Requirements Engineering Research: coordination and infrastructure

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0   Abstract

This paper gives a short description of RENOIR (Requirements Engineering Network of International Cooperating Research Groups) a "network of excellence" established within the Framework programme of the European Union. RENOIR will be a major vehicle for coordination and the provision of an infrastructure for requirements engineering research and technology development for organisations within the European Union (or in countries with cooperation agreements with the European Union). RENOIR can also act as a resource and an expertise broker for the wider international requirements engineering community.

1   Overview and Objectives

RENOIR, the Requirements Engineering Network of International Cooperating Research Groups is a "network of excellence" established within the Framework programme of the European Union. In other words it is a network of research groups, with established excellence in the area of requirements engineering, who are funded through the European Union provisions for research and technology development in information technology, to develop the coordination mechanisms and infrastructure for research in requirements engineering.

The objectives of RENOIR are: to provide a framework for coordinated joint research in requirements engineering related to industrial needs; to support the diffusion of requirements engineering research; to provide requirements engineering research training; to support technology transfer in requirements engineering.

RENOIR brings together research teams from industry, academia, and research centres round a set of shared technical goals relating to: the context in which the requirements engineering process takes place; the groundwork necessary for requirements engineering; the acquisition of the "raw" requirements; rendering these requirements useable through modelling and specification; analysis of the requirements; measurement to control the requirements and systems engineering process; communication and documentation of the results of requirements engineering. The primary long-term *technical* goal of RENOIR is to improve requirements engineering practice so that organisations can rapidly, accurately, and efficiently establish and maintain a requirements focus through the development process.

RENOIR is a natural fit with the IT component of the Framework programme which places a great emphasis on the needs of users and markets. Requirements engineering provides the tools, concepts and methods which mediate between information technology service and product providers and information technology service and product users or markets. It is difficult to overstate the importance of requirements engineering to industrial and commercial competitiveness or to the provision of societal services. An information technology product or service which does not meet the requirements of users, or which cannot be identified with the requirements of a market sector, will not be used, sold or yield social benefit.

2   Participation

Requirements engineering as a research field relies on a balance of skills between teams drawn from information systems and from software engineering; between those whose approach is experimental, or conceptual or formal; between those whose stance is theoretical and those who are technology-oriented; between computer science,

systems engineering, and the broader social and cognitive sciences. RENOIR comprises almost all the key research teams working in the area of requirements engineering within Europe. A list of the current RENOIR "nodes" is given below. The coordinator of RENOIR is City University, UK. Membership is open to any research laboratory or industrial group of researchers in Europe with interests in the area of requirements engineering, that subscribes to the aims of RENOIR and is interested in participating in the activities of the network. The scope, scale and strength of RENOIR provides coverage of the field of requirements engineering. In particular RENOIR draws from both the software engineering and information systems "communities". Application specialisations, such as safety-critical systems, are also fully represented.

RENOIR Nodes	
Austria & Switzerland	Universitaet Klagenfurt
	Universitaet Linz
	University of Vienna
	TU Wien
	GENESiS Hardware Software Consulting GmbH
	ETHZ
	Siemens Aktiengesellschaft Oesterreich
Belgium & Luxembourg	Facultes Universitaires Notre-Dame de la Paix, Namur
	Universite Catholique de Louvain
	SEMA Group
	Centre de Recherche Public Henri-Tudor
Denmark	Copenhagen Business School
	Aalborg University
	Innovation & Quality Management (IQM)
	Danish Electronics, Light & Acoustics (DELTA)
	Bruel & Kjaer Measurements
	Dansk Informations Teknologi (DIT)
Finland	University of Jyvaskyla
	University of Oulu
	University of Tampere
	Nokia Research Center
France	Universite de Paris I
	Universite de Nantes
	Universite de Paris-Sud
	CRIN/INRIA - Lorraine
	GEC Alsthom Transport
Germany	RWTH Aachen
	Alcatel SEL
	Universitat Essen
	Universitat Stuttgart
Greece	ICS-FORTH
	SENA S.A.
	Intrasoft S.A
	National Technical University of Athens

