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Final Report (39 Months)

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MONET:

The European Network of Excellence in Model-based Systems and Qualitative Reasoning.

EC DGIII European Commission

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Executive Summary

The principal and ongoing goal of the MONET Network of Excellence on Model-Based Systems and Qualitative Reasoning is to establish MBS & QR methods as a fundamental technology for industry by means of a broad base of applications and an integrated research effort.

The MONET Network has the following main objectives:

- Assist in the coordination of European research & development.
- Aid the transfer of MBS & QR technology to industrial applications.
- Stimulate European MBS & QR systems research to address the needs of industry.
- Increase the awareness of the technology through education and training.
- Provide information resources.
- Provide surveys and identify potential application fields and research fields

The main general achievement of MONET 1 has been the provision of an effective infrastructure by means of which the objectives can be further progressed in the future. Other specific achievements have been:

- The development of a website providing members with a comprehensive set of information resources.
- The creation and maintenance of the MONET Information Resource (MIR): a fully searchable database containing information about publications, tutorials, teaching aids, software, and applications in the field of MBS & QR.
- The compilation of an Applications Compendium.
- The organisation and running of the first MONET Summer School for training the next generation of MBS & QR practitioners.
- The initiation of a number of Task Groups to carry out particular tasks or to examine specific issues within the domain of MBS & QR.
- The development of a CD ROM containing the same resources as the website (including MIR) for those with no, or inadequate, internet access. The CD-ROM also provides a record of the final state of the website at the end of MONET 1.
- The provision of a set of items of demonstration software illustrating the techniques and applications of MBS & QR.
- The compilation of a Technological Roadmap.

These achievements provide a solid basis for further development and progress. The interactions and discussions that have taken place over the lifetime of MONET 1 lead us to believe that the next step is to focus the efforts of the community (through the Network). That is, the Network should concentrate most effort on the sector closest to commercialisation and use its resources to aid sector penetration. Success in this area would have the effect of driving theoretical development and application in other sectors. The infrastructure and foundation created by the MONET 1 Network of Excellence provides a solid basis on which to proceed with this task.

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Chapter 1

Introduction

The European Network of Excellence on Model-Based Systems and Qualitative Reasoning (MONET) has been running for three years. In that time it has expanded from the initial membership of 45 to its current size of around 85 nodes (with membership applications still being received). It has:

- created an infrastructure which makes European MBS & QR the best organised in the world (as has been recognised by our colleagues in the USA),
- facilitated the transfer of MBS & QR research to industry and
- set up a summer school to train the next generation of MBS & QR practitioners,

to name but three of its achievements.

This document is the final report of MONET 1; and contains the details of the aims, activities and achievements of the Network. These are presented sequentially in the following chapters. The aims of MONET and action plan for the Network are given in chapters 2 and 3. The activities of the co-ordinating node are described in chapter 4 and those of the Network committees in chapter 5; with the cost statements for each year of MONET being presented in chapter 6. Chapter 7 gives the details of all that has been achieved within MONET; and this is summarised as a retrospective with conclusions in chapter 8. The deliverables of the Network are contained in the Appendices.

Chapter 2

Network Objectives

The MONET Network of Excellence has, from its inception, had a number of aims and objectives which it has sought to progress within MONET 1, with a view to developing them even further in the future. In order to achieve these objectives, the Network at its beginning organised itself into a number of committees, each with a specific role within the Network. In this chapter the objectives of MONET are stated and the remit of each of the committees is described by its “terms of reference”.

2.1 The Network Objectives

The MONET Network has the following main objectives in the technological area of Model-based Systems and Qualitative Reasoning:

1. Assist in the coordination of European research & development.
2. Aid the transfer of MBS & QR technology to industrial applications.
3. Stimulate European MBS & QR systems research to address the needs of industry.
4. Increase the awareness of the technology through education and training.
5. Provide information resources.
6. Provide surveys and identify potential application fields and research fields.

2.2 Terms of Reference

The management structure of MONET was established by means of a meeting held in June 1997 and discussions amongst the Member Nodes. The resulting structure is shown in figure 2.1.

2.2.1 Research Coordination Committee (RCC)

The role of the RCC within the Network is captured in the following list of responsibilities and activities.

- Responsibility for surveying the field and reporting on developments, including identifying research gaps and opportunities.
- Helping to initiate new collaborative research projects.
- Defining benchmark criteria and reference problems which will further future MBS & QR development.
- Compiling a compendium of MBS & QR Research to provide information about academic and industrial research groups. (This activity is the joint responsibility of the RCC and the co-ordinating node, see section 4.4.3.)
- Encouraging discussion about research problems via workshops and other forums organised by the committee.

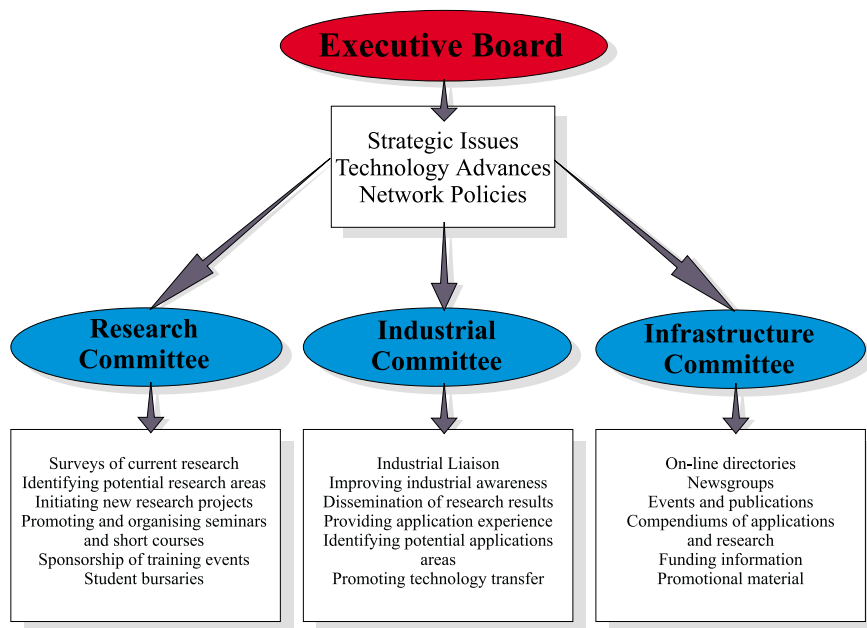


Figure 2.1: The MONET Management Structure

2.2.2 Industrial Liaison Committee(ILC)

The following list defines the function of the ILC within the Network.

- Responsibility for the pro-active interaction with the industrial sector.
- Helping to improve industrial awareness and liaise with industry to identify new applications.
- Keeping interested companies updated on the latest developments through industrial awareness events, in addition to the Newsletter and Web pages.
- Advertising the activities of the Network via professional institutes, professional societies, MBS & QR systems related journals and conferences of associated disciplines.
- The dissemination of application experience and research results from the network via training courses, workshops on applications and visits/exchanges between industry and academe.
- Surveying current applications, compiling the Compendium of Applications.
- Promoting technology transfer through industrial membership and affiliation to the Network.

2.2.3 Communications & Infrastructure Committee (CIC)

The Communications & Infrastructure subcommittee is responsible for ensuring the effective delivery of information to public access enquirers and network members. CIC members will be responsible for locating, assessing suitability (from a technical and IPR perspective) and reporting on :

- Lecture notes and seminar material from MONET Nodes.
- Funding for research and industrial staff/student exchanges and visit programmes including long and short term funding programmes at both national and European levels. As network membership grows to global levels it is anticipated that information concerning non-EU funding schemes will be incorporated.
- Information on opportunities for education, training and visits.

The CIC is to provide, via its knowledge of network information, the necessary mechanisms to bring together and encourage collaborative research projects. In this capacity it is involved in any technological transfer issues associated with the network. As such it may be described as the mediating committee between the RCC & ILC.

The promotional tasks associated with the CIC involves close communications with the other committees via certain members who are also members of the RCC and ILC.

Chapter 3

Action Plan for the Network Lifetime

3.1 Workplan Review

The three year Workplan for MONET 1 is shown in figure 3.1.

3.2 MONET NoE Deliverables

1. **Technological Roadmap**

Version 1.0 of the Technological Roadmap was delivered at the mid-term review; subsequently this was updated to version 1.1. Version 2.0 is contained in Appendix G

2. **Research Compendium**

The foundation of the research compendium was established as a mSQL database and exists as a web service open to all MONET members. It has also been delivered to all members on the CD-ROM (see item 8 below).

3. **Industrial Applications compendium**

The industrial applications compendium exists as a downloadable document on the website or available by request from the coordinating node. Copies have been sent to all nodes and the text of the document is on the CD ROM.

