Position paper on Stakeholder Response

Gareth Old, Mark Robinson and John Packman

With contributions from:

Simon Groot, Nicki Villars, Jens Christian Refsgaard, Charles Perrin, João Rocha, Jan Krejcik, Tanja Bergfeld, Jonas Olsson, Maria Kapetanaki, Gábor Bálint and István Zsuffa

April 2005
Contract EVK1-CT2001-00097

This page has intentionally been left blank.

HarmoniQuA is a project to carry out research, technological development and demonstration under the European Commission's "Energy, Environment and Sustainable Development" programme, Key Action 1 "Sustainable Management and Quality of Water", 1.1 Integrated management and sustainable use of water resources at catchment, river basin or sub-basin scale, 1.1.1 Strategic planning and integrated management methodologies and tools at catchment/river basin scale under contract EVK1-CT2001-00097.

This report is an official deliverable of the HarmoniQuA project. This R&D project is partly financed within the European Commission's "Energy, Environment and Sustainable Development" programme, Key Action 1 "Sustainable Management and Quality of Water", 1.1 Integrated management and sustainable use of water resources at catchment river basin or sub-basin scale, 1.1.1 Strategic planning and integrated management methodologies and tools at catchment/river basin scale under contract EVK1-CT2001-00097.

The full reference is:

Mark Robinson, Gareth Old and John Packman. 2004. Position paper on Stakeholder Response, WP4-4, www.HarmoniQuA.org

Table of Contents

1. Introduction

1.1 The HarmoniQuA Project

Harmonising Quality Assurance in model based catchment and river basin management (HarmoniQuA) is a 4 year project (2002 to 2005) supported by the European Commission. The HarmoniQuA project consortium is made up of 12 partner organizations from 10 European countries. Partners have expertise in 7 domains of model based water management.

HarmoniQuA has developed a Modelling Support Tool (MoST) to provide a user-friendly guidance and quality assurance framework that will contribute towards enhancing the credibility of catchment and river basin modelling.

MoST has the functionality to:

- Guide: to ensure a model is properly applied;
- Monitor: to record decisions, methods and data used in these tasks;
- Report: to provide reports suitable for managers/clients, modellers, auditors, stakeholders and the general public.

For further information see the project website:

www.HarmoniQuA.org

1.2 Stakeholders and HarmoniQuA

For this report stakeholders are defined as all persons who have an interest in model results but who are not directly involved in applying models. They include water managers, interest groups (including agricultural/industrial associations and green NGOs), planners, policy makers and concerned members of the public. However, stakeholders are central to the modelling process. They may be problem owners who commission modelling studies and may therefore want to specify how they are done. Given that the lives of many people are impacted by the results of model based decisions they are likely to have an interest in model studies and may want assurance that they are being undertaken to the highest standards. Furthermore, the Water Framework Directive encourages stakeholder participation in the modelling process.

HarmoniQuA serves stakeholders by:

- involving them in the modelling process;
- producing dedicated modelling study reports; and
- ensuring that studies are conducted to high standards.

1.3 Aim of this document

This report presents the views of stakeholders from across Europe on quality assurance in modelling. It is one of a series of 3 reports that summarise wide consultations on quality assurance and quality standards for modelling.

The official definition of quality assurance is: 'All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality' (ISO 8402, 1994).

The success of HarmoniQuA MoST depends on whether or not it is adopted by the modelling community. Wide dissemination of HarmoniQuA MoST is essential. However, to ensure dissemination is effective it is necessary to consult both stakeholders and professionals (report in preparation) to investigate their views on quality assurance in modelling.

The information presented in this report will guide the project team in the required content of dissemination material and scope of workshops. It is necessary to know whether stakeholders appreciate the potential benefits of modelling in addition to the adoption of rigorous quality assurance procedures. It is also important to investigate whether stakeholders believe that current practices are adequate. The views of stakeholders on HarmoniQuA MoST and its Knowledge Base will be reported in detail on the public website (following national workshops): see below. However, limited comments are presented in Section 3.10.

1.4 Stakeholder Consultation

Project partners were given responsibility for selecting, contacting and reporting on the views of stakeholders in their country. In total almost 600 stakeholders were targeted from across Europe. Responses were received from stakeholder consultations in Czech Republic and Slovakia, Denmark, France, Greece, Germany, Hungary, Netherlands, Portugal, Sweden and United Kingdom. Several other countries were targeted but no responses were received. The stakeholders that were targeted included public action groups, planners, private enterprises, policy makers, public administrations, national parks and those involved in operational water management.

