NEW INFORMATION TECHNOLOGIES IN PUBLIC PARTICIPATION: A CHALLENGE TO OLD DECISION-MAKING INSTITUTIONAL FRAMEWORKS

by

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ABSTRACT

Given the progress in information technology (IT) in the past 30 years, I hypothesized that radically new conditions exist for a qualitative improvement in public participation in decision-making. Two examples of key challenges are: 1) to bring more interaction early-on to the dialogue between citizens and decision-makers, rather than a "tunnel" two-step process (compile opinions-consider them at the very end); 2) to enable common, lay citizens to give meaningful contributions to decisions that require expert knowledge to understand the alternatives available. In order to test my hypothesis, I developed a prototype of an Intelligent Multimedia System to support public and technical consultation and, together with Internet-based collaborative tools, introduced it in the environmental impact assessment review process, for the solid urban waste incinerator of S. João da Talha, Portugal.

Supported by the evidence gathered from this experiment and by my analysis of the qualitative jump these IT developments represent, I argue that it is possible to use this new IT to capture and represent meaningful planning knowledge and with it enable multiple improvements in the public consultation, both qualitatively and quantitatively. On the other hand, observing the institutional responses and constraints during the process, my findings strongly suggest that the current institutional and regulatory context, inherited from old frameworks, is an impediment to fully set in place the improvements enabled by these IT developments. In other words, the decision-making institutional framework has not evolved at a pace fast enough to provide adequate responses to the challenges brought by the new IT. My findings also illustrate how different actors in a decision-making process are constrained by these old frameworks to follow different planning paradigms, further emphasizing the need to adjust to the new technology reality.

In this thesis, I present my hypothesis and research questions; the methodology I followed; the scientific traditions and bodies of literature that support this research; the case study and thesis experiment used to collect direct evidence; the analytical reasoning concerning the IT qualitative jump; the suggested research agenda for this domain; and the conclusions derived from this research, suggesting possible avenues to institutionalize some of the demonstrated IT-based improvements in public participation.

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SECTION 4 - Designing an Experiment

This section concerns the work towards setting up the thesis experiment, and includes the chapters:

1. Introduction
2. The Problem
3. The Scenarios
4. The Intelligent Multimedia System Design
5. The Experiment Design
6. The Quest for a Case Study

4. Designing an Experiment

Introduction; The Problem; The Scenarios; The Intelligent Multimedia System Design; The Experiment Design; The Quest for the Case Study

4.1. Introduction

My thesis methodology incorporates at the core of the research an experiment, in the context of a case study, in order to test the introduction of selected information technologies in a public participation process. While thesis research is far from relying solely on this experiment, since it is supported by extensive literature review, multiple cases observed and analytical argument, it is nevertheless a central piece of it and therefore important to document properly the several stages and preparatory steps for the experiment.

In this section I define, describe and discuss the problem motivating and guiding the experiment; the design steps it implied, including the elaboration of scenarios to bring a context to the problem and a preliminary discussion of possible variables and criteria of success; the Intelligent Multimedia System prototype that represented the new information technologies to test; and finally the long process of searching and selecting an adequate Case Study where the experiment could take place.

4.2. The Problem

Introduction; Deficiencies in the system of transmitting and accumulating experience; Difficulties to integrate multi-disciplinary and multi-organism processes; Difficulties in satisfying a wide range of audiences; Limitations of each "Forum" currently available for dialog and interactive analysis; Summary table; Problem formulation for the thesis experiment.

4.2.1. Introduction

In order to identify the problem in Environmental Impact Assessment Review motivating and guiding the experiment, I chose to review the literature concerning EIA in the USA and in the European Union (EU), and to interview EIA experts in Portugal, from private and public sectors and environmental NGOs.

The modern EIA review process, including a mandatory public consultation component, was establish in Portugal since 1990, corresponding to European Union Directives. Even if it was possible to profit from past experience in other countries, transition periods have a way to emphasize the typical problems emanating from complex processes. By 1995, both professionals and institutions in Portugal had already had the occasion to acquire their own vision of the field - the hard way.

After extensive literature review and informal interviews with experts and senior staff at environmental public agencies, and after analyzing the many problems which affect EIA studies and their public evaluation / consultation, I identified a few that have a particular interest to this research, given their potential for benefiting from modern IT. They are the following: *Deficiencies in the system of transmitting and accumulating experience*; *Difficulties to integrate multi-disciplinary and multi-organism processes*; *Difficulties in satisfying a wide range of audiences*; and *the limitations of each "Forum" currently available for dialog and interactive analysis*.[1] In this chapter I describe these classes of problems and the analysis I performed relating them with potential IT support systems, in

[1]This chapter is largely based on my early thesis working paper, “Sistema Multimedia Inteligente de Apoio á Consulta Técnica e Publica - Apresentação de Projecto” (Ferraz de Abreu 1995a). Also, the same subject was the base for a joint paper on this case (Ferraz de Abreu and Chito 1997)

order to build a preliminary framework for the thesis experiment design and provide a solid criteria for the case study selection.

4.2.2. Deficiencies in the system of transmitting and accumulating experience.

Many EIA can benefit from past experience, regarding data and documentation, as well as methodology, processes and "know-how". However, most of the relevant documentation is not yet in digital form, and when it is, in most cases it is spread among different organisms and in non-compatible formats (i.e. customized or "proprietary" data bases). Therefore, the transmission of knowledge and experience is done exclusively through (hiring) experts who have worked in previous cases, if available, and dedicating necessarily a lot of valuable time to gather, screen and organize critical documentation. This increases significantly the EIA costs.

On the other hand, the time schedule is tight, leaving little time for anything but the new study in progress. Yet, to ignore past experience is just as undesirable and it may prove to be an expensive gamble.

The same can be said about the EIA review process.

How can the new information technologies help? The need for experienced experts and extensive document research will always exist. The purpose of any support technology must then focus on making the process more efficient, reducing costs, requiring less time and human resources.

Artificial intelligence techniques (from knowledge representation, expert systems) enable us to capture, even if only partially, human experience and expertise, and accumulate this *repositoire* of experience in computers (knowledge bases).

Multimedia and hypermedia techniques (Shiffer 1994) (Wiggins and Shiffer 1990) facilitate data search and retrieve operations, without requiring a rigid structure either in data formats or visualization sequences (for example, direct access -- in seconds -- to scattered video segments, instead of access after rewinding tape -- in

minutes --, may make the difference between one deciding to explore or not videotaped information).

Part of my own research work at MIT was dedicated to combining these two sorts of technology (Ferraz de Abreu 1995).

4.2.3. Difficulties to integrate multi-disciplinary and multi-organism processes

Any EIA is, in essence, a multi-disciplinary study, and the current trend is to broaden even further the scope of impact analysis (such as detailed studies of economic, infra-structural and socio-political implications). Integrating the work of several field experts is difficult, especially when there is no time nor the resources to dedicate an initial period to build a common language and referential system. Therefore, the interactions between models (both conceptual and mathematical) used to evaluate the impact in each studied field are not always duly explored. Again, the same difficulties exist in the review process.

The other side of the same coin is the related difficulty to connect different organisms and entities (expert team, evaluation commission, local governments, state agencies, non-governmental organizations). Apart from the political subtleties and susceptibilities, which cannot be overlooked, many institutions have already their human resources overloaded with their usual obligations. This situation does not favor frequent inter-organism inquiries so as to evaluate any eventual incongruity to avoid, or any synergy to use, between each proposed alternative (in the EIA) and between different domains (e.g.. cumulative effects of multiple factors from different sectors of the study; overlapping jurisdictions of some entities; overlapping project plans, etc.).

In my view, the new information technologies, not being a *panacea*, may be extended to contribute in this area in two fronts:

First, by creating a “virtual office” space (in computer) with recorded opinions (and respective foundations) from experts from several entities. Such a "virtual consulting room" may allow overloaded experts -- and decision makers -- to explore at least some of the implications of each proposed option in areas outside

their specialty and experience, while siting on their own offices and at any convenient time for them.

Second, by using (experimental) techniques borrowed from artificial intelligence, in multiple-domain knowledge representation, using a shared inference engine. Such techniques (Gleizes and Glize 1990) (Ferraz de Abreu 1989), while not yet thoroughly proved, may possibly identify the interactions of knowledge units in a multi-disciplinary universe. This way, experts from several fields would be able to measure the degree of interconnection between their models and, for example, introduce corrective or calibrating factors.

4.2.4. Difficulties in satisfying a wide range of audiences

As far as public consultation is concerned, the essential product of the EIA is a report called "non--technical summary". In fact, the target audience for this report is very heterogeneous in what regards the depth and nature of their technical knowledge.This makes it very hard to satisfy both the legal requirements for this summary (a simple, lay, language), and the actual requirements of many citizens and groups of citizens that don't easily accept a conclusion without a well-justified foundation -- which often requires at least some depth of technical concepts and terminology.

New information technologies allow to complement the traditional paper report with a more flexible digital version (with Internet and / or CD-ROM based dissemination, for example). It is possible to use object-oriented and hypermedia technology (Booch 1991) (Heylighen 1991) to create information trails, in a very similar way ski resorts offer different ski trails graded for different required skills, or parks offer training schemes of variable intensity or difficulty. This electronic, digital version can therefore have the significant advantage of allowing each person to follow the EIA conclusions at any chosen technical depth, from the most superficial to the most detailed.

Combined with artificial intelligence techniques (like object inheritance, inference engines), such systems could facilitate to follow the experts' reasoning, both in depth and in extension, therefore enabling a better informed opinion, and consequently a more useful feedback.

4.2.5. Limitations of each "Forum" currently available for dialog and interactive analysis

In the present conditions, the public can participate in a EIA formal public consultation attending a meeting (public audience), reading the published EIA data, listening to, reading and watching the mass media and finally by writing their opinion to the EIA Review Committee. However, there is often a contrast between the apparent popular concern with the project in question, and the actual participation of citizens in the process: small numbered and frequently ineffective.

There are several possible explanations for this phenomenon. I am interested in particular in factors that are relevant to the role of the new information technologies. It is reasonable to assume that the following two factors contribute to the current state of affairs:

a) The only real opportunity for dialog -- the public audiences -- does not seem to offer good conditions to approach the problem according to each participant's angle, concern and background.

The 'traditional' mass media (radio, TV) is no substitute. Despite their unmatched power to publicize EIA-related events and to mobilize the public opinion, they are more likely to promote a short, simplistic view, or to polarize in extreme the arguments (according to the political agenda of the moment, or the need of a little sensationalism to gain audience share), rather than give a detailed and objective treatment to the problem. Consequently, one important advantage of the above mentioned "virtual office" would be to facilitate citizen access to multiple expert opinions, tailored to their specific concerns, that might otherwise be out of their reach, or hard to satisfy in public meetings.

b) The current formal public consultation process is shaped like a tight, one-way channel: first, from the proponents to the public, then from each (group of) citizen(s) to the decision makers.

The dialog will perhaps be richer -- and more motivating -- if each citizen is able to analyze the comments and proposals from his fellow citizens (for instance,

alternatives from non-governmental organizations), together with the EIA in debate, instead of being informed of such opinions only after the public consultation (and this, assuming that a summary of the said opinions is published and easily accessible).

Also, it will perhaps be less biased if the alternative proposals are subjected to the same depth of analysis and scrutiny as the official proposal (instead of just being publicized in interviews and opinion articles).

One may assume that this will benefit the more responsible proposals, therefore exerting pressure towards better quality in both opinions and proposals.

An information system with a mechanism for interactive access to existing opinions in some electronic equivalent of a "black-board" (for instance by using the Internet, with WWW technology - World Wide Web (Bonchek 1995)), may contribute to a more responsible, more motivating public consultation process, in short, closer to the ideal of a participatory democracy.

4.2.6. Summary table.

I summarize in table 4.2.6.1 the main problems in EIA and EIA review addressed here and the potential role of different information technologies I considered for possible support systems.

4.2.7. Problem formulation for the thesis experiment.

It was my goal to introduce IT capable of addressing each of these four problems in EIA, and test my expectation of its ability to help solving or at least minimizing them. While I did develop and introduce all the considered IT in my prototype and the information system I used during the experiment, in what concerns observation and analysis, not all four components were addressed. In fact, time and resource limitations led to concentrating instead on only a few components of the system, and leaving out completely one of the classes of problems ("Integrating multi-disciplinary and multi-organism processes"). However, even

this "natural selection" driven by "real-world" constraints is relevant research data, and will be discussed in the respective section.

Naturally, in the design stage, these limitations were not present. Once I had a clear problem formulation, supported by my review of past cases and the multiple interviews with intervening actors, I was ready to consider potential scenarios for the thesis experiment.

Table 4.2.6.1 - Summary of problems in EIA and role of IT

Problems in EIA and Role of Information Technologies:
1. Transmitting and accumulating experience
• Metadata
• Multimedia Knowledge Base
• Expert Systems
• Rule-based models
• Case-based models, with FAQ ("Frequently Asked Questions")
2. Integrating multi-disciplinary and multi-organism processes
• *Virtual office*
• Multiple-domain Knowledge Representation
• Shared inference engine
3. Satisfying a wide range of audiences
• Hypermedia reports
• Multi-level information trails
4. Limitations of current "*Fora*" for dialog and interactive analysis
• "Blackboard" vs. "Star" process
• Network (WWW) based tools

4.3. The Scenarios

Introduction; Scenario 1: Decision with no formal public participation; Scenario 2: Decision with formal public consultation, part 1 (preliminary review); Scenario 3: Decision with formal public consultation, part 2 (public participation); Next step.

