- Aspect-oriented testing
- Conflict management
- Analysis and design modeling
- Aspect-oriented programming
- Aspect-oriented frameworks

**NASA Independent Verification and Validation Facility**

**Vision**

The NASA IV&V Program is valued for its superior performance in independent validation and verification, its ability to provide high confidence safety and mission assurance of NASA software, its positive impact on the development of high quality software, and its expertise in software engineering.
Mission

The NASA IV&V Program provides assurance to our stakeholders and customers that NASA’s mission-critical software will operate dependably and safely.

Some Other Groups:
IIBA, INCOSE, Software Engineering Institute (USA), The Process Doctor, StickyMinds, Requirements Networking Group (RQNG), Sophist Group, Compuware, EasyWinWin, INCOSE (International Council on Systems Engineering), FIRE (Feature Integration in Requirements Engineering)

Related Researchers:

- Alan M. Davis, professor in the College of Business at the University of Colorado at Colorado Springs, USA

He is the author of following books:
- Software Requirements: Analysis and Specification (Prentice Hall 1990),
- Software Requirements: Objects, Functions and States (Prentice Hall, 1993)
- Just Enough Requirements Management (Dorset House, 2004).

Requirements Bibliography which provides a bibliography of over 5200 requirements-related papers and books

- Armin Eberlein, Associate Professor, Department of Electrical & Computer Engineering, The University of Calgary, Canada.

Topics for research projects:

- Requirements engineering and agile methods
- Development of tools for requirements engineering
- Requirements interaction management
- Application of artificial intelligence techniques to requirements engineering

His research has focused on the following areas:

- Process Support for Requirements Engineering
- Distributed requirements negotiations

Theses of former graduate students of his:

Mohammed Shehata (Ph.D.) Detecting Requirements Interactions using Semi-Formal Methods (July 2005)

- **Annabella Loconsole**, Professor of Software Engineering in the Software Engineering Research Group (SERG) within LUCAS at the Department of Computer Science (previously Telecom) at the Faculty of Engineering of Lund University, Lund, Sweden.

- **Aditya K. Ghose**, Professor at School of Computer Science and Software Engineering, University of Wollongong, Australia.

- **Ana Cavalcanti**, Professor in the Department of Computer Science, University of York.

- **Aybuke Aurum**, School of Computer Science and Engineering, The University of New South Wales, Sydney, Australia

- **Anthony Finkelstein**, Professor of Software Systems Engineering at University College London and Head of the Department of Computer Science. He established the Software Systems Engineering Group and has also been involved in the establishment of the UCL Centre for Systems Engineering and UCLGrid.

- **Axel van Lamsweerde**, Université Catholique de Louvain, Belgium

- **Alistair Sutcliffe**, University of Manchester, UK

- **Bashar Nuseibeh**, Professor of Computing, Director of Research, Computing Department, Faculty of Maths & Computing, The Open University, United Kingdom (U.K.):

**PhD Research Students:**

- **Francis Chantree** (October 2002 - )  
  o Working on analyzing natural language requirements
- **Robert Crook** (July 2001 - )  
  o Working on security requirements and policies
- **Charles Haley** (July 2002 - )  
  o Working on security requirements and trust assumptions
- **Luncheng Lin** (October 2001 - )  
  o Working on security requirements engineering using abuse frames
- **Derek Mannering** (October 2001 - )  
  o Analyzing formal safety critical system specifications
• **Karim Adam** (October 2004 - )  
  o Working on privacy requirements in ubiquitous computing

• **Armstrong Nhlabtasi** (October 2005 - )  
  o Working on requirements and feature interactions

• **Mohammed Salifu** (October 2005 - )  
  o Working on requirements for architectural stability

• **Ban Al-Ani**, Lecturer, [Faculty of Information Technology](#), University of Technology, Sydney

Projects:
- Qualitative Systematic Approach to Requirement Analysis (QSARA)
- Research Artifacts’ Validation (RAV) Framework
- A Framework for the Detection and Evaluation of Incompleteness in User Requirements Documents

• **Bjorn Regnell**, Professor of Software Engineering in the Software Engineering Research Group (SERG) within [LUCAS](#) at the [Department of Computer Science](#) (previously Telecom) at the [Faculty of Engineering](#) of [Lund University](#), Lund, Sweden.

• **Betty H.C. Cheng**, Professor in Computer Science and Engineering, [University of Illinois at Urbana-Champaign](#), Michigan State University, USA

• **Bala Ramesh**, Georgia State University, USA

• **Claes Wohlin**, Blekinge Institute of Technology, Sweden

• **Carson Woo**, University of British Columbia, Canada

• **Colette ROLLAND**, Professor of Computer Science in the department of Mathematics and Informatics at the University of PARIS-1 Panthéon Sorbonne

• **Connie Heitmeyer**, Naval Research Lab, USA

• **Daniela Damian**, Associate Professor in the [Department of Computer Science](#) at the [University of Victoria](#), BC, Canada
• **Didar Zowghi**, Professor of Software Engineering, Leader of the Requirements Engineering research (RE@UTS), Faculty of Engineering and Information Technology, University of Technology, Sydney (UTS)

**PhD Research Students:**

• **Steve Boyd** - Tentative Thesis Title: "A Constrained Natural Language and its supporting toolset for expressing requirements unambiguously", Part-Time, commenced March 2004, co-supervised with Dr. Vincenzo Gervasi from Pisa University, Italy.