4. **MONET Information Resource: MIR**

This is a development from the original research compendium and contains the database. It is a fully searchable web-based information engine providing the Network with a means of both information entry and extraction, which can deal with both research and application information. The data entry and categorisation mechanisms for references has been set up between the coordinating node and the Research Coordination Committee.

5. **Research and Applications Surveys**

The research and applications surveys were the result of the analysis and review of the contents of the research and applications compendia. These documents are available on the website and CD-ROM as well as in hardcopy form. They have continued to feed into the development of the Technological Roadmap, and are contained in Appendices I and J

6. **WWW services**

The Website underwent a major revision in May 1998. These services have been constantly monitored and updated. Regular contact with MONET members ensured that appropriate services were offered. Please refer to:

<http://monet.aber.ac.uk/>¹

¹Throughout this document, wherever reference is made to the MONET website, the information contained at the address referred to can also be found on the MONET CD-ROM (see section 7.3).

MONET Management/Action Plan - to Month 36 Progress Report

Committee	Annual Progress Report				Mid-Term Review				Annual Progress Report		Ph2Prop	
	Y1 Q1	Y1 Q2	Y1 Q3	Y1 Q4	Y2 Q1	Y2 Q2	Y2 Q3	Y2 Q4	Y3 Q1	Y3 Q2	Y3 Q3	Y3 Q4
	Publicity etc.											
CIC / Co	WWW service	23/6/97	7/11/97			22/6/98		24/3/99	22/6/99	24/9/99		
CIC	Mail list	23/6/97							22/6/99			
ILDC / Co	Newsletter	23/6/97	22/10/97		Open		Open	23/3/99	Open		Open	
	Publication date		24/11/97		28/9/98	18/12/98		22/6/99	To be reviewed		Open	
ILDC / Co	Publicity materials	23/6/97	6/10/97					24/3/99	22/6/99	24/9/99		24/3/00
Co / ALL	Promotional Media CD		25/11/97			23/8/98		1/2/99	22/6/99	1/11/99		24/3/00
CIC	Newsgroup / On Hold		22/9/97		22/5/98			24/3/99				
	Directories											
CIC / Co	Nodes	23/6/97		23/3/98					23/9/99			
CIC / Co	Participants	23/6/97		23/3/98								
ILDC / RCC	Events		22/9/97	23/3/98					23/9/99			
ILDC / RCC	Agencies / Sponsors		22/9/97	23/3/98				24/3/99				
ILDC / RCC	Courses		22/9/97	23/3/98				24/3/99	23/9/99			
	Compendia											
ILDC	Applications		22/9/97	23/3/98			24/9/98		22/6/99			
RCC	Research		22/9/97	23/3/98			24/9/98		22/6/99			
ILDC / RCC	Tools		22/9/97	23/3/98			24/9/98	24/3/99	22/6/99			
ILDC / RCC	Software		22/9/97	23/3/98			24/9/98	24/3/99	22/6/99			
ILDC / RCC	Materials (Tutorial etc)		22/9/97	23/3/98				23/3/99				
	Services											
ILDC	Applications survey		22/9/97		22/6/98			25/5/99		18/12/99		24/3/00
RCC	Research survey		22/9/97			23/8/98				18/12/99		
ILDC / Co	Applications Search		22/9/97	23/3/98				23/3/99		18/12/99	23/3/00	
CIC / Co	FTP service / On Hold		22/9/97	23/3/98			24/9/98				23/3/00	
CIC / Co	Disc service / On Hold				22/6/98	23/9/98						
	Demonstrations								22/6/99			24/3/00
CIC / Co	on-line software					23/9/98		23/3/99	24/3/99	22/6/99		24/3/00
	Further Activities											
	Guidelines					23/9/98			22/6/99			24/3/00
	Integration					24/9/98						24/3/00
	Libraries					24/9/98			22/6/99	24/9/99		
	Education					24/9/98				24/9/99		
	Task Groups							23/3/99		24/9/99		

Milestones

- Mail list
- WWW server
- Launch newsletter
- Second newsletter
- Directory of nodes
- Events Dir
- Apps compendium
- Publicity
- Online directories
- FTP and disc services
- Task Groups
- Tools and s/w online
- Applications comp update
- FTP and disc services update
- Update to research survey
- Third newsletter
- Applications survey
- Online software
- Demo software available
- CD ROM available
- Prep Monet II
- Research survey
- National awareness events
- Demo s/w avail
- Fourth newsletter
- Update of publicity
- Update Online dir
- Apps survey update
- Tools and s/w update
- Update Online directories
- Apps survey update
- PHASE 2 in
- Online software update
- Technology roadmap version 2.0

- CIC Communications & Infrastructure
- ILDC Industrial Liaison & Dissemination
- RCC Research Co-ordination
- EB Executive Board
- Co Project Co-ordinator

- Creation or major revision
- Major update or review
- On-going incremental updates
- Distribution Phase
- Project Deliverable

7. Publicity Material

The first designs of the publicity material were designed and agreed upon during the early stages of the project. Examples of the material are given in Appendix B.

8. CD-ROM

The original plan for a promotional CD-ROM was not considered a prudent investment of MONET resources for the following reasons:

- (a) CD-ROM technology has, for these purposes, been superseded by the Web; and in fact the MONET website has already covered much of what the CD-ROM was meant to advance.
- (b) A CD-ROM is inconvenient and inefficient to update and distribute than placing the information on the Web.
- (c) Given these facts the cost of producing a separate publicity CD was considered too high relative to the benefits.

However, it is also recognised that since some members do not have ready access to the web it was desirable to produce a CD-ROM to service their needs. This CD-ROM is an image of the MONET website (omitting personal data) at the end of the 3rd year. A copy of the CD-ROM is included with this document.

Chapter 4

Co-ordinating Node Activity

The node at the University of Wales, Aberystwyth is designated the Co-ordinating Node. This Node has co-ordinated the general activities of the Network as a whole and provided general administrative services to the Network as required. The details of operation and administration of the co-ordinating node, as well as the services provided are summarised in this chapter.

4.1 Meetings

Communication between the directors and administrative staff was maintained by regular weekly progress meetings at the coordinating node. These meetings were minuted and a record of the minutes filed which are available on request.

4.2 Procedures & Policies

The co-ordinating node has been instrumental in developing certain policies for the Network operation. A “Procedures and Policies” document was produced to act as a guide in this direction.

Communicating how the management of the network has been implemented, together with future decisions of committees to such a widespread and diverse membership, can be problematic. Contradicting policies and unclear procedures will inevitably arise within a newly formed multinational organisation unless steps are taken to provide a working policy document. Ultimately the responsibility of communicating the organisational concepts and strategy of MONET, plainly and unambiguously to the network members, lies with the network management. The procedures document has assisted in that task.

The policies and procedures document was designed to act as a quick reference to members, and others, who wish to clarify certain aspects of the operation of MONET. Examples of the kind of information which it is important to have available in this way are the procedures for: claiming expenses, applying for support and applying for membership (including the criteria for assessing the most suitable type of membership). A copy of the procedures document is included as Appendix A

4.3 WWW Services

The coordinating node was responsible for the design, compilation, ongoing development and maintenance of the MONET Website. The development was directed both by the needs of the Network as communicated to the committees and as specified by the committees and task groups.

To gain a fuller appreciation of this outcome please refer to the MONET website at:

<http://monet.aber.ac.uk/>

It is intended that this facility will be provided beyond the lifetime of MONET 1; and will be maintained by the co-ordinating node to a limited extent.

4.4 Administration

4.4.1 Personnel

During the life of the MONET 1 there have been a number of personnel changes. This is to be expected given the temporary nature of the contracts that can be provided; which means that staff will eventually look for more permanent posts (or posts more central to their career plan). The details of the personnel employed during the lifetime of MONET 1 are shown below.

Name	Start Date	End Date	Network Function	Reason for Departure
John Hunt	June 1997	Sept 1998	Director	Started own company
Suzy Shipman	June 1997	Nov 1998	Administrator/CO	Maternity leave
Suzy Shipman	March 1999	March 2000	Administrator/CO	Obtained permanent post
Tina Lewis	Nov 1998	March 2000	Administrator	Obtained permanent post
John McCardle	June 1997	April 1999	Manager	Obtained lecturing post
Julia Brant	June 1999	June 2000	Manager	End of contract
Lyn Jufferholz	April 2000	Aug 2000	Administrator/CO	Obtained permanent post
Jude Stockwell	April 2000	Aug 2000	Administrator/CO	Obtained permanent post
Olympia Petrou	Aug 2000	Sept 2000	Administrator/CO	End of contract

4.4.2 Administration, Materials and Records

The coordinating node has been responsible for the redesign and standardisation of:

1. Membership application forms.
2. Project proposal forms.
3. Financial claim and reimbursement forms.
4. Guidance notes.

(Examples of the standardised forms and letterheads available are provided in Appendix C)

In addition strict membership records have been kept including members contact details and CVs, contract documents with regard to participation in the network and all financial receipts and invoices.