4.3.1. Introduction

In order to design an experiment, I began by considering possible scenarios. In this chapter I introduce a short series of (3) composite scenarios, compiled as an abstraction built upon typical research cases I studied and considered relevant to my thesis (the description and characterization of a few of such cases, is presented later on). The objectives of these composite scenarios were to narrow down the class of problems my thesis is focused on, as discussed in the previous chapter, defining the typical profile of the targeted cases; to identify the kind of variables that were the object of research, and to briefly summarize (for each class of problems) the specific methodology .

The relevant cases are restricted to those that deal with *major development projects*, meaning projects that will have a significant impact over a large and well defined population, and where decision makers depend in some way of the good will of the affected population. That this good will can take the form of financial support, or political support (either from individual votes as citizens or from influential lobbies), or religious approval, etc., is non-important. What matters is how the decision making is brought to be. The degree of dependence of this good will usually affects the way public participation (in the decision making) is fashioned.

Decision makers may *decide entirely on their own* on a program and execute it, if they think they can afford to ignore public consultation (politically), or they may include *some form of formal public participation* in the decision making process.

The first option is included here because it is relevant and because it still is common practice -- and not only in dictatorships, since many representative democracies also have governments acting without any public consultation in major development decisions. Such cases would then concentrate on the

consequences of excluding formal public participation, and what role and shape took *informal* public participation. The restriction to *major projects* is meaningful, because they are most likely to fit the criteria of projects requiring some form of *environmental impact assessment*, in a growing number of countries (and international development agencies).

In these composite scenarios, I am postulating that some variables are irrelevant or non-critical to the issue in question: the impact of the new information technologies (IT) in public decision making. Accordingly, the *level of decision* is irrelevant (whether the decision making entity is a national or local government, for instance). Also non-critical is the *goal and nature of the development project* in question; whether it reflects a legitimate concern for the common good, or it is meant to bring economical advantages for some privileged group, for instance, may affect the process, but not in what I am concerned with. The same can be said about the *motivation* that led decision makers to accept or promote any process of public consultation.

4.3.2. Scenario 1: Decision with no formal public participation.

Stage of decision (1) : Adoption of decision-making format, evaluation of whether to include public consultation in the process.

Country X is a democracy, with an elected government. A government agency with jurisdiction over the harbor area (a large water front zone in a major city), administrated by non-elected officials, decides to transform one unused strip of the harbor into a commercial area with high rises. Although this plan conflicts with the guidelines of the city's master plan, they have legal authority to act on their own, and they decide to proceed despite opposition of the city's mayor cabinet.

Shortly after the decision was made, a leak (illegal, either politically or money-motivated) from the agency provides a privately-owned newspaper with the details of the plan. A major public uproar follows, with heated reactions from individuals and groups of citizens that cut across political boundaries. National elections are near, and the government exerts pressure on the agency -- despite legal autonomy -- which has to scrap the original plan, at large expense, and decides to present a modified version of the plan for public scrutiny.

Since there is no formal legal process or forum for public participation in this case, this scrutiny takes the form of newspaper letters and articles with many different views (from general principles to detailed well-documented expert opinions) for a long period of time, with no consensus in sight, fading into what seems a temporary freeze on any plan from this agency.

Characterization of scenario 1:

Class of problems (1) that may arise: Costs of ignoring public participation even if legal framework legitimizes that option -- opportunity costs (consequence of no project or of a delayed project blocked by public antagonism), cost of wasted resources (preliminary studies scrapped), political costs, etc. Variables in question:

a) Kind of IT attributes impacting on decision-making: IT likely to intervene in this scenario (newspapers, TV) as inadequate forums for reasoned and conclusive debate;

b) Political/legal decision model: Changes imposed by different IT context with different control of access to information and different social behavior, raising the issue of whether legal representative democracy framework became obsolete as the sole legitimizer of decision making.

Methodology to adopt (1): Compilation and analysis of flag cases (from literature survey and direct research) that provide enough analytical evidence of:

a) The dominant attributes of currently involved IT impacting on decision-making;

b) Whether there are significant changes in the adequacy of non-public participatory models of decision making (trend towards raising the standards of legitimacy).

Given the breath and complexity of the variables involved, the intention of this research step is solely to provide support for the thesis chapters discussing the political and technological context; for this class of problems, there will be no attempt to put together a controlled experiment (nor extract statistical evidence).

4.3.3. Scenario 2: Decision with formal public consultation, part 1 (preliminary review).

Stage of decision (2) : Definition of guidelines for environmental impact assessment (EIA); selection of an expert team and definition of the format of institutional and non-institutional involvement (government agencies and NGO) previous to public consultation.

Country X is a democracy, with an elected government. This government decides to promote a large infrastructure project (e.g. bridge, highway, sewage system) that will imply, by law, an environmental impact assessment with public consultation. In question is the site for the infrastructure, the level and nature of service to be provided (e.g. train and/or car bridge, number of lanes of highway, capacity of water treatment stations), and the technology to use.

The adopted procedure is to create an expert team to produce a preliminary EIA report (for "private" government use, not subject to public consultation) and to nominate an advisory commission with representatives from several government departments and agencies related to the project, and a couple of representatives from main stream NGOs.

Once taken in consideration the expert report and the opinions of the advisory commission, but not bound or committed in any way to such reports and opinions, the government will decide the final shape and site of the project, and will open a bidding process. The contracted private developer will then have the responsibility of producing an EIA, that will be reviewed by the government environmental agency and, if approved by it, presented for public consultation.

The process began following the adopted procedure. Soon, some members of the advisory commission complained that the expert team was not paying any attention to their input, as well as not providing them with timely and complete data from the ongoing studies. Members from the expert team argued that it made no sense to waste time in long dialogs in such early stages, and outside input made sense only after they had narrowed down the set of alternatives, therefore regular interaction (in the form of incremental paper reports and joint meetings) was too much of a burden with questionable gains, an inefficiency they could not afford.

Members of the advisory committee, particularly NGO representatives, wanted a say precisely in the criteria for such pre-selection; members from government agencies, overworked and understaffed, once they realized their input had no clout and because they did not perceive any particular threat to their 'turf' at this stage, distanced themselves from the process.

In consequence, the preliminary report did not assess potential conflicts arising from different priorities set by each sector (transportation, health, housing, etc.), as well as arising from competing access to public resources (scheduling). As for the NGOs, they remained fully critical of the process and considered themselves marginalised, despite the government procedure of including them in this stage of the process.

The government nevertheless made a decision and contracted a private developer, which produced an EIA report, including a non-technical summary for public consultation. This summary was reviewed by the government environmental agency and found inadequate on the grounds of too much technical depth. Experts in charge of the report complained of the impossible task of producing a report satisfying simultaneously the requirement of common sense language, with only superficial technical depth, and of consistent justification of the project options -- requiring technical reasoning.

Using privately owned newspaper and TV forums, NGOs questioned the criteria for the site selection made by the government, and contested in courts the whole process, on the grounds that the final EIA open to public consultation had been made only for the chosen site, and not for each of the alternative sites considered by the expert team in the preliminary study. This caused added delays, and the contracted developer sued the government for compensation of the costs of such delays. The government responded launching a public relations campaign, with massive advertising on the "grandeur" of the planned development. Meanwhile, the political opposition decided to use the issue as a campaign theme in approaching elections, which further increased uncertainty on the final outcome of the project.

And at this stage, with all this imbroglio already at full speed, the public consultation legal period (one month) has yet to begin.

Characterization of scenario 2:

Class of problems (2) that may arise: Institutional and extra-Institutional integration, multi-level audience, and forums of debate.

Institutional Integration: Government agencies are overworked, understaffed, so it is hard to achieve the needed institutional integration, as well the required multidisciplinarity integration:

a) in depth and breath (each sector reaching a wide grasp of the implications of each alternative on the table, in every other sector);

b) in phasing or scheduling -- some agencies (and NGO) complain that they should be integrated in the decision making earlier, right from preliminary work, while decision makers argue it is not practical.

There may be political factors involved, but it is usually a trade off between time available and staff costs.

Audience: Both expert teams and advisory commissions produce as final output a written report. The audience for these reports may be government decision makers, and may be the public, or other experts from government agencies, or other entities with political clout in the process. In each case it is not always obvious:

a) the optimal level of technical depth of the reports (report makers complain about this), and

b) the amount and type of preliminary (or raw) data that should be included in the reports to justify conclusions -- this problem is not only quantitative, but raises the issue of multiple levels of confidentiality, potential political implications of each document disclosure, etc.

Variable in question: Kind of IT attributes impacting on decision-making. IT likely to intervene in this scenario (printed reports) as insufficient format to:

a) allow more cost effective integration process?

b) consider larger space of solutions?

c) provide smoother and more flexible ways to filter and aggregate documentation with multiple technical depth and breadth?

Methodology to adopt (2): use of one case of EIA with public consultation to introduce a prototype of new IT (intelligent multimedia system) to test the level of adequacy of some attributes of this new IT to improve the process at this stage of the decision making, with two selected audiences in mind: a group of experts from government agencies and a group of experts from NGO's. Use of interviews and form-based surveys to evaluate results. If possible to control difference variables, make use of a control group.

4.3.4. Scenario 3: Decision with formal public consultation, part 2 (public participation).

Stage of decision (3): Format of public participation process.

In order to comply with the law, a period of public consultation of one month was announced (for the previous process described in scenario (2). Written copies of a non-technical summary were made available in two rooms of public buildings, and sent by mail to a few main stream NGO's. Small scale advertising informed the interested public on how to access those summaries, and where to address written comments.

Two meetings where scheduled, one by mail invitation and other by public advertising. Only 10 % of invited entities participated in the first meeting, in which the main criticism was focused on the process itself. The public meeting had a larger audience, with experts that had been involved in the process, political activists, journalists, and a few local residents. Because of the previous clashes between government political supporters and political opposition supporters portrayed by newspapers and TV, long before this meeting happened, the debate was dominated by political agenda, and echoed the same already polarized views.

Two NGOs sent (to the decision maker agency) detailed reports with their critical views, which where also summarized in news broadcasts, but basically ignored by the government. A small number of citizens sent letters by mail, and a few experts published both technical and opinion articles on the theme. Some of the critics argued about the lack of foundation in the non-technical reports for the proposed solution, while others complained about too much technical jargon and the lack of a simpler, common language in the same document.

Newspaper's polls showed the conviction that the final government decision was already taken and irreversible, as the main reason given for lack of interest from the general public in the process. Shortly after, the government announced its decision of approving the EIA presented by the developer, and to proceed with the project. NGO's contested again the decision, this time in multinational courts, and the political opposition raised the possibility of reversing the decision (with the state paying compensatory fines to developer), if elected. The government counter acted by introducing some changes, that the opposition quickly labeled as "too little, too late". Ironically, many of these last minute changes where not far from the initial counter proposals of many NGOs, now obfuscated by the political polarization.

Characterization of scenario 3:

Class of problems (3) that may arise: nature and level of participation; forums of debate.

Nature and level of participation: Many-to-few vs. many-to-may process. With current process, public opinions are collected, but the recipient is the decision-maker group, which then may or may not summarize public views. A different process that would build dialog over not only the decision makers' agenda proposed, but also including other alternative agendas proposed during the process by individual citizens or NGOs, could arguably be richer and more engaging. On the other hand, the current format of printed report (non-tech summary) does not satisfy easily the need felt for a variety of levels of depth and breadth to satisfy simultaneously different audiences.

Forum (Forae) of debate: Reasoned analysis vs. meeting debates. Current process (non-technical summary plus meetings) does not facilitate reasoned dialog, but is instead easily derailed into polarized extreme views, often in function of a unrelated political agenda.

Variable in question: Kind of IT attributes impacting on decision-making: IT likely to intervene in this scenario (printed reports, newspapers, TV) as insufficient or inadequate forums for reasoned, multi-level and conclusive debate, affecting the

degree of participation and facilitating the emergence of extreme, incompatible views.

Methodology to adopt (3): use of one case of EIA with public consultation to introduce a prototype of new IT (intelligent multimedia system) to test the level of adequacy of some attributes of this new IT to improve the process at this stage of the decision making, with three selected audiences in mind: a group of experts from government agencies, a group of experts from NGO's, and a sample of individual citizens participating in public sessions or acceding to public computer sites. Use of interviews and form-based surveys to evaluate results. If possible to control difference variables, make use of a control group.

4.3.5. Next step

Once enumerated and characterized the possible scenarios of interest for the experiment, with a more clear view of the possible role to play by new IT, I proceeded to design and build the IT tools I intended to test. Then, I chose the scenario settings I found most adequate and promising and derived, from both scenario and IT new tools, the design of the experiment.

4.4. The Intelligent Multimedia System Design

Introduction; Multimedia book; Metadata for multimedia and hypermedia; Intelligent automatic layout; Knowledge-based virtual office; IMS frame.

