MONET2

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Eighteen Month Report – January to June 2003

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Contents

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Bio-Medical Task Group	MONET Project
Education and Training Task Group	MONET Project
Bridge Task Group	MONET Project

1 Introduction

1.1 Purpose of this Document

This is the Eighteen Month Report from the MONET Network of Excellence in Model Based Systems and Qualitative Reasoning. This document identifies the achievements of the last six months and also stands as an illustration of the position of the Project at its half way point.

1.2 Project Update in Brief

The last six months has been a very successful time for the project, the Task Groups have generated a total of five new industrial projects; they have organised three workshops and been involved in two major AI publication Special Editions.

On top of this the Network itself has grown stronger; as well as increased clustering activities with EUNITE our membership also continues to grow. During the last six months alone our active (Task Group) Membership has grown over 50% from 47 to 71 Institutions. More significantly the Industrial proportion of this active membership has grown from 17% to 28%, in actual terms the number of active Industrial participants has increased by two and a half times.

One of the major achievements of the last six months is the creation of the Technological Roadmaps, these cover the technological area as a whole and also each of the focused domain areas. The envisionment of the Roadmaps and the continuing grown of expert base within the Network should make the next phase of the Project even more successful.

Members	***Year One End***	***18 month***
Total	*47*	*71*
University	*37*	*43*
Industry	*8*	*20*
Industrial members who are SME's	*6*	*11*
Research Institutions	*1*	*9*

2 Workpackage Deliverables Reports

2.1 Workpackage 0: Network Management

2.1.1 Introduction

The Technological Roadmap (and the co-ordination of the Domain Technological Roadmaps) has been a priority of the Co-ordinating Node over the last six months, along with its usual networking duties. We have also produced the third MONET Newsletter that has gone out to the membership and other interested parties. This should also assist with our clustering activities.

Work on the MONET Summer School continues, the timetable and lecturers are now set and most of the places have been filled. Two members of the Steering Committee have also edited a Special Edition of AI Magazine.

2.1.2 Deliverables and Milestones

Object	Description	Due Date	Nature[1]	Dissemination Level[2]
Milestones Year Two	MONET Summer School			
	Technological Roadmap (Version 3)			
	Third Newsletter (after Summer School)			
Deliverable	TR1 – Technological Roadmap (Version 3)	18	R	PP
Deliverable	NN3 – Newsletter 3	18	O	PU

2.1.2.1 *TR1 – Technological Roadmap*

In 1998, MONET produced two roadmaps for the technologies covered by the Network. This Technological Roadmap described here, is the third version, five years later and will identify the likely industrial developments of the technology, as well as the improvements to the technology needed to achieve the expected industrial development. For the full details of the previous Version of the Roadmap please see MONET Technological Roadmap Version 2 [1].

This latest version of the roadmap takes a different approach by focusing on the four application areas (automotive, applied diagnostics, biomedical, and educational). A roadmap has been produced for each of the application areas, examining technology drivers in that application area, and matching them to the capability of model-based reasoning systems. The roadmaps for the individual application areas have identified technological barriers to applications of model-based reasoning. The third version of the overall MONET roadmap collects and collates these technological issues, presenting them in a more logical order. The issues identified from the four main application areas have been supplemented from a wide range of other application areas for model-based reasoning.

2.1.2.2 *NN3 - Newsletter*

The third Newsletter was issued at the end of July and featured articles on the Bio-medical and Educational application domains. Other subjects covered were;

- Main Articles
    - QRSER: Qualitative Reasoning for Stream Ecosystem Restoration and Recovery : Report from the First Workshop
    - Learning Qualitative Metabolic Models
    - Model-based Approach to Improved Prescription of Antibiotics
- Updated Summer School Details
- Further Steering Committee Biographies
- Advertisements for Artificial Intelligence in Medicine'03 and Workshop on Qualitative Reasoning'03 conferences
- MIR Details
- Task Group Updates

[1] Nature codes: R = Report, P = Prototype, D = Demonstrator, O = Other

[2] Dissemination level codes: PU = Public, PP = Restricted to other programme participants (including the Commission Services), RE = Restricted to a group specified by the consortium (including the Commission Services), CO = Confidential, only for members of the consortium (including the Commission Services)

2.1.2.3 *Summer School*

Covered in Section 3.6 'Workpackage 5: Summer School'.

2.1.3 Other Activities

<u>AAAI - Special Issue of AI Magazine</u>

This Special Edition has been edited by two members of the MONET Steering Committee and will contain articles covering all MONET areas. AI Magazine is a highly prestigious publication, issued by the AAAI Organisation and has the widest publication coverage worldwide of any magazine in this field.

<u>Student Exchange</u>

MONET has arranged for a Student, Jose Alberto Maestro Prieto, from the University of Valladolid to spend 3 months at the University of Wales, Aberystwyth under the direction of Professor Price. Jose is a PhD student and a member of Staff for the Computer Science Department of the University of Valladolid. His main interests are in Knowledge Based (Expert) Systems, Diagnosis of Dynamic Systems and Knowledge Management. The funding for this exchange was gained by the University of Valladolid and they approached MONET for assistance with the arrangements.

