



Project no. **004074**

Project acronym: **NATURNET-REDIME**

Project title: **New Education and Decision Support Model for Active Behaviour in Sustainable Development Based on Innovative Web Services and Qualitative Reasoning**

Instrument: **SPECIFIC TARGETED RESEARCH PROJECT**

Thematic Priority: **SUSTDEV-2004-3.VIII.2.e**

## **M7.2.1**

### **1<sup>st</sup> NNR user group workshop on using QR technology**

Due date of deliverable: not specified  
Actual submission date: 08/04/2006

Start date of project: **1<sup>st</sup> March 2005**

Duration: **30 months**

Organisation name of lead contractor for this deliverable:  
**University of Amsterdam<sup>1</sup>**

Revision: Final

<b>Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)</b>		
<b>Dissemination Level</b>		
<b>PU</b>	Public	X
<b>PP</b>	Restricted to other programme participants (including the Commission Services)	
<b>RE</b>	Restricted to a group specified by the consortium (including the Commission Services)	
<b>CO</b>	Confidential, only for members of the consortium (including the Commission Services)	

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**Abstract**

This document describes the goals, contents, and results of the first NaturNet-Redime WP4 and WP6 workshop on Qualitative Reasoning and Modelling, at the University of Amsterdam, October 11<sup>th</sup>-14<sup>th</sup>, 2005.

**Document history**

<b>Version</b>	<b>Status</b>	<b>Date</b>	<b>Author</b>
01	Draft, outline	11/11/2005	Bredeweg
02	Draft, attendance	16/11/2005	Bredeweg, Liem
03	Draft, added more sections	05/04/2006	Bouwer
04	Draft, refinement of the text	07/04/2006	Salles
05	Draft, first attempt to finalise	07/04/2006	Liem
Final	Final corrections	08/04/2006	Bredeweg

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## 1 Introduction

This Garp3 user group workshop was the first in a series of training workshops in the context of the work in WP4 and WP6 of the NaturNet-Redime project. The main goal of this workshop was to support the WP6 partners in getting started with their work on developing qualitative reasoning (QR) models for their case studies. This entailed the following sub-goals for the workshop and its participants:

- Getting acquainted with QR concepts and terminology
- Learning to operate the Garp3 single user workbench
- Learning to build models following a structured approach

To address these goals, the Garp3 single user workbench (developed in WP4) for building qualitative models and running and inspecting simulations was presented. The UvA team prepared training materials and conducted training sessions to acquaint workshop participants with the Garp3 interface and functions, QR modelling aspects, and terminology.

The second part of the workshop focussed on the structured methodology for building QR models (developed in WP6). The methodology was presented and a significant part of the workshop was used for hands-on work using the methodology for building QR models. Participants collaboratively worked towards developing concept maps, causal models, and expected behaviour graphs of their case studies.

The work done during the workshop provided the conceptual understanding of QR and captured some of the important knowledge about the case studies which is required to successfully create qualitative models about these case studies. In addition, the workshop established a common understanding of the important issues to be dealt with in a curriculum on sustainable development.

## 2 Workshop agenda

After the half-year NaturNet-Redime Project Board meeting on Monday, October 10<sup>th</sup>, members of WP4 and WP6 carried on with a workshop on building qualitative models in the context of representing relevant aspects of sustainable development. The agenda for these activities was as follows:

### **Tuesday October 11<sup>th</sup>**

- 09.00 – 10.00 Introduction to Workshop & Qualitative Reasoning (L<sup>2</sup>) (BB<sup>3</sup>)
- 10.00 – 11.00 Usability assessment part 1 & QR software walkthrough & QR assignments session (A<sup>4</sup>)
- 11.00 – 11.15 *Refreshment break*
- 11.15 – 13.00 QR assignments session (A)
- 13.00 – 14.00 *Lunch*
- 14.00 – 18.00 QR assignments session (A)
- 16.00 – 16.15 *Refreshment break*
- 16.15 – 18.00 QR assignments session (A)