With regard to the general administration of the Network the staff of the co-ordinating node have been responsible for:

- all financial management,
- the creation, maintenance and updating of MIR,
- administration of the members meeting,
- organisation and administration of EB meetings,
- arranging of flights, accommodation and expenses reimbursement,
- administration of student bursaries,
- administration of the Task Groups,
- compilation and updating of the Technological Roadmap,
- compilation and production of Newsletters,
- production and dissemination of Network reports.

4.4.3 Development Tasks

Once the committees had specified the services required to enhance and progress the Network aims it fell to the co-ordinating node to implement and maintain these. In order to expedite the development of specific services it was sometimes necessary to augment the co-ordinating node staff complement for short periods, as outlined below.

The MONET Information Resource: MIR

- In July and August 1998 Mr D. Kendal was employed to implement the research compendium; following the specification laid down by the RCC.
- Between July and September 1999 Mr N. Hughes was employed to implement MIR as specified by the RCC. This resource has subsequently been maintained by the co-ordinating node, who have also entered and reviewed the data.

The CD-ROM

Between July 4th and September 22nd 2000 Mr. J. Bailey has been employed to create a CD version of the MONET website.

Chapter 5

Committee Activities

5.1 Executive Board (Chair: George Macleod Coghill)

5.1.1 Meetings

The MONET Executive Board (EB) has met at regular intervals throughout the lifetime of MONET 1; with e-mail communication being used to facilitate decisions and discussions between these meetings. The EB met on the following dates:

8th September 2000 - Paris, France.
25th May 2000 - Brussels, Belgium.
12th November 1999, Amsterdam, The Netherlands.
23rd - 24th September 1999, Edinburgh, Scotland.
1st August 1999 - Stockholm, Sweden.
10th June 1999 - Loch Awe, Scotland.
16th April 1999 - Seville, Spain.
10th December 1998 - Amsterdam, The Netherlands.
7th - 8th October 1998 - Brussels, Belgium
28th April 1998 - Birmingham, England.
19th September 1997 - Paris, France.
25th June 1997 - London, England.

The minutes of the EB meetings are on the members website at:

http://monet.aber.ac.uk/members_docs/members_pages/rep_min.html

5.1.2 Main Activities

The EB is responsible for the overall conduct of the Network. The EB performs a strategic planning and controlling function to define the long term goals of the Network (including the Technological Roadmap), and guide their implementation. As such it has the final say in the levels and distribution of funding to the various tasks of the Network. Although the Board does not play any major role in the affairs of the subcommittees, in its function as overseer the following decisions were made with regard to the funding of proposals.

Financial Proposals

1. A proposal for funding was received regarding DX'97. The proposal involved supporting 12 postgraduate students to attend DX'97 at a total cost of 5,300 euros.
Result - It was decided to fund the students for the full amount requested with provisos that the students write a report which may then be published in the MONET newsletter and that suitable acknowledgements be made at DX'97.
2. Support for a Model-Based Reasoning Colloquium held at the Institution of Electrical Engineers in November 1997: this proposal had been partly accepted as suggested by the Industrial Liaison Committee.
Result - MONET funded the attendance costs for one EB member but not the attendance costs/fees for the 3

Ph.D. students. The amount funded was 584 euros. The Executive Board negotiated that the MONET logo should be placed on flyers for the Colloquium and an attendance discount be offered for MONET members.

3. Solicitation of financial support from MONET for the invited session on Intelligent Prognostic Methods during CESA98.

Result - This proposal was rejected after much discussion based on the following criteria:

- (a) non-European venue,
- (b) not wide enough audience,
- (c) topic not central enough, and
- (d) benefits (to MONET) not shown.

4. A proposal was received for financial support regarding the Model-Based Systems section of ETAI (Electronic Transactions on Artificial Intelligence), to be edited by Dr. habil. P. Struss.

The idea of ETAI is to make papers public on the web and allow them to be discussed electronically. The associated newsletter would announce new submissions and contain summaries of the discussions. Several board members were not sure that having a joint newsletter with ETAI would be a good idea and were concerned about the amount of work that would fall on the Coordinating Node. Also, our newsletter is not frequent enough since the ETAI newsletter would need to be produced every 2 months. As a result the board members felt that MONET could support ETAI, but could not undertake the work.

The proposal was for a part-time administrative assistant, and required funding to the level of 8000 euros.

Result - The EB recognised the strategic importance of this task to the promotion of MBS & QR and the rapid dissemination of the results of research in the domain. The proposal was accepted subject to clearance with the EC.¹

5. A proposal was received to fund both QR'99 and DX'99 at 4000 euros each. This was to include 2 invited speakers and 4 - 5 students together with secretarial support. These international workshops were being held in Europe and being organised by members of the EB. They were meeting in the same location, sequentially with a one day overlap. They are the main venues for the publication of specifically MBS & QR related research.

Result - The EB recognised the importance of these workshops to the domain and granted the request. The student funding was granted with the same provisos as before regarding acknowledgement and the production of a report.

6. A proposal was received from the CIC to hold an All Members Meeting. This was seen as an important event in order to improve communication between members of the Network and increase the levels of activity within the Network (outside of the committees). In order to attract members and to demonstrate the relevance of the technology, major speakers were invited, real applications of MBS & QR were presented and an industrial awareness session was included.

Result - The importance of this event was recognised by all and a budget of 20000 euros was allocated to the task. This budget included: Speakers' expenses, accommodation for the participants, and limited travel for academics and students.

7. A request for financial support was received from the organisers of the Workshop on Application of Interval Analysis to Systems and Control (with emphasis on recent advances in Modal Interval Analysis (MISC'99)). This conference was being held in Europe and a number of papers were being presented by MONET members.

Result - The EB decided that while the subject of the conference was not primarily to do with MBS & QR there was a significant overlap and strong interactions. The EB felt that these links and interactions were worthy of developing; therefore a contribution of 2500 euros was agreed on the condition that the contribution be acknowledged in the proceedings (and that a copy of the proceedings be sent to the co-ordinating node).

¹This task was not implemented because, while a suitable candidate to carry out the work was found, they did not in the end take up the post. It was thought unlikely that a new person would be found before the end of MONET I; therefore this has been written into the MONET II proposal as an explicit task.

8. A request for support for two students to attend each of QR'00 and DX'00 was received.
Result - The EB approved this for the previously stated reasons and approved a bursary of 1300 euros per student with the same provisos as before.
9. A request for student support was received from a member of the Network to attend ECAI'2000. This major conference had a large MBS & QR content.
Result - The request was approved at a level equal to that which ECAI was itself providing for students (400 euros). It was also decided that three other bursaries be made available for students in the MBS & QR area to attend.
10. Following the feedback received from the mid-term review, it was decided that a number of task groups (TGs) should be funded. To this end a call was put out early in 1999. The details of the different task groups proposed are presented in section 7.1, though they fall into two distinct categories: those with a definite remit to bring about a short term achievement, and those with a more open and longer term remit.
Result - The different types of TG were funded to different levels. The Summer School and CD ROM TG's were allocated a budget of 65000 euros, the other task groups were allocated between 5000 and 6000 euros.
11. A proposal was received from the ILC to fund the production of a number of items of "demonstration software". The proposal envisaged that the software would be developed by students at member nodes. The purpose of the software is to illustrate the utility of MBS & QR in an accessible way.
Result - A "call for proposals" was sent out to the Network. The EB agreed to fund each accepted proposal at a level of 500 euros; this was apportioned as 250 euros on commencement (as an incentive) and 250 euros on acceptance of the software. It was recognised that there was a risk involved but the potential results were deemed to be worth the small outlay.

The Technological Roadmap

A deliverable of MONET is the Technological Roadmap, and it was the responsibility of the EB to produce this document. The first version of the roadmap was delivered at the time of the mid-term review.

The EB has continued to develop the roadmap over the period since the review. A major activity in this regard was a facilitation day held in Edinburgh in September 1999. The purpose of this event was to enable the EB to identify the important directions for the future of MBS & QR, and to use this to update the Technological Roadmap. The event consisted of a one day meeting led by a facilitator, whose role was to direct the discussion in order to develop, amongst other things: an understanding of the role of the roadmap, elucidate the vision of the Network, and map out the major features and benefits of MBS & QR. In order to ensure that a broad representation of MBS & QR was present, a number of non-EB members were invited to participate.

The notes of the facilitation day event are included in Appendix F and the latest version of the Technological Roadmap is included as Appendix G.