• **Dewi Mairiza** – Area of Research: Managing conflicts in Non-functional requirements, Full-Time, Commenced February 2008.

**Alumni:**

**Post-Doctoral**

**Daniela Damian** - Research Project: "A study of automated support for distributed software requirements negotiations", July 2001 to July 2002, Now Associate Professor in University of Victoria, Canada.

**PhD Principal Supervisor**


**Chad Coulin** - Thesis Title: "A Situational Approach and Intelligent Tool for Collaborative Requirements Elicitation", graduated in September 2007. Now ICT manager at BDO Kendalls in Brisbane, Australia, This award was obtained under a cotutelle agreement with l-Universite Paul Sabatier - Toulouse III (France) as a partner institution.

**PhD co-supervisor**

**Frank Moisiadis** - Thesis Title: "A Framework for prioritizing software requirements", Co-supervised with Professor Ray Offen, Graduated in September 2004 at Macquarie University, Now lecturer at Macquarie University, Sydney.

• **Dines Bjørner**, Department of Computer Science and Engineering, Institute of Informatics and Mathematical Modelling, Danmarks Tekniske Universitet.
• **David Bustard**, Professor of Computing Science, Head of School of Computing and Information Engineering, Faculty of Computing and Engineering, University of Ulster at Coleraine, Northern Ireland

• **Daniel M. Berry**, professor at the Computer Science Department, University of Waterloo

• **Eric Dubois**, Department of Computer Science, University of Namur, Belgium

• **Eric Yu**, Associate Professor, Faculty of Information, University of Toronto, Canada.

  • Agent-Oriented Requirements Engineering
  • Non-Functional Requirements

**Research Projects**

• The User Requirements Notation (URN) received final approval as an international standard today in Geneva, Switzerland, as ITU-T Recommendation Z.151.
  
  URN consists of the Goal-oriented Requirements Language (GRL), based on Professor Eric Yu's *i* modelling framework, and Use Case Maps (UCM), a scenario modeling notation.
  
  GRL provides a notation for modeling goals and rationales, and strategic relationships among social actors. It is used to explore and identify system requirements, including especially non-functional requirements

• **Agent-Oriented Requirements Engineering**
  NSERC Discovery Grant (2004-2009)

• **Developing Non-Functional Requirements for Service-Oriented Software Platforms**
  Siemens Corporate Research Research Grant (2008-2009)
  Industry partners: Siemens Corporate Research, USA

• **Strategic Requirements Analysis for Internet Services**
  NSERC Collaborative Research & Development Grant (2005-2008)

• **Strategic Requirements Analysis for Kids Help Phone**
  Bell University Labs Research Grant (2003-2005)
  Industry partners: Kids Help Phone, Bell Canada

• **Emmanuel Letier**, University College London, UK

• **Ian Sommerville**, Lancaster University, Lancaster, UK
- **Ivar Jacobson**, Creator of ‘Use cases’ and co-founder of the Object oriented design movement, UML and the Rationale Unified Process.

- **Jane Cleland-Huang**, an Assistant Professor at DePaul University's School of Computer Science, Telecommunications, and Information Systems.

- **Jim Woodcock**, Professor of Software Engineering, Department of Computer Science, University of York, United Kingdom.

- **Jim Davies**, Professor of Software Engineering; Director of the Software Engineering Programme, Governing Body Fellow of Kellogg College, External Roles.

- **Jeannette M. Wing**, President's Professor of Computer Science, Computer Science Department, Carnegie Mellon University.

- **John Mylopoulos**, Professor in the Department of Computer Science, University of Toronto.

- **Jo(anne) M. Atlee**, Associate Professor, School of Computer Science University of Waterloo, 200 University Ave. West, Waterloo, CANADA

- **James D. Herbsleb**, Professor of Computer Science and Director of the Software Industry Center at Carnegie Mellon University.

- **João Araújo**, Assistant Professor, Department of Informatics, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (FCT/UNL), Portugal.

- **Klaus Pohl**, Full Professor of Software Engineering, Institute for Computer Science and Business Information Systems (ICB), Faculty of Business Administration and Economics, University of Duisburg-Essen, Campus Essen, Germany.

- **Kim Guldstrand Larsen**, Professor in the Department of Computer Science at Aalborg University within the Distributed and Embedded Systems Unit.

- **Keng L. Siau**, Professor of Management Information Systems (MIS) and Full Professor of Management at the College of Business Administration, University of Nebraska-Lincoln.

- **Kecheng Liu**, University of Reading, UK

- **Kevin Ryan**, University of Limerick, Ireland
- **Lawrence Chi-Chung CHEUNG**, Professor in Department of Electronic and Information Engineering Hong Kong Polytechnic University

- **Ljerka Beus-Dukic**, Senior Lecturer in the Department of Software Engineering, Cavendish School of Computer Science, University of Westminster, London.