4.4.1. Introduction

The main vector to introduce IT in the experiment was the Intelligent Multimedia System software prototype. The choice of IT builds upon my IT review, as discussed in the respective chapter. In particular it is consistent with the favored role of knowledge representation (such as the case-based structure), the use of multimedia and inference engines (expert system like), and the importance of an interactive user interface "gluing" the different components. But it results also from the requirements that emerge from the possible scenarios of EIA review processes, and the role IT plays in them, as presented in the previous chapter.

Using my training as computer engineer and the experience acquired during my master thesis research in intelligent graphic interfaces (Ferraz de Abreu 1989a), I programmed a first version of an “Intelligent Multimedia System” (IMS) prototype. The IMS prototype was also based on previous programs, such as georeferenced hypertext multimedia browsers (Ferraz de Abreu 1991a), an expert system for infrastructure shortfalls (Ferraz de Abreu 1991b) and a multimedia system for case-based natural resource management (Ferraz de Abreu 2002b). Aspects of this previous work were already discussed in the chapter dedicated to review information technology recent developments.

Besides the expert system module, which was basically ready for its integration in the new “IMS”, my new development efforts went towards two major directions: Multimedia Book and Knowledge-based virtual office. Only in later stages I decided to develop an Internet based component -- therefore it was not part of the early design. Consistently, the Internet component is described in the Experiment section. In this chapter I describe the essentials of these developments, that were an integral part of the experiment design. The final IMS prototype, with its "real world" content, resulting from these early design stages, is described in more detail in the Experiment section.

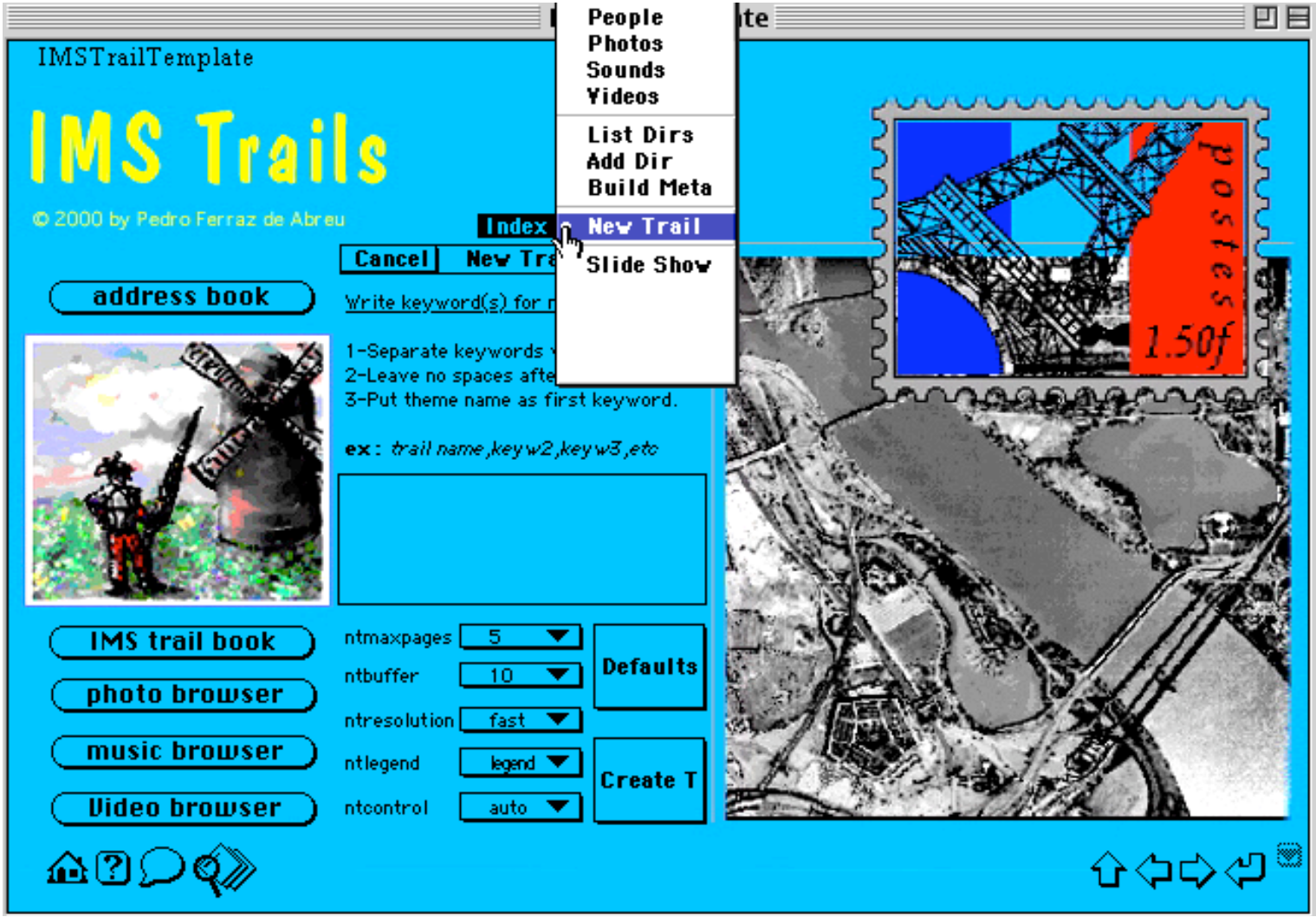

Fig. 4.4.2. - 1 - IMS Trail Template

4.4.2. Multimedia Book

The rationale behind the idea of a Multimedia Book was to take full advantage of the flexibility and media rich opportunities brought by computer-based reading and browsing of documents and data, as compared with a "normal" printed book or document. The basic key elements were:

• Incorporation of data in multiple media formats (text, sound, images and video);

• Use of hyperlinks to create a flexible book (or document) structure, allowing multiple sequences of going through the information, as opposed to the fixed structure of a printed document;

The use of these elements together was already beginning to show up in a few programs of the time (with relevance to the work on hypertext at Brown's University and some of the work done at MIT's Media Lab). In my view, they could be extended, to great advantage, to another level:

• Integration of georeferenced data, such as maps, in the sequence of my work with georeferenced hyperbrowsers (Ferraz de Abreu 1991a);

• Development of non-obtrusive metadata management, able to handle complex multimedia objects, such as images and video segments with "hot links" or "buttons" (Ferraz de Abreu 1992b);

• Use of object-oriented approach, in particular class inheritance, to extend the flexibility and "intelligence" of keyword-based search and selection tools;

• Seamless integration of these search tools with intelligent automatic layout routines, allowing to create (or re-structure) in real-time a theme-based, customized multimedia book.

The end product of my development was a multimedia book generator, that I called *IMS Trail Template* (Fig. 4.4.2 -1). With this program, the user can identify a theme by listing keywords, and the system will search, compile and select the files with objects related with these keywords, and then generate in real-time a digital book, ordering the objects by degree of match with the keyword list, and pasting them into “pages” according to an automatic layout algorithm.

The objects can be *simple* (multi)media files, or *composite objects*, incorporating several elements and layers of information, including transparent "buttons" linking an object to another, or performing other action.

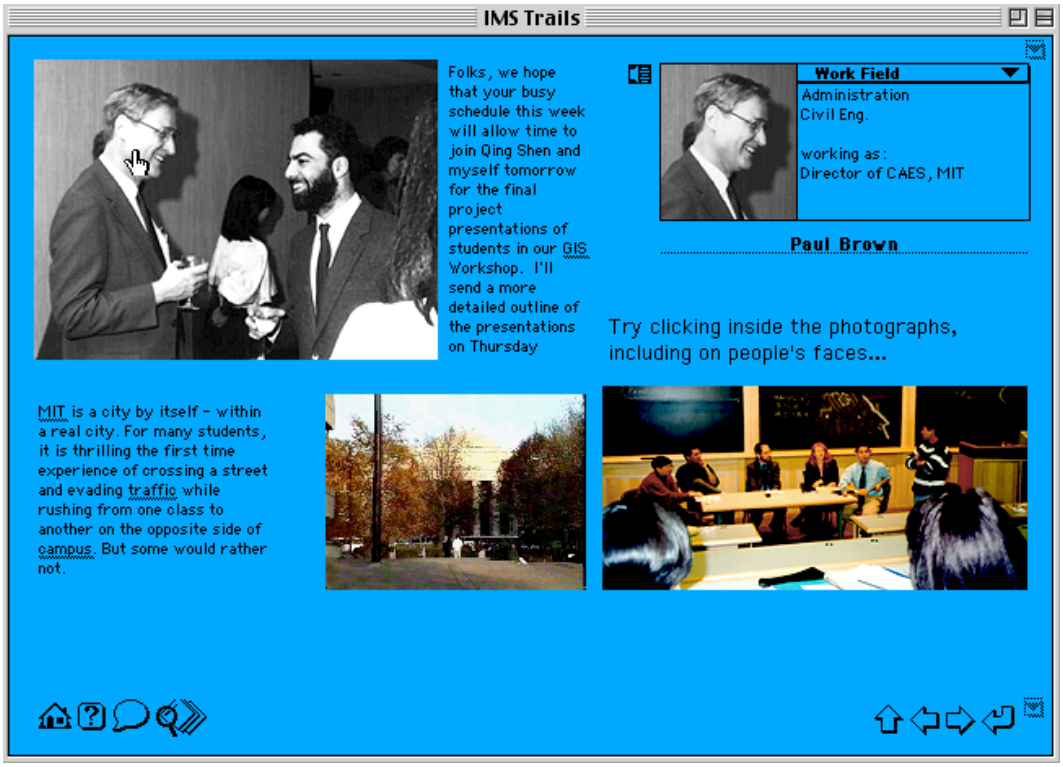

Fig. 4.4.2. - 2 - IMS Trail Book page (theme: Pedro at MIT)

Fig. 4.4.2.-2 shows an example of a "Trail section", or a customized multimedia book page, putting together photographs, video (MIT stairs, Toscanini) and text about my stay at MIT, from a keyword search within a set of files. But the photographs, text, etc., are not simple media objects. Notice that clicking a "hot area" (hyperlink) on the photograph, such as a face of a person, generates a request to a data base to visualize information concerning that person. Clicking underlined text term will query a glossary for the term, and clicking on the text in general activates a speech synthesizer that reads aloud the target text. And so on.

Each of these media objects are therefore composite objects. More importantly, when the "base element" is retrieved, say a photograph, the metadata associated with it allows the system to link the base element to other information and even build, layout and place, in real-time, other objects that are part of the composite (like the "buttons", or hyperlinks).

The multimedia book generated by the IMS Trail Template allows the user to further edit the book elements (Fig. 4.4.2. - 3), adding new ones or removing them, including hyperlinks, or moving media objects within the page.

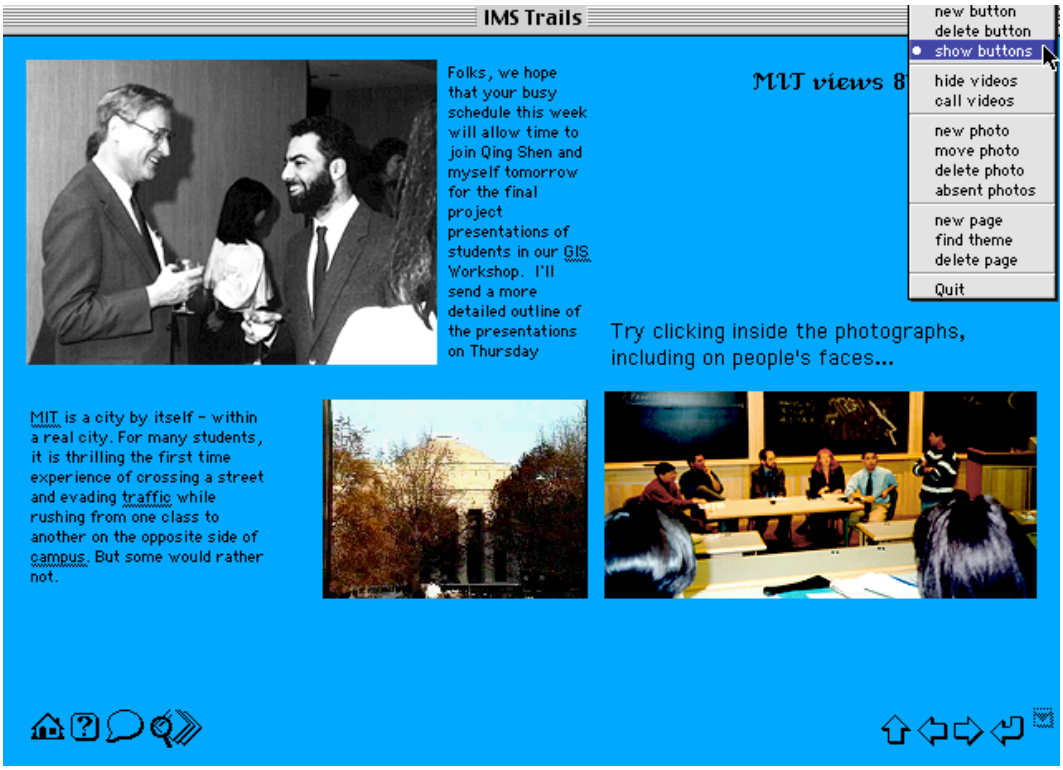

Fig. 4.4.2. - 3 - IMS Trail Book editing menu

The notion of "Data Trail" is a metaphor of the snow ski trails, or hiking trails. A trail is a path that allows the "trail user" to observe a chosen landscape, connected geographically (in the case of a real trail) or thematically (in the case of the virtual trail). But the "trail user" is not limited to observe, he or she can chose to interact and change the landscape (multimedia objects); and, as with physical ones, a trail can have pre-assigned different levels of difficulty or complexity compared with other available trails in the same area. As discussed in the chapter concerning the problem with EIA review processes, this flexibility addresses current limitations shown by paper-only versions of documents, targeting citizens that may have different areas of concern and different levels of expertise..