5.2 Research Coordination Committee (Chair: Bert Bredeweg)

5.2.1 Meetings

The RCC has had several meetings during the lifetime of the MONET 1 Network; with e-mail communication being used to facilitate decisions and discussions between the meetings. These meetings were more frequent during the earlier part of the term, while directions and tasks were being discussed and developed. Latterly, once specified, the tasks were handed over to a task group to bring to fruition, or to the co-ordinating node for implementation and maintenance. The RCC meetings held were:

- 31st July 1999 - Stockholm, Sweden.
- 19th April 1999 - Seville, Spain.
- 9th December 1998 - Amsterdam, The Netherlands.
- 27th April 1998 - Birmingham, England.
- 5th-6th November 1997 - Toulouse, France.
- 19th September 1997 - Paris, France.

The minutes of the RCC meetings are on the members website at:

http://monet.aber.ac.uk/members_docs/members_pages/rep_min.html

5.2.2 Main Activities

The initial RCC goals were set at the start of the Network in accordance with those presented in the original proposal. Subsequent discussion within the RCC led to the realisation that the goals as originally set down were too ambitious for the resources available. The RCC therefore reappraised and prioritised these goals and the conclusion of this exercise was a judgement regarding what was achievable within MONET 1. This was used by the RCC to decide which goals would be attempted.

The main tasks and activities of the RCC are itemised in this section; however, since several of the outcomes of these activities are dependent on collaboration between more than one committee and the co-ordinating node, the details are presented in section 5.5.

The Research Compendium

The committee met in November 1997 (see above), to discuss the research compendium, in consultation with the CIC and the ILC. This resulted in the following documents being produced.

- Specifications for the Research compendium (available at http://monet.aber.ac.uk/members_docs/members_pages/interface.html)
- Draft software compendium specifications
- A document outlining gaps in MBS & QR research

The research compendium specification was transferred to the co-ordinating node for implementation in April 1998.

The ongoing development of this compendium specification has resulted in the MONET Information Resource (MIR) (see section 7.5).

The specifications of this resource are available at http://monet.aber.ac.uk/members_docs/members_pages/MIR_Spec.html

The software compendium did not come to fruition in its originally intended form; rather, in collaboration with the ILC this has been implemented as a repository of Demonstration Software (see section 7.6).

The research opportunities document forms an integral part of the Technological Roadmap.

The MONET Summer School

The RCC (along with the other committees) recognise that the task of training the next generation of MBS & QR practitioners is extremely important. In order to facilitate this it was agreed that a MONET summer school should be established. At its meeting in April 1999 the RCC generated the outline of the summer school and appointed a task group of three people to bring it about.

The task group organised the summer school, engaging the world's leading exponents of MBS & QR as tutors. The summer schools was limited to 40 participants in order to optimise the benefits, and took place from the 15th to the 19th of May 2000. See section 7.2 for details. Both the Summer School itself and the educational materials provided therefor are deliverables of MONET 1, and so the educational materials are included as Appendix M.

Task Groups

In response to the report on the mid-term review, the RCC decided to examine the possibility of progressing the goals and vision of MONET by setting up a number of task groups. The RCC discussed and identified two classes of task group: those to deal with specific issues for the Network; and those with a more general remit examining a particular aspect of MBS & QR in order to address issues regarding research gaps and technology transfer within a given domain. The former were set up from within the committees and the latter were set up by means of a "call for proposals" to the Network membership, which was sent out early in 1999.

Further details on the task groups may be found in section 7.1.

5.3 Industrial Liaison Committee (Chair: Rob Milne)

5.3.1 Meetings

The ILC had some meetings during the lifetime of MONET 1; though most of the activities were carried out through e-mail interaction or smaller meetings between individual members in order to progress particular items.

The meetings of the full ILC were:

19th April 1999 - Seville, Spain.

25th September 1998 – Toulouse, France.

27th April 1998 - Birmingham, England.

19th September 1997 - Paris, France.

The minutes of these ILC meetings are on the MONET members website at:

http://monet.aber.ac.uk/members_docs/members_pages/rep_min.html

5.3.2 Main Activities

The ILC set its goals at the beginning of the Network, and continuously developed these throughout the Network lifetime. The main activities and tasks are itemised in this section; however, since several of the outcomes of these activities are dependent on collaboration between more than one committee and the co-ordinating node, the details are presented in section 5.5.

Applications Compendium

A document has been produced containing details of applications or projects that have been submitted in response to a questionnaire sent out to members. The contents of this document form the basis of the industrial application compendium and it is available via the MONET website as a downloadable document at

http://monet.aber.ac.uk/members_docs/members_pages/databases.html

and a hardcopy of the document is included in this report as Appendix I.

An overview summary showing the breakdown of industrial applications with respect to tasks, domains and geographical location was also provided.

Demonstration Software

The ILC (in collaboration with the RCC) recognised that in order to improve the industrial uptake of MBS & QR technology there was a need for accessible demonstrations of the technology. To this end a “call for demonstrations” was sent to members early in 1999. It was expected that the demonstrators would be written by students and as an incentive a small amount of money was made available for the successful proposals.

Four proposals were received and three were accepted as suitable as demonstrators. The one proposal which was rejected was not considered suitable because it amounted to the final stage of a piece of software which had had an extensive amount of development. As such the proposal was deemed to be for development work and therefore outside the scope of MONET.

Further details of the Demonstrators are contained in section 7.6

The CD ROM

The development of a CD ROM for publicity and communication was a task to be undertaken in the latter phase of MONET 1. The means of production, content and target were discussed in depth by the ILC, RCC and EB. An initial requirements specification was outlined and the task of producing the CD was delegated to a task group consisting of members of both the ILC and RCC (as well as the Network Manager). The details of the CD ROM development are contained in section 7.3

5.4 Communications and Infrastructure Committee (Chair: Luca Console)

5.4.1 Meetings

This committee met as a full committee whenever necessary during the lifetime of MONET 1. However, the committee has kept in electronic communication in order to progress the tasks within its sphere of responsibility. The meetings of the full committee were:

1st July 1998 – Aberystwyth, Wales.

19th September 1997 – Paris, France.

The minutes of the CIC meetings are on the members website at:

http://monet.aber.ac.uk/members_docs/members_pages/rep_min.html

5.4.2 Main Activities

This is a small committee of 4 members whose role has evolved over the course of MONET 1. The original terms of reference were not considered adequate to provide a suitable sphere for this committee with respect to the other committees and the Network as a whole.

Therefore the committee re-drafted its terms of reference. The Infrastructure Committee served as the liaison between the other committees and the coordinating node. It helped with the web page design, and decisions on access for different levels of membership. It also played a role in the decisions regarding how the database should be set up for the compendia: providing guidance to the Network Manager and Administrator.

The committee made comments on the web pages and comments on the compendia production. Further recommendations were also made on the Industrial Liaison Committee questionnaire, concluding that the compendia should be standardized.

Communications Questionnaire

It was noted that full-scale committee meetings use up a lot of the MONET resources. It was suggested that video conferencing may be an alternative. The Committee investigated further by experimenting with live meetings utilising video conferencing facilities, and publishing a questionnaire concerning the facilities of network members.

Obtaining access to the necessary equipment proved to be a problem for many members. It was noted that a PC with a video card was the minimum requirement but full video conferencing hardware with access to ISDN, or the use of a studio provided the best quality. Furthermore a meeting using video conferencing would need to be well planned and structured and provided little flexibility.

This indicates that it is not yet feasible to have Video-conferencing as a major means of communication within the Network; but a watching brief is being kept on this for MONET 2.

All Members Meeting

The CIC, along with the other committees, recognised the need to provide a forum to improve communication between the members of the Network and increase the levels of activity within the Network (outside of the committees). In order to attract members and to demonstrate the relevance of the technology, major speakers were invited, real applications of MBS & QR were presented and an industrial awareness session was included.

The All Members Meeting was held in November 1999. It was organised by the CIC in collaboration with the Network Manager and the Chair of the RCC. See section 7.4 for details.

5.5 Joint Committee Activities

While many activities involved the co-operation of more than one committee, most things could be assigned to the provenance of one or other of the committees. However, a number of events and deliverables were produced jointly by members of more than one committee. The results of these joint activities are recorded in this section.

Gaps Between Research and Industry Related to Model-Based and Qualitative Reasoning

This issue was the focus of an analysis carried out by members of the RCC and ILC. The document catalogues the main gaps which are perceived to exist between the technical state of the art and industrial needs. By creating an understanding of these gaps it is hoped that bridges can be developed to cross them.

A copy of the survey appears as Appendix H.

Institution of Electrical Engineers (IEE) Colloquium

Members of the RCC and ILC jointly worked to put on a national colloquium, early in the life on MONET 1, which highlighted the industrial applications of MBS & QR research. A summary of the colloquium is contained in section 7.10.1.

ECAI Workshop

The MONET committees decided to initiate a workshop with the purpose of providing an opportunity for researchers and industrialists to come together and debate the key issues that dominate and possibly hinder the progress of MBS & QR. The workshop took place on the 24th August 1998 at ECAI'98. A summary of the workshop is contained in section 7.10.1.