Stakeholder consultations mainly involved emailing questionnaires, discussions at workshops (e.g. HarmoniCA technical workshop) and telephone conversations. A discussion page and request for readers to complete questionnaires on the public website did not yield any responses. Experiences of professional modellers on the views of stakeholders were also considered. Overall questionnaire response rates were very low and it proved extremely difficult and time consuming to encourage

stakeholders to complete and return questionnaires. It was agreed at the September 2004 project meeting that only a small amount of the projects resources should be invested in encouraging stakeholders to respond. The stakeholder response presented in this report is largely based on the responses from questionnaires and the experiences of project partners. Out of the targeted stakeholder group (almost 600 persons) 104 persons responded. The questionnaire that was emailed to stakeholders can be seen in Appendix A.

Stakeholder representation at HarmoniQuA demonstration workshops (Wallingford: January 2004 and 2005; Copenhagen 2004) has been extremely low. Requests for comments on HarmoniQuA MoST and the Knowledge Base have not yielded feedback from stakeholders. Therefore, it has not been possible to fully report on stakeholder views on HarmoniQuA and its Knowledge Base. Further stakeholder consultation will take place through the national workshops planned for 2005 (see www.HarmoniQuA.org) and stakeholder views will be published on the public website. A dedicated newsletter will be used to encourage stakeholders to attend the workshops in 2005.

2. Modelling context

This chapter provides a summary of the types of modelling that are undertaken in each country targeted in the survey of stakeholders. It was important to identify the main areas of modelling in order to identify stakeholder groups for consultation.

2.1 United Kingdom

Most UK water environment modelling is commissioned by relatively large and well-informed organizations, namely the Environment Agency/Scottish Environment Protection Agency or the Water and Sewerage Companies/Scottish Water. Moreover, recent pressure to contract out most work to private consultants has meant that most modelling studies are performed by a small number of large 'framework consultants' working under contract to the commissioning organizations. Groundwater modelling is used to review water abstractions and broader scale impacts on the wider environment, such as changing climate and land use. Precipitation runoff modelling is commonly used in water resource management. Hydrodynamic modelling is used for the detailed design of specific flood defence schemes, but also as part of a national programme to define 100-year floodplains. Flood forecasting modelling is also undertaken to predict water levels for the 1200 predetermined 'Flood Warning Areas'. Surface water quality modelling is used to assess the impact of point and distributed discharges on watercourses. Biota modelling is used to predict the range of invertebrate species in specific watercourses. Comparisons are made between observation and model prediction to identify biological stress.

2.2 France

The Water Framework Directive (WFD) did not introduce many new aspects to the existing French system since water management at the catchment scale already existed in France since 1992. However, the WFD has resulted in a few technical modifications to the existing system in France:

- the WFD asks for classification of water types including surface waters, groundwaters, estuaries and coastal waters, comprising the following five quality classes: High, Good, Moderate, Poor, Bad. Until now, the French standards on water quality only concerned rivers.
- water quality is evaluated on an ecological ground, which was not done in France so far.
- water quality is assessed by considering an initial status and a reference status that need to be characterized.

Due to these modifications in the French water management organisation, there is today a need for new/improved tools for water quality and quantity characterisation and management. In that respect, models are obviously of central importance. Presently, the use of models in the water domain is quite large in France though the situation is very heterogeneous from one organisation to another. In a few fields however, a national policy has been defined to improve the use of models. Due to this uneven development of modelling tools, the interest and the need expressed for Quality Assurance tools is much dependent on the local or regional contexts.

2.3 Germany

German model studies cover all different domains of MoST. Since 1985, an extensive development of new models for water management has taken place. Germany intends to structure public research via two commissions, a Government-state-commission (Bund-Laender-Kommission füer Bildungsplanung und Forschungsförderung) and a science council (Wissenschaftsrat). But often parallel developments of models targeting the same purpose have occurred. To give an idea of the model diversity in Germany, the models used for river basin management in 1994 are listed in Table 2.3.1 (BMU 1997). In this study, only modellers answering a questionnaire were included, thus the study represents the minimum of model studies in German water management at that time.

Table. 2.3.1: Number of models used in the different domains in Germany in 1994 (BMU 1997).

