

Section 4 - Designing an Experiment

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

1. Thesis Introduction	5. The Experiment
2. Hypothesis and Method	6. Discussing the Experiment
3. Assumptions and Foundation	7. The Qualitative Jump
4. Designing an Experiment	8. Thesis Conclusions

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 established 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

¹This chapter is largely based on my early thesis working paper, "Sistema Multimedia Inteligente de Apoio à Consulta Técnica e Pública - 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 sitting 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	
	<ul style="list-style-type: none">• Metadata• Multimedia Knowledge Base• Expert Systems• Rule-based models<ul style="list-style-type: none">• Case-based models, with FAQ ("Frequently Asked Questions")
2. Integrating multi-disciplinary and multi-organism processes	
	<ul style="list-style-type: none">• <i>Virtual office</i>• Multiple-domain Knowledge Representation• Shared inference engine
3. Satisfying a wide range of audiences	
	<ul style="list-style-type: none">• Hypermedia reports• Multi-level information trails
4. Limitations of current " <i>Fora</i> " for dialog and interactive analysis	
	<ul style="list-style-type: none">• "Blackboard" vs. "Star" process• Network (WWW) based tools

SECTION 5 - The Experiment

This section concerns the thesis experiment and case study, and includes the chapters:

1. Introduction;
2. The Case;
3. The Actors;
4. The Experiment Models;
5. The Chronology;
6. The Expert Panel;
7. The Collaborative Tools;
8. The FAQ model;
9. The Institutional Response;
10. The Knowledge Acquisition;
11. The System;
12. The Public Consultation;
13. The Knowledge Gap;
14. Results Summary

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5. The Experiment

Introduction; The Case; The Actors; The Experiment Models; The Chronology; The Expert Panel; The Collaborative Tools; The FAQ model; The Institutional Response; The Knowledge Acquisition; The System; The Public Consultation; The Knowledge Gap; Results Summary

5.1. Introduction

To conduct the thesis experiment, I set up a fairly large research project to test the use of some specific "state-of-the-art" information technologies in the EIA review process, in particular the public consultation process. The base guidelines for this project followed the experiment design, as described and discussed in the previous section. This section describes the case study in which it is based (EIA review for a Solid Urban Waste Incinerator in Lisbon Metropolitan Area), its institutional context (actors and stake holders and their expectations), the timelines and major milestones occurred, the work of the project team's expert panel, the software prototype ("Intelligent Multimedia System" - IMS) plus Internet components I developed for this purpose, the IMS knowledge content and framework (canonical forms, taxonomies), the EIA review process with public consultation and the use of the IMS prototype, including a controlled experiment. The discussion of the outcome of this experiment is left to the next section.

5.2. The Case

The antecedents: the EXPO'98 "trigger" factor; Enter Valorsul and the CTRSU proposal; The making of a good case study.

The decision to build an incinerator for solid urban waste in the Lisbon metropolitan area had many ramifications (urban waste management strategy, site location, relation with Expo'98, central and local administration responsibilities, institutional process of decision), all of which raised strong controversy.

In the section describing the design of the thesis experiment, I introduced the context and major traits of the adopted case study, including the criteria used for this choice. In this chapter I describe the main settings of the case, concerning what was the object of decision, who was involved in it (main actors and stake holders), how the situation had evolved at the time my research became a part of the process and in which conditions the project was set.

5.2.1. The antecedents: the EXPO'98 "trigger" factor.

For many years, the city of Lisbon, capital of Portugal, had been dumping urban waste in an old-style sanitary landfill (not even complying with regulations) at Beirolas, an old industrial area, on the northeastern zone of Lisbon municipality.

In 1992, the Portuguese Government proposed to host the 1998 World Exhibition, on this part of the city. This proposal was approved and to manage Expo'98 it was created "Parque Expo", a state-owned company ("private enterprise of public capital").

With an exhibition area of about 100 ha, Expo 98 implied the cleaning up of an "intervention zone" of near 310 ha, a land strip with 3 km of river front with heavily polluted soil, including the Beirolas landfill and other industrial polluting sources. An alternative location had therefore to be found for all facilities still operating in the "intervention zone", including the urban waste landfill. Alternatives had to be functional by 1996, to allow time for clean up and build the Expo'98. (Ferraz de Abreu and Joanaz de Melo 2000).