With the exception of georeferenced maps (further discussed ahead), the IMS Trail Template integrates all the above proposed developments. Naturally, it is supported by a metadata management system, in order to create, maintain and update all the information needed about the media objects and composite objects.

To further provide flexibility to the system, I programmed an independent module able to handle all metadata management.

Developing these programs was no trivial task. One particular requirement, the "real-time" responsiveness of the system, is specially demanding in what concerns the efficiency of the code. The concept of "real-time" is not tied-up to any fixed response time; instead, it is usually defined as the response time found acceptable or reasonable by the typical user, according to user expectations or allowing the user to operate the system without disrupting or bogging down a normal session. In the case of a public consultation support system, the risk of slow responsiveness is to alienate many citizens from using it, defeating the purpose of the system. In the case of the busy expert user, the tolerance threshold is even lower.

It follows that this end product, the IMS Trail Template, would not be possible without solving before these and other difficulties. Given their significance, I discuss more in detail two of the most critical areas: metadata and automatic layout

4.4.3. Metadata for multimedia and hypermedia

The real power behind a system like a multimedia book, is a good and comprehensive handling of the metadata issue. The difficulties arise on three aspects: handling not just simple but composite objects; creating a general-purpose metadata standard able to handle all kinds of different media files; and define a sustainable strategy for acquiring and updating metadata, while keeping it consistent with general purpose standards.

4.4.3.1. Composite media objects

Handling simple media objects, like pictures, text, sound or even video, became trivial with built-in functions in new software generations emerging from microcomputer developments in the eighties. One of the examples of such software, that I adopted since its early days, was Apple's "Hypercard". A revolutionary environment at the time, it made easy to mix simple editing (text, graphic and paint), data-base functions, multimedia files and hypertext links with

a simple programming language (hypertalk), a kind of object-oriented "Basic" cleverly designed to read almost like natural language.

For more than simple browsing, however, you needed the ability to handle more complex objects, such as maps and graphs, and composite objects with combinations of media elements and hyperlinks ("hot" clickable areas within the object, leading to another object or set of objects).

Maps posed a particularly interesting challenge. One way to look at them is as image files in "rasterized" format, so that each elementary quadrille of a grid corresponds to one pixel (picture element, depending on the resolution of the image file); and georeferenced, that is, the picture grid is directly proportional to a system of geographic coordinates identifying (for instance) the latitude and longitude corresponding to each pixel.

Geographic Information System (GIS) software is the natural environment to handle maps, and corresponding spatial analysis. Interesting work was done towards building GIS infrastructures for sharing geographic information among environmental agencies, as well as the related development at MIT (DUSP-PSS) of an interactive "digital orthophoto service" on the Web (Evans 1997). However, GIS software demands a knowledgeable user, and even with the latest progresses, its user interface is not within reach of an occasional user, like a "lay" citizen participating in a public consultation process.

This lead me to develop a Hypercard version (extended with my code) of basic GIS functions, including the ability to "georeference" a picture, either a map or a an orthophoto, and link it to other data. Examples of successful applications of these functions were a system to support the management of underground heating fuel tanks for the city of Newton, and another to support the management of historical preservation data for the city of Somerville (Ferraz de Abreu 1993b, 1991a, 1990b).

4.4.3.2. Hypermedia data structures

In order to develop an advanced Multimedia Book, I had to establish solid concepts for data structures and metadata system. In particular, these had to be able to handle composite objects (like maps) and hyperlinks.

An example of a general data structure with hyperlinks can be seen in Table 4.4.3.2.-1:

Table 4.4.3.2.-1 - Example of data structure for composite media object

meta key	**meta key value**	**comment on meta key**
• file name	sample image	
• file type	pict	(one of basic media types)
• pixel width	320	(for images and videos)
• pixel height	132	(for images and videos)
• legend	"Diagram picture of the flux of solid waste through an incinerator"	(for images and videos)
• button list	{b.name=hot1; b.rect=30,22,40,50; b.script=show legend "This is the thing x of 'sample image' / b.name=hot2; b.rect=53,60,100,200; b.script=go to image y in page z of this book}	(a list of clickable "hot areas", where each button is described by its name, rectangle coordinates related to the top left of the picture, other design characteristics and the action upon made active with a mouse click within its rectangle coordinates).

Naturally, other data structures are needed for other type of objects. After extensive testing, I built a table of key file descriptors (in Appendix), able to handle practically all kind of media objects to include in a Multimedia Book.

Each set of these key file descriptors, or *meta keys*, constitute the metadata associated with each object in the Multimedia Book. This implies storing this information in such a way that not only the system is able to retrieve it easily to reproduce the object, but also that it can store any changes introduced in the object characteristics. In relation with the above described metadata structure, I defined a metadata management system using a standard metadata file naming convention:

Word 1 : file type;
Word 2 to N : qualifier (source, disk volume, etc.), and
Last word : short date, international format.

Example1: "MooV CRL 2001/05/10";
Example2: "JPEG CD ICPPIT 2001/01/31"

After extensive testing, I found this name convention the best compromise between access speed and volume of the metadata files.

4.4.3.3. - The acquisition of metadata

I found it important to define a non-obtrusive strategy to acquire and maintain metadata, within a microcomputer environment. For reasons I explain next, I chose the Mac OS (Apple) platform for implementing this experimental development.

The main elements of this strategy were:

a) To not impose any locality or format to any data or knowledge unit (file) accessed by the system;

b) To use a metadata index as the only internalization needed for the Intelligent Multimedia "perceive" and acknowledge new data and new knowledge;

c) To "stamp" this metadata index to every new file by appending a transparent resource;

d) To use the machine operating system (instead of a dedicated data base management system) to collect and update core information on every file

e) To use object inheritance (classes and instantiation) to build and maintain complementary metadata with multiple structures, as needed.

In a structured environment, with the relevant data already stored in some data base software, it is possible and desirable to take the path of creating standards of metadata for all available data. However, such scenario is too restrictive; more likely, such level of data organization and comprehensiveness will not be available in many processes of public consultation.

In a non-structured environment, where data is not formally organized, and is instead spread (for instance) across several autonomous computers, a different metadata approach must be used. I suggest that we should look at each PC as a virtual data base, in the form of a loose collection of files stored in hard disks, with rudimentary operators available to store and retrieve them, operators which are provided directly by the operating system (OS) and not by any specialized database software.

An Intelligent Multimedia System using this strategy does not need to impose any structure, format, or placement, in order to recognize data, new or old. A major advantage. But there are limitations. This approach has the obvious disadvantage of being operating system dependent. This may became less of a problem, given

the current tendency of microcomputer OS towards compatible or portable standards (ex. Java Virtual Machines, or the *CHRP - Common Hardware Reference Platform*, involving several PC makers including IBM and Apple).

An operating system needs to maintain a considerable amount of information about the resident files. This information is kept inside system data structures, such as disk directories, and is updated upon events. An event occurs every time a file is created, copied, moved from one directory to another, for example. Although much of this information is intended for internal system use only, and therefore not visible to the user, it is possible to fetch it.

For demonstration of concept, I used a Macintosh environment (Mac OS). In the Mac OS, this information includes useful data such as file name, path, date of creation (including time), date of last modification (idem), file size, file type, file creator, file version, etc. Examples of file types: TEXT, PICT, APPL (Application = Program), etc. The file creator code identifies which application (program) supports the file and in some cases identifies the software producer (ex. MSWD- Microsoft Word). Other information can be extracted from the files themselves, although accessing information from the files is considerably slower than accessing it from disk directories.

The Macintosh system metadata is therefore a "natural" standard for all files residing in Mac computers. This allows for automatic generation of a metadata catalog, a great plus. By contrast, all other kinds of metadata have to be treated case by case. Given the variations on what is considered the most relevant information to be included, the less restrictions a metadata generator system imposes, the better. For example, georeferencing information is crucial for spatial data like transportation networks, but hardly important for a functional description of a water treatment station.

Therefore, in my view, a good format for a metadata catalog has two parts: a system standard component, and a configurable component. Both components can be stored as line records in independent files (for instance, as comma separated values), and the first line of any metadata file (standard or configurable) will contain the description of the fields. Since the system metadata format is unique, the only information associated with each file we need to have is the name of the corresponding metadata file. This "metadata pointer" can be stored non-

obtrusively as a resource of each and any file (the only effect is to add a few bites to the file size). In certain cases, this information can even be obtained automatically (with a search by content on files to match the target file name), although the time penalty may be prohibitive.

With this approach, any user can create his or her own configurable section of the metadata catalog according to specific requirements, accumulate metadata over time, and have it merged with any other user/system metadata. The configurable part will allow to collect and maintain the most relevant information for each case. But with the infinite variations of what is relevant, how is this approach going to help? The solution is to use an object-oriented representation. For instance, each file will have a configurable metadata inherited from two worlds of classes: one, with default "slots" typical of each media, or file type (ex.: picture, video, text, sound, map, graphic, etc.); other, with default "slots" typical of each domain and its taxonomy (ex.: pollution -> water, air, noise; transport vector -> car, train, bus, etc.). The critical part is, naturally, the building of a class hierarchy, or taxonomy, for each relevant domain. Further work in the future may even introduce *rules* of taxonomy, instead of the taxonomy itself, in order to allow more flexibility.

How would this metadata approach reduce the overhead in "feeding" the system with new data? For instance, with current drag-and-drop technology, a user only needs to drag-and-drop a new file (or a set of files and folders within a folder) on top of an icon representing an OS script containing rules and criteria for building metadata, which will automatically perform all needed operations of metadata indexation and catalog. The source files, of any type and topic, will stay where they were, as they were - respecting the non-obtrusive requirement. More refinements may extend this automatic operation to general thematic classification with guided user input, etc.

Metadata management is an active area of research (GIS, 3-D modeling, etc.). For instance, new operation environments, such as web-based large databases to support e-commerce, require even more scalable metadata structures than the one proposed here.

In order to support my design of an Intelligent Multimedia System with a sustainable metadata strategy, I programmed several experimental scripts as described above, integrating their output with the “IMS Trail template” program.

4.4.4. - Intelligent Automatic Layout

At first sight, an automatic layout feature seems like a secondary detail. However, I concluded that the ability to generate, by user request, in real-time, a customized multimedia book, compiling all available data concerning a specific topic, was crucial.

The advantage of such feature follows from the discussion of the EIA review typical problems, in particular the one concerning the need to address both expert and lay citizens, and deal with the different focus by individuals within a vast multidisciplinary material.

As it happens, it is not practical to implement this feature without a sophisticated automatic layout function. Intelligent automatic layout addresses, for instance, the ability to search a space of solutions for multiple possible layouts given a set of media objects to fit within a page, in order to produce a good "solution" (layout respecting certain design standards).

To build this function into the “IMS Trail template”, I programmed a layout routine with the ability of back-tracking from bad "solutions" (or "bad" tree branches of the solution space). The outline of the general algorithm, including the automatic layout, is the following:

1) The user lists the keywords identifying the desired topic;

2) The system searches within the metadata files and compiles a list of matching files, with respective metadata record;

3) From each metadata record, the system assigns a rectangle (width and height) value needed by each object to be visualized within a (digital) page;

4) The intelligent automatic layout routine uses as input this rectangle list and the page layout conditions (pre-defined), and produces as output a corresponding list of coordinates and page assignments for each object;

5) The system creates the pages and places the objects accordingly, and builds any elements described in the metadata of composite objects.

Fig. 4.4.4. - 1 shows an example of a test of the intelligent automatic layout routine. At the right, it is visible the source list of rectangles (width and height in pixels) requested; the result is visible on the left, with “place holders” on the

assigned layout, corresponding to the source list. A monitor window of the intelligent layout routine shows the test parameters, including resolution and page constraints. During the layout generation process, it is shown the several tries (exploring the tree of solutions) with backtracking, weeding out also the impossible elements (ex. object too large for the page), until it settles on a final solution. The algorithm is actually able to decide in some cases to "crop" an image to fit the page, to limit the number of rejected objects.