QR'99 and DX'99

The Thirteenth International Workshop on Qualitative Reasoning (QR'99) and the Tenth International Workshop on the Principles of Diagnosis (DX'99) co-located at Loch Awe in Scotland. The chair of the organising committee of QR'99 was Chris Price, a member of the RCC; and a co-chair of DX'99 was Rob Milne, chair of the ILC.

IJCAI Workshop

A Workshop on Qualitative Reasoning for Complex Systems and their Control was held during IJCAI'99. This workshop was organised jointly by members of the RCC and ILC and served to display the range of applications of MBS & QR available. A summary of the Workshop is contained in section 7.10.1.

Chapter 6

Financial Details

The following pages show the financial details for each year of MONET 1.

MONET Personnel Costs 23/6/97 - 22/6/98

Name	Man Hours	hourly rate	Amount
Mark Lee	266.00	30.49	8,110.34
Chris Price	281.00	18.15	5,100.16
George Coghill	70.00	18.85	1,319.50
John McCardle	1,680.00	17.87	30,024.06
Suzie Shipman	1,680.00	8.33	13,986.52

£/ecu 24/6/99	1.52
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TOTAL	£ 58,540.58	ecu 88,770.94
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MONET Networking Costs 23/6/97 - 22/6/98

Dates	Destination	Travel & Subsistence		Sub (ecu)	Organisation	TOTAL	
		£	ecu			£	ecu
25-Jun-97	London Heathrow	1,641.99 +	7,127.19	9,617.11	708.94	1,075.04	7,051.00
9/9/97 - 10/9/97	Edinburgh - Amsterdam	673.88		1,021.87			673.88
19-Sep-97	Paris, France	6,479.51		9,825.53			6,479.51
5/11/97 - 6/11/97	Toulouse, France	1,958.24		2,969.48			1,958.24
17-Nov-98	IEE, London, UK	72.11		109.35			72.11
27/4/98 - 28/4/98	Birmingham, UK	5,262.51		7,980.07	1,017.02	1,542.21	6,279.53
28-Jul-97	Student Bursaries	3,495.12	5,300.00	5,300.00			3,495.12

TOTAL				36,823.40	1,725.96	2,617.25	26,009.39	39,440.65
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MONET Other Costs 23/6/97 - 22/6/98

Description	£	ecu
Software	75.74	
	227.21	
	46.81	
	21.28	
Network Server	143.98	0.00
	20,442.80	
PCs & Peripherals	305.00	0.00
	318.39	
	2,170.21	
Maintenance	558.00	0.00
External Printing	992.62	1,505.21
	986.00	1,495.17
	356.00	539.84
	1,575.00	2,388.33
	535.00	811.27
	135.00	204.71
Distribution	150.00	227.46
Admin support	23.49	35.62

TOTAL	29,062.53	44,070.42
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MONET Overheads Costs 23/6/97 - 22/6/98

Description	£	ecu
Postage	62.72	
	100.00	
	71.27	
Telephone	29.95	0.00
Fax	608.43	
Stationary	37.26	0.00
	13.29	
	22.35	
	68.14	
	36.03	
	64.54	
Reprographics	10.88	0.00
External	80.07	
Internal	89.92	
	43.25	
Photocopying	325.00	0.00
e-mail support	2,150.00	3,260.26

TOTAL	3,813.10	5,782.18
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	TOTALS	
	£	ecu
Personnel	58,540.58	88,770.94
Networking	26,009.39	39,440.65
Other	29,062.53	44,070.42
Overheads	3,813.10	5,782.18

TOTAL	117,425.60	178,064.19
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VAT	5,346.74	8,107.80
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MONET Personnel Costs 23/6/98 - 22/6/99

Name	Man Hours	hourly rate	Amount	euro
Mark Lee	285.00	34.50	9,832.50	14,945.40
Chris Price	106.00	29.17	3,092.02	4,699.87
George Coghill	178.00	20.55	3,657.90	5,560.01
John McCardle			24,877.84	37,814.32
Julia Brant			2681.23	4,075.47
Suzie Shipman			11,974.65	18,201.47
Tina Lewis			4,482.43	6,813.29
			£	ecu
TOTAL			60,598.57	92,109.83

£/ecu 24/6/99	1.52
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MONET Networking Costs 23/6/98 - 22/6/99

Dates	Destination	Travel & Subsistence	
		£	euro
8-Jul-98	Infrastructure Committee	221.09	336.06
23-25/8/98	ECAI Brighton	3,975.56	6,042.85
25-Sep-98	ILC Committee - Toulouse	545.59	829.30
7-8/10/98	Project review - Brussels	5,726.00	8,703.52
2-3/12/98	NoE meeting Vienna	1,157.95	1,760.08
8-10/12/98	Amsterdam - RC & EB	6,418.07	9,755.47
23-26/3/99	VMBD Demo - Stuttgart	416.12	632.50
15-20/4/99	Seville RC & EB	8,687.54	13,205.06
6-11/6/99	QR/DX Scotland	1,481.22	2,251.45
1-Aug-99	Stockholm Workshop	751.50	1,142.28
	Sponsored events	6,924.96	10,525.94
TOTAL		36,305.60	55,184.51

MONET Other Costs 23/6/98 - 22/6/99

Description	£	euro	
Software	18.00	27.36	
	1698.72	2,582.05	
Network Server maintenance	1423.66	2,163.96	
PC equipment	3226.96	4,904.98	
	25.00	38.00	
	471.98	717.41	
	100.00	152.00	
	242.06	367.93	
	393.63	598.32	
Portable data projector	3130.20	4,757.90	
External Printing	1465.00	2,226.80	
	665.00	1,010.80	
	995.00	1,512.40	
TOTAL		13,855.21	21,059.92

MONET Overheads Costs 23/6/98 - 22/6/99

Description	£	euro	
Postage	71.27	108.33	
	149.20	226.78	
	262.03	398.29	
	34.16	51.92	
	120.64	183.37	
	385.81	586.43	
Stationary	92.73	140.95	
	18.64	28.33	
	150.62	228.94	
	60.47	91.91	
	84.44	128.35	
	68.94	104.79	
	29.36	44.63	
Reprographics Internal	16.52	25.11	
	154.51	234.86	
Telephone	216.08	328.44	
Fax	77.75	118.18	
	73.23	111.31	
e-mail support	2150.00	3,268.00	
TOTAL		4,216.40	6,408.93

	TOTALS	
	£	euro
Personnel	60,598.57	92,109.83
Networking	36,305.60	55,184.51
Other	13,855.21	21,059.92
Overheads	4,216.40	6,408.93

TOTAL	114,975.78	174,763.19
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VAT 0.00

MONET year 3 accounts (Estimated before final charges.)

	Spent or committed		Subto
	\$	euros	
EB meetings			
Seville	1,976.34	3,162.14	
Loch Awe	1,032.48	1,651.97	
IJCAI Stockholm	2,615.26	4,184.42	
EB at facilitation site	3,459.74	5,535.58	
EB at AMM Amsterdam	3,276.01	5,241.62	
Brussels	4,165.91	6,665.46	
			<u>26,441</u>
Other meetings			
F5 seminar and EU seminar (jnb)	305.08	488.13	
Industrial visit - Brit Steel (mhl/gmc)	348.64	557.82	
ILC special meeting Edinburgh Oct 99 (ps)	190.14	304.22	
			<u>1,350</u>
Events IJCAI Workshops	2,644.76	4,231.62	
Facilitation days	3,709.41	5,935.06	
All Members Meeting	9,441.05	15,105.68	
Summer School	24,442.27	39,107.63	
			<u>64,379</u>
Other costs RCC support (inc Summer School)		7,800.00	
ILC support	1,900.00	3,040.00	
Task groups		13,000.00	
CD ROM from Website	2,500.00	4,000.00	
MIR maintenance	1,000.00	1,600.00	
QR/DX student support		5,200.00	
Student demos		2,000.00	
ECAI student support		1,600.00	
			<u>38,240</u>
Coord node Materials	1,434.53	2,295.25	
other costs (consumables)	2,154.98	3,447.97	
Services - publicity	4,916.35	7,866.16	
MIR software development	4,968.78	7,950.05	
Coord node staff (estimate)	66,080.32	105,728.51	
			<u>127,287</u>
Extension costs (estimates) Staff	11,500.00	18,400.00	
materials	2,000.00	3,200.00	
consumables	1,400.00	2,240.00	
Office PC upgrades	1,800.00	2,880.00	
newsletter	1,300.00	2,080.00	
final dept infrastructure charges	5,000.00	8,000.00	
Final EB/ILC meeting		10,000.00	
Additional Task group funds		8,000.00	
New Task group (Education)		5,000.00	
			<u>59,800</u>
			<u>317,499.28</u>
	euro rate	1.6	
	Budget for year 3		<u>322,173.00</u>
	Total spend		<u>317,499.28</u>
	Estimated remainder		<u>4,673.72</u>

Table 6.1: MONET Year 3 Accounts

Chapter 7

Exploitation Activities

As was stated in chapter 2, the MONET Network of Excellence is committed to working towards a number of objectives which are inherently open ended. In this chapter we present the main achievements of MONET 1 with respect to these objectives.