5.2.2. Enter Valorsul and the CTRSU proposal

Under these circumstances, Lisbon and three other municipalities on the metropolitan area (Loures, Amadora and Vila Franca de Xira), with about a million and a half inhabitants, created a "consortium" together with Parque Expo, plus the state owned national electricity utility company, and a state holding. The main mission of this consortium, "Valorsul", was to manage its urban solid waste, and the core of the multi-municipal management strategy was to build an urban waste incinerator, the heart of a Solid Urban Waste Treatment Plant (CTRSU).

Created by decree the 21 November 1994 (Decreto Lei 297/94), the Valorsul "multi-municipal system" was granted a concession contract by the Ministry of Environment the 28 September of 1995, for 25 years. Its shareholders were:

- * Parque Expo 98, S.A. (26%)
- * EGF-Empresa Geral de Fomento, S.A. (25%) [mostly a state holding]
- * EDP-Electricidade de Portugal, S.A. (11%)
- * Camara Municipal de Lisboa (20%)
- * Camara Municipal de Loures (10%)
- * Camara Municipal de Amadora (4%)
- * Camara Municipal de Vila Franca de Xira (4%)

Naturally, the timing was critical: Expo 98 had to take place, well, in 1998. No room for the usual deadline slide. This meant the CTRSU had to be in full operation by early 2000, since the Beirolas landfill would be removed by 1996 and sealed before, and the temporary sanitary landfill to be used meanwhile (Mato da Cruz, Vila Franca de Xira) had a small capacity. Plus, and this was no minor factor, European Union funds for the project might be lost if there was no immediate commitment and consistent progress (Ferraz de Abreu and Joanaz de Melo 2000).



Fig. 5.2.2.-1 shows the area of intervention of Valorsul.

The four municipalities generated, in 1994, around 590 000 tons of solid waste, corresponding to approximately 19% of the urban solid waste (USW) produced in Portugal. Among the four, Lisbon and Amadora contributed with 66 % of the USW of the region, and were in the most critical situation. (Valorsul 1995)

Fig. 5.2.2.-1 - Municipalities in Valorsul

Valorsul studied scenarios for 3 solution sets: 1) sanitary waste landfill for USW; 2) composting and waste landfill; 3) incineration, composting and waste landfill. They concluded that all solutions not integrating incineration implied large areas for the waste landfills (between 190 and 340 ha until the year 2020) (Valorsul 1995). In their view, such large amounts of land surface would be problematic in a predominantly urban area, if not impossible.

Therefore they opted for what they called “an integrated solution”, with the incineration (CTRSU) at the core, providing also electricity for the national electricity net. Between 1993 and 1994, they selected the site, based on studies by EDP (Electricity of Portugal) and IDAD (Institute for Environment and Development), considering specially factors such as air pollution and road access: S. João da Talha, in the Municipality of Loures (Valorsul 1995).

Aiming to incinerate about 2 000 ton/day of urban solid wastes produced in Amadora, Lisboa, Loures and Vila Franca de Xira, and to remain in service for 30 years, the CTRSU was set to produce different kinds of wastes, such as scoria (non-toxic inert), ashes and smoke treatment wastes.

While the first kind, about 20 % of the waste's weight, could be put in landfills or used in construction, the others, corresponding to around 3% of the waste's

weight, were hazardous wastes, requiring therefore special handling. In this pollutant group, there are dioxins and furans derived from smokes, which have such an high toxicity that even small quantities can be extremely dangerous. So even if the issue of building a solid waste incinerator was not as sensitive as the issue of building an incinerator for hazardous waste, it was impossible to evade the “hazardous” word. (Ferraz de Abreu and Chito 1997)

5.2.3. The making of a good case study

Waste-related projects are always highly controversial. Waste is perceived as something bad to have in your backyard (NIMBY syndrome), even if technical studies grade environmental impact as low. But in this case, given the proximity to very dense urban areas, burning of waste could arguably result in significant pollution and public health risks. Therefore, it was reasonable to expect strong concerns of the local population about the CTRSU impact on their lives and health, and an active participation in the public consultation process.