- **Leszek Maciaszek**, Macquarie University, Australia

- **Michael Jackson**, Visiting Research Professor at Department of Computing, The Open University, Visiting Professor at School of Computing Science, University of Newcastle.

- **Martin Feather**, Information Sciences Institute, USA

- **Martin Glinz**, Full professor, Department Head, Department of Informatics Head of the Requirements Engineering Research Group, Department of Informatics University of Zurich

- **Mats P E Heimdahl**, Professor of Computer Science and Engineering, University of Minnesota, USA

- **Marina Jirotka**, Oxford University, UK

- **Manfred Jeusfeld**, Tilburg University, Netherlands

- **Mikio Aoyama**, professor at the Department of Information and Telecommunication Engineering, Nanzan University, Japan

- **Marsha Chechik**, Professor in the Faculty of Arts and Science at the Department of Computer Science, University of Toronto, Canada.

  - Her main research interests are in the use of formal methods to improve quality of software. These include: scalable automated verification techniques, model-checking and theorem-proving; easy to read and review formal specification languages;

- **Marina Jirotka**, Director of the Centre for Requirements and Foundations at Oxford University Computing Laboratory
- **Nancy Mead**, Professor of software engineering at [Software Engineering Institute, Carnegie Mellon University](https://www.sei.cmu.edu), USA,
  - Principal Investigator of **SQUARE**: Requirements Engineering for Improved System Security, The Security Quality Requirements Engineering (SQUARE) methodology consists of nine steps that generate a final deliverable of categorized and prioritized security requirements

- **Neil Maiden**, City University, UK

- **Naveen Prakash**, Delhi Institute of Technology, India

- **Oscar Pastor**, Valencia University of Technology DISC-UPV, Spain

- **Robyn Lutz**, Iowa State University and JPL, USA

- **Roel J Wieringa**, University of Twente, The Netherlands

- **Seok-Won Lee**, Assistant Professor at [Knowledge-Intensive Software Engineering (NiSE) Research Group, Dept. of Software and Information Systems, College of Computing and Informatics, The University of North Carolina at Charlotte](https://www.cs.unc.edu/)

- **Steve Easterbrook**, Professor in the [Department of Computer Science](https://www.cs.toronto.edu/), University of Toronto, Canada.
  - Studying how NASA verifies the software for the Space Shuttle, Space Station, and various planetary probes at the [NASA Independent Verification and Validation Facility](https://www.nasa.gov/) in Fairmont

- **Steve Fickas**, Computer Science Dept., Deschutes Hall, University of Oregon

- **Sebastian Uchitel**, Imperial College London, UK and University of Buenos Aires, Argentina

- **William Heaven**, Research Associate, [Distributed Software Engineering Department of Computing, Imperial College London](https://www.ic.ac.uk/)

- **Yeni Li Helgesson**, PostDoc of [Software Engineering Research Group](https://www.ic.ac.uk/) at the [Department of Computer Science](https://www.cs.unc.edu/) of [Lund University](https://www.lu.se/), Lund, Sweden.
Completed a PhD in 2007 with Alessandra Russo and Michael Huth entitled "Object-Oriented Specification: Analysable Patterns and Change Management".

Yair Wand, University of British Columbia, Canada

Related Conferences

- 18th IEEE International Requirements Engineering Conference (RE’10), 27 September – 1 October 2010, Sydney, Australia.
- 17th IEEE International Requirements Engineering Conference (RE’09), 31 August – 4 September 2009, Atlanta, Georgia, USA
  - Scope:
    - Requirements elicitation, analysis, documentation, validation and verification
    - Requirements specification languages, methods, processes and tools
    - Requirements management, traceability, viewpoints, prioritization and negotiation
    - Modeling of requirements (formal and informal), goals and domains
    - Prototyping, simulation and animation
    - Evolution of requirements over time, product families and variability
    - Relating requirements to business goals, products, architecture and testing
    - Social, cultural, global, personal and cognitive factors in requirements engineering
    - Collaborative requirements engineering
    - Domain-specific problems, experiences and solutions

- The Third IEEE International Workshop on Requirements Engineering For Services (REFS’09), Seattle, Washington, July 20 - July 24, 2009
  - Scope:
    - Service requirements models and descriptions
    - Service requirements identification, elicitation, and acquisition
    - Service requirements communication, negotiation, and validation
    - Service requirements analysis and design methods
    - Service engineering and management processes
    - Knowledge engineering and management for Services
    - Service anthologies, metrics, and benchmarks
    - Service design, management and manufacturing
    ...

- International Working Conference on Requirements Engineering: Foundation for Software Quality (RefsQ’08), Montpellier, France, 16-17, June, 2008.