Type of study	**Number of models**
Precipitation-runoff	64
Hydrodynamics	6
Flood forecasting	4
Groundwater	28
Surface water quality	13
Biota/ecology	Not included in the study

Models for biota and ecology in water management were not included in the study from 1994. In comparison to the other domains, only in recent times models have been developed in these subjects. In Germany, the focus is on integrated models, mostly as decision support systems (e.g. Elbe DSS, Large River DSS, DSS Weiße Elster). It can be assumed that only a small number of ecological models for water management exists (e.g. INFORM).

BMU (Federal Ministry for the Environment Nature Protection and Nuclear Safety) (1997): Stand und Einsatz mathematisch-numerischer Modelle in der Wasserwirtschaft. 63 pages.

2.4 Denmark

The largest modelling market in Denmark is related to groundwater modelling. The two key issues being addressed in this respect are (i) the availability of groundwater resources for water supply purposes and the effects of groundwater abstraction on streamflows, and (ii) preparation of actions plans against groundwater pollution.

Modelling is also carried out for rivers and marine areas, but to a much lesser extent and with far fewer organisations involved. Modelling of lakes is also carried out, but there is a very small market and the applied modelling tools are usually relatively simple empirical tools.

As described in the HarmoniQuA State-of-the-Art Report from 2001 improvement of the quality of groundwater modelling work has been a key issue for all stakeholders

during the past 4-5 years. Thus, quality assurance is not an unknown term for the stakeholders and it is an important element for the regional authorities and the water works when they hire consultants for carrying out model studies.

2.5 Sweden

From the perspective of the Swedish Meteorological and Hydrological Institute, the main modelling areas in Sweden of interest to various stakeholders include nutrient transport from agricultural fields, inflow to dams and reservoirs for hydropower production and flood forecasting.

Concerning nutrient transport, leakage of nitrogen and phosphorus from agricultural land has lead to and continues to lead to eutrophication problems in lakes and coastal areas in different parts of the country. Much effort has been spent in recent years on developing models for nutrient transport, both on field and catchment scales. The model HBV-NP has been used for national assessments of nutrient transport as well as scenario analyses of various means to reduce future transport. The development of HBV-NP has largely been performed within the Swedish Water Management Research Programme, VASTRA. Within VASTRA, the issue of how to efficiently communicate model results to stakeholders has been widely investigated, e.g., by case study round-table discussions involving both modellers and stakeholders (e.g., farmers). An output of VASTRA is a "tool-box" for simplified use of nutrient transport model output by stakeholders.

The Swedish hydropower industry is an important stakeholder, in particular for short- and long-term hydrological forecasting of river discharge. In early spring a forecast of the entire spring flood is issued in order for the hydropower plants to optimise their operational management. Further, the hydropower companies, as well as other stakeholders of river discharge, have access to an Internet-based national system for continuous hydrological and meteorological information as well as short-term forecasts (WebHyPro).

Finally, Sweden rarely experiences severe flooding events, but a number of cases in recent years have put the issue in focus. Hydrological and hydraulic modelling aimed at identifying areas prone to floods are performed by request of the Swedish Rescue Services Agency, which is thus another example of modelling with stakeholder interest.

2.6 Portugal

Portugal has a reasonable capacity to run existing and locally developed numerical models in the water resources domains. Considering its large coasts, an important part of modelling is dedicated to the coastal and estuarine water bodies.
Portugal's water resources modelling is mostly commissioned by the main public administration's water related organizations, namely the *Instituto da Água* (Water Institute), the five *Comissões de Coordenação e Desenvolvimento Regional*- CCDRs (Regional Institutes for the water and territorial planning), *Instituto do Ambiente* (Environmental Institute) and large partially public enterprises for water supply and energy production (including the large percentage of hydroelectric power plants).

Most work is contracted out to private consultants such as international consulting enterprises (e.g. W.S Atkins and F.B.O.), and Portuguese enterprises with large curricula in modeling studies.

All classic domains are covered. Precipitation runoff modelling is commonly used in water resources management and design studies, including Portuguese own methodologies based in field research studies. Groundwater modelling is used to support decisions of CCDRs for water abstractions and licenses. Hydrodynamic modelling is used for the main hydraulic schemes, and Portuguese law imposes 100-year flood design. Only limited flood forecasting modelling is undertaken. Surface water quality modelling should be increased, and the major difficulty encountered relates to the need for better field data. Detailed surface water quality modeling is being undertaken on some main rivers. Very few biota modelling studies have taken place.