Also, the selected site for the plant was near a very sensitive ecosystem, the Tagus Estuary, established as a Natural Reserve, with classified fauna e flora. If nothing else, this was certain to bring the environmental NGO's active intervention to the scene.

Public Administration handling of the EIA review process was not going to be an easy task. On one hand, the irreversible process triggered by Expo 98, as described above, with full government support, was a powerful factor pushing for an urgent adoption of this kind of facility in Lisbon's periphery; on the other hand, the EIA Review Committee could not ignore the public health risks, and other environmental concerns.

It is useful to refer also to other factors that contributed to such complexity (Ferraz de Abreu and Chito 1997):

- The Ministry of Environment was preparing a Strategic Waste Management Plan, and the project proponent ("Valorsul") was completing a regional operational plan (POGIRSU), having invited experts designated by environmentalist associations to participate. However, the CTRSU solution was

adopted before these plans were completed and discussed, which impelled environmental groups to strongly oppose the whole methodology, on the grounds that the absence of alternatives was linked to the absence of a coherent policy on waste reduction and waste management at both municipal and national level.;

- The project proponent, "Valorsul", is a society where local government and state-owned companies hold a majority of vote. This integration of local state and private interests was an obvious determinant to the project choices, and raised the issue of having a review process conducted by the state, where the state itself was involved and had strategic interests at stake;

- A press conference publicized the adjudication of the construction of the incinerator to a contractor, before the beginning of the EIA review, concurring to a certain public mistrust regarding the usefulness of the review process and public participation.

In short, the case settings were such that all actors, including local population, local and national administration and environmental NGOs, seemed well motivated to discuss the issue, although coexisting at the same time with a strong mistrust; there were strong arguments, both political and technical, pro and against the project; part of the information was highly technical and not readily available to the general public; and the environmental administration, in the wake of recent European Union directives transported into Portuguese law, was making an effort to improve public access to information.

This process was concluded with a favorable decision by the Environmental Minister in 96.08.05, on condition that several measures about the CTRSU proposal were to be satisfied (Ferraz de Abreu and Chito 1997). In the next chapters I will present, step by step, the main and most relevant aspects of the EIA review that ended with that decision, as well as the introduction of the new IT in the process, beginning with the actors involved.

5.3. The Actors

Introduction; National Government; Local Government - Municipality of Loures; Local Government - Municipality of Lisbon; Public administration decision-makers; Public administration technical staff; EIA Review Committee; Facility promoter; Environmental NGOs; Local citizen's committees; Private consultants that produced the CTRSU's EIA; Consultants in competing EIA private enterprises; CITIDEP; The author; The conspicuous absent; Summary table.

5.3.1. Introduction

With the case study selected (CTRSU of S. João da Talha) and with the basic IT tools to be used in the experiment already available (IMS prototype), I proceeded to meet with the different actors involved, in order to gather their support for the project, characterize more precisely their specific perceptions of the problems that could be addressed by the new IT, and thus map their expectations for this experiment.

I identified initially the following actors: National Government, Local Government-Municipality of Loures, Local Government-Municipality of Lisbon, Public administration decision-makers, Public administration technical staff, EIA Review Committee, Facility (CTRSU) promoter, Environmental NGOs, Local (site) citizen committees. Later, I added two other actors that were clearly relevant: Private consultants that produced the CTRSU's EIA, and Consultants in competing EIA private enterprises. Finally, I added another two that ended up playing a role and were considered as intervening party by other actors: CITIDEP, a not-for-profit private research center that was created in the process and included several members from my project team, and ... myself.

It is worth to note that in the beginning all actors, without exception, were supportive of the experiment and claimed to regard as positive and important the introduction of the new information technologies in the process, even if their views on why were mostly vague and their motivations and expectations varied substantially. While part of the reasons why I obtained their support can be related, in some cases, to my personal and political relationships, as well to their

own (actor's) political or market strategy, it became clear that they had a real interest in investing in the introduction of new IT, albeit in different degree and fashion. How this support evolved (and wavered, in a few cases), will be treated in more detail in the following chapters.

5.3.2. National Government

In this case, as in many others, the political decision makers at government level played a double role. Institutionally, they had the responsibility to supervise the EIA review (Ministry of Environment); but on the other hand they (Government at large, Ministry of Industry, Ministry of Planning) had a stake in the object in review, since the promoter of the work was a consortium of municipalities and state controlled companies (EXPO, Electricity, etc.), and a significant part of the funding for the urban waste incinerator (CTRSU) would come from government-negotiated European funded programs for Portugal, that would be at risk if the work did not take place as planned.