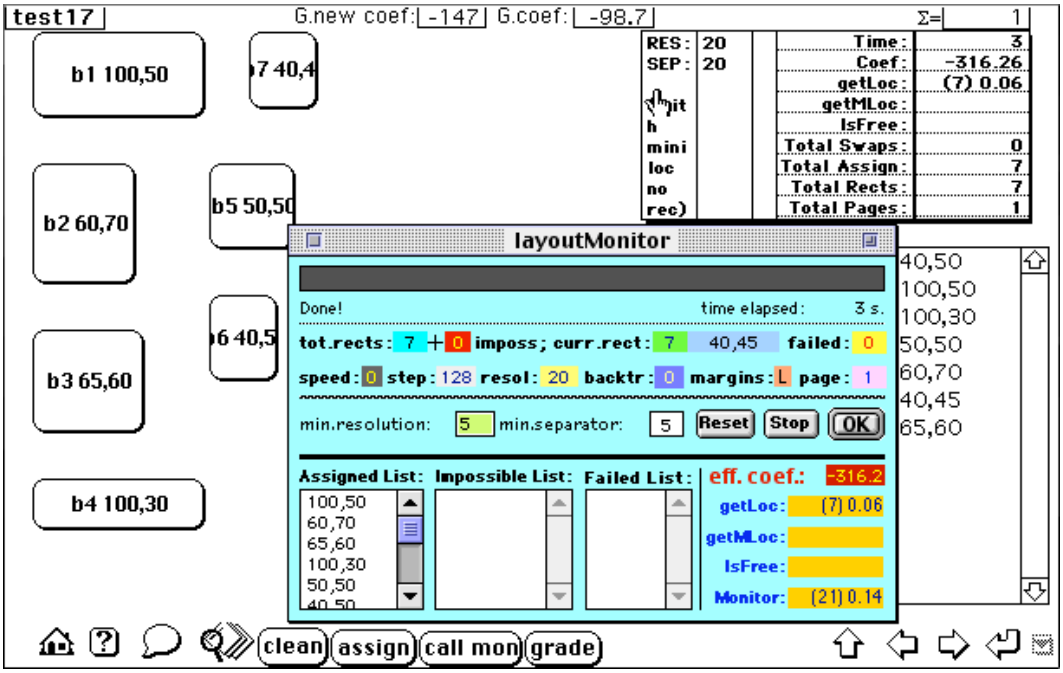

Fig. 4.4.4. - 1 - Example of test of the intelligent automatic layout system.

After several iterations of tests and routine adjustments, the intelligent layout feature was successfully integrated in the "IMS Trail Template" program, the core tool to generate Multimedia Books, or "Data Trails".

4.4.5. Knowledge-based virtual office

With the implementation of the "IMS Trail Template" in advanced stages and the metadata strategy and structure defined, it was time to tackle the other public and technical consultation support tool I had conceived, in response to EIA review problems discussed in this section: a Knowledge-based Virtual Office.

The basic concept was to capture expert knowledge, in some structured or semi-structured way, digitize and represent it in some form that could be consistently retrieved by means of a simple user interface, much like a citizen going to an expert's office to consult with him or her about the issues in question.

We are dealing now with another level of information. We can look at the "IMS Trail Template" as dealing with elementary data chunks or data units, like text or video files, even if some of these units are represented as composite objects, as described above. A "Virtual Office" has to deal with knowledge units, with some semantic value. But in the end, knowledge units are basically collections of data units, organized in some meaningful way.

The first design challenge lay with the representation of this expert knowledge and its seamless articulation with other information, be it data or knowledge units. The representation model needs to facilitate the insertion of new knowledge, in order to allow for a sustainable update and maintenance procedure.

I considered that the best approach was to use the representation model I used to develop a multimedia system for case-based reasoning, as my starting point. To facilitate this description, I recall here again the Figure 3.3.5.4.-1 , introduced in the "Information Technology Review" chapter, when discussing this model. In it, all levels of information are articulated, from non-structured to more structured levels.

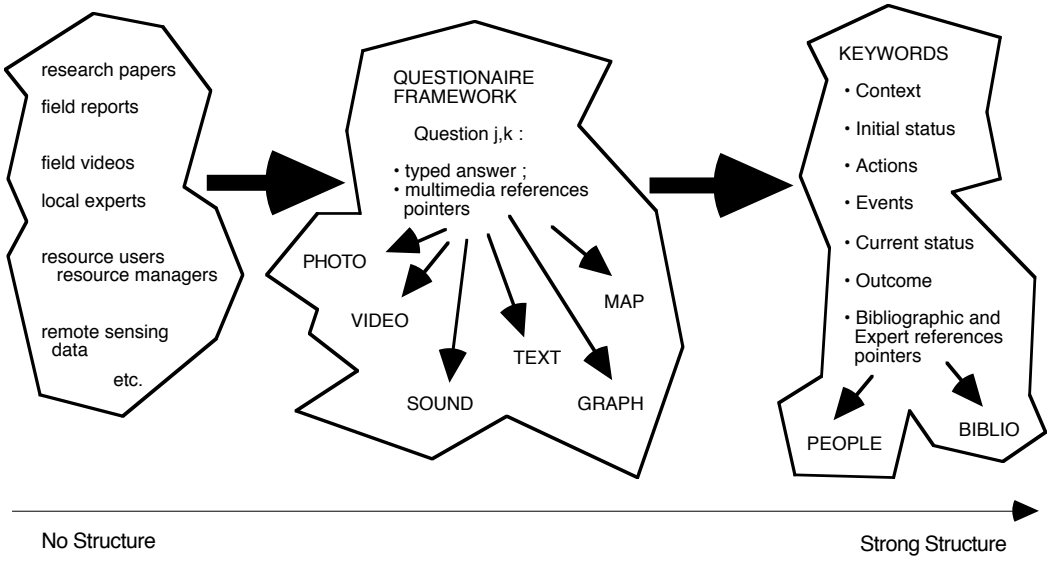

Fig. 3.3.5.4.- 1 - Data Model for Case-Based Knowledge Representation

Naturally, the choice of structure derives from the nature of the information and the function of the system -- in this case, to support natural resource management.

I proceeded to adapt this model to serve the "Virtual Office" function, and deal with the kind of data handled in typical in EIA reviews. The result is shown on Fig. 4.4.5.-1.

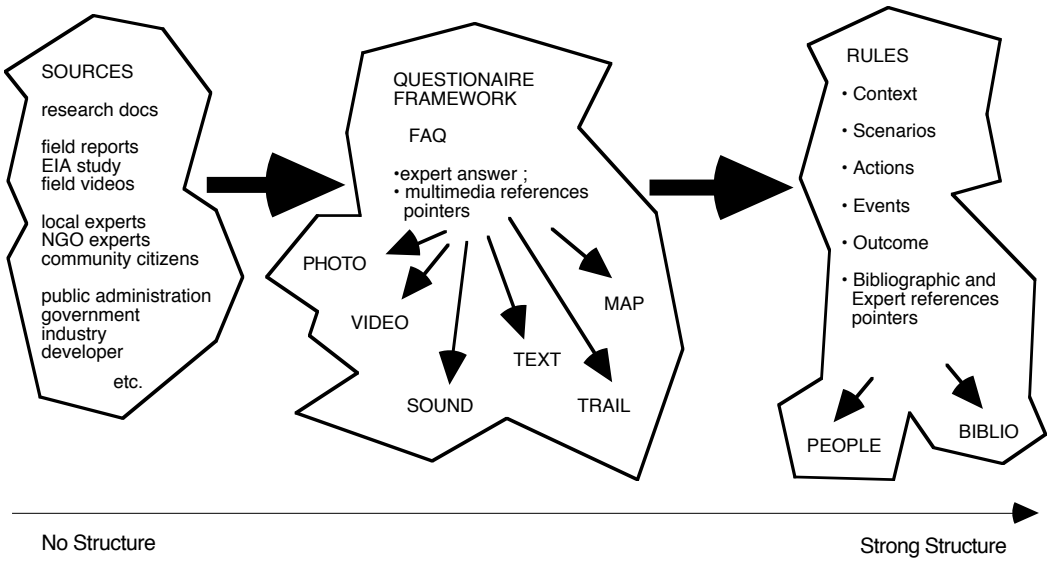

Fig. 4.4.5.-1 - Data Model for Knowledge Based Virtual Office

To the first level, sources, I associated the notion of direct access, to browse "raw" data files. I called it the "Archives".

To the second level, questionnaire, I associated the notion of a kind of a FAQ (Frequently Asked Questions) server, but "personalized" by direct access to individual authors of the responses. I called it the "Experts' Offices".

To the third level, rules, I associated with the notion of an expert system, with direct access to experts' causal reasoning, in function of user set scenarios. I called it the "Oracle"[1].

The simplest user interface approach was to program one module for each of these levels.

[1]A reference to the famous 'Oracle of Delfos'. In fact, the Egyptians invented the idea, with citizens turning for advice to oracles, which were statues with priests hidden inside [Kurzveil 1990]

To handle the “Archives”, I used the functionality already present in the “IMS Trail Template” program.

To handle the “Experts’ Offices”, I used part of the automatic layout routine, in order to generate “office space” for each expert that provided a response to one of the FAQ. Expert responses could also point to one or more media objects, including composite objects and multimedia books, like “Data Trails”.

To handle the “Oracle”, I used the expert system program I developed for infrastructure shortfalls (presented in the chapter reviewing IT developments), adapting it to a common interface.

Besides a common user interface, aggregating the functionality’s of each module, this design implied also a knowledge acquisition strategy: collect and handle raw media files, define a questionnaire framework for the “FAQ” and collect expert answers, and compile rules representing experts’ causal reasoning.

The Knowledge-based virtual office was the direct seed to the final "Intelligent Multimedia System" (IMS) prototype design frame.

4.4.6. IMS frame

With all the base elements in place, I proceeded to program a first version of the prototype of an “Intelligent Multimedia System”, in support of the technical and public consultation, for environmental impact assessment reviews. To simplify and avoid redundancy, I will present the final version of the IMS modules in the next section, when they were already filled with case-related knowledge and data units. In this chapter I conclude the presentation of the IMS design with a summary of the formal definitions behind the IMS, and an overview of the designed system.

4.4.6.1. Formalism in the IMS design

All IMS design, in particular its interface, was based in a formal description using a definition language notation (BNF). This was the only way to keep consistency

within a large program, with thousands of lines of code and dozens of modules, such as this one. The complete description of the formal definitions can be found in one of the IMS modules (IMS Formal Definitions), and is included in the Appendix (and CD-ROM).

Tables 4.4.6.1. - 1, 4.4.6.1. - 2 and 4.4.6.1. - 3 show extracts of such formal definitions. In there can be found the structure of the program, its modules and components, including the data and knowledge units.

The general design principle is based on the distinction between the *representation* and *presentation* concepts:

• 'representation' refers to descriptors of each kind of knowledge representation paradigm, with its respective slot structure requirements.

• 'presentation' refers to descriptors of each kind of media channel, with its respective typical slot structure for data and visualization.

Table 4.4.6.1.-1 - Extract of IMS formal definitions - initial form

{*SU_name : system unit ; *type : S } slots := *parent , *metaclasses , *classes , *SU_name , *type , *comment referencelist := nil *parent := nil *metaclasses := presentation , representation , question , proximity , link , domain , people , entity , place , timeframe *classes := agent , knowledge_unit *SU_name -> identifier *type := S | metaclass | class | slot | instantiation | definition *comment -> brief text description S -> (init symbol)	Symbol table: ':' -> attribute assignement '*' -> slot identifier ':=' -> instantiation assignment '|' -> 'or' list separator ',' -> 'and' list separator '->' -> definition '{x}' -> any instantiation of x

Table 4.4.6.1.-2 - Extract of IMS formal definitions - examples of metaclasses (i)

{*SU_name : knowledge_unit ; *type : class} slots := *metadata_identifier , *representation_descr , *presentation_descr , *domains , *peoples , *entities , *places , *timeframes , *source_people , *source_entity , *links , *cross_ref referencelist :=nil *parent := system unit *metadata_identifier := metadata_ID *representation_descr := representation *presentation_descr := presentation *cross_ref := { metadata_ID }	{*SU_name : link ; *type : metaclass} slots := *link_ID , *l_origin , *l_destination , *l_kind , *l_date , *l_creator , *l_status , *l_guards , *l_weight , *l_why , *l_button referencelist := nil *parent := system unit *link_ID -> integer *l_origin := { knowledge_unit | question } *l_destination := { knowledge_unit | question } *l_kind := domain | places | people | entities | question *l_creator := { people } *l_status := enabled | disabled *l_guards := set of conditions *l_weight := 0 ... 1 *l_buttons := { button }

Table 4.4.6.1.-3 - Extract of IMS formal definitions - examples of metaclasses (ii)

{*SU_name : representation ; *type : metaclass} slots := nil referencelist := nil *parent := system unit *classes := textual | tables | logic | commands | images | audiovisual | maps | equations | rules | frames equations := algebraic logic := boolean | predicate_calculus textual | algebraic | boolean | predicate_calculus -> ascii string commands -> IMS program instructions (script or compiled) [parameters]	{*SU_name : question ; *type : metaclass} slots := nil referencelist := nil *parent := system unit *classes := what (info) about this | who (states) this | when (was) this | where (is) this | Why (is) this | expand/specify/generalize this what (are) the consequences of this what [contradictory | corroborative] (statements) to this (exist) what [knowledge_unit] (are within) proximity (to) this how this relates to that this | that := knowledge_unit | set_of knowledge_unit

4.4.6.2. IMS core design.

The core of the IMS prototype is a multi-domain knowledge base (KB). This KB can be described as a set of *knowledge units*, a set of *relationships* connecting or structuring those knowledge units, and three *engines* (inference and search). The data structure follows the representation model described for the "Knowledge-based Virtual Office".

1. The *knowledge units* present in the knowledge base are the following:

   • Vocabulary list;
   • Keyword list (sub-set of the Vocabulary list);
   • Vocabulary Descriptors;
   • Glossary (sub-set of the Vocabulary descriptors);

- Question list;
- Answer list;
- Answer descriptors;
- Tuples of condition-relation-value;
- Rules;
- Rule descriptors;
- Support documents.