RENOIR Nodes (cont.)	
Ireland	University of Limerick
	Trinity College Dublin
Italy	Politecnico di Milano
	University of Ancona
	Universita di Bologna
	Engineering
Netherlands	Universiteit Twente
	Free University of Amsterdam
	Leiden University
	Eindhoven University of Technology
Norway & Iceland	Norwegian Institute of Technology
	University of Bergen
Portugal	University of Lisbon
Spain	Universitat Politecnica de Catalunya
	Centro de Calculo de Sabadell S.A.
	E.T.S.E. Telecomunicacion de Vigo
	Universidad de Murcia
Sweden	KTH/SU
	SISU - Swedish Institute for Systems Development
	University of Skovde
United Kingdom	Imperial College
	City University
	University of Newcastle
	University of York
	UMIST
	University of Oxford
	QSS Ltd.
	Defence Research Agency
	Philips Research Labs
Canada	McGill University
	University of Toronto
Israel	Technion, Haifa

3   Technical Goals

RENOIR has formulated its goals in terms of "research areas", reflected in the organisation of the network. Each research area presents a set of associated "tasks". These tasks are identified below.

A   Context

Goal

To understand the context in which the requirements engineering process takes place.

Tasks

>   *Preconditions*
>   Establishing what needs to be in place, elsewhere in the process, in order for effort and resources devoted to the requirements engineering process not to be dissipated.
>
>   *Organisational setting*
>   Differentiating between the different organisational settings in which the requirements engineering process takes place.
>
>   *Contract and procurement procedures*
>   Understanding the contractual and procurement procedures within the organisations party to the requirements engineering process and their implications for that process.
>
>   *Personnel and staffing*
>   Identifying the skills required by, selection, and organisation of, the individuals and groups involved in the requirements engineering process.

B   Groundwork

Goal

To provide support for the groundwork necessary in order to establish a requirements engineering process.

Tasks

>   *Bounding*
>   Establishing the scope and delineating the bounds of the requirements and design spaces.
>
>   *Feasibility and risk*
>   Determining the feasibility of satisfying the preliminary requirements and identifying the primary risks to which the system development process is exposed.
>
>   *Make or buy?*
>   Determining the likelihood that the system will be developed or purchased, and configuring the requirements engineering process appropriately.

C   Acquisition & Construction

Goal

To support the acquisition of the "raw" requirements and/or the construction of those requirements through development of a common problem or reference structure.

Tasks

Stakeholder analysis
Identifying those "roles" that should have a voice in the requirements engineering process.

Participation
Facilitating group work, codevelopment, consensus building and negotiation.

Information gathering
Gathering information on the requirements and on the domain and environment in which they are situated by methods such as observation, interview, analysis of texts, questionnaires.

D   Modelling

Goal

To provide the means for rendering "raw" requirements useable through modelling and specification.

Tasks

Value modelling
Identifying and building a quality model relating those attributes which are valued in a system which responds to the originating needs.

Identifying goals and required services
Identifying and specifying the goals that a projected system is required to satisfy and the services that it should supply. Identifying and specifying the constraints under which the goals are to be achieved.

Environment modelling
Building a model or models of the environment in which the projected system will reside which may include enterprise or organisational modelling.

Task analysis
Identifying the users of the projected system and developing an understanding of their tasks through modelling supported by participation, exploration and observational studies.

Reuse
Reusing the products and process of requirements engineering, including organising for reuse, specifying "families of systems" (aka domain modelling) and "reverse engineering" products of the development process to obtain requirements information.

E   Analysis

Goal

To support the analysis of the requirements.

Tasks

Validation
Analysing the products of the requirements engineering process and establishing the extent to which they accurately embody the originating needs.