2.1.4 Clustering

MONET has continued its clustering activities with EUNITE – see the Bio-Medical Task Group Section for details. Iain Russell gave a presentation on MONET to the General Assembly Meeting of EUNITE in July 2003. The aim was to introduce the Project to the wider membership of EUNITE and foster closer links in the areas of Bio-Informatics and Bio-Medicine.

The Bio-Medical Task Group organised a joint MONET – EUNITE Workshop on Bio-Informatics (Chaired by George Coghill) at the same event. One of the benefits of this workshop was commitment on both sides to continue and further develop the close ties between the Bio-Medical Task Group of MONET and the IBA D: Human, Medical and Healthcare Committee of EUNITE. Further collaborative work is planned.

2.2 Workpackage 1: Automotive Task Group

2.2.1 Introduction

This has been a very busy period for the Task Group and has seen them meet three times in the last six month. The majority of the work has been on investigating projects that could develop from the area and so far they have been involved in four such projects.

2.2.2 Deliverables and Milestones

Object	Description	Due Date	Nature	Dissemination Level
Milestones Year Two	Holding of series of 'exchange centres' with the goals of: • Transferring technologies • Singling out opportunities for the application of the technology			
	First Version of Roadmap			
Milestones Year Two / Three	Commencement of projects resulting from network influence: • Application projects • Projects to identify potential new research opportunities, to address new problems emerging from applications			
	Final version of Technological Roadmap			
Deliverable	A4 – Automotive roadmap (Version 1)	16	R	PP
Deliverable	A2 – Outline of areas for potential new projects etc. for European automotive sector	19	R	PP

Expected Result

Increased interest from major European industry players

Greater understanding of MBS/QR technologies by major European industry

Evident deployment of these technologies beyond project stage, with evident impact on market share, reduction of costs, quicker design cycles

Further collaborative European projects

2.2.2.1 *Holding of Series of 'Exchange Centres'*

These Exchange Centres have the goals of ‘transferring technologies’ and of ‘singling out opportunities for the application of the technology’. To this end, the Task Groups has worked hard to bring together Automotive (and Automotive supply) Companies in order to exchange ideas and generate potential avenues for the transfer of technology. During 2002 the Task Group held a series of meetings with Automotive Companies which resulted in the production of a list of Industrial requirements. To develop this yet further, they then held a major meeting in Turin, during April of this year, which was again attended by many of the European Automotive companies. This meeting build upon those industrial requirements and developed and grouped them into application areas that had the potential to solve the issues raised by the Companies. The results of these meetings are described more fully in Section 2.2.2.2 ‘Commencement of Projects Resulting from Network Influence’.

As well as this concentrated work, individual members of the Task Group have met with a number of companies not directly involved with the project at present. They hope that this work will not only spread the awareness, and therefore the development, of MBS&QR applications within this domain, but will eventually bring these companies together for the good of the overall Industry.

New non-members we are dealing with are as follows:

- VW
- Audi
- Ford Research Centre, Aachen
- Jaguar Cars
- Mentor Graphics, UK
- Alstom (examining the relevance of these technologies to the train industry).

Also, in June 2003 Louise Travé-Massuyès was invited to present at a Workshop on 'Immobot Technology and its Application to Automotive Realm' at the Car Internet Research Program (CIRP) Conference. CIRP is an industry-sponsored research initiative administered through the University of Ottawa. The program is exclusively focused on projects that assess the extent to which new information and communication technologies impact the automobile industry.

2.2.2.2 *Commencement of Projects Resulting from Network Influence*

At an Automotive meeting in April the Task Group discussed projects that could come from their work. They already had the list of industrial requirements that had been gathered the previous year from several major European Automotive companies and they decided that this would be a valuable place to start. The Task Group addressed the concerns raised by the Industrial partners and grouped these into four areas that could be interesting for future projects; they then gathered interest in these areas and worked towards generating projects.

<u>Pre-Dic</u>

Out of these four project areas, the action towards predictive diagnosis seemed to be the most significant for the industry and was also the most aligned to expertise of the Task Group. Eventually headed up by MONET member DaimlerChrysler, the project was developed in two further meetings and has formed the basis of an FP6 Project proposal for the Second call under Embedded Systems.

<u>Test-Gen</u>

Another of the Project topics discussed by the Task Group was that of Test generation and Model-based testing of embedded systems, this has impressed Audi so much that they have decided to take this work forward themselves.

<u>UBITOWN</u>

The Task Group have also been involved in a project investigating the application of intelligent systems and advance software and a focusing these on mobile systems. The results of the groups work will be a proposal to be submitted to the second call of FP6, IST under the keyword "Applications and services for the mobile user and worker".

<u>ESA / Alcatel</u>

Recently the network has also helped to establish contacts between the Automotive industries and the Space industries. Initiated by the European Space Agency (ESA) and Alcatel, a proposal for an IP has been prepared in which companies and institutions join their efforts to achieve a higher degree of autonomy of the respective systems. The goal is to develop a common architecture for embedded systems that allows the integration of various software modules for diagnosis, control, recovery, mission planning etc. and to share such modules.