Support documents can be any simple or composite media file (text, sound, pict, video, graphs, maps, trails, etc).

Descriptors contain metadata, including information about the author of the knowledge unit and links to other knowledge units or media files.

2. The *relationships* connecting or structuring those knowledge units are:

- Multiple domain taxonomy;
- Object inheritance within taxonomy classes;
- Pointers.

3. The knowledge base *engines* are:

- Forward-chaining inference engine;
- N and Z inheritance search engines;
- Indexed and content based search engines.

The first version implemented followed this IMS design frame and allowed to define a more specific scenario for the experiment, considering the potential uses of the IMS. I was now ready to complete the experiment design.

4.5. The Experiment Design

Introduction; Phase 1 - Environmental impact assessment review previous to public participation; Phase 2 - Public consultation process after preliminary EIA review; The choice of media IT; Criteria of success

4.5.1. Introduction

In this chapter I present a hypothetical view of a new scenario emerging from the previous composite scenarios, in which new IT is introduced (Intelligent Multimedia System - IMS), and my original estimated implications (of introducing IMS) in the process itself are projected. The assumption is of an optimal case, where all the introduced changes produce their best expected results. The objective of this projected scenario was to facilitate the design of an experiment, consisting in the introduction of the prototype of an IMS, as described in the previous chapter, in a case with public participation, in order to evaluate the impact of the different attributes and features brought by the new IT.

The goal of the thesis experiment is not to achieve a scenario as projected in this "design phase" (which would imply optimal conditions and a fully functional, fully tested IMS, instead of a simple IMS prototype that implements only some of the possible functions), but to test the validity or potential of key ideas proposed in my thesis, both in technological innovation and in technology-process integration.

To simplify the description, the projected scenario uses the same settings of the previously defined composite scenarios; the differences being in some of the **procedures** adopted and in the **new IT** introduced. We have therefore the following entities (or actors): *Decision maker* agency; *Expert team*; *Advisory commission*; Public *agency* (or department) in charge of *conducting and / or reviewing the public consultation process*. The rationale behind the choice of the new IT presented in the projected scenario is discussed later. The problems addressed with the introduction of this new IT correspond to the class of problems (2 and 3) summarized in the previous chapters (Problem and Scenarios).

4.5.2. Phase 1 - Environmental impact assessment review previous to public participation.

Both the expert team and the advisory commission have available a IMS PC software that allows, among others, the following operations:

- To catalog and classify the material relevant to current case, and to previous cases (not yet internalized in the system) that may be useful precedents to learn from;
- To provide a blackboard of expert opinions, including on implications of each proposed solution (answer to what if questions);
- To follow the reasoning of proponents of each alternative solutions in order to prepare a rebuttal or to consolidate a supporting vote.

In the description that follows, I identify only one or two kinds of actors using each IMS function. This is a simplification for the only purpose of providing examples, since any actor (including common citizens) may use the IMS for any of its functions.

A - *To catalog and classify the material relevant to current case, and to previous cases (not yet internalized in the system) that may be useful precedents to learn from.*

Main **actor** described: expert assigned by the decision maker agency to the expert team.

In a typical day, an expert arrives at his (her) personal working area, carrying notes from a field trip. He (or she) logs through a modem to the team's computer server, with several gigabytes of disk array, where all raw data gathered by the team is kept. He checks a shared folder marked "not classified", where data clerks (secretarial staff assigned to the team) and the experts themselves input scanned text and photo files, or digitized streams of video and sound. Finding a few files that relate to today's work, he downloads them, and uses the IMS software to classify those files from his point of view (dragging the files over a few desktop icons, and typing a few lines of more specific detailed notes from his field book). When satisfied, he uploads the files into a shared folder marked "classified material". Non-obtrusively, the IMS automatically "stamps" the file with a

metadata index (if not there already) and updates all corresponding metadata files residing in the common server.

Next, he uses the IMS to check upon related files already classified by him or other experts (in "classified material" folder), to add a new classification criteria in some files (e.g. 'this photo is-a swamp'), and relates the new class item with existing classification taxonomy (e.g. '**swamp** is-a-kind-of **wetland**'; by establishing this relationship, 'swamp' -- and therefore the photo -- automatically inherits all other wetland classifiers and respective slot information previously introduced by other expert in wetlands). Next he 'hyperlinks' an area in a photo to another text file and to a segment of another video file. Next, using a user-interface form helper (user input is only italic parts), he adds a metarule to the system, according to the insight acquired in last field trip, for instance:

if
doc-metadata-on [*domain*] contains [*water-draining*] and
doc-metadata-on [*thing*] contains [*pump*] and
doc-metadata-on [*place*] is-within [getcoordinates(*Urgeiriça,Muroa islands,Hiroshima*)]
then
add document-metadata-on [*domain*] put [*radioactivity*]
add document-metadata-on [*topic*] put [*risk-procedure*]
end if

, metarule that will have as consequence that in the following search operations all documents whose metadata satisfies the antecedent (**if** part) of the rule will have automatically their metadata updated accordingly (**then** part), even those documents inserted by other experts in other fields dealing with draining water but that are not aware that using a pump to drain water in areas with potential residual radioactivity from nuclear tests is a risky procedure.

The next expert to use the system will find a richer set of classified data, and because the IMS metadata system maintains a common consistent vocabulary of well-formed expressions and tuples of variable-operator-value, the whole system slowly accumulates compatible cross-references and links, that can be inherited from case to case. And because the system is not limited to keyword classification (with corresponding SQL search engines, for instance), existing metadata can

interact with each other by means of inference engines and different sets of metarules guiding the strategy of inference.

B - *To provide a blackboard of expert opinions, including on implications of each proposed solution (answer to what if questions).*

Main actor described: expert assigned to represent a intervening public agency in the Advisory commission.

Periodically, the expert team dumps a subset of the working (classified) data into a small collection of CD-ROMs (Compact Disk - Read Only Memory), using as a filter a pre-defined criteria satisfying confidentiality, political sensitivity and other requirements (identified as a combination of metadata values). The CD can be reproduced and distributed (e.g. mail) by the secretarial staff to NGOs and other agencies represented in the Advisory commission, with negligible transaction costs.

An expert from one of the represented public agencies receives the CDs and, with the help of the IMS, proceeds to analyze the potential *interaction* between the current proposals (or chunks of analytical data) and the activity of his own agency: on legal / jurisdiction issues, on the competition for common resources (human, equipment, financing), on schedule issues (synergy to be explored or potential contradictions to be avoided), on the assignment of priorities for the development project's proposed tasks and the related agency tasks already planned or in planning phase.

The expert from this agency has the firm conviction (a trait shared by all other experts of the same agency) that when it comes to topics within the agency's turf, only he knows how to approach a problem and follow up the implications. Since the material from the expert team is not limited to a written report, but includes IMS compatible documentation, he is not forced to follow a pre-defined framework or path of analysis (like a book structure) and can instead make use of the hypertext browsing ability of the IMS to explore the data according to his own mental framework and follow the presented reasoning his own way.

On the other hand, the same expert is more than willing to admit that outside his domain of expertise, he must either skip it or consult with another expert. Before,

he had no time for such cross-domain or cross-agency consultation, so he would skip it, but the IMS provides him with a virtual consultant board, albeit limited, that he can use from his desk at his own pace. So he decides to explore the potential consequences of a certain course of action in domains outside his expertise (transportation, for instance), and he asks the IMS 'what are the consequences of critical **transportation** conditions (such as traffic jams, road pavement erosion, etc.) in other domains'.

The system is not prepared to answer that exact question, but indicates that there are available relevant knowledge units from experts on land use planning, regional economy, and environmental risk management. He can see by himself possible implications in the first two domains, but is intrigued by the last one, and asks for *specification*. The IMS launches a video of an expert explaining in a interview (and illustrated with linked photos and graphs) that certain toxic waste materials in transit by **truck** may suffer evaporation in a worst-case scenario (high temperatures, corroded packaging), but still with low concentration of hazardous emissions (the IMS was able to link this knowledge unit to the previous question because of class inheritance: **truck** is-a-kind-of **transportation** vector). The transportation expert was thinking in terms of **critical** transit conditions, so he quickly infers that with such a truck in the middle of a traffic jam, the emissions may accumulate and reach a dangerous concentration. Therefore he inserts a flag with a note for further inquiry of probability of occurrence of those combined factors, and what alternative solutions are readily available. This is a new issue, not obvious before, and it may imply either changing the agency's own view or planning, or the need to counter-propose a different approach in the joint meeting. The system can be used to prepare foundation argument for both cases (for in-house or joint commission counter proposals).

Synthetic evaluations from all these analysis, together with expert opinions on issues pertaining to the agency "turf" of this expert are finally expressed and documented, and automatically "stamped" by the IMS using the same, compatible metadata format into a folder marked "interaction: project A / our agency" in the common server of the agency. The contribution from this or other in-house agency expert (evaluation plus expert opinions plus related documents) can take the form of stand-alone text or video files, as well as pre-formatted files with one or more of the available knowledge representation forms (frames, rules, equation model, case); and with a simple click the expert will 'hyperlink' each one of them to the

relevant chapter titles or specific paragraphs from the CDs (the IMS will automatically generate pointers and store them in local metadata files, ready to merge with previously defined metadata in next cycle).

A new CD is then produced (files downloaded from the common server of the agency), and distributed to other Agencies and NGOs represented in Advisory commission, as well to the expert team.

C - *To follow reasoning of proponents of alternative solutions -- to prepare a rebuttal or to consolidate a supporting vote.*

Main **actor** described: expert / activist from one NGO engaged in the process.

Using both sets of these CDs, experts from NGOs will download the data into their own PCs and use the IMS (with similar settings as described above) to browse through the data, exploring the rationale adopted by the expert team or other agency, and then adding their own set of links, data and classification, which they will use in two forms:

a) To speed up the production of point-by-point written comments / rebuttals on the expert team approach, preparing for next joint meeting;

b) To produce their own CD_ROMs from a different set of data and knowledge base with a different view or approach on the problem, but in a compatible metadata format, that can be studied by the expert team and the Advisory commission -- or distributed later to public consultation sites if no consensus is achieved.

4.5.3. Phase 2 - Public consultation process after EIA preliminary review.

Main **actors** described: local citizen, from one of the proposed sites, and expert from the public institution in charge of following the public review process.

Both experts and citizens will be able to use IMS for, among others, the following operations:

- To provide a blackboard of expert opinions, including on implications of each proposed solution (answer to what if questions) (previous B);

- To follow the reasoning of proponents of each alternative solutions in order to prepare a rebuttal or to consolidate a supporting vote (previous C);

- To provide a blackboard of citizen comments and proposals, facilitating a multi-thread dialog and the potential integration of such views in the final decision.

At the end of the preliminary phase, the entity responsible for the EIA presents a final set of CDs, ready for public consultation, with the "official" proposal and list of alternatives in consideration. The CDs are mailed to several entities and agencies, at national and local level, and also (for a nominal fee, cost of the media only) to any citizen that may request them. Their content will also be presented in a publicized World Wide Web (WWW) Internet home page. Several sites with open (public) access to PCs with IMS software installed will be made available. Some NGOs also take the initiative of installing such sites.

Citizen John Doe comes to one of these public consultation sites. He lives on one of the proposed project development sites, is worried about how the development may affect his neighborhood life style (including here environmental standards, local economy, property values), and wants to know exactly what is at stake. What he read and listened on TV and newspapers, and also at a public hearing, was enough to raise his concerns, but he mistrusts the political motivations of some of the intervening people. He prefers to come to the public site to get detailed information (he expects to read a document, ask a few questions to an attendant, or maybe get a free copy of a non-technical summary), rather than try Internet access to the publicized WWW page. He is college educated, but there was no Internet in his school days, and he has been too busy to get into it.

The person in permanence at the public consultation site is able to respond to some of his questions, and to provide him with a very brief non-technical summary, but his expertise is limited and in consequence suggests the citizen to obtain more detailed expert information by using the IMS.

The citizen sits at the PC (which has a large hard disk, a CD drive and a fast modem) and after a few minutes familiarizing with the use of the program, he begins by browsing the opinions of other citizens. Transparent to the user (other

than a slight delay), the IMS automatically connects to the WWW server and downloads the last comments inserted (from all sites) since the last local connection. He flags some paragraphs (which will be transported into a "scratch pad" area dedicated to this user) he found interesting or useful, thinking he might later write his own comment on it.

Next the citizen calls to the screen the virtual consultant board of experts, selects one of the listed FAQ (frequently asked questions) and drags it into the virtual office of the ministry of industry to obtain its answer. Wanting a second opinion, he drags the same question to the virtual office of a local NGO. Next, he proceeds to pose a new question, one that he did not find among the FAQ. The IMS uses metadata links and its inference engines to put together a set of knowledge units (e.g. video interview segments, geo-referenced aerial photos, pages of text documents, business cards of experts) that relate to the question and are inter-linked in some meaningful way: a kind of "data trail" presented to the user.