  - Requirements engineering: capture, consistency, and change management of software requirements

  - Requirement analysis and specification
  - Software specification, verification and validation
• Formal methods for testing, re-engineering and reuse

• 8th Australian Workshop on Requirements Engineering (AWRE’2003), held 4-5 December 2003, University of Technology, Sydney, Australia.
  * Requirements elicitation techniques
  * Requirements validation techniques
  * Requirements management and traceability
  * Requirements evolution
  * Requirements and software architecture
  * Requirements and business architecture
  * Requirements prioritizing and negotiation
  * Specification of quality attributes
  * Requirements metrics
  * Tool support for RE
  * RE case studies and experience reports
  * Cognitive, social and cultural factors in RE
  * RE education

• International Conference on Fundamentals of Software Engineering (FSEN), Iran

• Proceedings of the International Conference on Software Engineering (ICSE), IEEE/ACM Press

• Proceedings of the International Requirements Engineering Conference/Symposium (RE), IEEE Computer Society Press

• Upcoming Software Engineering Conference Map

• Software Engineering Conferences, Statistics and Rankings

• more

Related Journals:

• Requirements Engineering Journal, Springer, Quarterly, ISI, ISSN: 0947-3602.


• IEEE Transactions on Software Engineering, ISI.

• ACM Computing Surveys, an ACM Journal, Publishes surveys, tutorials, and special reports on all areas of computing research. Volumes are published yearly in four issues appearing in March, June, September, and December.

• ACM Transactions on Software Engineering and Methodology (TOSEM)

• ACM SIGSOFT Software Engineering Notes
- IBM Journals
- IEEE Transactions on Software Engineering
- Information and Software Technology (Elsevier Inc.)
- International Journal of Software Engineering and Knowledge Engineering (IJSEKE)
- Journal of Systems and Software (Elsevier Inc.)
- Software Process: Improvement and Practice
- more

Books:

The Requirements Engineering Handbook Ralph R. Young Artech House 2004
ISBN:1580532667 me


Introduction to Requirements Engineering Ian Bray Addison-Wesley 2003
ISBN:201767929


Writing Better Requirements Ian Alexander Richard Stevens Addison-Wesley 2002
ISBN:0-321-13163-0

User-Centred Requirements Engineering Theory and Practice Alistair Sutcliffe Springer 2002
ISBN:1852335173

Requirements By Collaboration Ellen Gottesdiener Addison-Wesley 2002
ISBN:0-201-78606-0

Requirements Engineering Elizabeth Hull Ken Jackson Jeremy Dick Springer Verlag 2002

Software Requirements - styles and techniques Søren Lauesen Addison-Wesley 2002
ISBN:0-201-74570-4


Writing Effective Use Cases Alistair Cockburn Addison-Wesley 2001
ISBN:0-201-70225-8

Effective Requirements Practices Ralph R. Young Addison-Wesley 2001
ISBN:0-201-70912-0

Customer-Centered Products: Creating successful products through smart Requirements Management Ivy F Hooks Kristin A Farry Amacom 2001
ISBN:0-814-40568-1

Use Cases: Requirements In Context Daryl Kulak Eamonn Guiney Addison-Wesley 2000
ISBN:0-201-65767-8

Managing Software Requirements - a unified approach Dean Leffingwell Don Widrig Object


**Mastering the Requirements Process** Suzanne Robertson James Robertson Addison-Wesley 1999 ISBN: 0-201-36046-2


**Software Requirements & Specifications, a lexicon of practice, principles and prejudices** Michael Jackson Addison-Wesley 1995, ISBN: 0-201-87712-0


A Survey of Techniques, Approaches, and Tools, Zowghi D., Coulin C., Chapter in the book Engineering and Managing Software


- Goal Identification and Refinement in Specification of Software-Based Information Systems (Antón)
- Process Support for Requirements Elaboration (Darimont)
- The Albert II Language - Formal Specification Language for Requirements Analysis (Du Bois)
- Automated Support for Requirements Transformation in Software Engineering (Durney)
- Requirements Acquisition and Specification for Telecommunication Services (Eberlein)
- Requirements-Based Performance Evaluation for Design Exploration (Frezza)
- General Principles of Requirements Engineering Across Disciplines (Gaska)
- Contribution Structures for Requirements Traceability (Gotel)
- Requirements Engineering with Interrelated Conceptual Models and Real World Scenes (Haumer)
- The Competence of Users in Formulating their Requirements in Information Systems Development (Hökenhammar)
- Analogical Processes for Requirements Acquisition (Massonet)
- An Enterprise Requirements Traceability Approach for Supporting Change Management (Mokitimi)
- Dealing With Performance Requirements During Information System Development (Nixon)
- Expressing Inter-Perspective Relationships: A Logical Approach (Perrussel)
- Deriving Real-time Monitors from System Requirements Documentation (Peters)
- Formal Justification in Requirements Engineering (Smith)
- Software-Based Information Systems That Support the Structural, Social, Political and Symbolic Dimensions of a Work (Ramos)
- Prototyping to Requirements (Ravid)
- Factors in Conceptual Requirements Modeling Influencing the Maintainability of Information Systems (Verelst)
- Requirements Envisaging By Utilizing Scenarios (REBUS) (Zorman)
- A Logic-Based Framework for the Management of Changing Software Requirements (Zowghi)

Courses


Oxford University, United Kingdom Oxford University Computing Lab & Department of Continuing Professional Development Requirements Engineering course option for MSc

University of Calgary, Canada Department of Computer Science in the Faculty of Science Graduate Course in Requirements Engineering, [http://www.cpsc.ucalgary.ca/](http://www.cpsc.ucalgary.ca/)