2.2.2.3 *A4 – Automotive Roadmap (Version 1)*

In order to be able to offer continuing assistance to the competitiveness of the European Automotive Industry it is necessary to continue that assistance into the future. However, to be able to offer genuine applications of our technologies we must attempt to predict what this domain will require in the years to come. This Roadmapping document will attempt to provide the required insight to achieve this.

This Automotive Technological Roadmap presents the application of model-based systems and qualitative reasoning techniques in the automotive industry. The techniques and trends discussed are relevant to all powered land vehicles and to a great extent, to other forms of transport such as aeroplanes and ships, especially where they share the characteristics of increasing complexity and reduced development time.

The potential for technological development in the Automotive Domain over the next ten years is huge and this document could not cover all of the likely factors. Thus the Roadmap has been focused directly on the technologies to which model-based reasoning can offer considerable assistance and development support.

2.2.3 Task Group Membership

Institution Name	***Country***	***Classification***
ACTIA	*France*	*I*
CRF	*Italy*	*I*
DaimlerChrysler	*Germany*	*I*
FirstEarth	*United Kingdom*	*I (SME)*
LAAS	*France*	*R*
LIPN	*France*	*U*
OCCM GmbH	*Germany*	*I (SME)*
R.O.S.E. GmbH	*Germany*	*I (SME)*
Robert Bosch	*Germany*	*I*
SPORE Ltd	*United Kingdom*	*I*
Techniche Universitat Munchen	*Germany*	*U*
Universita'degli studi di Torino	*Italy*	*U*
UReason	*The Netherlands*	*I (SME)*
UWA	*United Kingdom*	*U*

Comparison with end of Year One

Members	***Year One End***	***18 month***
Total	*10*	*14*
University	*5*	*4*
Industry	*5*	*9*
Industrial members who are SME's	*3*	*4*
Research Institutions	*0*	*1*

2.3 Workpackage 2: Bio-Medical Task Group

2.3.1 Introduction

In the context of the Biomedical Task Group the term 'industry' is interpreted somewhat differently from the other Task Groups and clarifying the views of the Task Group members on this issue was one of the first goals of the Roadmapping exercise. In addition to health-care, the Task Group distinguished the patient and patient groups, the IT service industry, biomedical equipment producers, and the pharmaceutical industry. These results gave further input for targeting specific groups.

During the last six months, Task Group members have been involved in approaching various commercial companies such as Vitatron, Organon, Hugin, PharmaDM for information about the potential role model-based and qualitative reasoning approaches could play in their branch of industry. Vitatron approached Peter Lucas about ways to implement a diagnostic system for a new series of brady-pacemakers. Contacts with research-oriented hospitals have also improved. For example the Grampian Health Trust has clearly indicated its interest in work in this field.

Considerable time has also been spent by the Task Group members in organising the Bioinformatics workshop held at the EUNITE Symposium on Intelligent Technologies, Hybrid Systems and their Implementation on Smart Adaptive Systems on 10-11 July, 2003. Finally, this Task Group is organising the Workshop on Model-based and Qualitative Reasoning in Biomedicine, which will be held during AIME-2003 on 19th October, 2003.

2.3.2 Deliverables and Milestones

<table>
<tr><th>Object</th><th>Description</th><th>Due Date</th><th>Nature</th><th>Dissemination Level</th></tr>
<tr><td rowspan="2">Milestones</td><td>Development of B2 and publication of first version</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Workshop at a major bioinformatics / medical AI conference (B4)</td></tr>
<tr><td>Deliverable</td><td>B2 – Biomedical roadmap (Version 1)</td><td>16</td><td>R</td><td>PP</td></tr>
<tr><td>Deliverable</td><td>B4 – Biomedical Workshop</td><td>20</td><td>O</td><td>PP</td></tr>
</table>

Expected Results

Wide understanding within this domain of the contribution that MBR can make to solving biomedical problems

Increased uptake of the technology within the sector

Pan-European collaborative projects to realise the potential highlighted by this task group

2.3.2.1 *B2 – Biomedical Roadmap (Version 1)*

The first version of the Biomedical Roadmap was drafted during the Roadmap Exercise. This was subsequently refined during the next couple of weeks however, the current version contains a number of open issues that will be elaborated upon during the next project period.

The Bio-Medical Domain is vast and varied with many factors relying on public / political will instead of Technological ability. However, it is within the field of Bio-Medicine that MBS&QR has the greatest potential to be of significant use.

Considerable time during the preparation of this document was spent on understanding the various constituencies that can be distinguished in the health-care and biomedical communities, both involving industry in the strict sense and academia. Based on the insights gained during this work, the remainder of the issues were organised according to the structure which we considered to be most natural for the biomedical field. As a consequence, the structure of this document is different from the other roadmaps drafted at the other MONET 2 Task Groups.