Government actions and words indicated that a decision had most likely already been made in favor of building the incinerator. It is therefore understandable that their major concern was the potential political backlash, given the reaction of the population at the selected site, and the risk of such reaction causing critical delays in the implementation schedule (tied-up with EXPO 98, a deadline cast in stone), or even blocking the work. For the Government, the main problem they wanted to address, in the context of the experiment's realm, was the predominance of emotional reactions and fears, frequently exploited politically, allied to the difficulty to convey to common, lay people, in a convincing manner, the technical justification for the CTRSU and the selection of S. João da Talha for siting the facility.

Government support was uncharacteristically quick to be conceded: I was received by the Minister of Environment one week after my audience request¹, and she decided on the spot to fund my thesis experiment and instructed the Head of the Central Environmental Agency (DGA) to implement the mechanisms for

¹A courtesy gesture that I attributed mostly as directed to my father, then Vice-President of the Parliament. While from parties with opposing views, I knew they had each other in high regard.

the funding and to, in turn, instruct the related services (DGA, DRARN-LVT, IPAMB) to cooperate with my work. It is however important to note that this was at an earlier stage, when the case study concerned an incinerator for hazardous waste, even more controversial than the CTRSU. The Minister had witnessed the violent reactions of locals on pre-selected sites, who prevented EIA teams to complete their work, and my proposal was seen as a timely contribute to address the above referred concerns. Incidentally, the funding itself was more characteristically slow to arrive (more than a year after), but one must make allowances for the fact that meanwhile the Government changed, and with it changed the hazardous waste policy, canceling the projected incinerator, leading to a focus on the urban waste incinerator (CTRSU) case study instead.

The institutional expectations, as represented by procedures and regulations in place, were that a small number of experts from stakeholders would want to consult in detail all the EIA technical data, while the population at-large would be provided with (and better served by) a non-technical summary. The IMS would then be expected to increase the level of acceptance through improving quality and reach of both kind of documents, targeting their corresponding different audiences.

5.3.3. Local Government - Municipality of Loures

Since the planned development, the CTRSU, was sited in the Municipality of Loures, it was only natural that their local government became a key actor in the process.

The main problem they faced was the same as the National Government's (political loss arising from the negative emotional reactions and fears, the need to provide a technical justification for the CTRSU and the selection of S. João da Talha for siting the facility), but in more acute terms. This is why the Municipality of Loures had negotiated a set of pre-conditions and compensations before supporting the CTRSU, and it became very important for them to convey the message that Loures would not accept the facility unless the EIA proved it was harmless for public health and there was full compliance with conditions such as, for instance, the construction of a highway variant, to eliminate traffic problems. In other words, convey the message that by accepting the CTRSU Loures would gain important advantages and suffer no real harm.

Another part of the equation was that EXPO'98 ground was partially (although minimally) within Loures jurisdiction. This made Loures Municipality a stakeholder in EXPO'98 and all its related problems, including of course the one arising from the urgent need to close de waste dump of Beirolas (as described in the previous chapter). Part of the deal the Municipality was trying to work out, included the promise to transform that part of EXPO'98 area, at the time a extremely polluted zone around the estuary of the polluted Trancão river, into a leisure zone, a green area, having in mind to better serve Loures inhabitants and indirectly acting as a compensation for the nearby CTRSU site, with its industrial character.

The Mayor of Loures promptly received me and decided to support the IMS experiment, and instructed other administrators and technical staff to fully cooperate with my work. While it didn't hurt that I was perceived as a potentially politically friendly observer, there was a genuine concern in using all possible means to facilitate explaining the decision, as well as projecting the image that they were supportive of all efforts to increase public consultation transparency. This lead to a genuine interest in supporting the IMS project.

