

# Taking the OpenMI forward

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**Abstract:** The pressure to take a more integrated approach both to science and to management increases by the day. A consequence of this situation is that there is strong encouragement in the science world not just to understand and to be able to predict the response of individual processes but also to predict how those processes will interact. The manager is similarly encouraged to think in the widest possible terms about the likely impact of any policy before it is implemented. One response to this situation has been an increased interest in integrated modelling and a consequent interest in technologies that allow models of different processes, based on different concepts and from different suppliers to be linked. A European Commission co-funded group has developed such a mechanism, the OpenMI, and is now transforming their research output into an operational standard. However, a technical solution alone is not sufficient. It must be delivered in a way that makes its use acceptable across the world. This paper sets out for discussion in Workshop 13, a strategy for the future development, delivery and use of the OpenMI.

**Keywords:** Model linking; Model coupling, Integrated Modelling, Integrated water management, OpenMI, Open Modelling Interface.

## 1. INTRODUCTION

The pressure to take a more integrated approach both to science and to management increases by the day. At almost any scale from local to global, it is no longer possible to consider issues in isolation; to do so runs a high risk of creating more problems than are solved. The consequence of this situation is that there is strong encouragement in the science world not just to understand and to be able to predict the response of individual processes but also to predict how those processes will interact, one with another. The manager is similarly encouraged to think in the widest possible terms about the likely impact of any policy before it is implemented. A new reservoir might solve a water supply problem but will it adversely affect the fishing and hence the local tourist trade? Biofuels may be renewable but will they create a food shortage? One approach to predicting such impacts would be to create new models simulating more and more processes. This, however, is neither feasible nor useful and would make poor use of the huge investment to date in the current models. A better approach, bringing with it many extra benefits, would be to find a way of linking existing models and modelling components such as databases or visualisation systems.

Against this background, the European Commission, as part of its research programme to facilitate the introduction of integrated water management, commissioned HarmonIT, a project to find a generic solution to the linking of simulation models at run time. The outcome of this work was the Open Modelling Interface (OpenMI) together with a set of supporting software. The work has now moved to a second phase, where the aim is to transform the research output into a supported operational standard. It is this second phase that will form the basis for the discussion in Workshop W13.

## **2. DISCUSSION TOPICS**

### **2.1 Introduction**

Learning from the projects that preceded HarmonIT, its leaders appreciated from the outset that success would depend on the project delivering two things: a technical solution and a plan for its support that would make its use acceptable across the world.

HarmonIT developed and tested version 1.0 of the OpenMI. This successfully demonstrated the feasibility of linking not merely models but any modelling components. It did so with components sourced from different suppliers, using different modelling concepts representing a variety of domains. However, there were many known requirements that the available resources did not allow to be addressed, for example, linking a model running in the .Net environment with one running in a Java environment. Further, although a set of supporting software had been developed to help make models OpenMI compliant, link and run them, it was fully appreciated that this would have to be made much more user friendly before it would be accepted by even sophisticated end users. Although the testing involved the use of the OpenMI in a variety of model linking situations, it was primarily aimed at checking that it functioned correctly at the IT level. It did not really demonstrate the benefits sort from integrated modelling.

As the OpenMI became more widely known about and the possibility that it might represent a solution to the problem emerged, so the focus of user interest shifted to how it would be made available and supported in future. To be acceptable, the OpenMI would have to be open, non-proprietary, international, backed by a credible organisation and able to support its users. Substantial demonstrations based on real world problems under operational conditions would also be required.

While the benefits of integrated modelling and the OpenMI are becoming accepted amongst the modelling community, this is far from being the case amongst managers; indeed, it is probably true that there are some modellers still to be convinced. If the OpenMI is to succeed, then managers must be convinced first of the benefits of integrated modelling and then the OpenMI. It is not just managers who have to be convinced. The model developers must also be convinced. Potentially, the OpenMI changes the modelling market. The OpenMI's creators, who include three leading developers, all believe that the OpenMI creates new opportunities not only for themselves but also for individuals, small companies and universities, because the OpenMI dramatically reduces the cost of entering the market. Similarly, the consultants who run models for government agencies must be convinced. Interestingly and at this stage unexpectedly, the first commercial applications of the OpenMI have been successful not just technically but commercially – the work was completed in less time for fewer resources.