2.3.2.2 *B4 – Biomedical Workshop*

The Task Group has been involved in the two Workshops in the first half of this year and is organising a further Workshop to be held towards the end of this year. The details of the events are as follows;

- EUNITE[3] 2003 – Workshop on Intelligent Technologies for Gene Expression Based Individualised Medicine. 9th May 2003. Jena, Germany
- EUNITE 2003 – Joint MONET – EUNITE Workshop on Bio-Informatics held at the European Symposium on Intelligent Technologies, Hybrid Systems and their Implementation on Smart Adaptive Systems. 10th – 11th July 2003. Oulu, Finland
- AIME'03 Workshop: 'Qualitative and Model-based Reasoning in Biomedicine' held as part of The European Conference on Artificial Intelligence in Medicine (AIME'03), 18th – 22nd 2003 October. Cyprus

<u>EUNITE 2003 – Workshop on Intelligent Technologies for Gene Expression Based Individualised Medicine. 9th May 2003. Jena, Germany</u>

George Coghill was invited to the EUNITE Workshop on Gene Expression to deliver a paper and to work to encourage closer links with MONET. The paper was entitled 'Qualitative Bioinformatic System Identification: Motivation and Method' and was authored by George M. Coghill, Ross D. King and Simon M. Garrett.

The Workshop was a great success and led to the development of a joint Workshop with EUNITE at their 2003 Symposia.

<u>EUNITE 2003 – Joint MONET – EUNITE Workshop on Bio-Informatics held at the European Symposium on Intelligent Technologies, Hybrid Systems and their Implementation on Smart Adaptive Systems. 10th – 11th July 2003. Oulu, Finland</u>

In order to advance the work of the Bio-Medical Task Group and to continue their clustering activities they held a Joint Workshop at EUNITE 2003 on Bio-Informatics, the Workshop saw two speakers from EUNTE and two from MONET deliver papers on the subject.

One of the significant benefits of this workshop was a commitment on both sides to continue and further develop the close ties between the Bio-Medical Task Group of MONET and the

[3] EUNITE is the European Network of Excellence on Intelligent Technologies for Smart Adaptive Systems.

IBA D: Human, Medical and healthcare Committee of EUNITE. Further collaborative work is planned.

AIME'03 Workshop: 'Qualitative and Model-based Reasoning in Biomedicine' held as part of The European Conference on Artificial Intelligence in Medicine (AIME'03), Cyprus

In order to assist with forwarding the wider understanding of the Bio-medical MBS & QR field and for completion of Deliverable B4 the Bio-Medical Task Group has organised a Workshop at a major Bio-Medical AI Conference. The Workshop, entitled 'AIME'03 Workshop: Qualitative and Model-based Reasoning in Biomedicine' will be held as part of The European Conference on Artificial Intelligence in Medicine (AIME'03). The event will be held from the 19th to the 22nd of October, 2003 (http://www.cs.kun.nl/~peterl/aime03-ws.html), with the Workshop itself to be held on Sunday, 19th October 2003.

The focus of the Workshop is modelling, which is of central importance when tackling problems in medicine and human biology, as it is the biomedical researcher's aim to uncover the biological structures and mechanisms underlying biological processes. Their high complexity; their common non-linear mathematical nature, and the efforts required in collecting biomedical data makes it hard, and often impossible, to describe biomedical mechanisms quantitatively. However, it is often possible to describe various aspects of biomedical problems qualitatively, and one may argue that these qualitative descriptions are fundamental to the understanding of many processes studied by the life sciences.

Preliminary Programme of the Workshop.

Invited talks

- Ivan Bratko: Qualitative Reasoning and Machine Learning
- Linda van der Gaag: Qualitative Probabilistic Networks

MONET contributions

- Raffaella Guglielmann: Qualitative Reasoning for Modelling Metabolic Systems - a Case Study
- Stefania Tentoni: Challenging QR Research Issues in Electrocardiology
- John Fox: Probability, Logic and the Cognitive Foundations of Rational Belief
- Rene Quiniou: Kardio and Calicot: a Comparison of Two Cardiac Arrhythmia Classifiers
- Peter Lucas: Medical Decision Support and Model-based Reasoning

Regular contributions

- Robert Trelease and Jack Park: Qualitative Reasoning in Integrative Biology: Evolving a Network Experiment Modelling System for Collaborative Multilevel Systems Research
- Jung-Wook Bang, Raphael Chaleil, Jon Williamson and Stephen Muggleton: Two-stage Bayesian Network for Metabolic Network Prediction
- Anand Kumar, Barry Smith, Mario Stefanelli, Silvana Quaglini, Matteo Piazza: Implementing Clinical Guidelines in an Organizational Setup
- Agnieszka Onisko and Marek J. Druzdzel: Effect of Imprecision in Probabilities on Bayesian Network Models: an Empirical Study

2.3.3 Task Group Membership

Institution Name	***Country***	***Classification***
IMATI - CNR	*Italy*	*R*
INRIA Alpes	*France*	*R*
IRISA	*France*	*R*
Max-Planck Gesellschaft zur Foerderung der Wissenschaften e.V.	*Germany*	*R*
TU, Berlin	*Germany*	*U*
TU Wien	*Austria*	*U*
UReason	*The Netherlands*	*I (SME)*
University of Aberdeen	*United Kingdom*	*U*
University of Nijmegen	*The Netherlands*	*U*
University of Wuerzburg	*Germany*	*U*
UWA	*United Kingdom*	*U*
Cancer Research UK	*United Kingdom*	*R*

Comparison with end of Year One

Members	***Year One End***	***18 month***
Total	*7*	*12*
University	*6*	*6*
Industry	*0*	*1*
Industrial members who are SME's	*0*	*1*
Research Institutions	*1*	*5*

2.4 Workpackage 3: Education and Training Task Group

2.4.1 Introduction

The Education and Training Task Group has put considerable efforts, over this six month period, into starting their first project. They organised a Workshop in Jena, Germany and began work on a QR Stream Modelling system coupled with a Decision Support System for Ecosystem Management and Training. In other words this is effectively two projects rolled into one. The work that they have also done on the Roadmap and the Review of MBS&QR Technologies, along with the growth in the Task Group should see a great success in this and future projects.