5.3.4. Local Government-Municipality of Lisbon

The Municipality of Lisbon was directly involved in two ways: first, they were the major partner in the planned development, CTRSU, and by far the largest producer of solid urban waste among the four municipalities involved (besides Loures and Lisbon, the other two were Amadora and Vila Franca de Xira, all contiguous "concelhos" in the northern metropolitan area of Lisbon), making it the one that had more at stake in solving the urban waste problem; second, most of the EXPO'98 ground was in Lisbon, not to mention most of its impact, So the main concerns were both similar to the National Government's and Loures', with a shift: less concern with justifying the siting, as compared to the much more pressing concern with solving it's waste problem, and securing a successful EXPO'98.

Just as with Loures, the Municipality of Lisbon was among the actors that quickly and warmly welcomed my project and decided to support it. Again the

personal and political factor helped (I knew both the Mayor and the City Council for Environment from student union times, and we liked and respected each other), but nevertheless the objective and genuine interest was very much present, for the same reasons.

5.3.5. Public administration decision-makers

As political appointees, the directors of the public administration agencies are supposed to pursue government policy and orientation, and therefore they followed the lead from the Minister by offering full cooperation with my experiment. This was expressed either in the form of ceding equipment and documentation to my team (IPAMB, DGA), as well as setting-up top level staff meetings to introduce my project (DRARN-LVT), with a clear message of support.

By the same token, their problem formulation and their expectations regarding the introduction of the new IT did not differ from government's. However, these decision-makers are in the front line of whatever practical consequences derive from either policy implementation or pilot experiments. In particular, it is at this level that EIA Review Committees are defined and controlled. This is why I considered them an independent actor; I was counting on some differentiation of their concerns and expectations along the process, as indeed happened, as we will see.

5.3.6. Public administration technical staff

Under the orders of the political appointees (directors and their heads of departments and public services, decision-making level), senior, middle and junior technical staff plan and execute the defined policies, in what concern the technical functions of the public administration at all levels (national, regional or local).

Technical staff in charge of the EIA review sections, or handling tasks related to solid urban waste management, or involved in related environmental monitoring, were supportive, but skepticism predominated. Understaffed, under-funded and overworked, used to unfulfilled promises and some of them well set in their old

routines, technical staff from environment public agencies (either national or local) formulated the problem more in terms of these chronic and endemic shortcomings of public administration. Nothing short of deep policy changes and a much higher slice of the budget would make a dent on their skepticism. This did not stop many of them to warmly welcome the initiative and participate willingly in the experiment (not just because of the stated "official" sponsorship), but the general level of expectation was low, and in consequence I did not expect them to play a major role in the experiment. I was wrong.

5.3.7. EIA Review Committee

The EIA Review Committee is the institutional, formal entity in charge of the review process of a specific EIA. According to law and regulations, it is usually chaired either by DGA or one of the regional agencies of the Ministry of Environment, depending on the nature of the development under review. The same regulations stipulate the presence in this Committee of other related agencies, like (at the time) IPAMB (in charge of the public consultation process), ICN (Institute for the Conservation of Nature), IM (Meteorology Institute), etc.

Although formally an actor in any EIA review process, my observations quickly led me to consider that in fact, this actor did not behave as a homogeneous, separate entity. For an institutional analysis, in this case, I considered more accurate and transparent to consider it integrated in the actor "Public Administration decision-makers", in what concerns the decision level, and in the actor "Public Administration technical staff", in what concerns expert review work.

5.3.7. Facility (CTRSU) promoter

The promoter of the projected facility was the consortium ("Valorsul") of the municipalities of the northern Lisbon metropolitan area with "Parque Expo" (Expo'98) and others, as described in the previous chapter. Expo'98 was the major shareholder and the entity that had more at stake in the timely implementation of the incinerator.

This consortium ("Valorsul") had a small staff, led by a small, strong executive body responding to a board of administrators representing the shareholders. After a demonstration of my IMS prototype, they were impressed but blunt: they did not see any advantage in supporting such IT for EIA review, mostly because they saw the danger of it creating a high demand for thorough explanations and raising expectations for real-time responses, which they were not in condition to satisfy. Thus, they risked a negative outcome for them. However, they wanted to present Valorsul as fully supporting public information and were motivated to respond positively to my research efforts. The final result was that they settled for funding a web publication of their EIA summary documentation.

Valorsul formulation of the major EIA problems did not differ much from Government's, since for the most part Valorsul itself resulted from a common Government-Local Municipalities policy and strategy to deal with solid urban waste. Their model of expectations for each of the tools for EIA review were, on the other hand, much more clearly defined.