During the period 1998 to 2001 a large amount of work focused on the preparation of River Basin Management Plans. The Portuguese territory was divided into 15 River Basins. Plans were also prepared for the management of the Islands of Madeira and Azores, which are Regional Authorities with some autonomy.
Socio-economic modeling is viewed as a separate area and effort to link it to other hydraulic models shall be developed.
Expertise in coastal and estuarine modelling has been developed, mainly in LNEC, and the present KB of MoST is relatively insufficient to deal with this domain.

Stakeholders were targeted from public administrations, enterprises and NGOs.
In addition there are other dominant stakeholders in the water resources area, the Municipalities managing directly or indirectly the water supply and wastewater. However these, in number larger than 350, are or relatively small or work in groups, the holding dealing with numerical simulations was contacted.

2.7 Greece

Greece is generously endowed with freshwater resources. However, freshwater resources are unevenly distributed throughout the country, and a reliance on infrastructure is necessary and continues to spark controversy across the country. Greece is divided into 14 water districts.
Greece shares five rivers and three lakes and has signed a number of bilateral agreements and protocols addressing water management issues with neighboring countries.

Water resources management and marine and coastal ecosystems protection is a high priority for Greece. Ministries assign projects to private

companies, universities etc., after tenders depending on the case and according to their needs. e.g. the Ministry of Development recently assigned the " Management Plans" needed for the WFD and the Ministry of Environment assigned other projects related to the "Harmonization of the WFD".

There are 120 private companies employing consulting engineers and planners and they usually provide services in Engineering design and development in the sector of water, environment and transportation as well as maritime and port works, structural geological and geotechnical works, electrical and mechanical works, etc.

Research in Greece is mainly funded either from the European Union (DG Research, DG Regional Policies etc.) or from the General Secretariat for Research and Technology (GSRT). The GSRT is responsible for the planning, development and funding of various research and technology programs. It supervises 32 of the most important R&D Centres and establishes new institutes and makes open calls for projects, in every field, to institutes and universities.
There are three institutes that undertake research related to water: The Hellenic Centre for Maritime Research (HCMR), the National Agriculture Foundation (NAGREF) and the Institute of Geology and Mineral Exploration (IGME).

Finally, the universities play a very important role, not only in conducting basic and applied research, but also in managing research projects. The NTUA is the oldest and most prestigious technical university in Greece and it is involved in many projects and research programs in the sector of water.

2.8 Netherlands

The following bullets summarise the main parties involved in modelling in the Netherlands:

- National level: Rijkswaterstaat (RWS), part of the ministry of Transport, Public Works and Water Management.
- Research & Technical institutes, also providing advice to the national government, as well as doing applied research and consultancy work:
  e.g. WL |Delft Hydraulics, TNO, RIVM, Alterra
- Consultants, working nationally and internationally: e.g. DHV, Haskoning, Arcadis, many others
- Water Boards (for local water management. There are 37 covering the whole country)
- Universities

RWS has Specialized Divisions (SDs) that focus on freshwater systems, marine water systems, and Road & River Engineering (RIZA, RIKZ and DWW, respectively). Furthermore, RWS has several Regional Directorates throughout the country. The Regional Directorates and especially the Specialised Divisions regularly conduct modelling studies to support all aspects of water management. RWS have their own line of operational model codes, called SIMONA. SIMONA is used to calculate the physical conditions in marine and fresh water systems such as water levels, salinity, waves, sediment transport and comprises the following model codes:

- WAQUA (2D hydrodynamics)

- TRIWAQ (3D hydrodynamics)
- SIMPAR (2D particle model)
- SLIB3D (3D sediment transport)

RWS also uses the GEM code for water and sediment quality, and primary production.

WL | Delft Hydraulics also has its own line of operational model codes (primarily Delft3D and SOBEK) which are used in research and advisory studies and are also sold commercially. These model codes cover the subjects of hydrodynamics, hydraulics, morphology, sediment transport, water and sediment quality, diffuse and point source loads, ecology (primary production), particle tracking (for oil or other spills), and early warning systems for quantity and quality. In 2000, there was a cooperative agreement signed by RWS and WL | Delft Hydraulics to merge the two operational model lines into one model system (Open Model System). This is a long-term and ongoing process. The model codes of RWS and WL | Delft Hydraulics are the most common codes that are applied in the Netherlands. Universities and research institutes also develop their own codes.

