AIR-EIA: A MULTIMEDIA APPLICATION FOR ENVIRONMENTAL IMPACT ASSESSMENT STUDIES

KARATZAS K., MOUSSIOPoulos N.
Laboratory of Heat Transfer and Environmental Engineering, Department of Mechanical Engineering, Box 483, Aristotle University Thessaloniki, 54006 Thessaloniki, Greece

FEDRA K.
Environmental Software and Services GmbH, Austria,
LOHMeyer A.
Lohmeyer Consulting Engineers, Germany,
KOUROUMLIS CH.
Intellectron S.A., Thessaloniki,

An Environmental Impact Assessment (EIA) is a formal study process used to predict the environmental consequences of a proposed project/activity, by applying scientific knowledge and taking into account existing legislation and methods. The present paper describes a multimedia framework that combines CD-ROM and Web-based methods and tools for the development of an application concerning EIA studies related to air quality (AQ), using European resources and information. This application aims at covering both the needs of the technical world for an integrated, advanced and ready to use reference for EIA/AQ studies as well as the desire of the public for information supply on relevant issues.

Introduction

The environmental consequences of a proposed project/activity are usually predicted in the frame of an Environmental Impact Assessment (EIA) study. For each European country, this formal study is done by specialists, it is based on the application of existing national and EU legislation and scientifically sound and widely accepted methods and its results have a reflection in the quality of life and the well being of the public. In the frame of an INFO2000 project named AIR-EIA, a multimedia application has been developed aiming to provide scientific and technical support to all parties involved in or affected by EIA studies, and to improve the information flow and awareness concerning the EIA issue in the European Union (EU) Member States [1].

The multimedia-EIA concept

When referring to a formal EIA study, one has to take into account its information content and its information domain. The former includes procedures (e.g. information on methods and available tools) and EU & national legislation concerning EIA, while the latter is directly linked with the environmental domain of interest, here the atmospheric environment.

Thus, the information content refers to regulations and administrative dispositions together with scientific and technical data, while the information domain corresponds to environmental issues of the science applied. Both information content and information domain should be appropriately “translated” to multimedia content. This means that in order to construct the multimedia application, one has to take into account the requirements of the end users of this application, and should then “translate” these requirements into audio-visual information. In order to do so, the project consortium included partners that had many years of experience in EIA studies related to AQ, and have worked both in the EIA field as specialists and in developing methodologies and suggesting legislation to authorities. Thus, two major concepts were underlined during the development process of the application:

- Procedures, which include (in order of importance) legislation (national and EU), administration guidelines, suggested methodologies from expert groups and available scientific literature, [3,4,5,6,7,8] and
- Modelling tools, that interpret in scientifically sound and widely accepted computational methods for the assessment of the environmental impacts studied [9,10,11].
As the modelling tools have by definition increased demands for interactivity when compared to the procedural part, while the latter should be stand alone in order to serve as a reference material for all interested parties, it was decided to use a CD-ROM platform for the procedural part and a web platform for the modelling tools. The overall project architecture is presented in Figure 1.

**Multimedia structure**

The CD-ROM application is a stand alone application, and serves as a source of reference material, while also possessing an instructional value for the expert who wishes to learn more on methods and procedures regarding the compilation of an EIA study but also for the general public. As the latter was supposed to have a very narrow view of the air quality issues and the related problems arising from anthropogenic activities, it was decided to include a general introduction on the basis of a carefully planned presentation scenario. For this purpose, the user is introduced to a multidirectional multimedia path that leads to an individual, stand alone first chapter of the multimedia presentation that covers:

- The atmosphere and its vertical structure, in order to be able to locate the “co-ordinates” of the problem discussed within its physical boundaries.
- A review of the history of air pollution in order to construct the conceptual relation between the development of human visualisation and environmental problems
- Main pollutants and their impact to man and the ecosystem, to allocate problem categories and bring up the severity of problems
- Sources of pollution which include categories of anthropogenic activities and their role in air quality problem generation and
- The issue of assessment, that will lead to the second chapter of the presentation

A short example of this scenario-based presentation is illustrated in Figure 2.

The second chapter is intended to be used from the EIA experts and professionals, and addresses EIA/AQ legislative information, providing a short introduction and a database of the EU and national legislation (in Germany, Greece and Austria). In the same chapter and for all major categories of construction projects, an example of a real world case study is given in a two-fold manner: As a structured knowledge base of procedures, methods, applications and results, and as real-world study in the native language that was initially compiled and in the same form that it went through the administrative controlling, verifying and licensing procedure. An important aspect of the second chapter is the inclusion of short air quality model results animations which aim at
providing in-depth knowledge of the interrelation between environmental parameters and EIA to the professionals.

The architecture of the second chapter of the application reflects the information classification used, which serves as a first step towards the technological materialisation of the CD-ROM. Main technological aspects used are the following:

- **Digital media handling.** The technology for digital media handling is QuickTime [14] for its extensive support of dynamic data types (movies, virtual reality movies, etc.) formats and compression schemes.

- **Multimedia presentation.** The multimedia presentation is created with Macromedia Director [15], the industry standard for authoring of interactive multimedia presentations.

- **Documentation system.** For the documentation database, web authoring tools will be used. This tool combines extensive user-interface options, rapid development and digital media support. Actual legislation texts will be accessible in Adobe's Portable Document Format (PDF) and Acrobat Reader will be included on the CD-ROM [16].