In my view, they supported web-based information, because they considered it would reach mostly student population and environmental activists already concerned, therefore would not generate any more requests than they were expecting anyway from these groups, and it would show their willingness to facilitate access to information.

In other words, they did not expect the web component of the experiment to impact the local site's population, mostly blue collars unlikely to have access to Internet, as opposed to a real-time interactive system (IMS) available off-line to locals. To deal with the local population's concerns, they favored a series of face-to-face meetings, way before the "official" public audiences. These meetings provided a level of interactivity they could handle and with a timing and agenda of their choice.

Interestingly, as we will see, this actor was one that evolved from a more guarded and skeptical attitude to a more intense participation in the experiment (web component).

5.3.8. Environmental NGOs

There are in Portugal three major environmental NGO's intervening at national level: Quercus, GEOTA and LPN. All three were engaged in this case, and were very supportive of the experiment. The Presidents of the first two (both Ph.D.'s) were active participants in my expert panel, and representatives of all the three contributed to IMS content (knowledge base and structure) and use.

The personal factor counted here too, but more from the perception of myself as someone sympathetic towards the environmental cause in general and public participation in particular. While I knew personally well one of the leaders, most of the activists were from a younger generation, with whom I had little contact, emerging during the years since I left Portugal to come to MIT (1986). So the major factor was undoubtedly the direct interest in the use of new IT in general, and of my IMS prototype in particular, after demonstrations I performed, in multiple sessions for small (or individual) audiences.

NGO's formulation of problems to address were different from other actors. In their view, there was a general lack of public participation and deficient spread of information to the public. For this case in particular, they also perceived that the option to build a solid urban waste incinerator had been made without a previous strategic plan for urban waste management, and therefore debating the details of CTRSU EIA was the wrong issue. Consequently, they were concerned with conveying both to the public and to decision-makers the need to concentrate previously on the strategic plan, as well as on the urban waste policy options, and only after that re-evaluate whether a CTRSU in S. João da Talha was an acceptable path.

Their expectations regarding the experiment were concentrated on improving and widening public access to information, in particular to the alternatives offered by environmentalists and the debate between them and the other actors.

5.3.9. Local (site) citizen committees

Inhabitants of S. João da Talha were, understandably, the most mobilized actor in this case. Because many feared the impact of CTRSU on their health and their

property value; because many mistrusted state and promoter's reassurances, by past experience; because many felt abandoned and betrayed by their traditional political leaders, given the multi-party, multi-municipal agreement that was behind Valorsul and CTRSU, most of the participants were concerned on how to obtain and use any information and argument that could prevent the construction of CTRSU, or at least contribute to postpone the decision.

Even with a predominance of blue collar workers, self-confessedly unprepared for technical debates and with barely the basic schooling, all the ones I contacted were enthusiastic supporters of the experiment, and expected the new IT to help them bridge the gap between their lack of school education and the technical lingo, so that they could fish useful arguments for their cause. I was intrigued by this expectation, and later decided to complement the case study with another experiment, this one controlled, to collect more evidence.

5.3.10. Private consultants that produced the CTRSU's EIA

Contracted by Valorsul to do the required EIA for the projected CTRSU, these private consultants (working for the hired EIA private companies, or independent consultants providing components like mathematical models) were keen on affirming their professional independence (concerning the EIA conclusions) towards their client, a stand that was always corroborated by Valorsul itself. This was a point of contention, since citizens from S. João da Talha and many environmental activists claimed this independence was compromised by the fact they were paid by Valorsul, and some consultants were bluntly accused of just reaching conclusions that would please the client.

Their formulation of the problems to be addressed was interesting and derived from their role in the process. For them, the focus was on producing the EIA and the most difficult EIA document was the legally required non-technical summary. They claimed they were routinely either accused of being too technical, or of being too superficial, both by the Ministry review committees and by the public.

These consultants were interested in the new IT, as an aid to their professional work and to the public presentation of their reports, and as a possible competitive advantage. One of the companies was producing a multimedia presentation for the

non-technical summary and was clearly interested in the type of IT used by IMS, giving a warm, positive evaluation after a demonstration. However, neither of them was interested in participating in the experiment, and did not facilitate access to their documents, as it will be referred later. While there is no hard evidence of the rationale behind this conduct, I am inclined to interpret it as some persons integrating this actor regarding the IMS prototype and myself as competition in the same market. In other words, their expectation vis-a-vis the experiment might have been that I would eventually enter the market of EIA services with my IMS prototype.