Following this data trail, the user is led to view several photos and videos documenting the degradation of other sites that failed to commit to a solution (consequences of zero action). He is impressed by this, and his concerns expand beyond the initial personalized problems, and he decides to consult on the amount of tax money wasted just to mitigate the current situation. He begins to think that he must consider also the national and long term implications of each proposed alternative, before forming a firm opinion. So he calls the "Oracle" (what-if questions on hypothetical scenarios) to inquire about the consequences of a certain set of conditions (for instance: certain regulations, worst case accidents and choice of technology X and Y). The IMS calls the most adequate inference engine according to the best fit representation for the set of hypothetical conditions, and presents an estimate of the consequences. The user inquires why a particular step of an inference regarding the effect of a certain regulation, to which the IMS shows the corresponding rule of inference, and its author. The user disagrees, based on his knowledge of local institution dynamics, and writes a comment suggesting an alternative rule of inference, as well as his justification (and qualifications for a competent opinion). The IMS links this comment to the rule, sends a message to the previous rule author's mailbox.

Another citizen asking thereafter a similar question will be presented with both paths of inference, and with an explanation on the diverging point (and respective

authorship's). By the end of his session, the citizen will write some final comments. The IMS compiles the several inputs, "stamps" them with the relevant metadata indexes and uploads them into the common WWW server.

Meanwhile, an expert from the public institution in charge of following the public review process uses the IMS from her office, to check on last public input, and eventually to recommend that some of this input be taken in consideration, be it to complement the current proposal, to justify further studies regarding the environmental impact assessment, or to actually change the decision on the favored alternative. The IMS can also be used to produce and publish a summary of the public input, with or without official comment/responses, conveying the message that such input is important and valued.

This summarizes the expectations reflected in the design of the experiment. Naturally, I had the clear notion that it was impossible to anticipate and stereotype, in this or other fashion, the behavior of the actors in the process (in particular citizens participating in the public consultation), given the infinite variations of character and condition. But by building this scenario, taking care in basing it in real world conditions in past cases, I provided some kind of a guideline to structure my preparation of the experiment.

4.5.4 The choice of media IT

As defined during the design of the IMS (previous chapter), the two critical components of the new IT proposed to integrate the public participation process are Artificial Intelligence (AI) and Multimedia. The justification for this particular choice was discussed in another section ("Technology at the Service of Public Participation"). But this does not exhaust the new IT developments that have a meaningful impact in the EIA review process. It is useful to present at this point some reflections on the suggested use of CD, vs. , for instance, the use of internet's WWW as the common communication support at all phases.

My focus was on identifying key IT concepts (key to process improvement, in public participation), rather than on IT specific implementations, given the fast pace of change and evolution of such implementations. One possible analogy, is the advice that any experimented computer data base (DB) consultant is likely to

give: to concentrate on which data structuring and data input organization to adopt rather than on which DB software to buy, since the latter will evolve fast and the former will have an enduring impact on the sustainability of a successful process.

This is not to say that the choice of IT implementation to use has no effect on the process. For instance, it is possible to argue that a CD-based process as described for phase 1 (previous to public consultation period) commits the authors of an expert opinion (and potentially an agency) to a specific text wording, while a simply WWW-based process would not, since WWW home page can be changed minute by minute. This can be positive or negative; on one hand, rigid commitment makes the authors more accountable on positions taken during an intermediate phase, on the other hand this may cause self-imposed limitations on exploring creative solutions, for fear of the consequences of such accountability.

In general, CD-based procedure is associated with a "milestone-like" process, while WWW-based process may perhaps be associated with a more fuzzy, permanently fluid process. Since current processes (on phase 1) are more engineered towards milestones than towards fluidity, it may also be argued that it will be therefore easier to introduce changes to current process with a CD-based process. As for phase 2 (public consultation period), when the expert body of knowledge is solidified in a final form (proposal in debate) and the fluidity is on the body of feedback, this very fluidity will arguably constitute an advantage, by enabling an incremental multi-thread dialog, one that is simultaneously citizen-decision maker and citizen-citizen.

A similar line of reasoning applies to the relationship between a model of information flow and the choice of IT. Focusing again on the choice of CD vs. WWW, a limited distribution of CDs allows to avoid dilemmas of the all-or-nothing kind (either very limited documentation made available in preliminary phase or all documentation available to all in all phases). Clearly, defining mail lists of CDs is an easier mechanism than defining a complex multi-level user access control in WWW. Leaks are always possible, but if that is not the issue, then a CD-based process allows for a more gradual, systematic and multi-level presentation (the final CDs produced are different, even if derived from, earlier stage's CDs). Again, at the stage of public consultation, with a crystallized set of documentation and knowledge to present, a WWW-based process offers the advantages of an easier integration of the citizen input.

Finally, the objective of the projected scenario is to establish the foundation for an experiment. Circumstance factors may affect decisively the choice of new IT to use. My initial assessment was that it would be more difficult to establish an Internet-based experiment in the current settings of the chosen research case, than the use of CDs as the support of intercommunication. But part of the value of the experiment was, precisely, in providing some evidence regarding this question.

4.5.5. Criteria of success

Even if the thesis experiment was not designed having in mind a quantitative approach, it is nevertheless crucial to define what is success and have a notion of how one can measure different degrees of success. in order to establish a term of reference fro qualitative analysis. There are two steps of analysis where it is important to have a defined criteria of success: to evaluate the process facet of public participation, and to evaluate the impact of using a specific IT as decision or planning support system. We need to consider plausible dimensions, not only the directly measurable but also the relevant externalities in the public participation process. Here are some of the measures for evaluation I considered interesting:

- Number, type and role of departments and divisions involved
- Number and kind of participants
- Role of participants of each kind
- Type of skills needed (more or less physically/intellectually demanding, time consuming, pleasant)
- Scope of information considered before and after
- Quality of information, idem
- Number and quality of alternative solutions considered
- Speed of process
- Percentage of information reviewed over the total relevant information available
- Results, in terms of the role of the agency (effectiveness, efficiency, etc.) and of expectations/goals
- Perception of success, level of satisfaction
- Capital of good-will among different agencies

- Changes in public constituency, public image

Naturally, it was out of the scope of the experiment to gather all this data, let alone statistically meaningful quantitative data. Nevertheless, I designed survey forms and interview guidelines upon reflection on these elements, having in mind to obtain the most interesting possible information. The chapters in the section on the experiment reflect this concern.

Once designed the experiment and built the required fundamental tools, it was time to select an adequate case study to provide the proper context for implementing it.

4.6. The Quest for a Case Study

Introduction; Portuguese EIA context; Overview of EXPO'98 issues; The hazardous waste incinerator case; The Trancão river case; The solid urban waste incinerator case

4.6.1. Introduction

To complete the design of the thesis experiment, having defined the problem to address and corresponding scenarios, set the experiment framework, selected and developed the basic information technology / information system to test, it remained to identify a suitable Case Study.

Since it became clear (from the discussion of the problem) that I would need to address political and institutional issues besides the more technical facets of the study, I made a preliminary choice of restricting the searching ground to Portugal, where I could use personal contacts in all these levels, from my past academic, professional and political experience.

At that time, the major development in Portugal involving important Urban Planning and Environmental Impact Assessments was the 1998 edition of the World Exposition (EXPO'98), projected to take place in Lisbon. Naturally, my first approach was to consider the whole EXPO'98 endeavor or some sub-set of it, as a good candidate. In this chapter it is described the search and selection process for the most adequate Case Study for this thesis research, and discussed briefly the criteria used in the selection.

4.6.2. Portuguese EIA context

Given the option to focus on Portuguese cases, it became important to acquire a quantitative view of the overall scenario of public participation in Portugal at the time. The relatively new phenomenon that represented institutionalized public consultation in EIA (Environmental Impact Assessment) processes had the advantage of allowing to acquire a global picture with a glance: between 1986 and 1992, there were less than 200 processes "registered" in Portugal. Here is the

compiled data by 1994, on 53 cases (sources: (Partidario 92) (Rua 93) (Costa 93) and specially (Lobos 93)):

Table 4.6.2.-1 - Number of processes by year:

Year	1986	1987	1988	1989	1990	1991	1992
Processes	1	0	3	4	12	40	76

Table 4.6.2.-2 - Duration of processes (in days):

Duration	20-30	31-40	41-50	>50
Processes	31	11	10	1

Table 4.6.2.-3.- Number of public consultation locations (Municipalities,INAMB,CCR,GAT) per process:

Locations	1	2	3	4
Processes	11	24	13	5

Table 4.6.2.-4. - Number of written summaries produced (by Municipalities, Associations, Institutional Entities), per process:

Summaries	0	1-5	6-15	>15
Processes	17	26	7	3

Table 4.6.2.- 5. - Number of ads in newspapers (in National, Regional and Local newspapers), per process:

Ads	0	1	2	>2
Processes	6	24	13	10

Table 4.6.2.- 6. - Number of invited entities (GO or NGO, Municipalities, Associations,Universities,Administration), per process:

Entities	1-10	11-20	21-30	>30
Processes	13	25	9	6

Table 4.6.2.-7. - Number of people participating (from Municipalities, Associations,Administration, and private citizens - total 202 p.c.), per process:

People	0	1-5	6-20	>20
Processes	18	27	5	3

Summing up: the number of processes of mandatory public consultation in Portugal is small but growing exponentially; the typical duration of consultation is one month or less; the number of places used for consultation is small (typically 2); the ratio of number of invited entities versus number of participating entities is

at best around 1:2, which raises interesting questions (reasons for non-participation). More importantly, there was no apparent measure of failure or success achieved by the new legal regime for public participation. As for current techniques of participation at the time, they were often limited to the publication of one or two ads in newspapers, a few printed copies of summaries made available in a couple of sites, and a leaflet mailed to a dozen or more entities like Municipalities, local Associations and NGOs.

4.6.3. Overview of EXPO'98 issues

In late 1994, I talked with several of my acquaintances in the environmental movements to have an idea about the possibility of involving several of them in the experience of using the Intelligent Multimedia System in the context of some public consultation regarding the Expo98. I also had several meetings with Expo98 officials, including the President (Commissar) of the Expo98 corporation (created to manage EXPO98) and members of the Expo98 board. All were very supportive, but the overall situation was that most of the delicate and therefore potentially interesting planning and decision-making issues concerning the core of EXPO'98 per se, were basically committed already to an approved path, and the current and following phases were essentially simple execution of plans and physical implementation (building, etc.).

My next step was to look into side effects of the EXPO'98 core process. The planned developments for Expo 98 involved:

• Transportation infrastructure (extension of metropolitan, new bridge over the Tejo river, new road connections);

• Land use changes (reallocation of oil refinery storage and solid waste facilities, reallocation of local inhabitants -- including slum dwellers--, and siting of new hotels and services), and

• Environmental clean-up (river Trancão and soil pollution from oil storage).

Although not dependent in any significant way of EXPO 98 commission, the siting of the new bridge over the Tejo river had a huge impact in EXPO plans (one of the possible "anchor" points was right next to EXPO site). With a mandatory environmental impact assessment process with public consultation, it was by far

the one case generating more public controversy at the time. Naturally, it attracted my attention and I studied both this case and a related one concerning the "old" bridge over the Tejo. While very interesting and with rich elements that I use to better illustrate the discussion section of the thesis, I concluded that they did not offer the most adequate conditions for the experiment. One of the major factors was that the EIA and its public consultation were already on, therefore with no conditions for setting up the experiment on time.

Consistent with my focus on EIA related cases, I decided to look next into EXPO related environmental problems.

Fig. 4.6.3.-1. Partial view of the area planned for World Expo 98, in Lisbon (photo 1992) courtesy of EXPO98

Experts working for the EXPO 98 commission identified 5 major environmental problems in which EXPO had to play a direct role (Camara 1994):

a) Soil contamination from industrial activity (oil);

b) Polluted mud's accumulated along the margins of river Trancão (estimated volume to remove: 350 thousand m3);

c) Pollution of river Trancão;

d) Degraded quality of the water of the estuary of Tejo, unfit for the planned use by EXPO 98 (recreation and sports);

e) The inactivation of the solid urban waste site of Beirolas, with the implication of finding another solution for the Lisbon's metropolitan area waste.

I proceeded to explore systematically each one of these issues. To that purpose, I contacted several consultants from the New University of Lisbon (DCEA-FCT-UNL), who were in charge of an impact assessment regarding the polluted soils (issues a) and b)) to be removed from the Expo site and taken to somewhere else in environmental sound conditions, a task of considerable dimension and complexity. However, it soon became clear that the EIA was not going to be a focus of significant controversy, mostly because the process had been carefully crafted so that there was a wide political consensus and this allowed to follow a minimal EIA review process, making the best of the weak regulation concerning EIA and therefore the expectation was a very low key, low profile process with little if any public visibility.

Given also my previous contacts with the Municipality of Loures, one of the partners in Expo, I considered then to concentrate on the cleaning up the Trancão river, one of the most polluted rivers of Portugal and that crosses the Municipality of Loures, and with its estuary right within the area of Expo98 (above issues c) and d)). It seemed to be an interesting case, well documented, that could be the basis for experimenting the use of the targeted information technology and even for evaluating its impact.

4.6.4. The Trancão river case

One interesting scenario arises from the issue of environmental clean-up of the estuary of river Trancão, at the site planned for EXPO 98, in Lisbon.

I collected statements from different professionals involved in some way with the clean-up efforts, regarding the implications of the steps towards this goal, either being considered or already in motion. The statements were collected in the form of videotaped interviews, technical reports and newspaper articles.