Exploration
Prototyping and system simulation as vehicles for exploring the requirements.

Inspection
Systematically examine the products of requirements engineering with a view to eliminating errors and process improvement.

Verification

Establishing relations between, and analysing the products of the development process (notably design and test) with respect to the requirements.

F   Measurement

Goal

Defining measurement schemes to control, with respect to agreed objectives, the requirements and systems engineering process.

Tasks

Metrics
Obtaining measures of the products and process of requirements engineering.

Estimation
Deriving estimates of development cost, effort and schedule.

G   Communication & Documentation

Goal

Support for the communication and documentation of the results of requirements engineering.

Tasks

Information management
Management of large volumes of interrelated textual and graphic information.

Recording rationale and argumentation
Recording the rationale and argumentation underpinning the products of requirements engineering.

Traceability
Following the life of requirements in both a forward and backward direction through the development process, maintaining the integrity of the requirements in the face of system evolution and changes in the domain.

Standards and Conformance
Ensuring conformance to standards and codes of practice in requirements engineering.

4   Approach

RENOIR aims to exploit the breadth of skills and backgrounds to develop a "broad spectrum" approach to requirements engineering combining experimental, conceptual, formal and observational methodologies. RENOIR is uniquely placed to foster such an approach. It will place particular emphasis on developing balanced assessments of the merits and demerits of different approaches and on the contexts in which they can best be applied. RENOIR will emphasise the development and use of, industrially relevant, shared exemplars and focus problems.

By focusing on research areas and tasks there is a danger that insufficient emphasis is placed on the requirements engineering process as a whole. A major theme in RENOIR, cutting across all the research areas will be the requirements engineering process and process improvement. RENOIR will pay specific attention to the means by which individual contributions in specific research areas can be assembled into a coherent tool-supported method (using that term loosely) sensitive to the evolutionary and incremental character of the systems development process.

RENOIR will, in addition to building on research in software engineering and information systems, draw together research with relevance to requirements engineering originating in the areas of human factors, systems science, management and the social sciences.

5   Programme

RENOIR provides a framework for research coordination; research training; infrastructure; industrial liaison and technology transfer. This is reflected in our programme of activities. It provides a means for overcoming practical problems associated with a distributed and heterogeneous research community. These problems are evident in all the areas which RENOIR addresses but is most immediately obvious in the areas of infrastructure and in industrial liaison and technology transfer. The difficulty of access to existing, but somewhat fragmented expertise, excludes research groups and industry (particularly SMEs) and has inhibited technology transfer and process improvement in the area of requirements engineering.

RENOIR will provide an opportunity for the key European research groups to work together and to develop joint research; it aims to: improve the dissemination of the products of research; foster a critical research and technology development community; allow economy of effort through shared infrastructure and research training; bring together application, technology and domain expertise to focus on common problems.

To these ends RENOIR will deploy a variety of mechanisms research area circles; exemplar circle; meetings; tutorials; summer schools; radicals workshops; newsletter; bulletin; network services; short courses; challenge and opportunity meetings; research broker service; repositories.

Research Area Circles. The primary means of research coordination are the research area circles. Each research area described in our categorisation of technical goals is covered by a "research area circle" which brings together groups with active research interests in that area and the issues within it. The purpose of the group is to support the exchange of ideas through: discussion; informal meetings and exchanges; information exchange. A particular emphasis will be on supporting those nodes who are using or systematically evaluating the work of other nodes. Each research area circle will work within a "charter", reviewed on a regular basis, which will be a

statement of the evolving research issues and current focus of work. The research area circle will also maintain an "inventory" of ongoing research projects and activities within its research area. It will produce regular "state of play" reports.