In additional to the model codes which are used for specific water management studies, there are also models which are used in 24/7 real-time operational systems, at the 5 operational model centres in the Netherlands:

- Hydro-Meteo Center Zeeland (HMCZ) for water levels, tides and weather in the Delta, and spill modelling as necessary;
- Hydro-Meteo Center Rijnmond (HMR), for water levels, tides and weather at the entrance to Rotterdam Harbour;
- Information Center Lelystad (RIZA), for flood modelling (water level) in the Rhine, IJssel, Waal, and Maas rivers as well as Lake IJssel, as well as spill modelling as necessary
- Oosterschelde Center (management of the flood protection barrier)
- KNMI (National meteorological service, for water levels and tides as well as weather prediction).

2.9 Czech Republic and Slovakia

Simulation modelling, based on theoretical background, is becoming increasingly important in the Czech Republic and Slovakia. Several tens of projects have been completed. These studies have focussed on urban drainage, flood protection, water management and water supply domains. The contractors are now more experienced in the practical application of modelling techniques in terms of data requirements, project costings and expected outputs. Competition in the market of simulation modelling is gradually growing too. However, all these trends still need to be seen as a beginning phase of the full application of simulation modelling. Local legislation is still missing with regard to tender documentation requirements. In addition, the use of simulation modelling is in some cases seen as a task rather than a tool for solving the task.

With regard to quality assurance (QA), no history of QA procedures is known. QA is limited to undertaking as good as possible calibration of models with available data. On the other hand, the whole set of procedures related to task definition, model formulation, software selection, etc. was mainly on the responsibility of modelling team with hardly any input from the contractor. In the context of the above market conditions it is expected that some verification (quality) standards are going to be required in a near future.

2.10 Hungary

Most hydrological modelling in Hungary is commissioned by national level administration, related departments of the Ministry of Environment and Water, National Environmental and also the Nature Protection and Water Authority. Many studies are commissioned jointly by several organizations. In some cases local and regional self-governments also use such services. Environmental groups conduct their own studies, they rely on voluntary work by professionals (mostly academics at universities) and never hire consultants. Typically hydrological modelling is only part of the larger task the consultant overtakes.

No real market exists for modelling studies. Most of hydrodynamic, rainfall-runoff and hydrological forecasting studies are carried out in the frame of in-house research and development and application of modeling tools or involve consultants from a very small group of competent institutions, units. The situation is similar in the field of flood studies. In the case of projects financed from outside of Hungary the involvement of international consultants (mostly EU based) is significant, however local branches of foreign consulting firms are also very active in projects initiated nationally.

The determination of vulnerability of groundwater resources and the delineation of protective areas involves large numbers of consultants using groundwater modelling as a tool. The investigation of polluted sites also involves modelling of subsurface waters. A large number of environmental impact studies are carried out each year but very few of these apply modelling techniques. Elaboration of complex catchment and river management plans together with the classification of water bodies represents an upcoming field of activity which involves hydrological modelling. However, the projects completed to date have only had a small modelling component.

All of the Danube countries including the non-EU and non accession countries of the Danube River Basin accepted the EU Water Framework Directive (WFD) as their guideline in water related activity. WFD became part of the Hungarian law in the process of accession to the EU. There is a growing interest among policy makers for: (1) objective measures of compliance to the WFD; and (2) the need for Quality Assurance.

3. Stakeholder response report

3.1 Introduction

Questionnaires were sent to project partners for dissemination to their chosen stakeholders. Project partners summarized their country results before returning them to WP4 leaders at CEH for further analysis. At CEH the results were analysed at both the country and European level.

Given the small sample numbers for individual countries the results for each category at the European level are analysed first (104 completed questionnaires received from a total distribution of almost 600) and then at the individual country level where there may be national differences (2 to 35 replies). The numbers of responses from individual countries can be seen in Table 3.1.1. The very small sample numbers must be remembered when considering the comments on the country responses. Response rates varied between countries. This reflected the different approaches adopted by project partners. Some partners targeted a small number of contacts with which they had strong links and got a high response rate (e.g. ~20% Denmark). Other partners targeted a larger number of stakeholders which resulted in a lower response rate (e.g. 6% Germany).

The replies are summarised below showing both the number of respondents in each category and the percentage of the responses (since some people did not answer all of the questions). As there were less than five responses from Czech Republic and Slovakia, Denmark and Sweden results from these countries were not included in the country discussions.

Table 3.1.1 Response to questionnaires

Country	**Number of questionnaires sent**	**Number of completed responses**
Czech Republic and Slovakia	19	1
Denmark	19	4
France	90	9
Germany	166	10
Greece	50	35
Hungary	30	7
Netherlands	8 or more	8
Portugal	16	16
Sweden	90	2
United Kingdom	89	12
TOTAL	577	104

3.2 Stakeholder backgrounds

The biggest single group of responders was Planners (including some people who classified themselves as 'designers') who constituted 56% of the responders. The rest were approximately similar numbers of Public administrators, public action groups and private companies (Table 3.2.1). These people are all stakeholders being users of model results rather than actual modellers.