2.4.2 Deliverables and Milestones

Object	Description	Due Date	Nature	Dissemination Level
Milestone 0.5 - 1.5 year	Review of state of the art and commence at least one project exploiting MBD in education			
Milestone 1.5 - 2.5 year	Review QR/MBS & WWW/Multimedia. Initiate collaborative project utilising training over the Web.			

Deliverable	ED2 – Review of MBS/QR technologies and their usefulness for teaching.	15	R	PP
Deliverable	ED4 – Education and training roadmap (Version 1)	16	R	PP

Expected Results

Three online documents will be produced that review the field of QR/MBS and its potential for tutoring and training. The focus will be on (1) industrial applications and (2) how the technology should be further developed to integrate with and benefit from the emerging properties of the WWW and multimedia.

2.4.2.1 *ED2 – Review of MBS/QR Technologies*

The Task Group has completed work on the (ED2) Review of MBS&QR Technologies and their application to teaching. Educational model-based reasoning has a comparatively long history in model-based reasoning, starting with the Sophie system for teaching engineers to diagnose circuits in the early 1980's. This document examines the latest model-based technology being employed for tutoring and education-oriented systems, with case studies of some of the most recent systems to be built.

2.4.2.2 *ED4 – Education and Training Roadmap (Version 1)*

Model-based Systems (MBS) and Qualitative Reasoning (QR) technology is of great importance for developing, strengthening and further improving education and training on topics dealing with systems and their behaviours. It is well known that an essential part of modern education and training involves the comprehension of systems and their behaviours. That is, being able to distinguish a system from the environment in which it operates, to identify the parts that it is made of, and to predict or explain its behaviours. The latter is concerning the overall system behaviour, how it potentially interacts with the behaviour of the environment, as well as how the system's behaviour originates from the individual behaviours of each of the parts[4] that it consists of. Although, not all education and training involves reasoning about systems (for example, language teaching does not seem to fall within such a paradigm), many matters in educational settings, work situations and every day life do. MBS&QR technology is important because it provides a computer-based means to capture and communicate knowledge and insights that overcome limitations of currently used technology, such as numerical-based simulations. However, MBS&QR technology is not well known to a wider audience and there are few who are ready to use products and tools available to exploit the capabilities of this technology. This is an undesirable situation as a great possibility for improvement is potentially left unexploited. In this roadmap we depict the current situation concerning MBS&QR technology for education and training. We then envision how this should change in the future and how we may accomplish that vision; following the needs and desires from the field.

2.4.2.3 *Commence at Least One Project Exploiting MBD in Education*

The Education and Training Task Group has been working to formulate a basis to practically demonstrate the applicability of MBS & QR technology to the Education and Training Domain. The Task Group realised that the demonstration of the Technology required a

[4] The term 'Parts' does not only refer to components that constitute artefacts (*e.g.*, a switch being part of a device of some kind), but also refer to entities or object in general from which systems have grown (*e.g.*, a tree being part of a forest) or have been built (*e.g.*, a pole supporting some physical structure).

specific area for it to be applied to and this would mean explaining the principles to non-computer scientists. Ecological modelling was the field that they felt would be the most applicable.

With the assistance of other Task Group Members, Bert Bredeweg conducted discussions with experts in the field of Ecosystem modelling and persuaded them that not only could MBS&QR build their models for them, but that it could also develop a 'Decision Support' system to assist in stream restoration and recovery programmes. The Task Group, therefore, held a Workshop in Jena, Germany, in order to jump start this Project.

Thus, the 'Jena Project' is effectively two MBS&QR projects in one. The Ecological modelling field has been introduced to the advantages of these technologies and shall be putting them into use. They have also come together to build a qualitative Management and Training application that can also be used for Ecological Education.

Jena Project Workshop

This Project represents an initiative to start a pan-European collaboration to build qualitative reasoning training and decision support models for stream ecosystem restoration and recovery. The first QRSER (Qualitative Reasoning for Stream Ecosystem Restoration and Recovery) Workshop was held in March 2003 in Jena, Germany, with 17 participants from Europe, Brazil and the USA. The program of the workshop was well balanced between theory and practical sessions. After an introduction to QR in general and to each participant's research, focused lectures about QR were given. Participants had the opportunity to work out assignments and to practice building QR models. A discussion about the future development of the QRSER initiative, possible projects and proposals, and future meetings built a successful end of the first QRSER workshop.

Jena Project

Running water bodies constitute a major component of the landscape and are one of the most important limnological habitats with unique structure and function. They have, however, suffered decades of degradation from agricultural and industrial pollution and from weir or dam construction, channelisation, and dredging. This damage has reduced their ability to provide economically important ecosystem services including drinking water, irrigation, hydropower, commerce, recreation and fisheries.