To address these and many other issues, a second project, OpenMI-Life, has been created with the help of the European Commission. The objectives of this project are to develop version 2.0 of the OpenMI and to plan and put in place a support organisation. However, the EC funding rules only cover demonstrations and this has led to an interesting and ultimately beneficial approach to the problem. OpenMI-Life has been set up as an operational demonstration not just of the OpenMI but of the whole support organisation. By the end of the project, if all goes well, the support organisation should have been shown supporting seven operational demonstrations based on real-world problems. During these demonstrations, it will have responded to user requests for enhancements and in response, it will have developed and released Version 2.0. In parallel, it will have undertaken all the dissemination and promotion activities that would be expected of such a support organisation.

The support organisation is now in place and called the OpenMI Association. The remainder of this paper will raise a number of discussion points relating to the future development of the OpenMI and the association, on which the Association would be most interested to hear the modelling community's views, so that it can shape its future strategy.

### 3. THE OPENMI ASSOCIATION'S FORWARD STRATEGY

The aspirations in the OpenMI Association's Charter have been translated into:

- A vision of the role of modelling in relation to the integrated management of land and water
- A mission statement for the Association
- A strategy for achieving the mission

To stay relevant, all three will need to evolve over time, as needs and technology change. The Association therefore welcomes discussion on its strategy, which is outlined below.

#### 3.1 OpenMI Association Objectives according to its Charter

The OpenMI Association is an association ('vereniging') established under Dutch Law. Its Charter and Standing Orders are available on the Association's website. The Association is open to international membership for both organisations and individuals. According to its Charter, the objective of the Association is:

*"The promotion of the development, use, management and maintenance of the Open Modelling Interface (the OpenMI), a standard for the exchange of data between computer software in environmental management."*

The Association seeks to achieve this goal, among other things, by:

- *"Exchanging information with regard to the standard specified in the objective, by word, writing and by means of electronic devices such as a website, both within the Association and with other organisations that pursue a similar objective"*
- *"Stimulating the maintenance and development of the OpenMI Standard and its supporting software and managing their release"*
- *"Stimulating the provision of information and promoting discussion on the OpenMI in Europe and across the world by the organising of and participating in events"*
- *"All that which may be further conducive to the objective"*

These aspirations have been translated into a vision of the role of modelling within the management of land and water, a mission statement for the Association and a strategy for achieving the mission.

#### 3.2 Vision

Today's world is one where the fair and sustainable allocation of diminishing natural resources between competing demands is increasingly important to avoid conflicts. Making such decisions, however, is far from easy. Although we have considerable knowledge of individual environmental, social and economic processes in the land and water domains, our ability to predict how those processes will interact is limited; hence, it is difficult to foresee the wider implications of natural events and management policies as is required by integrated management.

It is neither feasible nor particularly useful to build a single model of all the processes in a catchment. However, emerging technologies, such as the OpenMI, are making it possible to link together new and existing models from different suppliers, based on a variety of modelling concepts and representing different domains. There is already preliminary evidence that this linked or 'integrated modelling' approach will offer an effective tool for developing and assessing integrated management options and that it leads to better decisions, i.e. decisions that make the best use of the resources.

The OpenMI Association believes that integrated management in some form or other is the only option for the future management of our resources. Because of the complexities inherent in integrated management, managers will demand ever more sophisticated decision support systems. These are essentially predictive models. As the need to understand the wider impacts of any decision increases, so the models will have to take account of more and more processes. The OpenMI Association, therefore, foresees a future where the concept of integrated modelling is widely accepted by authorities as leading to better decisions, and where it is the adopted practice in optimising the management of complex systems.