The general achievement is the provision of an effective infrastructure within which the objectives can be further progressed in the future. The major specific achievements described in this chapter are:

- The Task Groups (General and Specific).
- The MONET Summer School.
- Development of the CD ROM.
- The All Members Meeting
- The MONET Information Resource (MIR).
- Demonstration software.
- The production of materials to publicise MONET.
- The MONET Website.
- Presentation of MONET at major conferences and to industry.
- The sponsorship of Workshops at major international conferences.

7.1 Task Groups

In order to progress the aims of the Network a number of Task Groups (TGs) were set up or approved. These TGs fell into two categories: those with a specific remit to perform a particular task for the Network (e.g. the Summer School), and those which were open and dealt with particular aspects of MBS & QR (e.g. Multiple Models).

The “Call for Task Group Proposals” was sent out after the midterm review. The EB had discussed and identified a number of topics for which TGs should be set up. However, the process of assessing proposals and finding suitable leaders for selected TGs meant that it was late in the lifetime of MONET 1 when the TGs were operational. The result of this was that the achievements of the General TGs were limited as is detailed in section 7.1.2. The lesson learned from this was that the General TGs should have been set up early in the life of MONET 1, and this was one of the reasons for basing the MONET 2 proposal around a number of TGs.

7.1.1 Specific Task Groups

There were three TGs set up to provide a specific service to the Network: one to organise the Summer School, one to organise the All Members Meeting, and one to develop the CD-ROM. Each of these items is of sufficient importance to merit a section of its own and they are listed here in the interests of completeness in sections 7.2, 7.3 and 7.4.

7.1.2 General Task Groups

TG's to assess and develop the goals of the Network were initiated by means of a "call for proposals" sent out to the membership early in 1999. The criteria for each TG was:

- that it should be central to the development of MBS & QR,
- the proposed TG must involve at least three MONET nodes, and
- it should be of direct benefit to the aims of the MONET Network.

Once approved each TG was open and any member of the Network was free to join any TG that was of interest to them. A fixed budget was allocated towards the cost of a meeting and it was up to the TG members to decide how the budget would be apportioned.

Four TG proposals were received and approved: Multiple Models, Model-based Educational Software, Diagnosis (bridging the gap between the MBD and FDI communities) and Biomedical applications. Each of these is central to the MONET domain and approval was given early in 2000. Given the length of time left till the end of the MONET 1 Network, funding for the short term goals of the TGs were modest, with the expectation that they would develop longer term goals that would directly benefit European industry by means of enhanced technology transfer within the context of the proposed MONET 2 NoE.

The Multiple Models TG

The short term goals of this TG were to develop:

- a list of examples of (targeted) applications of model-based systems and their requirements on the form and content of the models and on the exploitation of different models, and
- a proposal for a characterization of work in multiple modelling and their way to address the requirements of the above list.

This TG has had some e-mail discussion regarding plans and directions, and a meeting was planned for Spring 2000. Unfortunately, this meeting had to be cancelled and it has not proved possible to find a suitable time within the lifetime of MONET 1 when a sufficient number of TG members were able to meet.

However, this situation represents a good start for the TG with respect to member nodes wishing to be involved and the goals for the TG. The discussions identified a number of longer term goals which have been included in the MONET 2 proposal.

BRIDGE

BRIDGE is the name given to the diagnosis TG. The main objective in creating this TG is to bring together diagnostic practitioners from the AI and control communities, who currently address diagnostic problems independently of each other, and begin to characterise and harmonise the concepts and practices of the two communities. The short term goal of BRIDGE is to organize a workshop to begin the process of realising the objective.

Extensive e-mail discussion has taken place within BRIDGE (it did not take place within the context of a mailing list and has thus not been archived). This TG has had two meetings: one during the SAFEPROCESS'99 conference and one in Paris on the 7th of September 2000. (Only the latter was funded by MONET). The minutes of these meetings are contained in Appendix K.

The results of the BRIDGE TG at the end of MONET 1 is that a workshop has been organised to take place in the spring of 2001 (co-located with DX'01). The provisional programme for this event is contained in the minutes of the Paris meeting. In addition, the discussions between group members have helped to elucidate a number of further goals which have been included in the MONET 2 proposal.

Biomedical Applications TG

The short term goals of this TG were to provide:

- a list of examples of specific biomedical applications and their requirements for modelling tools (automated or manual), and

- a proposal for a characterisation of work in modelling of biomedical systems and the means whereby they can address the requirements of the above list.

Unfortunately, due to organisational difficulties outwith the control of the TG members this TG was not able to meet during the lifetime of MONET 1.

The Model-Based Educational Software TG

The aims of this TG are:

- to establish a forum of active users and researchers that develop an overview of MBS & QR technologies and their usefulness (applicability) for teaching and training artefacts, particularly for industrial requirements.
- to further specify, via the forum, the integration of MBS & QR with recent developments in terms of the WWW and multimedia.
- to determine the possibilities and limitations of this approach.
- to determine what problems have to be solved in order to use MBS & QR with the WWW and multimedia effectively.

The decision was made early on that the meeting of this TG would take the form of a mini workshop which took place in Aberystwyth on the 5th and 6th of September 2000. The purpose of this was to bring together European researchers interested in this area in order to discuss the possible areas of collaboration and develop a strategy for meeting the aims of the task group. The mini workshop was a success in that it generated the necessary purposeful commitment to the aims of the TG, facilitated the interactions requisite for useful collaboration, and enabled plans to be formulated for the continuation of the TG within MONET 2.

7.2 The MONET Summer School

The MONET summer school was a facility provided to the Network for training two groups of people: the next generation of MBS & QR practitioners, and other engineers and scientists who wish to learn about this technology.

The organisation of the summer school was set up as a TG activity consisting of three people from the MONET committees. The aims of the summer school were:

- 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 which arise from interactions with complex systems,
- to inform the participants of the types of problem that can be solved by application of MBS & QR,
- to present a coherent and comprehensive overview of the main results and achievements of MBS & QR research, and
- to survey the state of the art of MBS & QR technology, highlight the problems and open issues, and point out the research opportunities for the near future.

Since this was the first such Summer School it was not thought appropriate to seek accreditation for doctoral studies at this stage.¹

The Summer School ran from the 15th - 19th May 2000. The tutors on the Summer School were among the world's leading experts on MBS & QR. A copy of the course timetable is included with the Educational materials in Appendix M and a report and evaluation of the Summer School is included as Appendix L.

It should also be noted that this highly successful event was put on for under 40000 euros which was well below the initial estimated cost. This fact is a reflection of the effort put into organising the Summer School by the TG committee.

¹However, several attendees independently requested that the course count towards their research training. The Italian attendees were successful in having the Summer School count towards their doctoral studies; and one Eng.D. student at Cranfield University (UK) was successfully assessed at the masters level on the content of the Summer School.

The feedback received from the course participants was extremely favourable, with many suggesting that it should be run again next year. This feedback has been acknowledged by the EB; however, given the time, effort and expense involved in the production of such an event it is felt that once every two years would be a more reasonable expectation.

The course tutors have given permission for their slides to be put on the MONET website. These can be found at:

http://monet.aber.ac.uk/summer_school/announcement.shtml

7.3 CD-ROM Development

A task group consisting of members of each of the committees and the Network Manager was set up to design and implement the publicity CD-ROM. This TG explored the various possibilities for a multimedia tool to: introduce MBS & QR technology, disseminate and demonstrate example applications and provide tutorials on the domain. The TG consulted with a professional media agency about the resources needed to deliver a high quality promotional product. The results of the TG deliberations were:

1. CD-ROM technology has, for these purposes, been superseded by the Web; and in fact the MONET website has already covered much of what the CD-ROM was meant to advance;
2. a CD-ROM is inconvenient and inefficient to update and distribute compared with placing the information on the Web; and
3. given these facts, the cost of producing a publicity CD was considered too high relative to the benefits.

On the other hand it was recognised that while the Web was designed to bring MONET information to the whole membership, there were those (in certain industrial organisations) who do not have access to the WorldWide Web (or if they have access it is with insufficient bandwidth). In order that they might also have access to the MONET resources it was decided that a CD ROM should still be produced, but that it should have a narrower remit. Rather than being a general publicity tool it would be a resource for MONET members.

The final decision was that an image of the MONET Website at the end of the MONET 1 Network would be copied to a CD ROM and modified to run in that format (including the MIR database). This is a much lower cost production than the originally specified CD. It also serves the dual function of being a record of the MONET website at the end of the project and also a tool for MONET members (particularly those without Web access).

A copy of the CD ROM is included as Appendix N.