### **Wednesday October 12<sup>th</sup>**

- 09.00 – 09.45 An advanced QR model: The Ants' Garden (L) (PS<sup>5</sup>)
- 09.45 – 10.30 Advanced QR assignments session (A)
- 10.30 – 10.45 *Refreshment break*
- 10.45 – 12.00 Advanced QR assignments session (A)
- 12.00 – 13.00 *Lunch*
- 13.00 – 15.00 Advanced QR assignments session (A) & Usability assessment part 2
- 15.00 *Enjoy Amsterdam*

### **Thursday October 13<sup>th</sup>**

- 09.00 – 09.30 Guidelines for Sustainable Development Curriculum (L) (TN<sup>6</sup>)
- 09.30 – 10.00 Structured method for model building (L) (BB)
- 10.00 – 11.00 Presentation of case studies (L) (DDNI, CLGE, UnB)  
*Focus: Structural model and global behaviours*
- 11.00 – 11.15 *Refreshment break*
- 11.15 – 13.00 Structured method for model building – Case studies part 1 (A)
- 13.00 – 14.00 *Lunch*
- 14.00 – 16.00 Structured method for model building – Case studies part 2 (A)  
*Focus: Detailed behaviour and causal model (case studies)*
- 16.00 – 16.15 *Refreshment break*
- 16.15 – 18.00 Structured method for model building (A)

### **Friday October 13<sup>th</sup>**

- 09.00 – 09.30 Millennium Development Goals (L)
- 09.30 – 10.30 General WP4/WP6 discussion

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<sup>2</sup> L: Lecture.

<sup>3</sup> BB: Bert Bredeweg (UvA)

<sup>4</sup> A: Assignments being carried out by the participants.

<sup>5</sup> PS: Paulo Salles (UnB)

<sup>6</sup> TN: Tim Nuttle (UoJ)

- Focus: next version of QR software, meetings schedule, means for collaboration, etc.*
- 10.30 – 10.45 *Refreshment break*
  - 10.45 – 11.15 General WP4/WP6 discussion (Cont.)
  - 11.15 – 12.00 Structured method for model building – part 3 (A)  
*Focus: textual descriptions of model fragments (case studies)*
  - 12.00 – 13.00 *Lunch*
  - 13.00 – 14.30 Administrative issues related to WP6
  - 14.30 – 15.00 Closing discussion
  - 16.00 – 18.00 *Boat trip in Amsterdam*

## **2.1 Detailed description of the activities**

On Tuesday, October 11<sup>th</sup>, the workshop started with an introductory lecture by Bert Bredeweg about the workshop goals and an introduction to fundamentals of Qualitative Reasoning. After a walkthrough demonstration of the Garp3 workbench, the participants worked with Garp3 on a series of assignments using the Garp3 user manual [1] and the QR vocabulary document. The latter being part of the curriculum for learning about QR modelling [3]. These exercises culminated in a simple, but complete QR model, which can be run to generate simulations.

On Wednesday, October 12<sup>th</sup>, Paulo Salles presented an advanced QR model about the Ants' garden, an intriguing example of interacting populations. Afterwards, the participants worked on advanced assignments where they had to build a model about the consequences of deforestation step by step, obtaining simulations of increasing complexity.

On Thursday, October 13<sup>th</sup>, and Friday, October 14<sup>th</sup>, most of the time was allocated to the structured method for model building based on the framework for conceptual QR description of case studies, as described in NNR deliverable report D6.1 [4]. This specifies how the WP6 project members can build qualitative models following a sequence of six steps from orientation and initial specification to implementation and model documentation, each involving specific model-building steps with concrete forms of output.

On Thursday, October 13<sup>th</sup>, Tim Nuttle presented the guidelines for developing a curriculum about sustainable development [6], specifying learning objectives based on concepts from the UN Millennium Ecosystem Assessment. This links human well-being to services provided by Earth's ecosystems, such as fresh water provision and flood regulation. Bert Bredeweg gave a lecture about the framework for conceptual QR description of case studies, and next the partners that are starting their work on case studies presented their initial ideas and proposals for the modelling effort (DDNI, on the Danube Delta Biosphere Reserve; CLGE, on River Mesta, Bulgaria; and UnB on the Riacho Fundo, Brazil). It is expected that the qualitative models that will be developed for the case models in WP6 will contribute to a better understanding of causality in the linkages between such ecosystem services and human well-being (for more details, see NNR deliverable report D6.8, [6]).