Table 3.2.1 *Professions or affiliations of the stakeholders responding to the questionnaire*

	TOTALS	
	Number	Percent
Stakeholder affiliation		
Public action group (NGO)	10	9.8%
Policy	16	15.7%
Planner (+ design/research)	52	**51.0%**
Public Enterprises	6	5.8%
Private Enterprises	2	2.0%
Public administration	9	8.8%
Operational management	7	6.9%
Total	102	

The distribution of stakeholder backgrounds varied considerably between countries because each country partner was asked to select his/her own group of stakeholder contacts. It may also be a problem of differences in definitions and job titles between different countries rather than a genuine difference in their roles. Furthermore, many stakeholders have mixed roles and their classification into a category in Table 3.2.1 is difficult.

3.3 Stakeholder interests

As expected stakeholder modelling interests were diverse. Interests were expressed in the following domains: flood forecasting, hydrodynamics, precipitation-runoff, water quality, diffuse/dispersed pollution, groundwater, water balance, wind/wave models, coastal engineering, weathering models, river management, river morphology alteration, water resources management, eutrophication, solute transport, climate and climate impacts, carbon cycling, ecology and socio-economic.

3.4 Contact with models

The majority of consulted stakeholders had contact with the results of models less than 10 times per year or under 5 times per year (Table 3.4.1).

Table 3.4.1 *Number of modelling studies that the stakeholders have contact with each year*

Number of modelling studies per year		
(1) <0.2/yr	4	4.4%
(2) <1/yr	7	7.6%
(3) <5/yr	35	**38.0%**
(4) <10/yr	31	**33.7%**
(5) >10/yr	15	16.3%
Total	92	

The highest levels of contact with models were reported for Greece and Portugal where all the respondents had more than one contact per year, and 74% and 50% respectively had over 5 contacts per year. The lowest rates were for France (where 11% had under 0.2 contacts per year, and 22% had less than 5 contacts per year) and Hungary (where 100% of respondents had less than 5 contacts with model results per year).

3.5 Credibility of model results

Their opinion of the credibility of the model results that they used in their work was largely that they were accurate or a best estimate (Table 3.5.1). A minority considered that they were either very accurate or just an estimate. This indicated that most consulted stakeholders thought that they were a useful tool, with only one from Hungary thinking that they were only a guess.

Table 3.5.1 *Opinion of the credibility of modelling results*

Credibility of results		
(1) Very accurate	14	14.4%
(2) Accurate with stated errors	31	32.0%
(3) Best estimate	41	**42.2%**
(4) An estimate	10	10.3%
(5) Guess	1	1.0%
Total	97	

The credence in model results was broadly similar across the individual countries with the exception of the French responses which showed much greater faith in models – 56% considered them to be very accurate and 44% that they were accurate.

3.6 Presentation of model results

In confirmation of the use of model outputs for their work, the stakeholders were fairly evenly split between those who found the results clear and understandable, and those who found they required close study to understand and interpret their results and implications (Table 3.6.1). Only one Hungarian stakeholder admitted to not understanding model result. This is consistent with the previous finding that most consulted stakeholders found model outputs to be of value.

Table 3.6.1 *Opinion of the clarity of modelling results*

Clarity of results		
(1) Clear and understandable	37	40.7%
(2) Close study needed	53	**58.2%**
(3) Confusing	1	1.1%
Total	91	

Satisfaction with the presentation of model outputs was highest for France (78% replies stated that results were both clear and understandable). It was lowest in Britain where 92% of replies considered that the results should not be taken at face value and that close study was needed. Hungary and Portugal also had a majority view that the results needed close examination, while Greece and Portugal were evenly divided between the view that model outputs were clear on their own or that they needed close study.

3.7 Information on how model results were obtained

Almost all of the responders found that the information on the way that the models were applied was clear, although half would like further details (Table 3.7.1).

Table 3.7.1 *Opinion of the information on how the model was applied*

Model application		
(1) Clear and detailed	40	42.6%
(2) Clear but incomplete	44	**46.8%**
(3) Unclear but detailed	7	7.4%
(4) No documentation	3	3.2%
Total	94	

The highest percentage of respondents stating that they found the results to be clear and detailed were from Britain (58%) which appears to contradict the finding that they also expressed the strongest view that model results needed to be examined closely. Similarly the majority of the respondents from France (56%) found the information to be incomplete although they found it to be clear.