University of Toronto, Canada Department of Computer Science Graduate Course in RE, [http://www.cs.toronto.edu/DCS/](http://www.cs.toronto.edu/DCS/)

University of York Department of Computer Science Graduate course in RE (MSc coursework), [http://www.cs.york.ac.uk/](http://www.cs.york.ac.uk/)

Alistair Cockburn Use Cases, [http://alistair.cockburn.us/](http://alistair.cockburn.us/)

Ian Alexander Independent Consultant, [http://easyweb.easynet.co.uk/iany/](http://easyweb.easynet.co.uk/iany/)


TriReme - software development process expertise Offers a 3 day course in requirements engineering,
James & Suzanne Robertson of the Atlantic Systems Guild Volere Requirements Education programme, http://www.volere.co.uk

Some of RE Centers

Aachen University of Technology, Germany, Department of Computer Science - several projects in RE, http://www-i5.informatik.rwth-aachen.de/lehrstuhl/index.html

Catholic University of Louvain, Belgium, Department of Computing Science and Engineering Follow link to Research Areas -> SE -> RE http://www.info.ucl.ac.be/

Lancaster University, Computing Department Cooperative Systems Engineering Group, http://www.comp.lancs.ac.uk/computing/research/cseg/

The Open University, United Kingdom, Computing Department http://computing.open.ac.uk/home/

Oxford University, United Kingdom, Computing Lab The Centre for Requirements and Foundations (CRF), http://web.comlab.ox.ac.uk/oucl

Umeå University, Sweden, Department of Computing Science Software Engineering Group, http://www.cs.umu.se/research/software/


Tools:

GRL - Goal-oriented Requirement Language, University of Toronto, CANADA

(OME) Organization Modeling Environment
OME is a general, goal-oriented and/or agent-oriented modeling and analysis tool. It provides users with a graphical interface to develop models, and supports access to a powerful knowledge base that allows for sophisticated computer-aided analysis. This tool is intended to provide software developers with a clear link between the requirements, specification and architectural design phases of development.

Accept 360° from Accept Software Corporation
Is a requirements management tool that also supports product planning. Tools help users to define and track feature dependencies with tree diagrams, and to relate these to the market, project plans, implementation considerations and competitor analyses.
**Accompa from Accompa**  
Is a requirements management service provided on the Web for a small monthly fee per user. It can be customized with any number of fields and reports using sorts and filters.

**Agility from Agile Edge**  
Is a tracking database for user requirements, issues, tasks and bug tracking, permitting tracing between these items.

**Aligned Elements from Aligned AG**  
Is a tool for handling requirements traceability and risk in the medical device industry. It includes a Requirements Management module. Its purpose is to handle all the evidence needed in the strict regulatory environment of medical devices.

**AnalystPro**  
Is a versatile, yet robust, enterprise requirements and lifecycle management application.

**ARM (Automated Requirement Measurement) from NASA**  
Is a simple tool that carries out a set of checks on a list of (shall-statement) requirements in plain text. As such it can be applied to almost any set of contractual style requirements just by exporting them to a plain text file and then running ARM. It helps to find a range of possible problems. Once you get the idea, it is easy to re-implement a set of ARM-like rules with your own extras in a scripting language.

**Blueprint from Blueprint Inc.**  
This tool (formerly Profesy) won the 2005 Gartner Cool Vendor prize for being “innovative, impactful, and intriguing”. It was sold as a 'Visual Requirements Definition and Validation product' and is said to integrate intelligently with a range of 3rd-party tools. It assists with the creation of requirements, flowcharts, test scenarios and documentation.

**CaliberRM from Borland**  
Is a well-known requirements management tool. It is intended for large and complex systems, and provides a database of requirements with traceability. The company views requirements as part of the software quality management process, which it considers also includes testing and defect tracking. Caliber is Internet-based, and it handles document references, user responsibility, traceability, status and priority.

**CaseComplete from Serlio Software**  
Is a requirements management tool centered on Use Cases. It allows users to quickly create use cases then add diagrams, requirements, screen prototypes, and test cases to create a complete set of requirements. It can generate reports in Word, Excel, or HTML formats. The tool can generate activity diagrams (flowcharts) from sequences of steps and extensions (exceptions).

**CASE Spec (formerly AnalystPro) from Goda Software**
Supports requirements editing and traceability, change control, diagrams including use cases, and other features of full RM tools at a low price per seat. CASE Spec is described as a "Specification, Requirements & Lifecycle Solution".

**Contour from Jama Software**
Contour "connects the entire project team to requirements regardless [of] location using an intuitive Web 2.0 interface. Contour enables the team to see impact before making changes, who’s working on related items and how current tasks relate to project deliverables. Contour runs on all major platforms and is built on open standards for seamless integration."

**Cradle from 3SL**
Cradle is a multi-user, multi-project, distributed and web-enabled requirements management and systems engineering environment. It is intended for all sizes of requirements and systems development projects. It offers configuration management, edit histories and version control. It automates document production and can manage the generated documents. Through its web interface, it can integrate disparate stakeholder groups by creating customizable read-write portals to all project data.