Decision makers in restoration and recovery need predictions on which to plan their activities. Quantitative training and decision support systems targeted towards ecosystem models may provide such predictions, but they are not only difficult to parameterise, but also difficult to explain to non-experts. Stream ecosystems are especially difficult to model because of our generally poor understanding of ecosystem structure and functioning.

QR is an innovative technique that captures the fundamental aspects of a system, while suppressing much of the irrelevant detail. This approach makes expert knowledge available to non-experts for direct use in applied contexts. It will help reconcile the conflicting interests of water users and facilitate forecasting, management, and restoration of running waters throughout Europe.

2.4.3 Task Group Membership

Institution Name	***Country***	***Classification***
Brunel	*United Kingdom*	*U*
Fundacio ESADE	*Spain*	*U*
Heriot-Watt	*United Kingdom*	*U*

Jena	*Germany*	*U*
Lancaster University	*United Kingdom*	*U*
Public Industry Authority	*Kuwait*	*I*
Ramapo College of New Jersey	*United States of America*	*U*
Strathclyde	*United Kingdom*	*U*
TU Dresden	*Germany*	*U*
TU Graz	*Austria*	*U*
Udine	*Italy*	*U*
University of Amsterdam	*The Netherlands*	*U*
University of Brasilia	*Brazil*	*U*
University of Wuerzburg	*Germany*	*U*
UReason	*The Netherlands*	*I (SME)*
UWA	*United Kingdom*	*U*

Comparison with end of Year One

Members	***Year One End***	***18 month***
Total	*10*	*16*
University	*10*	*14*
Industry	*0*	*2*
Industrial members who are SME's	*0*	*1*
Research Institutions	*0*	*0*

2.5 Workpackage 4: Model Based Fault Detection and Diagnosis (BRIDGE) Task Group

2.5.1 Introduction

The Bridge Task Group has been working towards the Deliverables and Milestones and also putting considerable effort into reaching an ever increasing audience. The Group has had two meetings in Toulouse, one general meeting and another aimed specifically at the Roadmap, as well as a further meeting during the Roadmapping exercise.

2.5.2 Deliverables and Milestones

Object	Description	Due Date	Nature	Dissemination Level
Milestones	Collation of technology transfer problem specifications (MBD3)			
	Production of tutorial materials (MBD4)			
	Production of first version of Roadmap (MBD6)			
Deliverable	*MBD3 – Collection of Reference Problems*	15	O	PP
Deliverable	MBD6 – MBD / FDI roadmap (Version 1)	16	R	PP

Expected Results

Wider understanding in industry of the value of applying common FDI/DX technologies to industrial domains

New researchers will be able to more easily understand the area and avoid duplication of research

Systems developers will be able to understand and select appropriate technology from the growing number of commercial and near commercial diagnostic products

Collaborative projects to realise the synergistic potential of these technologies

2.5.2.1 *MBD3 – Collection of Reference Problems*

This deliverable provides the description of a set of reference problems of different natures. These are presented along a common format, which therefore makes it easier to perform parallel analysis.

These problems will be later used to compare and characterise the presumptions and scope of applicability of Model Based Diagnosis (MBD) technologies developed in Fault Detection and Isolation (FDI) and Diagnostics (DX). Based on the analysis of every reference problem, competing and complementary methods using the DX MBD technology alongside the FDI MBD technology will be exhibited as well as useful “bridges” for beneficial combinations of techniques will be identified and defined.

2.5.2.2 *MBD6 – MBD / FDI Roadmap (Version 1)*

Technologies, such as those used in DX or FDI, have always faced issues when it comes to the realisation of real world applications. End Users often do not have a clear idea of the technologies. Hence, it should be our responsibility to ease the transfer from our research field to ‘Technology Supply Companies’. At this time, and in the Bridge context, it is clear that FDI techniques are more established and are more well known by engineers than DX ones. Hence, one of the main goals of Bridge should be to provide those companies with products combining both technologies. The Technological Roadmap will be used to clarify the path that will be taken to achieve this.

The aims of Bridge (and therefore the focus of the Roadmap) are to provide both DX and FDI communities with a better understanding of the methodologies of the other community. Following this we shall build a common framework which will allow both communities to share the best from both worlds (results and techniques), and also to assist in the transfer of these results and the creation of new products (for instance, Tool-Kit Products) that can smoothly combine both approaches. This task will be facilitated by the future-planning that is shown in the Roadmap and the methods that are applied to achieving these goals will also be determined from the conclusions drawn in this document.

2.5.2.3 *Production of Tutorial Materials (MBD4)*

This process has been brought forward as some tutorial materials have already been produced along with the Industrial Reference Problems. Also there will be sessions on Diagnosis held during the MONET Summer School; the materials produced for these will also be of assistance in fulfilling the Deliverable.