On Friday, October 14<sup>th</sup>, Paulo Salles illustrated some of the important issues in sustainable development using implemented qualitative models, and how these relate to the Millennium Development Goals as declared by the UN [8]. The discussion about structured ways of building models continued until lunchtime. Furthermore,

administrative issues were discussed and there was room for discussions about the work in WP4 and WP6, which included topics such as future developments to the Garp3 software, the schedule for future meetings, and means for collaboration.

### 3 Participation

During the first two days of the user group workshop, 25 participants were taught how to use the Qualitative Reasoning and Modelling (QRM) software. In addition to WP6 project partners, many interested members from the rest of the project participated. Furthermore, two researchers from outside NaturNet-Redime project joined this part of the workshop. One from the Institute for Biodiversity and Ecosystem Dynamics (IBED), Faculty of Science, University of Amsterdam who is interested in modelling, and another from Leibniz Center for Law, Law Faculty, University of Amsterdam who is interested in Knowledge Representation and Reasoning.

The last two days, which focussed on the QR modelling methodology, were not open for participants from outside the project. However, some non-WP6 partners from the project remained, in addition to the WP6 group making a total of 18 participants.

The overall participation during the workshop is shown in Table 1.

Table 1: Workshop participation

Tuesday/Wednesday (Modelling)	Thursday/Friday (Methodology)
Andreas Zitek (BOKU)	Andreas Zitek (BOKU)
Eugenia Cioaca (DDNI)	Eugenia Cioaca (DDNI)
Richard Noble (UoH)	Richard Noble (UoH)
Una Bike (KLC)	Una Bike (KLC)
Peteris Bruns (KLC)	Peteris Bruns (KLC)
Maris Alberts (IMCS)	Maris Alberts (IMCS)
Yordan Uzunov (CLGE)	Yordan Uzunov (CLGE)
Emilia Varadinova (CLGE)	Emilia Varadinova (CLGE)
Elena Nakova (CLGE)	Elena Nakova (CLGE)
Tim Nuttle (UoJ)	Tim Nuttle (UoJ)
Paulo Salles (UnB)	Paulo Salles (UnB)
Ana Luiza (UnB)	Ana Luiza Rios Caldas (UnB)
Wendy Moreno (MOVIQUITY)	Michael Neumann (UoJ)
Michael Neumann (UoJ)	Bert Bredeweg (UvA/HCS)
Marcus Jochum (FELIS)	Anders Bouwer (UvA/HCS)
Octavian Iercan (FELIS)	Jochem Liem (UvA/HCS)
Jiri Hiess (VYSOCINA)	Elinor Bakker (UvA/HCS)
Nino Paterno (FRANCAVILLA)	Peter Barz(ENL)
Rinke Hoekstra (UvA/LCL, no partner)	
Willem Bouten (UvA/IBED, no partner)	
Bert Bredeweg (UvA/HCS)	
Anders Bouwer (UvA/HCS)	
Jochem Liem (UvA/HCS)	
Elinor Bakker (UvA/HCS)	
Peter Barz(ENL)	



## 4 Working on Qualitative Reasoning

On Tuesday, October 11<sup>th</sup> and Wednesday, October 12<sup>th</sup>, the workshop focused on how to build QR models with the Garp3 workbench. The walkthrough demonstration of the Garp3 software served to get participants acquainted with the range of features in the Garp3 interface for building model ingredients, assembling model fragments and scenarios, and running and inspecting simulations. All features of Garp3 are documented in detail in NNR project deliverable report D4.2.1, the User Manual for Single-User version of QR Workbench [1]. A screenshot of the Garp3 main screen and model fragment editor is shown in Figure 1.