**DESIRe from HOOD Group**
Is an "expert system" tool for checking requirements.

**DOORS from IBM (formerly Telelogic)**
DOORS is a tool primarily for large organizations which need to control complex sets of user and system requirements with full traceability. It provides good visualization of such documents as hierarchies, and its extension language enables a wide range of supporting tools to be built, and many are provided as menu commands and examples. Further options include DoorsNet which allows controlled interaction over the Internet, and the Change Proposal System which automates the requirement review cycle. There are live interfaces to many CASE tools, and the promise of tight integration with the Tau toolkit for specification, design, and testing based on UML and the SDT approach to real-time systems development centered on telecommunications. DOORS use is therefore moving towards integrated project support. The web-based Focal Point is also in the IBM stable.

**DOORS & DXL Training Courses**

**FeaturePlan from Ryma Technology Solutions**
FeaturePlan is a "requirements gathering, analysis and definition" tool (what used to be called Requirements Elicitation or Capture, and which is now more trendily named Discovery or Creation) intended for Product Managers. Since these early tasks are barely covered by most Requirements Management tools (which focus on supporting traceability, documentation, and configuration management), FeaturePlan's claim that it works alongside the likes of Caliber RM, RequisitePro and DOORS is very plausible. It provides a simple table for basic market requirements, and supports this with traceability (ah well, perhaps it's really an RM tool too) and numerous predefined reports. The idea of giving 'customers' direct access to FeaturePlan's web forms is engaging, however.
**Focal Point** from IBM
is a market-driven requirements management tool. It incorporates customer collaboration, prioritization, visualization, decision-making and planning processes inside a tailor able web-based platform. It links requirements to market segmentation, competitor analysis, release planning and other processes in product life cycle management.

**GatherSpace** from GatherSpace.com
Is a requirements management and use case development tool that offers multi-user and team functionality. The system is an online solution with different user-tiered packages. There are a variety of reports from basic functionality reports to use case models. A free 30-day trial is available.

**GMARC (The Generic Model Approach to Requirements Capture)**
GMARC is one of the first - if not actually the first - Requirements Engineering methodologies ever developed. Its formalisation was originally sponsored by the UK's Department of Trade & Industry in 1990 together with the participation of the Civil Aviation Authority, the Ministry of Defence, the City University and Kings College of London University. GMARC is unique in its approach and it is uniquely effective in terms of its ability to reduce project/programme risk

**iRise** from iRise.com
Is a tool for previewing or prototyping a software application before doing any coding. In the process, the requirements are "completely and unambiguously fleshed out - including application and page flows, user interfaces, business logic, data structures and other requirements."

**IRQA** from Visure
IRQA is a tool specifically designed to support the complete RE process. In IRQA the complete specification cycle including requirements capture, analysis, system specification, validation and requirement organisation is supported via standard models.

**Leap SE** from Leap Systems
Leap SE is a requirements engineering CASE tool that produces object-oriented models directly from a system requirements repository or specification (SRS). A 30-day trial version is available.

**LEXIOR** from Cortim
Is a service for reviewing requirements, involving both automated checks and "native English speaking reviewers". Turnaround is promised within 48 hours. Output is in the form of review reports including European Space Agency-style "Review Item Discrepancies" (RID forms). Services are provided to (for example) the automotive and aerospace sectors.

**Lighthouse** from Artifact Software
Is a requirements management (database) tool available both as a hosted web-based service and as software to run on your own premises. Requirements can be imported from
Word and exported to Word, HTML and Excel. The usual facilities like traceability, history, comments, filtering and release management are provided.

**MKS Integrity for Requirements Management** from MKS
MKS Integrity for Requirements Management is a 'right-weight' RM tool. It is built as an integral part of a wider project support system, which uses workflow to take requirements through to design, step by step "within a highly flexible authoring and approval environment". It integrates with Microsoft Word, organizes requirements hierarchically with rich text and "an intuitive document centric view", provides history, base lining, metrics, traceability to source code, suspect links, etc. Low cost of ownership is claimed.

**MockupScreens** from Igor Jese
MockupScreens is a rapid User Interface prototyping tool. You create screen mockups and organize them into scenarios, complete with buttons, fields, lists etc. Free evaluation copy from website.

**Objectiver** from Cediti
Cediti is a spin-off from the University of Louvain, Belgium (UCL), and the tool is based on the KAOS method of analyzing goals devised by Prof. Axel van Lamsweerde. The tool thus has a solid foundation (capable of formal proof) for modeling goals, requirements, agents, entities, events relationships, actions, etc, with all the relationships between them (cause-effect, conflict, instance-of, goal refinement, etc), supported by editable diagrams.

**OptimalTrace** from Compuware
OptimalTrace takes a structured view of requirements, breaking them into Functional (in the form of a Use Case-like storyboard structure of main flow, alternative flows etc.) and non-functional requirements (qualities and constraints). These map seamlessly to functional test cases, UML activity diagrams, requirements based milestones in project plans etc. Ease of use is emphasized.

**Polarion Requirements** from Polarion Software
Polarion is (like Pace and others) a web-based requirements management solution. It promises better requirements elicitation and collaboration, lowest cost of ownership in the market, and to be as easy as MS Office with the power of Web 2.0 technology.