3.8 Importance of model application information

Most respondents stated that detailed information of how the model was applied was useful, important or crucial (Table 3.8.1)

Table 3.8.1 *Importance of model documentation*

Model documentation		
(1) Crucial	27	25.7%
(2) Important	44	**41.9%**
(3) Useful	32	30.5%
(4) Not needed	2	1.9%
Total	105	

This information was considered to be 'crucial' by 75% of British respondents and 56% of French and 36% of German respondents, and to be 'important' by all Portuguese, 45% of German, 66% Hungarian and 34% of Greek respondents. It was considered to be 'useful' in 56% of Greek respondents.

3.9 Stakeholder groups that responded

A wide range of stakeholders were consulted from across Europe. All partners experienced great difficulty in obtaining responses. The results presented in this report are biased to the stakeholders that had perceived modelling and quality assurance to be important. Many of the stakeholders that responded belonged to large organisations such as English Nature and the UK Forestry Commission which are familiar with outputs from modelling studies. However, responses from wider stakeholders from National Parks, and public action and conservation groups that are more removed from model studies were very low.

3.10 Experiences of professionals on stakeholder views

Partners within the HarmoniQuA project have considerable experience of the views of stakeholders on modelling. These views that have been generated through conducting modelling studies, communicating model results and presenting and discussing the HarmoniQuA project are summarized in this section.

Stakeholder familiarity with modelling
Employees at CEH have experienced many cases where stakeholders do not appreciate the need and relevance of modelling. It is often seen as a ‘mystical’ discipline and many stakeholders would be far more comfortable with decisions based on field data alone. They would be more likely to accept the results of models if they understood the way in which the models had been applied, and the underlying assumptions, even if they did not understand the internal mathematics of the models themselves. An unfamiliarity with modelling also became apparent whilst consulting

stakeholders for this report. In several cases stakeholders didn't feel they could answer the questions.

Stakeholder familiarity with Quality Assurance
Experience suggests that stakeholders are often unsure of what quality assurance procedures should be followed in modelling studies. Stakeholders need guidance in how to evaluate a modelling study.

Documentation of errors and assumptions
Several stakeholders expressed the need for modellers to clearly state what errors and assumptions are likely to have a large impact on the results.

Views on MoST and its Knowledge Base
Discussions with water managers in the UK have indicated that there is interest in HarmoniQuA MoST. Indeed the Environment Agency makes reference to HarmoniQuA in their hydrology strategy 2004. There is support for the quality assurance framework being proposed by HarmoniQuA. However, it is likely that stakeholder organisations would like to produce their own Knowledge Base. Furthermore, although there is support for the HarmoniQuA approach it is likely to take a significant amount of time for new software to be accepted by large organizations such as the UK Environment Agency.

Many Danish stakeholders (particularly water managers in the groundwater domain) also perceive a need for improved quality assurance procedures in modelling. They have expressed a desire for guidance on how to implement quality assurance in practice. HarmoniQuA MoST and its Knowledge Base appear to meet their needs.

There is also support for a quality assurance system such as HarmoniQuA in the Czech Republic and Slovakia. However, modelling activities are still in an early stage of widespread adoption. It is likely to be too early here to expect stakeholders to invest large amounts of resources in quality assurance. The above comments will be explored further in national workshops.

3.11 Reporting uncertainty

Within the modelling community it is widely accepted that greater emphasis should be put on presenting uncertainty of model results. However, many stakeholders often find it difficult to understand and deal with uncertainty. It is important that modellers incorporate the uncertainty of their results in decision frameworks.

4. Concluding Remarks

Following discussions with stakeholders and the receipt of more than 100 completed questionnaires, several conclusions may be made as to the opinions of stakeholders on quality assurance in modelling.

- Unfortunately it was not possible to obtain equal numbers of responses from the range of stakeholder groups consulted. Therefore, the response presented in this report are biased towards planners.

- Nearly 90% considered that models provided a best estimate and were accurate. Therefore, the consulted stakeholders generally believe that model results are credible.

- Over half found that model results required close examination to be understood. This suggests that the stakeholders feel that improvements could be made in the presentation of model results.

- Less than half the respondents expected clear and detailed information to be available on how the model was applied. This suggests that documentation on model application should be improved.