5.3.11. Consultants in competing EIA private enterprises

It was interesting to observe that quite a few other EIA private consultants, not contracted for this job, followed nevertheless closely the whole process, and were very supportive of the experiment. In here I include some members of the academia, since many faculty or researchers affiliated in Universities frequently work as consultants in EIA studies.

Their formulation of the problems to be addressed was similar to the previous actor, that is, from the point of view of who is technically responsible to produce an EIA: For them also, the most difficult document was the legally required non-technical summary. Their expectation was that new IT would solve this difficult problem or at least improve the duality of this document. Another big issue was the difficulty of integrating the work of a multidisciplinary team of consultants into a coherent report. Consistently, they were interested in, and attentive to, IT developments. Partly also in result of personal relationships, maybe partly also because they were not in direct competition with the IMS prototype and with the experiment, they were willing and enthusiastic participants, and some of them played a key role in the expert panel.

5.3.12. CITIDEP

CITIDEP - Research Center on Information Technology and Participatory Democracy, was an unforeseen actor, but nevertheless it played a role in the EIA review process, thus becoming one.

The birth of CITIDEP was directly related to the thesis experiment, more specifically to the research project (IMS Project) I set to conduct it. Sixteen researchers and professionals accepted to integrate an “Expert Panel” for this project, and many more cooperated in different aspects of it. During the project meetings, it became clear that many of the participants were very interested in this kind of multi-disciplinary approach and, encouraged by the experience, wanted to prolong it beyond the time frame and substance of the IMS Project.

The general feeling (and I include myself) was that there was a certain lack of an institutionalized support for this multidisciplinary research agenda in academia, and from there (and many other issues, debated in parallel in other meetings) arose the proposal of creating an independent, international research institution, able to work together with both academia and “civil society”. Thus was born CITIDEP, first informally, a few months before the EIA review process, and then legally incorporated (as a non-profit research institution) , a few months after. Among the 24 researchers, students and professionals that founded CITIDEP, 9 were from the IMS Expert Panel and another 3 from the IMS Web team.

I was an active party and key element in this process, since in my view it was a good initiative in the long term and the ideal organizational support for the IMS Project and its team in the short term. So after CITIDEP was created, when the time came to obtain funding to publish on the Web a special consultation-ready format of the EIA (part of the thesis experiment), it was formally executed by a CITIDEP team, led by myself.

This way, CITIDEP played a direct role in the EIA review process, even if strictly integrated in the context of the introduction of new IT that was part of the approved experiment.

Besides being an interesting spin-off of the thesis experiment, the motivation and conditions that led to its existence are worth some analysis, and will be addressed later. More relevant details on CITIDEP mission and constitution are left to the thesis appendix.

5.3.13. The author

My original intention was to be an intervening actor only in the sense that I was the source of introduction of the new IT in the EIA review, and remain a simple non-obtrusive observer for all other aspects of the process. This was consistent with the early design stages of the experiment, when I viewed it as changing only one macro-variable -- the IT used in EIA review -- and observe the effect on the other macro-variable -- the EIA review process. But the situation proved to be not so linear.

By the same token, my only original concern was to deal with potential bias in precisely my non-obtrusive observer role. Since I had my own environmental and political views on the topic in review (the incinerator and its impacts), I wanted to make sure I would purge all personal involvement and be as objective as needed. In consequence, instead of ignoring the obvious personal relationship established (or pre-existent) with other actors, including the political or environmental *engagé* overtones of these relationships, I chose to openly characterize and identify them, 1) as my method to set a demarcation line between the personal factor and the rest, 2) in order to provide the reader with all the information needed to form his or her own critical view of any possible bias in my observations.

This is why, during the above analysis, I included explicit notes of the personal factors involved, whenever was the case. It is important to emphasize that is the sole reason for mentioning them: no one in this case went out of their way, or did something out of character, just because of friendship or political proximity. It certainly helped expedite things, brought more willingness to fit some collaboration in a very busy schedule, and in general facilitated access. That is certainly relevant, but not far from real world conditions, and it certainly did not invert or even changed any basic stand or position on issues of any actor.