Exemplar Circle. It has been frequently observed that a major shortcoming of research in requirements engineering is the lack of shared examples and case study material. This makes it difficult to compare techniques or establish their validity across a range of domains. With each research team using different case studies, relying on local domain knowledge or unstated assumptions there is a lack of a feedback and critical appraisal. Further, nodes with limited access to industry may be tempted to use unrealistic case studies. RENOIR will, through its, Exemplars circle develop and promulgate shared case studies and to coordinate the distribution and exchange of whole or partial working of those case studies and associated discussion.

Meetings. It is anticipated that RENOIR will hold Annual Plenary meetings. These meetings will "review" the research area circle charters and state of play reports.

Tutorials. The purpose of tutorials is to provide an opportunity for a research group to teach their technique, language or tool to other nodes who would like to make use of it. These Tutorials should be clearly distinguished from Summer Schools whose purpose is research training and from Short Courses whose purpose is technology transfer. RENOIR is very concerned to support nodes in building on the work of other nodes (to eliminate the "not invented here" culture prevalent in computing research).

Summer Schools. To meet the need for advanced research training and to ensure that new researchers in the field are brought rapidly up to speed and can contribute to RENOIR, the network will organise summer schools covering specialist research topics in requirements engineering.

Radicals Workshops. Existing networks have held successful "radicals" workshops which have aimed to bring less experienced researchers from network nodes together to build joint research projects and foster cooperative work. RENOIR plans to hold a small number of these workshops timed to link with calls issued under the Framework Programme.

Newsletter. RENOIR will build on the existing Requirements Engineering Newsletter to provide an email based news service updating nodes on developments in requirements engineering, including network events, meetings organised by network nodes and so on.

Bulletin. In conjunction with the Newsletter a regular bulletin will be issued (and made available through WWW) providing abstracts from, and pointers to, publications and technical reports issued by network nodes. The bulletin will also carry charters, inventories and state-of-play reports from research area circles.

Network Services. A particular feature of RENOIR will be its use of Internet based services to support its primary activities. This involves a number of obvious tasks such as: maintaining a WWW site with information on RENOIR, on requirements engineering and with links to the sites maintained by network nodes; managing distribution and address lists; providing advice and guidance on infrastructure to less experienced nodes. RENOIR also plans to support the use of virtual spaces (MOOs) as a forum for research discussion in requirements engineering and to exploit recent developments in Internet based video-conferencing.

Repositories. RENOIR will establish repositories containing: requirements engineering process models and methods that can be used by nodes; information and experiences related to the adoption of requirements engineering technology; prototypes and demos; training material.

Short courses. RENOIR will support the joint development of short course material on requirements engineering. This will be made available to network nodes to provide short industry-based courses to SMEs. These short courses will be prepared on a European basis, through RENOIR, and delivered locally through computing and engineering societies and through local industrial consortia coordinated by network nodes. Industry nodes will be involved in the definition and testing of course material. In this manner RENOIR aims to

reach organisations and individuals who would otherwise would not have access to Network expertise.

Challenge and Opportunity Meetings. It is a common error to assume that "technology transfer" is a one way process - from research laboratories to industry. Much fruitful applied research works from problems observed in practice and attempts to understand and generate solutions to those problems. RENOIR will organise challenge and opportunity meetings in which practitioners will be able to introduce challenges arising from their experience that can act as a spur to research.

Research Broker Service. RENOIR will operate an enquiry service which will attempt to match enquiries from industry and in particular from SMEs with appropriate expertise. Such enquiries may vary from research updates, training, or particular consulting problems arising from projects. The service will act as a broker and a central repository of expertise which can provide direction and can build partnerships of network nodes.

6   Conclusion

RENOIR is currently scheduled to start in March 1996 (anybody interested in participating in RENOIR should, in the first instance contact the author of this paper), concurrently with this first issue of the Requirements Engineering Journal. Together they represent important steps forward in the creation of a broad research community. Both are essentially concerned with coordination, infrastructure and dissemination - they can foster, but cannot create, research advance and technology development. The next step must be for researchers to grapple with the underlying intellectual problems of requirements engineering and to organise their findings in such a way as to make their use by industry practical.