2.5.3 Task Group Membership

Institution Name	***Country***	***Classification***
Aberdeen	*United Kingdom*	*U*
ACTIA	*France*	*R*
Brescia	*Italy*	*U*
ENEL	*Italy*	*I*
EPFL	*Switzerland*	*U*
France Telecom	*France*	*I*
Graz	*Austria*	*U*
Grenoble	*France*	*U*
Hull	*United Kingdom*	*U*
Intelligent Applications	*United Kingdom*	*I (SME)*
IRISA	*France*	*R*
LAAS	*France*	*R*
LAIL	*France*	*U*
Lille	*France*	*U*
Linkoping	*Sweden*	*U*
LIPN	*France*	*U*
Loughborough	*United Kingdom*	*U*
Piemonte	*Italy*	*U*
OCCM	*Germany*	*I (SME)*
Public Industry Authority	*Kuwait*	*I*
R.O.S.E. GmbH	*Germany*	*I (SME)*
TUHH - Technologie GmbH	*Germany*	*I (SME)*
TU Munich	*Germany*	*U*
Universita'degli studi di Torino	*Italy*	*U*
University of Ferrara	*Italy*	*U*
University of Wuerzburg	*Germany*	*U*
Uni-Poly Catalunya	*Spain*	*U*
UReason	*The Netherlands*	*I (SME)*
UWA	*United Kingdom*	*U*
Valladolid	*Spain*	*U*

Comparison with end of Year One

Members	***Year One End***	***18 month***
Total	*20*	*30*
University	*17*	*19*
Industry	*3*	*8*
Industrial members who are SME's	*3*	*5*
Research Institutions	*0*	*3*

2.5.4 Other Activities

Co-located SafeProcess'03 and DX'03 and Joint BRIDGE day:

The International Workshop on Diagnosis 2003 was co-located with SafeProcess 2003 and was a great success. The one-day BRIDGE workshop was organised primarily by members of the MONET Bridge Task Group and many members from the SafeProcess community attended the event.

The BRIDGE workshop included two FDI and DX plenary invited talks by senior researchers of the FDI and the DX fields, followed by three technical sessions. This is a major achievement for the Bridge Task Group, as it strengthened the willingness to work towards a common program for the areas of DX and SafeProcess, this willingness was clearly demonstrated by the attendance of researchers from both fields. The Bridge day was a tremendous driver for increasing the awareness of researchers about FDI and DX technologies and their combination.

IEEE Bridge Issue

This publication is now in the final stages of preparation and will contain six articles (subject to the conditions of the review panel) on Bridge issues and should appear around the second quarter of 2004.

DX'04

Preparations are beginning for the International Workshop on Diagnosis 2004 which shall be held in Carcassonne (France) in 2004. Much of the organisation is being done by members of the Bridge Task Group.

2.6 Workpackage 5: Summer School

2.6.1 Introduction

The Summer School plans are now in the final stages. The venue, timetable and lecturers are now confirmed, with a total of 37 Students to date, including several industrial students. Leading MBS&QR experts Ken Forbus and Dedre Gentner will give the plenary speeches and teaching sessions. Other interactive teaching sessions will be led by Steering Committee Members. The teaching materials and the Summer School Proceedings will be available at the end of the event, both on the MONET Website and as CD ROMs for the participants.

2.6.2 Deliverables and Milestones

Object	Description	Due Date	Nature	Dissemination Level
Milestones	Month 18 – Summer School event			
	Month 21 – Provision of educational resources on the web			
Deliverable	SS1 – Summer School	18	O	PU
Deliverable	SS2 – Summer School educational resources	18	O	RE

2.6.2.1 *SS1 – Summer School*

MONET is holding a Summer School for Doctoral Students and Industrialists interested in increasing their knowledge of these Technologies.

Its Goals include;

- To inspire and prepare the next generation of researchers in the field of MBS/QR.
- To convey to young industrialists, the potential of MBS/QR technology for solving problems resulting from interacting with complex systems and their behaviour.
- To communicate the type of problems that can be solved by applying MBS/QR technology.
- To present a coherent and comprehensive overview of the main results and achievements of MBS/QR research.
- To layout the state of the art of MBS/QR technology, highlight problems and open issues, and point out the research opportunities for the near future.

The Summer School will provide an excellent foundation for research in the area or for applying these Technologies to real world problems.

2.6.2.2 *Proposed Timetable*

There will be four sessions each day, as well as a chance to meet the experts on a one to one level both in dedicated sessions and at the evening social events.

Day / Date	*Session 1*	*Session 2*	*Session 3*	*Session 4*	*Evening*
Monday 8/9/03	*Plenary Lecture (Ken Forbus)*		*Modelling Practical Session (Garp / Visi-Garp) - (Bert Bredeweg)*		*Drop in Session*
Tuesday 9/9/03	*Ecology: Lecture & Practical Session (Bert Bredeweg)*		*Model Based Diagnosis Lecture (Peter Struss / Louise Travé-Massuyès)*		*Drop in Session*
Wednesday 10/9/03	*Diagnostic Practical (Peter Struss / Louise Travé-Massuyès)*		*Cognition Lecture (Ken Forbus & Dedre Gentner)*	*Cultural Trip*	
Thursday 11/9/03	*Education Lecture (Bert Bredeweg)*	*Bio-Medical Lecture (Peter Lucas / George Coghill)*	*Industrial Application (Neal Snooke / Chris Price)* *Lecture*	*Practical*	*Gala Dinner*
Friday 12/9/03	*'Challenges in MBR' Lecture (Chris Price)*	*Concluding Session - Panel with Ken, Bert, Peter, etc.*	*Delegates depart*		