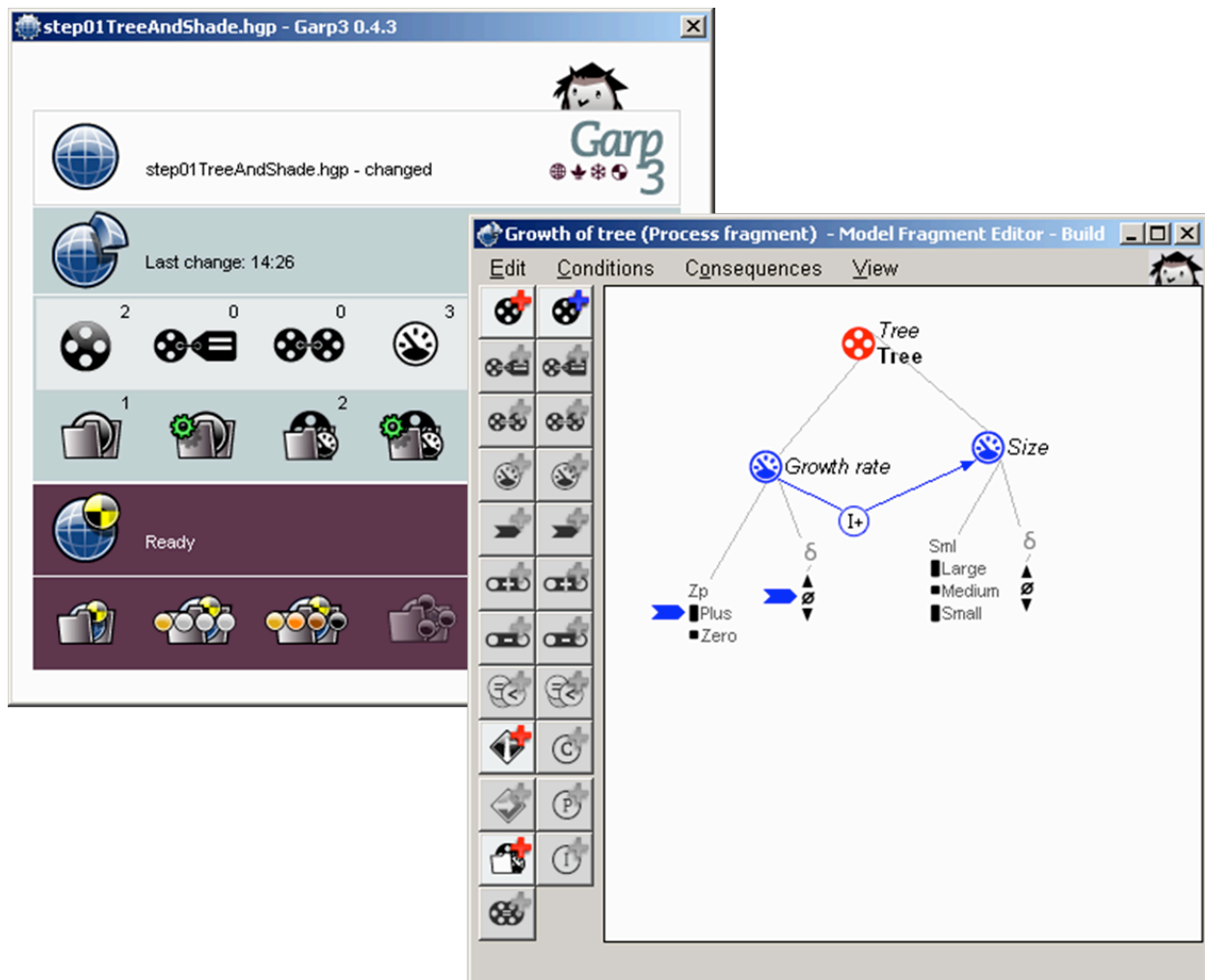


Figure 1: Screen shots of the Garp3 main screen and model fragment editor.