The selected technologies and tools are all suitable for cross-platform portability, which will allow for porting of the CD-ROM to the MacOS platform, if required.

**Web contents**

One part of the AIR-EIA application are on-line interactive simulation models. They are important components of the toolkit for any study and formal air quality impact assessment. Therefore they are not only included as a description of methods and tools, but made available for direct on-line, interactive use, both for didactic as well as for operational purposes. There environmental modelling tools are based on a generic client-server architecture that combines a powerful model server for high-performance computations required for interactive modelling, with the flexibility of an HTML or Java based user interface. The models can be used interactively, with the scenario parameters defined through either HTML FORMS or a Java applet; the user-specified parameters are sent to the server, where basic data and the model executable are located. The model is triggered through the Common Gateway Interface, and the results are sent back to the client either as a complete GIF (model results displayed over a background map) plus HTML pages, or as data streams interpreted by the Java applet [17].

The simulation models included in the website range from simple Gaussian regulatory codes to complex 3-D dynamic Eulerian models. As an example, the user can be familiarised with various types of pollutant sources, such as single-sources, simulated by steady-state Gaussian models which are the most commonly used form of air quality simulation models in the case of EIA studies. In order to evaluate a single source (industrial point source with an elevated stack), a number of basic equations are available and the existing

Fig. 2. A short example of the structure of the first chapter of the CD-ROM.
example demonstrates the interdependency of meteorological and stack parameters and shows estimated concentrations downwind from a stack.

Finally, a list of models that can be used for operational purposes and are suggested and used in German EIA studies is provided, which can be download and installed locally. Moreover, links to the ETC/AQ (European topic Centre on Air Quality) MDS (Model Documentation System), and EPA (Environment Protection Agency) are provided, from where a model for a specific application can be chosen and downloaded if it is a public domain model.

The primary role of the Web modelling part is to add innovative elements to the information content by offering:

- the possibility of dynamic updates of contents;
- the possibility to link to other dynamic services related such as frequently asked questions, user feedback etc., all of which are inherently dynamic (over a longer time);
- the possibility to use more complex analytical tools over the net that go beyond the capabilities of a PC/CD version and
- the possibility to give the user an introduction in the use of air quality dispersion models in EIA studies and the interdependence of environmental parameters influencing the outcomes of such studies.

Specifications and design criteria

The Web site provides availability of air quality dispersion models used for regulatory purposes together with an interface environment, followed by EIA/AQ background information. This part of the application is independent of the CD-ROM part, and has increased needs for interactivity and interoperability. In addition, and in order to better facilitate the use of the air quality dispersion models from the expert user, an educational module was constructed based on the play and learn method. The main design criteria for the web application were:

- Simplicity and a clear structure for easy navigation, minimisation of distracting elements and components that depend on client-side rendering;
- A structure that helps the direct access from search engines (minimising the use of frames, dynamically generated pages (other than models), extensive use of META tag keywords);
- Efficient viewing performance by minimising graphical content on primary pages; images are offered as thumbprint, that trigger optional download of the full sized versions.

Model results are displayed graphically, animated where applicable, and offer a variety of visualisation methods such as map overlays and 3D displays and diagrams. Direct comparison between alternative scenarios as a basic paradigm in EIA are supported through the parallel display of two sets of results and the computation of deltas between them. Model results also include a comparison of predicted concentrations of various air pollutants with the respective EU air quality standards and guidelines, e.g., 96/62/EC and proposed new limit values in COM(97)500.

The client-server architecture

The models use a set of server-side scenarios including, e.g., different background data on the geographical domain (background maps, digital terrain models, long-term weather data, source inventories) including very simple base-line scenarios that the user can modify. In addition, a number of selected key parameters describing emission characteristics and the weather can be modified by the user interactively.

Expected results

AIR-EIA is expected to:

- Allow all EU member states and accession countries to have a common reference on EIA issues.
- Provide valuable information on environmental management/auditing activities.
- Advance the educational issues on EIA.
- Allow the multimedia industry to apply the project methodology in compiling all science/regulatory integrated presentations.
- Open a new market in both EIA and multimedia applications.

The cost-effectiveness of the project can hardly be measured directly. Yet, high benefits are expected, as EIA studies are performed for economically important projects, and thus they will smooth the planning and especially the licensing process, where each month of delay corresponds to considerable losses. The number of hits to the interactive Web-base EIA modelling part of the application and the queries for relevant information will serve as a project performance indicator.

Conclusions

In this paper an activity is presented with the aims to supply source information content, to integrate innovative and fragmented information and to facilitate the usage of multimedia based, dynamically available
EIA/AQ resources. The project leads to a prototype pilot multimedia information system, (CD-ROM & Web), including dynamic updates and interactive use of models. The multimedia application includes Web-based interactive simulations of case studies with different air quality models and interactive (Web-based) access to a rule-based expert system for screening level EIA implementing the relevant EU regulations. Moreover, the produced CD-ROM contains a complete information set on EU legislation and methodologies concerning EIA/AQ, while also being a complete tool for introducing the EIA/AQ issue to the public, thus considerably increasing environmental awareness and promoting harmonisation in the use of EIA/AQ information.

Acknowledgement

This paper is related to the project AIR-EIA that is co-ordinated by the Laboratory of Heat Transfer and Environmental Engineering, Aristotle University Thessaloniki. AIR-EIA is funded by the European Commission (DGXIII) under Contract No. PUB1221 (INFO2000 Programme) [18].

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