2.6.2.3 *SS2 – Summer School Educational Resources*

- Workshop Proceedings (paper)
- On-line
  - Proceedings
  - Links to demo applications

- o Lecturers and contact details
- o Presentations

3 List of Members

Institution	Country	Membership	Classification
Agents Inspired Technologies, S.A.	Italy	Full	U
British Maritime Technology Ltd	United Kingdom	Full	R
Brunel University	United Kingdom	Full	U
C.R.F. Società Consortile per Azioni	Italy	Full	U
Cancer Research UK	United Kingdom	Full	U
Centre Nationale de la Recherche Scientifique (CNRS-LAAS)	France	Full	U
Daimler Chrysler AG	Germany	Full	I
Dipartimento di Elettronica per l'Automazione, Università degli Studi di Brescia	Italy	Full	U
Dipartimento di Informatica – Università di Torino	Italy	Full	U
Dipartimento di Matematica e Informatica, Università di Udine	Italy	Full	U
Ecole Polytechnique Federale de Lausanne	Switzerland	Full	U
Enel Produzione S.p.a.	Italy	*	I (SME)
FirstEarth Ltd	United Kingdom	Full	U
France Telecom	France	*	U
Friedrich Schiller University Jena	Germany	Full	U
Fundacio ESADE	Spain	Full	U
Heriot-Watt University	United Kingdom	Full	U
Institut für Technische Informatik, Technische Universität Graz	Austria	Full	U
Institut National de Recherche en Informatique et Automatique	France	Full	U
Institute für Informationsverarbeitung und Computergestützte Neue Medien – Arbeitsgruppe für Softwaretechnologie	Austria	Full	U
Institute of Computing and Information Sciences, University of Nijmegen	The Netherlands	Full	U
Institute of Information Systems, Technische Universitaet Wien	Austria	Full	U
Instituto di Mathematica Applicata e Technologie Informatiche – CNR, Pavia	Italy	Full	U
Instytut Podstawowych Problemow Techniki Polskiej Akademii Nauk	Poland	Full	U
Intelligent Applications	United	Full	I (SME)

	Kingdom		
Jaume I University	Spain	Full	U
Laboratoire d'Automatique de Grenoble	France	Full	U
Linkoping University	Sweden	Full	U
Loughborough University	United Kingdom	Full	U
Max-Planck Gesellschaft zur Foerderung der Wissenschaften e.V.	Germany	Full	U
OCCM Software GmbH	Germany	Full	I (SME)
Potsdam-Institut fur Klimafolgenforschung	Germany	Full	U
Public Authority of Industry	Kuwait	**	I
R.O.S.E Informatik GmbH	Germany	Full	I (SME)
Robert Bosch GmbH	Germany	Full	I
Spore Ltd	United Kingdom	Full	I
Technische Universitaet Berlin	Germany	Full	U
Technische Universitaet Dresden	Germany	Full	U
Technishe Universitaet Muenchen	Germany	Full	U
TUHH – Technologie GmbH	Germany	Full	U / I (SME)
Universidad de Malaga	Spain		U
Universidad de Sevilla	Spain	Full	U
Universidad de Valladolid	Spain	Full	U
Universidad Pontificia Comillas de Madrid	Spain	Full	U
Università degli Studi del Piemonte Orientale “Amedeo Avogadro”	Italy	Full	U
Universitaet Klagenfurt	Germany	Full	U
Universitat de Girona	Italy	Full	U
Universitat Politèchnica de Catalunya	Spain	Full	U
Universitat Rovira I Virgili	Italy	Full	U
Universite Paris 13	France	Full	U
Universiteit van Amsterdam	The Netherlands	Full	U
Universitie des Sciences et Technologies du Lille	France	Full	U
University Koblenz-Landau	Germany	Full	U
University of Aberdeen	United Kingdom	Full	U
University of Edinburgh	United Kingdom	Full	U
University of Ferrara	Spain	Full	U
University of Huelva	Spain	Full	U
University of Hull	United Kingdom	Full	U
University of Lancaster	United Kingdom	Full	U
University of Leeds	United Kingdom	Full	U
University of South Australia	Australia	**	U
University of Strathclyde	United Kingdom	Full	U

University of Wales, Aberystwyth	United Kingdom	Full	U
University of Wuerzburg	Germany	*	U
University of Brasilia	Brazil	**	U
UReason Holding B. V.	The Netherlands	*	I (SME)
Vanderbilt University	USA	**	U

* Organisation has completed on-line application form but not yet signed a full Membership contract
** Organisation is outside the European Community, so cannot achieve full Membership status.

4 References

[1] MONET Technological Roadmap Version 2. Deliverable TR1. Available on-line at http://monet.aber.ac.uk:8080/monet/docs/tg_minutes_and_reports/co-ord/monet2_overall_rm.pdf

5 Document History

Version	*Date*	*Changes made to document*	*Changed by*
1.1	31st July 2003	Document Prepared by Task Groups and Co-ordinating Node	MONET
1.2	3rd October 2003	Document updated with standard format. Text remained unchanged so release date remains July '03.	RIR