- Almost all (98%) said they needed model documentation, and two-thirds considered that it was 'important' or 'crucial' for their needs. Therefore, the need for clear and detailed documentation is widely accepted.

From the results summarized above it is clear that the consulted stakeholders believe model results may be credible. They are aware of the importance of clear and detailed documentation of the activities conducted during model studies but are also aware that it is often inadequate. Therefore, these stakeholders should be convinced by the usefulness of HarmoniQuA MoST which is able to support the modelling process by helping users document their actions. Indeed discussions with stakeholders in several countries have identified support for the HarmoniQuA MoST and Knowledge Base. Stakeholders in partner countries that have a less developed modelling market may be less willing to invest resources in quality assurance.

However, the responses presented above are biased to those stakeholders who perceived an importance in modelling and quality assurance and thus completed a questionnaire. In the case of the UK, these stakeholders are mostly from large organisations that are familiar with model study results. However, there are many wider stakeholders who view that modelling is a mystical and overly complex activity. These people need convincing of the benefits of modelling before they can appreciate the usefulness of HarmoniQuA MoST. Models should not be overly complex. In many situations models simply structure the information held by stakeholders and provide a means for drawing generalizations or interpolating between know values. If wider stakeholders are to be convinced of the usefulness of modelling, participate in modelling studies and appreciate the benefits HarmoniQuA MoST then communication between modellers and the wider

stakeholder community needs to be improved. A dedicated stakeholder newsletter is being produced to encourage stakeholders to attend national workshops that are being held in partner countries throughout 2005. At these workshops stakeholders will be encouraged to give more detailed comments on HarmoniQuA MoST and its Knowledge Base. However, several stakeholders have already shown interest in HarmoniQuA MoST.

Country specific issues

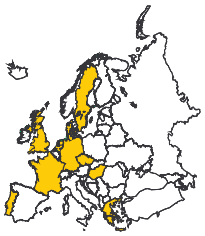
It is interesting to note that French stakeholders had greatest faith in models. They believed that model results and details of application are generally credible, clear and understandable.

Reporting Uncertainty

Uncertainty must be reported in an appropriate way to stakeholders. If this is not done they could loose confidence in the results of the model study. It may be better to combine the various elements of uncertainty in the decision support framework rather than quote very large error bands on model results themselves.

Related information
This report is the first of three reports considering consultation on quality assurance, MoST and its Knowledge Base and quality assurance standards for modelling. These reports will be available on the projects website: www.HarmoniQuA.org.

APPENDIX A



STAKEHOLDER ATTITUDE SURVEY ON QA IN MODEL BASED CATCHMENT AND RIVER BASIN MANAGEMENT

Covering: Groundwater Precipitation-Runoff Hydrodynamics Flood forecasting Water quality Ecology/biota Socio-economics

To help the HarmoniQuA project develop its strategy for developing QA tools, we request a few moments of your time to fill in this informal questionnaire.

Please email completed questionnaires to Gareth Old (harmoniqua@ceh.ac.uk)

1. **Please give your name and telephone details.**

2. **Please indicate the context of your interest in model based water management?**
   For example, are you a member of a public action group, a policy maker, a planner etc?

3. **Please give an example of the types of modelling studies that have been of interest to you?**

4. **Indicate how many modelling studies you have contact with per year?**

   A. Less than 1 per 5 years
   B. Less than 1 per year
   C. Less than 5 per year
   D. Less than 10 per year
   E. More than 10 per year

4. **Which phrase best describes your opinion of the credibility of model results?**

    A. Very accurate
    B. Accurate with stated errors
    C. A best estimate
    D. An estimate
    E. No better than a guess

5. **Which phrase best describes your opinion of the clarity of model results?**

    A. Clear and understandable
    B. Possible to understand after close study
    C. Confusing

6. **Your opinion on the availability of information that describes how the model was applied.**

I would expect to find:

    A. Detailed and clear information
    B. Incomplete but clear documentation
    C. Detailed but unclear information
    D. No documentation

Please comment on any personal experience if appropriate:

7. **Importance of clear and detailed documentation of how a model was applied?**

    A. Crucial
    B. Important
    C. Useful
    D. Unnecessary

8. **How do you feel modellers could improve the credibility of model results?**

Your help in this survey is much appreciated. Further details of HarmoniQuA can be found at www.HarmoniQuA.org, from your country representative, or from Gareth Old at the address above.

The Guideline Tool may be downloaded by registering with www.harmoniqua.org/tools/download