**Pixref** from Pi Shurlok
Pixref is a "lightweight but powerful tool for automating project specific traceability".

**Process Impact - Process goodies**

Sample requirements documents, including a vision and scope document, use cases, software requirements specification (SRS), business rules, data dictionary, and some analysis models for a small information system (ZIP file)

Current Requirements Practice Self-Assessment and an Excel spreadsheet to analyze the data (courtesy of Tom Mego, Keithley Instruments)

Software Requirements Specification Template
**Vision and Scope Document Template**
**Use Case Template**
**Change Control Process**
**Template for Change Control Board Charter**
**Requirements Change Impact Analysis Checklist and Worksheet**
**Requirements Prioritization Spreadsheet**
**Requirements Analyst Job Description**
**QuARS from the SEI**
The Quality Analyzer for Requirements Specifications is a tool for checking requirements in natural language, produced by the SEI.

**Rally from Rally Software Development**
Rally (formerly Projecticity) is a requirements management tool integrated with a set of web-based tools to manage the entire project lifecycle. The toolkit contains specialized tools with dedicated on-screen forms to manage change requests, issues, defects, test plans/results, tasks, schedules, risks, documents and more. Rally formerly made software specifically for Agile software development.

**RaQuest from SparxSystems Japan**
This is an add-on tool for managing a list or tree of requirements with SparxSystems' UML modeling tool Enterprise Architect. It has been developed and marketed by SparxSystems' sister organisation in Japan.

**Raven from Ravenflow**
The "Requirements Authoring and Validation ENvironment" (RAVEN) is apparently the first commercial tool meant specifically to help find errors in requirements text. It works by translating use case text into UML activity (ie flowchart) and responsibility diagrams, where with luck any errors will be spotted by "requirements writers" or "business leaders". A requirements export integration to RequisitePro is provided.

**ReMa (Requirements Manager) from Accord**
Is a fully-featured Requirements Management tool. Its features are clearly derived from the capabilities of DOORS, (with structures such as modules, attributes, requirements, links and so on) but the implementation is entirely new, with an easily-navigable hierarchy that can be expanded and collapsed as in a code editor.

**RequirementsAssistant from Sunny Hills Consultancy BV**
Is a tool for checking and reviewing requirements.

**Requirements Management Database from Requirements Management, LLC**
Wins the prize for the RM tool with the longest name. It seems remarkable that such a generic name could have been trademarked - we will now all have to talk carefully about "RM database tools".
The tool offers a pre-configured solution for the common requirements elements including priority, description, history, stakeholders and so on. Use Cases and Test Cases
are similarly also built in. Not surprisingly for an RMDB, filtering and reporting are simple and intuitive.
A "no questions asked" download and free 14-day evaluation is offered.

**Requirement Tracing System (RTS)**
The RTS toolset comprises of 4 sub-modules that may be purchased separately and added-on to the core system at a latter time. These modules are as follows:
- Requirement creation and specification, known as the Functional Specification,
- Requirements fulfillment, covering the design and coding of the individual requirements, known as the Program Design Specification, and the system acceptance testing of the same, known as the Test Specification, and
- The requirement-tracing database providing the analysis of the requirements defined for a system.

**Requisite Pro from IBM**
Requisite Pro aims especially at managing change in requirements, with traceability for software and test specifications. It is closely linked to Microsoft Word, and Rational is a Microsoft Development Partner. The tool permits the use of Oracle on Unix or Windows as the back-end database, and also supports SQL server on Windows.

**RESDES from Jenz und Partner**
The REpository-driven Specification DEvelopment Suite is a collection of software applications and services that make use of a shared requirements repository. There is support for the evaluation process; there is a browser to view requirements packages; there are web services supporting access to the repository. The overall idea is for projects to reuse requirements in areas of software functionality and quality that are useful on many different software development projects. This tool is thus quite different in scope and purpose from typical requirements management tools such as DOORS, and "does not overlap" with their functionality.

**Rhapsody from IBM**
Rhapsody is an Object-Oriented Analysis and Design tool for embedded software. The emphasis is on design, with analysts using UML to define objects for fully automatic code generation. There is a range of integrations between Doors, Rhapsody, and other products, helping to bridge the gap between textual requirements and model-based design and testing.

**RQA (Requirements Quality Analyzer) from The REUSE Company**
Is a checking tool that carries out lexical and syntactic analysis of requirements, providing warnings of errors.

**ScenarioPlus**
ScenarioPlus offers a suite of Microsoft Office templates for requirements work, including the Onion Model for Stakeholders, a hierarchy of Qualities and Constraints ("non-functional requirements"), and a range of Use Case styles for different kinds of project.
**SAT from CassBeth**
The Specification Analysis Tool analyses and checks requirements automatically but "allows humans to make final decisions at each level". It looks for "complex specification problems such as missing capabilities" and gathers metrics. SAT is one of a range of natural language analyzers from CassBeth including tools to check Legislation, Medical Transcripts, Plain Language (for government use) and Contracts.

**Smartcheck from Smartware Technologies**
Is a tool for checking requirements. It "locates ambiguities within requirement or technical specifications based upon a word, word category, or complexity level."