7.4 The All Members Meeting

A meeting to which each member node of the Network was invited was organised for November 11th - 12th 1999. This meeting had a twofold purpose: firstly to get feedback from the Nodes about the Network, and secondly to increase the activity levels within the Network by presenting the membership with information about:

- what the Network has to offer,
- what the Network has achieved, and
- the future plans for the Network.

The meeting provided two important features also designed to enhance these aims:

1. A talk by Patrick Corsi of the EC about the IST programme in Framework 5, particularly with regard to MBS & QR.
2. A presentation by Brian Williams of MIT (formerly of NASA) on the model-based diagnosis and reactive planning tools incorporated in the Deep Space 1 exploration probe launched in 1998.

The meeting provided the membership with an opportunity to give their opinions about the Network and provide input to its development. The results of this meeting included: positive feedback and constructive criticism of the Network and, most importantly, evolution of the vision regarding the future development of the Network.

In particular there arose a consensus that MONET should focus the bulk of its efforts on one market sector (the one with most current commercial application – which in this case is the Automotive sector). The expectation is that this focussing would expedite the solving of practical problems in this sector and so enhance technology transfer. This would in turn have a positive effect on work in other domains of MBS & QR. This approach had been seen to work in other areas.

A TG was seen as the best means of achieving this, and while the idea was highly valued, there was not thought to be sufficient time within MONET 1 to do it justice. Instead this philosophy was used as the basis for the MONET 2 proposal.

7.5 The MONET Information Resource (MIR)

MIR is a database which developed out of the research compendium (and subsumes it). The purpose of the database is to collect, organise and disseminate technical information about MBS & QR. A specification was developed by the RCC and passed to the co-ordinating node in the summer of 1999 for implementation. The initial implementation was completed in late summer 1999, though refinement has continued until the end of this phase of the Network.

MIR allows fully functional searches on a number of fields; the information is categorised under several headings: scientific publications, software packages, courses, lecture slides, newsletter articles and the MONET website pages. Information can be submitted to MIR online and, subject to suitable review, will be included in the database under the appropriate heading. Reviewing is also performed online by MONETR members.

While the original specification arose from the RCC and was intended as a development of the research compendium, it can also be expanded to include application items, making it a versatile resource for the MONET membership. MIR is located at:

http://monet.aber.ac.uk/mir_test/index.msql

7.6 Demonstration Software

The MONET committees were concerned about the lack of software available for demonstrating the concepts of MBS & QR; therefore a call was sent out to the membership to solicit proposals for the production of such demonstration software. Three proposals were approved as meeting the criteria of the call; and these are outlined below.

DYP

Dyp is a unix based demonstration of a model-based diagnostic tool for monitoring complex networks such as telecommunication networks. A network is composed of a set of interconnected equipment. This includes a a managed network which transmits data and also a management network. The management network transmits alarms emitted by the equipment to a supervisor which has to interpret them. The method, which is mainly based on the approach proposed by M. Sampath et al, involves a finite-state machine called "diagnoser" drawn from a model based on an automaton. The purpose of the diagnoser is to recognize the alarms and identify the failures.

CIRQ

This demonstration software illustrates the ideas behind qualitative modelling of electrical circuits. Simple circuits, containing resistors, connectors and switches, can be drawn by the user or loaded from file. A simulation algorithm then runs to analyse the circuit. For technical details, see M.H. Lee, "Qualitative Circuit Models in Failure Analysis Reasoning", AI Journal. vol 111, pp239-276, 1999.

GARP

GARP is a shell that allows users to simulate (first order) qualitative models. New domain models can be defined and presented to GARP. The interface of GARP is text-based and allows the user to control the simulation and

inspect the simulation results. The current version of GARP does not include tools for model-building, the user has to build models using a regular text editor. GARP is actively used in research projects (see A. Bouwer and B. Bredeweg, "Explanation and Qualitative Reasoning", Proceedings of the Thirteenth International workshop on Qualitative Reasoning, QR'99, pages 27-31, 1999).

7.7 Publicity

Publicity material was designed and published in October 1997 (a copy of the basic leaflet is reproduced in Appendix B. This has been used for recruitment and dissemination of information about MONET throughout the lifetime of the Network.

Leaflet mailshots Leaflets and request cards were distributed via newsletter inserts, conferences, seminars and colloquia as well as targeted mailshots through specific professional institutions such as the Scottish Software Federation.

Poster Production Printed A3 Posters illustrating MONET objectives, services and membership are available for presentations at conferences and seminars.

Newsletter There have been four Newsletters produced during the lifetime of the Network. These exist in both hardcopy and Web versions. Copies of the Web versions can be found at:

<http://monet.aber.ac.uk/>

7.8 World Wide Web Site

World Wide Web services have been constantly under review and updated depending on the requirements of MONET members. The initial pages were set up within the same month as the start date of the project though the web site has undergone revisions (major and minor) as well as continuous development and extension throughout the lifetime of the Network.

A diagram showing the final structure of the Website is contained in Appendix E; though to obtain a comprehensive picture of the structure and content of the Website please refer to:

<http://monet.aber.ac.uk/>

7.9 Presentations

Presentations about the Network have taken place in two contexts: at conferences/workshops within or related to the domain of MBS & QR, and during visits to industrial companies. Only industrial visits assisted by MONET are recorded here.

7.9.1 Conferences and Workshops

1. The 11th International Workshop on Qualitative Reasoning (QR'97), 4 June, Cortona, Italy - Prof. Lee as Network Director introduced MONET.
2. DX'97, 15th-18th September 1997, Mont-Saint-Michel in France – Dr. Price of the coordinating node presented MONET related subjects.
3. DUTCH/BELGIUM AI conference, 12th-13th November, 1997 – Dr. Bredeweg, University of Amsterdam presented MONET related material.
4. An AI conference – CAEPIA'97 13th November 1997 - The MONET network was presented by Dr. habil. Travé-Massuyès, Laboratoire d'Analyse et d'Architecture des Systèmes, CNRS, France.
5. IEE Colloquium on Applications of Model-Based Reasoning, London, 17th November 1997 – Dr. McCardle introduced MONET services as Network Manager.

6. The 17th BCS International Expert Systems Conference, Cambridge, 15th December 1997 – Dr. Hunt as Network Director presented MONET services to BCS members.
7. QR'98 /DX'98 – Various members of the MONET committees including Dr. Coghill as Deputy Director presented information on MONET membership.
8. QR'99/DX'99 – Ms Brant as Network Manager presented information on MONET.

7.9.2 Meetings with Industry

1. Unilever Research, Vlaardingen, The Netherlands - 9th March 1998 – Dr. Bredeweg & Dr. Struss presented MONET to the research laboratory staff.
2. The MONET all members meeting - 10th & 11th November 1999. Several companies were represented at this meeting. The interactions permitted the current directions and goals of MONET to be presented and adapted in light of feedback received via the discussions.
3. British Steel (now Corus UK), Middlesbrough, England - 12th January 2000 – Dr Coghill & Prof Lee presented MONET to the staff of the Teeside Technology Centre in the UK.

7.10 Conferences & Workshops

7.10.1 Workshop sponsorship

Monet has sponsored a number of workshops relevant to the promotion of MBS & QR; in particular with reference to its applications in industrial contexts.

The Institution of Electrical Engineers (IEE), Savoy Place, London

A colloquium was held at the IEE in London on 17th November 1997 which highlighted the industrial applications of qualitative model based reasoning. The sessions provided case studies where model-based techniques have been used to solve practical engineering tasks.

Model based reasoning techniques were shown to have been applied in the automation of model formulation, simulation, and of engineering tasks such as design, diagnosis, monitoring and control and have been successfully exploited in application domains containing problems that cannot easily be solved with traditional methods.

The speakers at the colloquium were leading exponents in the use of model-based reasoning techniques.

Presentations included: Industrial applications of model-based reasoning; Performing practical model-based diagnosis; Tiger – process monitoring and diagnosis; AutoSteve – electrical design analysis; Selecting tools and models for model-based diagnosis.

The event was managed locally by staff of the IEE and co-sponsored by MONET and The British Computer Society Specialist Group on Expert Systems.

ECAI'98 – Workshop Title: Model-Based Systems and Qualitative Reasoning

MONET Committees made a decision to initiate a workshop at ECAI'98 on the 24th August 1998 at Brighton, UK. Invitations were extended to those active in the MBS & QR community, both academic and industrial. Members of research institutions, universities, high technology SMEs, large systems providers, as well as existing and potential end users, were encouraged to participate. The workshop was designed to be an opportunity for researchers and industrialists to come together and debate the key issues that dominate and possibly hinder the progress of MBS & QR.