All the professionals (hereby designated as experts) project a non-adversarial attitude towards each other (the same cannot be said towards the political instances with decision power), and in many cases suggested themselves the usefulness of contacting this and that other expert, in a direct acknowledgment of the broader, multi-domain scope of the problem. However, it became apparent, even in this limited form, that they were not aware of potential mutual conflicting views, or mutual dependencies on each separated projected activity, suggesting poor interaction and coordination.

This poor interaction and coordination can be the result of institutional deficiencies, over-worked human resources, difficulty in establishing a common language or referential, or other factors. But it presented a potential opportunity to test the role of an intelligent multimedia system, as a facilitator of multi-expert, multi-agency dialog, which has a direct bearing in public participation.

4.6.4.1 - Different views on Trancão

Here follows a summary of these different views:

- Environmental expert (M. Cardoso da Silva, Quaresma):
  (Quaresma 1989) (Quaresma 1992) [phone interview 94]

It makes no sense to think in terms of cleaning up the Trancão estuary, meaning the EXPO 98 area; instead, one must think in terms of the whole Trancão hydrographic system. The main problems with the pollution of this system are:

Chaotic occupation of the soil, disturbing the natural regularization of the water flow, and flood prevention;

Degradation of the water quality, posing a serious public health risk, because of the contamination of the public water supply and the practice of using "raw" water to irrigate vegetables, etc.

Degradation of the ecosystem of river Tejo, where intense fishing occurs.

The main sources of the problem, which have to be acted upon, as a priority, in order to improve the situation, are:

The lack of coordination of the 8 municipalities visited by the Trancão, which are developing independent collection and treatment systems for the residual waters;

The great number of medium to small industries installed outside the urban perimeters, not served by any water collection and treatment systems;

The recourse of public water systems to serve industries within urban perimeter, when the requirements are very different.

• Social Service expert (Filomena Henriques):
[videotaped interview 1994]

The absolute priority must be to solve the problem of use "raw" water from Trancão for irrigation of vegetables; there is an acute health problem, aggravated by the fact that many of the users of such waters are slum dwellers, including in the EXPO 98 area. Therefore, the problem of housing and infrastructure services for the slum areas cannot be dissociated from the clean-up efforts.

• Top Manager of EXPO (Cardoso e Cunha):
[EXPO 98 newsletter]

Cleaning up the Trancão estuary, with visible results right on 1998, cannot wait for optimal whole encompassing environmental solutions. This will imply above all the removal of large volumes of polluted mud. The main problem is to find a site for these mud's.

• Transportation expert (Adriana Bernardino):
[videotaped interview 1994]

Removal of such large volumes of mud imply a large number of heavy trucks for many days a year, many years. Current road system do not sustain that type of heavy traffic. Because road system takes a long time to implement, it must be a immediate priority. Building new roads or upgrading existing ones will cause considerable disruption in current traffic, for a long period. Creation of alternative routes will have a visible effect on the local economy. Also, the provision of a large and improved road supply will tend to increase traffic in long term, it will affect land development, and it will change land use.

• Water treatment expert (Ana Mata, Figueiredo):
(Figueiredo 1993) [videotaped interview 1993]

The priority is clearly to regulate the different parameters of water quality mandatory for industrial residual waters that use municipal water treatment systems (in Trancão and affluents). The problem is that current water treatment stations are not dimensioned to handle industrial waste waters besides urban "domestic" waste waters. Either industries will have, by regulation, to treat their own water, or then be taxed to finance new water treatment stations with added capability. To note that one of these stations is right on EXPO 98 site (ETAR Beirolas).

• Remote sensing expert (J.M. Rebordão):
[videotaped interview 1993]

Any plan for the Trancão will imply correlating data from different sources, different institutions, and different domains. This cannot be done adequately without a good base map in digital form (at the convenient scale), and the geo-referenciation of all relevant data. While digital maps (some even in GIS) exist already for some areas of the Trancão hydrographic system, there is a lot more missing. This should be a priority, because it is a pre-condition for most planning activities regarding the cleaning-up of the river.

• Architect expert (Margarida Carmo):
[videotaped interview 1994]

EXPO 98 should be an opportunity to give back to the populations the access of the river front areas that were taken away with the oil refinery development. The cleaning-up of the Trancão estuary presents a unique opportunity to humanize that space, and in particular to serve local working populations with a leisure center. The municipality of Loures is therefore right in forwarding such plan.

Fig. 4.6.4.-1 Loures plan for estuary of Trancão (EXPO 98 area)
courtesy of Loures Municipality

• Urban planner expert (Antonio Crisostomo Teixeira):
[newspaper series of articles (O Publico, 1993)]

The Expo are is 310 hectares. Of those, only 25 will be used as Expo "core". What is then the intended use for the remaining 275? This is the main question, and there has been no clear indication of what is planned.

The essential strategy delineated by the Expo 98 'Commissary' is to use the "property transfer" of those 310 hectares as the financial guaranty for the bank loans needed for the Expo expenses. Since the Expo budget is 300 million escudos, it is not feasible to sell lots at roughly 100 thousand escudos / square meter, unless for high volumes of construction in tertiary. This raises the issue of whether the environmental standards set for the cleaning-up of Trancão are good enough for this kind of land use. Hence two issues: 1) will the market demand cover such large supply (at the right price)? 2) will the Municipalities of Loures and Lisboa wish to fill the area next to river Tejo and to the estuary of Trancão with long strips of office towers and high rises?

4.6.4.2. Discussion of the case.

The different views over what was the real problem bring with them potential contradictions, and can be summarized this way.

Public health concerned people focused on poor communities in the neighborhood of the Trancão river using heavily polluted waters to irrigate their tomatoes and lettuces, therefore worried about an imminent public health problem of epidemic dimensions if nothing was done about it on the short term. And they complained that this kind of problems about those communities should be the absolute priority in the planning about Trancão.

From another point of view, some urban planners put in question the expectations of Expo98 corporation to be able to sell land after or before 1998 to developers at the kind of price they were expecting to, given precisely the connotation with a polluted area, bad smells from Trancão and the former waste dump site of Beirolas in the region, and the not so convincing results so far of the cleaning process, raising the issue of whether for instance the Trancão pollution will be solved in time for the value of the land to raise enough to become attractive for the developers to build top-quality office buildings and upper and middle class walkups in planned residential areas. Because the EXPO'98 budget depend heavily

on these expectations, it follows that EXPO'98 is more interested in anti-pollution actions that produce immediate improvements in EXPO land, than in procedures that target other areas and other concerns.

In fact, Expo 98 officials' were concerned that while the Municipality of Loures was putting in practice a plan of building water-treatment stations along the river and taking measures to control pollution of chemical and organic nature, other measures involving the oxygenation and ventilation of the waters of the river and its filtering were not high priorities in the view of the municipality. Of course it was a high priority for the Expo98 to have already in 1998 water not muddy but crystal-clear. However, water may possibly look good with a quick fix (f.i. oxygenation techniques), even if remains unhealthy for watering gardens. Hence there was a conflict of priorities, and EXPO'98 corporation claimed some jurisdiction in the process in order to take over the final chunk of the cleaning up of the Rio Trancão.

Despite these differences, there was no real conflict as to the goals and even to the technical measures for the procedures of the cleaning up. Summing up: although everyone was aware that cleaning-up the Trancão involves multiple areas of expertise and several entities, and while there was a general agreement concerning what has to be done (no major contradictions in the space of solutions). The only real quarrel between Expo98 and the Municipality of Loures had more to do with issues of timing, of priorities involving scheduling and eventually the fears that some short-terms solutions, good enough to satisfy Expo98, would contradict long term objectives and the plan the Municipality of Loures was already implementing for many years.

So besides an issue of eventual conflict of jurisdiction in some aspects of the cleaning up, on the essential issues there was no really contention about what had to be done and about how to do it. Basically there was not much room for an interesting case, one with an engaging case to motivate public participation.

Consequently, I was lead to the conclusion that despite the fact that the Trancão river case involved interesting issues, despite the fact that I could obtain the support of most of the institutions that were involved with the cleaning up of Trancão, the problem in itself was not the best of problems for this kind of experiment.

Table 4.6.4. -1 - Trancão case summary "business card"

Research Case "Business Card"	Cleaning up river Trancão
Principal domain	Environment
Main Issue	The 1998 deadline (EXPO year) imposes a different dynamic to already made plans regarding the cleaning-up of Trancão, and introduced some new requirements of its own (higher standards for visual and smell conditions, and use of water); Potential conflict between priorities of EXPO and Municipalities
Institutions involved	Ministry of Planning and Land Use; Ministry of Environment and Natural Resources; Ministry of Agriculture and Fishing; Ministry of Health; EXPO 98 Commission; Municipalities of Loures, Amadora, Arruda dos Vinhos, Mafra, Sintra, Sobral de Monte Agraco, Vila Franca de Xira.
NGOs involved	Associação dos Benefeciarios de Loures; Associação de Jovens de Sacavem.
Institutional Process	Created a Technical Team from involved ministries; created an Advisory Commission (Comissão de Acompanhamento) including involved Municipalities, 3 government agencies, and 1 NGO (Ass. Benefeciarios de Loures). Technical Team is to study problem, propose solution and coordinate implementation; Advisory Commission is to advise on proposed solutions and help in coordination. Decision Maker: Government (Joint ministries involved). No public consultation is under consideration, but some EXPO 98 sub-projects in this area are subjected to mandatory consultation.
Non-Institutional Process	Grass roots protest from time to time over the unbearable smells and health hazards; multiple articles in the press, bottles of polluted water sent to public officials, etc. (over 15 years). Municipality of Loures is particularly active informing citizens of measures and follow-up, with newsletters, dedicated videos in display in public sites, presentations in conferences, etc.
IT involved	Printed press, TV reporting and interviews; VCR - VHS; PCs and mainframes

4.6.5. The hazardous waste incinerator case

After all these considerations, I tried to identify another setting where there was more controversy, since it would increase the chances of providing a more challenging background for my experiment. And indeed it suddenly emerged the problem of building a hazardous waste incinerator.

Dealing with hazardous waste is always a delicate issue, and in this case it became overnight a very hot topic in Portugal, when local populations of one of the candidate sites for a landfill to support the incinerator were very aggressive towards representatives of the Minister of Environment. Grassroots committees from some of these candidate sites also blocked the Environment Impact Assessment teams from acceding to the area under consideration, harassing the

experts (there was a mention to vehicles damaged and alleged threats), leading eventually to a suspension of the EIA process.

These events contributed to an emerging interest from the Environmental Ministry towards the use of new information technologies (IT), in the hope they could contribute to a less emotional debate and a more persuasive way to convey technical arguments to the public in general. On the other hand, environmentalist non-governmental organizations (NGOs) were also eager to use the new IT and IT-based tools to facilitate and increase the role of public participation in the overall process of decision-making, particularly during EIA reviews. Consequently, and while with different expectations, the drive to introduce new IT in public participation gained general support (Ferraz de Abreu and Joanaz de Melo 2000).

While this case had no direct relationship with my early study of EXPO'98 issues, it seemed a good candidate for a case study. Encouraged by the strong interest from all actors on the use of such an experiment and their willingness to help out on the experiment, I took the initiative to request an interview with the Minister of Environment of Portugal, which was granted soon after (March 1995), and where I obtained the pledge of funding and also support from the public administration to my project.

In that context, I started preparing the case and presented a formal project proposal (Ferraz de Abreu 1995a). However, bureaucratic follow-up was much slower than the political decision of granting support and I had to wait until December 1995 before my funding was approved, through a protocol between the Ministry of Environment (DGA) and the Dept. of Environmental Sciences and Engineering of the New University of Lisbon (DCEA-FCT-UNL), thanks to the warm support to the project also by the DCEA Dept. head. By then, the political party in power (Social Democrats, PSD) lost the national elections to the major opposition party (Socialists, PS), giving place to a new Government and a new Minister of Environment.

Soon the new government put in place a shift in environmental policy, in particular concerning the handling of hazardous waste, where they favored the study of co-incineration (using already existing incinerators with other industrial purposes, such as cement, with processed hazardous waste as an alternative fuel)

versus "dedicated" incinerator. This led to the immediate suspension of the hazardous waste incinerator process and therefore of the case.

4.6.6. The solid urban waste incinerator case

Meanwhile, curiously obfuscated by the media attention to the hazardous waste case, another waste incinerator plan was going forward: the "CTRSU" - with an incinerator for solid urban waste for the Metropolitan area of Lisbon.

In fact, this was a direct consequence of another of EXPO98 issues referred above:

> "(e) The inactivation of the solid urban waste site of Beirolas, with the implication of finding another solution for the Lisbon's metropolitan area waste."

As it happens, the major push for this urban waste incinerator was resulting from closing Beirolas, and it is significant that the major shareholder of the consortium of the municipalities preparing the mentioned "CTRSU" (Valorsul) was....the EXPO 98 Corporation.

Suddenly without a case due to the policy shift, I immediately considered the possibility of migrating the work already done and, most importantly, the funding already granted, to this issue, since it involved also an incinerator for waste, therefore sharing many of the previous problems.

In fact, I was encouraged by several experts both from the Public Administration and private sector, as well by environmentalist groups, to consider the CTRSU / Valorsul case. .In early 1996, I was granted the transfer of the previous support to the new case.

The solid urban waste incinerator case became therefore my final choice. This case is described in next section.

And this way, interestingly enough, I ended up back in an EXPO-related issue, where I began my quest for a case study.