The QR assignments involved working with Garp3 to build models of increasing complexity. On Tuesday, the first assignment was to create a model of the growth of a single tree, which casts a shade proportional to its size. To make this work, participants had to create an entity for the tree, quantities for tree size and growth rate, a scenario specifying initial values, a static model fragment, and a process model fragment. The right part of Figure 1 shows the model fragment editor with the process model fragment, which specifies tree growth.

The state graph, shown in Figure 2, shows the results of simulating the scenario *a tree with small size*. The corresponding quantity value history is shown in Figure 3. As

expected the *Size* of the tree increases from *small* to *medium* to *large*, as does the *Shade*. At the same time the *Growth rate* keeps increasing within its *plus* interval.

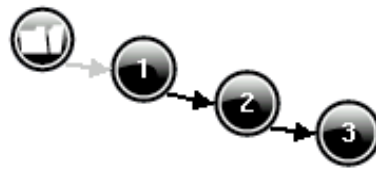


Figure 2: The state graph generated by simulating the tree with small size scenario.



Figure 3: The quantity value history belonging to the state graph shown in Figure 2.

After completing the first model, a series of models had to be created concerning different aspects of population growth. The basic model contained a population entity with quantities for Biomass, Birth, and Number-of (population size). This basic model was extended to include competing processes (birth and death), alternative representations to make processes depend on specific conditions, agents for colonisation and immigration, and model fragments for positive, neutral, and negative growth. All of the models used in these exercises are described in detail in NNR project milestone report M6.11, which is integrated in the curriculum for learning about QR modelling [3].

On Wednesday, Paulo Salles presented an advanced QR model about the Ants' garden, which involved four interacting populations. Besides an interesting case study, this model also showed some important modelling principles, such as building model fragments for populations in general, and specializing these in more detail for different populations. Afterwards, the participants worked in teams on a more advanced assignment where they had to build a model about river ecology, including aspects of rainfall and erosion.

## 5 A structured approach to modelling

On Thursday and Friday, the focus was on the modelling methodology described in NNR project deliverable report D6.1, the Framework for conceptual QR description of case studies [4]. An overview of this structured approach to building qualitative models is shown in Figure 4.