**Specification Tool**
Is the integrated tool for managing requirements. One of the most powerful features of Projectricity is its ability to manage your requirements, use-cases, constraints, business processes and just about any other type of specification you might need to capture and manage on your projects.

**Statestep from StateStep**
Is a free specification tool based on a state model. The user interface allows required behaviour to be defined in decision tables. The tool helps to check systematically that all unusual cases are considered. The resulting model is a finite state machine, which can be checked automatically for completeness and consistency, e.g. that no undesirable state is reachable. The tool has been used commercially to specify consumer electronic systems.

**Teamcenter from Siemens**
includes a requirements tool (formerly Slate): "Industrial Strength Groupware for managing requirements, architecting systems, and accelerating product development". Tools cover design and testing as well as requirements. The examples on the website include radar and aircraft carrier, so there is a perceptible military-industrial orientation. The tool provides for conventional box-and-arrow diagrams, but also allows document and object hierarchies, and arbitrary traceability linking.

**TopTeam Analyst from Technosolutions**
is a commercial multi-user requirements management tool. It supports use cases, traceability, screen prototypes, documents, issue tracking, and change proposals.

**The Volere Template from The Atlantic Systems Guild**
The Volere Template is a comprehensive list of all the components that the Robertsons recommend should go into a requirements specification. It is closely associated with the Volere method described in their book, but contains many useful suggestions that could enhance any requirements method. The template can be used with any general RE tool or simply with word-processed documents.
Other Resources about Tools:

Ludwig Consulting Services, LLC

Volere Requirements Resources
http://www.volere.co.uk/tools.htm

Related Projects:

**i**∗, At University of Toronto, Canada: The *i* framework proposes an agent-oriented approach to requirements engineering centering on the intentional characteristics of the agent. The *i* framework is the basis and starting point for the **Tropos** project towards methodologies for agent-based systems.

**Tropos**: At the Technical University of Aachen (RWTH), proposes a software development methodology founded on concepts used to model early requirements. In particular, the proposal adopts Eric Yu's *i* modeling framework, which offers the notions of actor, goal and (actor) dependency, and uses these as a foundation to model early and late requirements, architectural and detailed design. The methodology complements proposals for agent-oriented programming platforms.

Several research groups are involved in this work.

- **Tropos at the University of Toronto, Canada**
- **Tropos at the University of Trento, Italy**
- **Tropos at the Technical University of Aachen (RWTH), Germany**
- **Tropos at the Federal University of Pernambuco (UPFE), Brazil**

**GREWS** (Cooperative Requirements engineering With Scenarios):

To develop, evaluate, and demonstrate the applicability of, methods and tools for cooperative scenario-based requirements elicitation and validation.

**The FARE Project: Formal Aspects of Requirements Engineering**, Department of Business Systems, University of Wollongong

Requirements engineering is a crucial first step in the software development process, given that the quality of the software artifacts developed is directly related to the quality of the initial descriptions on which this development is based. Requirements engineering faces three major challenges. First, effective tools and languages need to be developed through which requirements can be elicited, articulated and represented. Second, automated support needs to be provided for ensuring compliance with certain normative criteria, such as completeness, traceability, verifiability and reusability. Finally, several
aspects of the requirements engineering process need specialized support, including requirements evolution and viewpoints and inconsistency management. Existing frameworks for requirements engineering are severely deficient in the face of these challenges. Requirements engineering processes, as well some of the normative criteria mentioned above, are typically poorly understood and lack sound formal definitions. Requirements modelling languages tend to be overloaded with linguistic constructs, conceptually cluttered and lack formal semantics. This project seeks to address these deficiencies by developing a formal framework that includes a parsimonious conceptual modelling language at the front-end and an underlying formal knowledge representation language based on which the normative requirements criteria and processes such as evolution and management of inconsistency and multiple viewpoints could be formally defined. This would thus serve as the basis for a requirements engineering toolkit that would provide comprehensive automated support and enjoy the benefits of clear semantics, formal verifiability and their concomitant impact on software quality.

**Feature Integration in Requirements Engineering (FIRE)**

**University of Birmingham School of Computer Science Project**

**Objectives**

FIREworks will develop feature-oriented specification methods, in which features are treated as `first-class citizens' and which will address the potential conflicts between features.

**Deliverables**

The aim of FIREworks is to provide a method with which companies can build products by taking an existing product and adding, removing, or respecifying some features. Such a method will consist of feature-oriented specification languages and suitable validation tools.

**Other Resources:**

- **Ian Alexander** Independent Consultant - resources for RE  
  [http://easyweb.easynet.co.uk/iany/](http://easyweb.easynet.co.uk/iany/)

- **RE-Online - Mailing List Archive - 2001 - Mar 2005**  

- **RE-Online - Mailing List Archive - 1997-2000**  

- **Strategic Business Decisions, Inc. (SBDi) RE archives**  

- **IBM - Rational software**
Online resources:

ACM Portal
IEEE Xplorer
UNC Charlotte Library Resources for Information Technology
Requirements Engineering Theses Home Page
Google Scholar
FacetedDBLP