### **3.3 Mission**

The attainment of the vision will require the combined efforts of developers, modellers and users. Within this context, the role, and hence the mission, that the OpenMI Association has set itself, is to:

- Promote integrated modelling as a means of achieving better management decisions, so that resources are more fully exploited and impacts are better understood;
- Develop and support the OpenMI Standard so that it becomes the first choice for model integration.

The OpenMI Association has defined for itself the following boundaries:

- Technical scope:
  - The exchange of data between independent models and modelling components either at run-time or when the models are run sequentially
  - Facilitating the embedding of linked models and components in decision support systems (DSS)
- Application domain: environmental management with the priority on land and water systems.
- Intended user groups of the OpenMI and its applications: model developers, the modelling community and the competent authorities.
- Geographic focus of dissemination activities: although the OpenMI Standard can be applied world-wide, the priority regions for the OpenMI Association in the first years will be Europe and the United States of America.

### **3.4 Implementation Strategy**

To achieve its mission, the OpenMI Association will focus on the following key actions:

- Creating a culture that eases the adoption and acceptance of integrated modelling as a concept and the use of the OpenMI as the recognised option for integrated modelling
- Ensuring that the OpenMI remains relevant, easy to use, of high quality and available under acceptable conditions
- Supporting the community of OpenMI users and providing a compliancy service for developers who have adopted the OpenMI Standard in their products
- Disseminating necessary and useful information
- Enabling the user community to influence the development of the OpenMI and its Association
- Being the legal body that holds the ownership of the OpenMI
- Securing the necessary resources to fulfil its mission and implementation strategy

### **3.4.1 *Creating a culture for integrated modelling***

Changing attitudes to integrated management and modelling will require the provision of information and the creation of new skills at both high and low levels in user, modelling and developer communities.

The top-down approach will be to ensure that key decision-makers (competent authorities) are aware of the added value of integrated modelling and the role of the OpenMI Standard. Their needs will be identified so that they can be provided with the information that will enable them to make well-informed decisions about the use of integrated modelling and the OpenMI.

In parallel, the OpenMI Association will identify the most widely used model codes and decision support systems and will encourage their developers to make them OpenMI compliant (if not yet so).

The bottom-up approach will be to create a new body of scientists, engineers and IT professionals with integrated modelling and OpenMI skills. This will be achieved by liaising with respected higher educational institutions and encouraging the inclusion of material on integrated modelling and the OpenMI in appropriate undergraduate, MSc and PhD courses, workshops and seminars. The Association will co-operate with the educational institutions to create course material. The development of training services by the Association's members will be similarly encouraged.

### **3.4.2 *Ensuring the OpenMI remains relevant***

Following the Open Source model, the Association will maintain, develop and release the OpenMI standard. The Association will establish a group to monitor the driving forces, user needs and new technologies. Using the combined resources of the group and the user community, it will periodically propose changes and, after consultation with the user community and their agreement by the OpenMI Executive Committee, implement them. In this way, the OpenMI Association will seek to ensure the continuing relevance of the OpenMI Standard.

### **3.4.3 *Supporting the OpenMI user community***

Through its Technical Committee, the OpenMI Association will provide and supervise a forum for discussion and questions (<http://sourceforge.net/projects/openmi/>); this forum is intended primarily for developers. Additionally, the Association will provide and maintain a website and a 'wiki' site ([wiki.openmi.org](http://wiki.openmi.org)). The web site will be the entry point for the Association and the OpenMI. It will contain final copies of all key documents, news and announcements and will be designed with end users and those new to the OpenMI in mind. The site will link to the wiki, which will be the home page of the Technical Committee. The wiki will have a more informal style and will provide access to detailed technical information and reports of user experiences with the OpenMI.

The Technical Committee is not resourced to maintain a staffed help desk and cannot guarantee that all questions on the discussion forums will be answered by them. However, the Association will foster the creation of a mutually supportive OpenMI Community in the open source spirit.