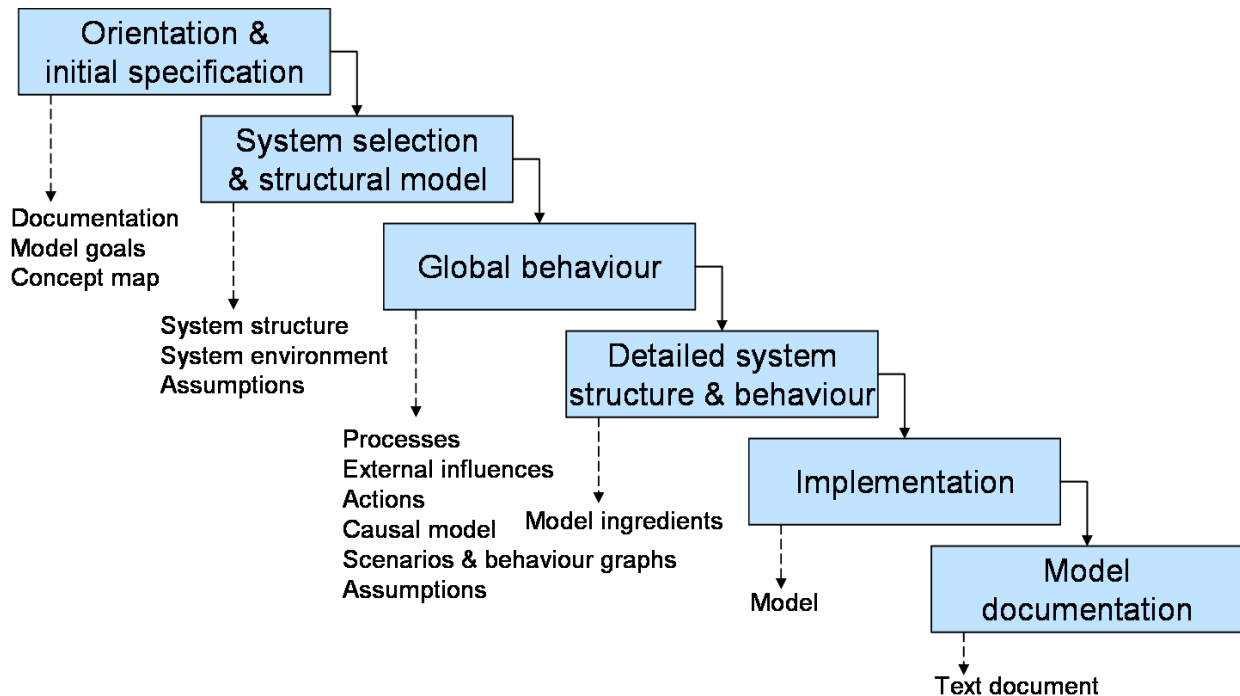


Figure 4: Structured approach to building qualitative models.

The methodology consists of six steps, and starts with step 1, orientation and initial specification of the system. Important output of this step includes the model goals and a concept map capturing the important aspects in the domain. In step 2, system selection & structural model, the system to be modelled is identified in terms of its constituents and the surrounding environment. In step 3, global behaviour, the relevant behavioural aspects are listed, including processes, external influences, actions and behavioural assumptions. Furthermore, this step will result in a causal model diagram, a description of scenarios and behaviour graphs illustrating the expected behaviour. In step 4, detailed system structure & behaviour, all the relevant knowledge is specified using the Garp3 terminology. In step 5, implementation, the Garp3 workbench is used to implement the model. Besides creating the model ingredients, this also involves simulating and debugging in order to improve and optimize the model and obtain the required results. Step 6, model documentation, is necessary to provide information about the model, and underlying argumentation.

Following the first three steps of the methodology, participants worked on the case studies (Task 6.2, 6.3, 6.4, 6.5, and 6.6) in several sessions on Thursday and Friday. The participants were divided into three groups (with people from different institutes), one for each case study. To allow comparison and feedback from other groups, each group had to present their preliminary results. On Thursday, each group gave a presentation about their domain, including model goals, concept map, system structure, external influences and assumptions. On Friday, each group gave another presentation including processes, causal model, scenarios and expected state-transition graph.

## **6 Usability and Evaluation**

Before and after working with the software, the user group workshop participants filled in questionnaires to investigate the usability of the workbench, particularly emphasizing the learn-ability of the icon language used to operate the software. See D4.1 for results [2].

Considering the results that some workshop participants have produced after the workshop (cf., [5,7,9]), it is clear that the objectives of the workshop have been addressed successfully. The participants show that they master the structured methodology by successfully applying it to the case studies. They also demonstrate proficiency in elementary use of the Garp3 workbench.

## 7 Conclusion & Discussion

The workshop was successful in attracting participants from the target audience of WP6 partners who have to develop qualitative models, as well as some participants from the rest of the project and other institutes who had interest in the QR technology developed within WP4. All participants worked fruitfully on assignments involving models in different domains, and by the end of two days of exercises, they had mastered using Garp3 to build and simulate several models by themselves. In addition, the presentations and discussions during the last two days established a clear method for proceeding towards building models for the different case studies.

Feedback from participants included questions and comments on the Garp3 workbench, including features that confused them, and requests for additional features. Some participants commented they needed some time to get used to the QR terminology, but many were impressed by what it could do, and some participants realized that it could be helpful to them (for instance, one participant mentioned 'managerial opportunities' after seeing the first examples).

The group sessions with people from different institutes working together triggered creativity and sparked interesting discussions, and led to results which may well feed into the next phases of the project. Overall, participants commented that the workshop was an instructive and enjoyable experience. From the organisers point of view the workshop was a success as the participants have been made proficient with the structured modelling methodology and with the basic functionality of the Garp3 workbench.

## 8 References

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