The workshop was aimed at stimulating discussions on the present state-of-the-art of MBS & QR research and applications. Sessions included: Technical Aspects of MBS & QR with discussions on formalisation methods, taxonomies, present and potential areas of research; Testing and validation issues including benchmark problems for evaluating / characterizing MBS & QR techniques; Gaps between research and industry - a debate on the issues surrounding technology transfer and research collaboration; Applications of MBS & QR - case studies and technical approaches to real world problems; Recommendations for future research targets and industrial collaboration.

This very successful workshop not only provided high quality technical papers but the final panel session set the foundations for establishing the gaps between research and industry. This workshop also provided the impetus for the revised technological roadmap.

ECAI'98 – Workshop Title: Model-Based Reasoning for Intelligent Education Environments

This workshop was the fourth international workshop in a series dealing with research on how to use Model-Based Reasoning (MBR) techniques for the construction of education systems. The importance of MBR techniques for tutoring and training systems has been identified by many researchers in the area of Artificial Intelligence in Education (AIED). MBR appears to be appropriate for the implementation of the major functions of intelligent training, help and teaching environments. The major aim of this fourth workshop was to further discuss and establish the role and use of MBR techniques for instructional systems.

The workshop set out to focus on the following main themes: The use of MBS & QR techniques for realising tutoring and training functions; Coping with complexity and management issues in Model-Based Learning Environments; and Support for construction of subject matter representation and simulation models. In addition questions regarding the kind of models of interest, and the requirements for a fully operational education system based on MBS & QR techniques were also addressed.

The final talk sought to integrate the ideas that had been presented during the day, and it became clear that these diverse ideas could be actually be integrated into a single framework. This provided a very positive conclusion to a highly successful workshop, leaving the impression that there was certainly room for further workshops of this kind.

IJCAI'99 – Workshop Title: Qualitative Reasoning for Complex Systems and their Control

The participants and organisers of this workshop considered it to be very successful. Over 30 people attended and roughly half these were new to the field and had not presented at such a workshop before. This means that the workshop had the added dimension of helping to bring new, young people into the field.

A problem for the model based and qualitative reasoning community is that there seem to be very few applications. This workshop was a landmark point in changing that old view. Although there are a few obvious diagnosis applications around, most are in the narrow area of technical diagnosis. This workshop showed a new perspective on the state of applications. From the 11 presentations, 10 different application domains were shown! This included: Sociology, Software, Water Treatment, Process Plants, Automotive, Telecomm, Molecular Biology, Medicine, Neuroscience and Materials. The workshop was perhaps most notable for showing the application of MBS & QR to such a diverse range of domains. This is important for the MBS & QR community, as it does demonstrate the wide applicability of the technology.

The second interesting landmark was the mix of young and old among the participants. There were several people who had been involved with MBR since its start, but also many PhD students.

The results of working to apply the technology are very encouraging and look to be successful. This is important to give the field a boost and generate optimism for future applicability.

At the same time, the workers all had very similar problems. Importantly, the problems were generally not technical, but application related. Although there are fundamental issues to be addressed in MBS & QR, these limitations were not holding back the applications efforts presented at the workshop. The conclusion is that there is enough technical capability now to be getting on with good applications. (Although other areas need technical advancement to enable even more applications).

The examples that were presented were all real, but only involved small sets of test data or examples. It is hoped that future workshops will show the same range of real problems, but with lots of examples and test data.

Overall, the workshop represented a landmark in the progress of MBR for 3 reasons:

1. the wide range of application domains.
2. the complexity and maturity of many of the application examples.
3. the mix of established members of the community with new members.

7.10.2 Student Sponsorships

As discussed in section 5.1.2 a number of bursaries were made available to support students to attend major events incorporating MBS & QR. These conferences and workshops are itemized here for completeness.

- The 8th International Workshop on the Principles of Diagnosis, DX'97
- The 13th International Workshop on Qualitative Reasoning, QR'99
- The 10th International Workshop on the Principles of Diagnosis, DX'99
- The 14th International Workshop on Qualitative Reasoning, QR'00
- The 11th International Workshop on the Principles of Diagnosis, DX'00
- The European Conference on Artificial Intelligence, ECAI'2000

Chapter 8

Summary of Achievements

The achievements of the MONET 1 Network can be viewed in two different ways. First there are the tangible achievements which are recorded in the events and deliverables output from the Network. But then there are also the intangible achievements: the lessons learned, the development of the discipline and the growth and advancement of the community.

Looking at the latter of these first. In brief, our mission has been to promote MBS & QR technology, both in research and applications, and to provide structure and coherence for the MBS & QR community within Europe. When we first started, over three years ago, the expertise in the area was scattered, disorganised and isolated. The USA was the most prominent and Europe's contribution consisted of isolated pockets of very small groups or individuals. We found we had difficulty explaining to the uninitiated what MBS technology was and what it could offer. We even had to convince the EC that this was a distinct and valuable technology in its own right (and not part of other "vague" reasoning AI methods) - a task that we clearly achieved at the mid-term review!

From our present vantage point, at the end of MONET 1 we can ask the question: "How prominent has MBS & QR become?" At the recent ECAI'2000 conference in Berlin (the 14th European Conference on Artificial Intelligence) we find that the refereed technical papers are classified into 16 categories and MBS & QR jointly forms the second largest category (with Multi-Agent Systems, below Machine Learning). This is a tightly refereed conference (31% acceptance rate) and submissions came from 42 countries, so we can attach some significance to the fact that over 10% of the papers are in MBS & QR. Our own activities have also shown a consistent growth of interest. In November 1999 we held an all-members meeting in Amsterdam which was open to all persons at the 80 sites of the network and also other interested parties. This was very successful, with invited speakers Patrick Corsi from the EC and Brian Williams from NASA/MIT.

So the research side of MBS seems to be healthy; we have seen a growth in both interest and activity. However, the applications side is always harder to assess. We know that companies and industries adopt new research results and methods according to the relevance for their particular needs, but reports and papers are of secondary importance and therefore much less in evidence. One source of information is the PAIS track at ECAI'2000 (Prestigious Applications of Intelligent Systems). Of the 31 papers submitted, 11 were accepted and 3 of these were in the MBS area (including the impressive NASA Deep Space One control system). On this basis, MBS & QR is making good inroads into applications as well as research.

Other assessments of the take-up of the technology into applications are largely a matter of personal experience. In the UK, the members of the co-ordinating node have been encouraged by a success story in which we were involved. A large company had had some serious problems with a fault monitoring system on a chemical plant and approached MONET in order to explore MBS & QR and assess if it could help in their work. Following a visit by a MONET team we were able to show how MBS & QR could provide robustness and coverage over fault cases that is difficult to achieve with rule-based approaches. A consultancy analysis then took place and this led on to a joint university/company project to implement an MBS solution. The potential gains for this are considerable, we believe, as the safety, pollution, and economic benefits are likely to show. In addition, large companies are able to transfer and reproduce solutions over many similar plant thus increasing the leverage of the original outlay. The university will also benefit by being stimulated in new research directions by the demands of this novel case study. One major message (and lesson learned) from this example is that what industry really wants (and needs) is an easy mechanism for finding out about and accessing the developing technology and research, rather than a catalogue of existing applications.

On the other hand the tangible achievements of MONET 1 are also clearly identifiable. Over the past three years

the Network members have succeeded in creating an effective infrastructure for the dissemination of information to the MBS & QR community and industry; and a foundation on which to build the means of transferring the technology into industry.

Two major resources made available to the community are:

- The MONET website (and the contents thereof), and
- The MONET Information Resource;

and this is the first time such an integrated service has been provided.

The other tangible achievements of MONET 1 are:

- The continuing education of practitioners and new researchers (by means of workshops, the Summer School, and members meetings)
- The initiation of a number of Task Groups to carry out particular tasks or to examine specific issues within the domain of MBS & QR.
- The development of a CD ROM containing the same resources as the website (including MIR) for those with no, or inadequate, internet access. The CD-ROM also provides a record of the final state of the website at the end of MONET 1.
- The provision of tutorial material and a set of items of demonstration software illustrating the techniques and applications of MBS & QR.
- The compilation of a Technological Roadmap.

Finally, it is clear that MONET has made a difference to the discipline of MBS & QR. As well as the achievements detailed above it has provided a focus, not just for European researchers but also for the worldwide MBS & QR community. This is evinced by the recognition afforded to MONET by our colleagues in the USA, who now see MBS & QR in Europe as being far better organised than it is in their own country.

These achievements form a solid beginning. The next step is to consolidate these strengths and focus the efforts of the community (through the Network). The interactions and discussions that have taken place over the lifetime of MONET 1, culminating in the All Members Meeting, lead us to believe that the correct next step is to concentrate most effort on the sector closest to commercialisation and use its resources to aid sector penetration. Success in this area would have the effect of driving theoretical development and application in other sectors. The infrastructure, foundation and standing created by the MONET Network of Excellence provides a solid basis on which to proceed with this task.



Prifysgol Cymru
Aberystwyth
The University of Wales