The Association will always recommend end users to go first to their software supplier for support. The OpenMI Association will encourage software suppliers to build up OpenMI skills among their support staff, so that they can help their users with OpenMI-related queries. Hence, from an end user's (modeller's) point of view, the preferred channels of communication are the same as those that exist in today's single-domain modelling. All users seeking support will be welcome to explore the information available through the website and the wiki. All users, but particularly developers, should feel welcome to report bugs and make proposals for change to the OpenMI.

The OpenMI Association will supervise the co-ordination and organisation of training sessions for model developers to help them make their modelling software OpenMI-compliant. The Association will not provide the training itself but will collaborate with dedicated third-party trainers, who can advertise their services on the Association website. Registration for training sessions will be co-ordinated through the website. Links to published training materials and tutorials will also be provided.

End users will be asked to contact their own software providers for specific OpenMI-related training. Generic examples and general information on the functionality and use of the OpenMI User Interface, as offered by the Technical Committee, will be provided by the Technical Committee as soon as resources permit.

#### **3.4.4 Dissemination of information**

The main medium for disseminating information will be the OpenMI Association website ([www.openmi.org](http://www.openmi.org)), through which all formal information about the OpenMI Standard and the OpenMI Association will be made available. This website will also provide information on events, training and where to find OpenMI-compliant software.

Members will be allowed to advertise their products and services on the website. More informal information, primarily focused at developers, will be held at the OpenMI Association's wiki, which will be accessible via the website. In addition, the Association will provide a forum on Sourceforge for debate, feedback and the informal exchange of information and experience relating to the OpenMI, model integration and integrated modelling.

The OpenMI Association will convene specific sessions on the OpenMI at conferences. It will also publish papers and articles in the scientific and popular press and maintain a newsletter.

Basic material for creating OpenMI-related presentations will be made available through the website.

#### **3.4.5 Availability of the technology**

The Association will impose no restrictions on the use of the OpenMI for research or commercial purposes, and will not impose any royalty charges or licence fees.

The OpenMI Association will release the OpenMI Standard and provide access to it through its website. The Standard will be released under the Lesser General Public Licence (LGPL) (<http://www.gnu.org/licenses/lgpl.html>). The Association will provide all necessary documentation relating to the Standard.

New releases will be timed to achieve a balance between the need for stability and the need to move with the times.

In order to maintain the high quality and reliability of the Standard, the OpenMI Association will adopt quality assurance procedures and quality control standards.

The OpenMI Association will ensure that there is always at least one documented Software Development Kit (SDK) and Graphical User Interface (GUI) available under suitable open-source licence conditions. It will also allow and encourage third parties to develop, deliver and maintain other versions of the SDK and GUI, or any other tools that will simplify the migration (making modelling components compliant), linking and running of integrated models.

#### **3.4.6 Compliancy**

The OpenMI Association will develop a procedure for establishing that components comply with a particular release, and will allow developers to label such components as 'OpenMI version *n.m* Compliant'. The Association will hold a register of OpenMI

compliant components. The Association will not make any statement of warranty about OpenMI-compliant components. The Association will work towards establishing an auditing service.

#### **3.4.7 *The Association as a legal entity***

The Association will be an international, non-proprietary and not-for-profit organisation.

New members will always be welcome, particularly those willing and able to contribute actively.

The OpenMI Association, as a legal entity, will ensure and safeguard the copyrights and intellectual property rights (IPR) of the OpenMI Standard and any related products created by the OpenMI Association. (The OpenMI logo and the name 'OpenMI' have been registered as a trademark and the domain names [www.OpenMI.org](http://www.OpenMI.org) and [www.OpenMI.com](http://www.OpenMI.com) have also been registered.)

#### **3.4.8 *Secure resources***

The OpenMI Association will seek the resources to support its activities by membership fees, contributions in kind, donations, project funding or any other resource that is approved by the General Assembly.

In order to keep the required resources to a minimum, the OpenMI Association will actively encourage services to be carried out by third parties, thus creating business development opportunities for the OpenMI community.