As it happens, my role was much more obtrusive than I had anticipated, and by totally different reasons. I must say it took me by surprise, maybe precisely because I was focused on avoiding contaminating my ability to be an independent, objective observer, rather that contaminating the experiment by being an actor in unforeseen ways. In any event, it happened, and paradoxically provided the key to one of the interesting experiment findings, that I will present and discuss later.

5.3.14. The conspicuous absent (political parties)

The presentation of the actors would not be complete without a reference to an unusual absence: political parties.

Given the political nature of many of the issues in this case, and the fact that despite the increasing role of NGO's, political parties clearly dominate the institutional framework of government at all levels, this absence deserves an explanation.

In my view, the major political parties took the back seat in this process, because the contradictions and different positions did not fracture according to party lines. In fact, the CTRSU project and the Valorsul strategy was put in place still during the social-democrat government (1994), before the watch of the socialist government (incumbent when the EIA review took place). Valorsul itself was a partnership where major parties were represented indirectly, through the EXPO'98 structure and the most relevant local governments profited from the facility. The government of the Municipality of Loures was held by the communist party; Lisbon's Municipality, by a Socialist-Communist coalition, presided by the socialists. Therefore, there was some tacit agreement that kept the political parties somehow distanced from the direct debate.

This is a significant trait of this case, and by no means a common one. As it will be referred during the discussion of the experiment, a totally different situation occurred with the case concerning the handling of hazardous waste, where there was a policy disagreement along party lines (social democrat leadership favored a dedicated incinerator, while the socialist leadership favored a co-incineration solution).

5.3.15. Summary Table

In table 5.3.15.-1 (next page) I summarize the intervening actors, their perception of the problems related with the EIA review (relevant for the experiment), and their expectations for the role of new information technology (IMS Prototype and Internet) in helping to deal with them.

Table 5.3.15.-1 - Actors' characterization summary

Actor	Problem to Address	IT Expected Goal	Expectation Level
Government (national, local)	<ul style="list-style-type: none"> • Likely strong local public opposition • Exploitation of emotions and fears based on misinformation • Need to demonstrate the importance of planned facility 	<ul style="list-style-type: none"> • Convey technical arguments to lay people • Focus the attention on technical arguments • Promote a perception of transparency in decision-making 	Medium
Public administration decision-makers	<ul style="list-style-type: none"> • Likely strong local public opposition • Need to demonstrate the importance of planned facility 	<ul style="list-style-type: none"> • Convey technical arguments to lay people • Focus the attention on technical arguments 	Medium
Public administration technical staff	<ul style="list-style-type: none"> • Lack of EIA review human resources • Deficient EIA review policies and procedures 	<ul style="list-style-type: none"> • Facilitate inter-institutional interaction • Provide decision makers with better understanding of policy implications 	Low
Facility promoter	<ul style="list-style-type: none"> • Likely strong local public opposition • Need to demonstrate the importance of planned facility 	<ul style="list-style-type: none"> • Convey technical arguments to lay people • Focus the attention on technical arguments 	Low
Environmental NGOs	<ul style="list-style-type: none"> • Lack of public participation • Lack of public information 	<ul style="list-style-type: none"> • Reach and mobilize more public • Provide public and decision makers with better understanding of policy implications 	Medium
Local (site) citizen committees	<ul style="list-style-type: none"> • Fear of facility negative impacts • Mistrust of promoter's experts • Need of political leverage • Difficulty of access and interpretation of technical knowledge 	<ul style="list-style-type: none"> • Facilitate access and understanding of technical data • Facilitate obtaining arguments favoring their interests, as perceived by them. 	High
Private consultants that produced the CTRSU's EIA	<ul style="list-style-type: none"> • Difficulty of producing EIA non-technical summary • Difficulty of presenting technical data • Importance of maintaining an image of technical neutrality and independence 	<ul style="list-style-type: none"> • Facilitate compilation of technical data • Convey technical arguments to lay people • Facilitate presentation of technical data for multi-level audiences 	Medium
Consultants in competing EIA private enterprises	<ul style="list-style-type: none"> • Difficulty of producing EIA non-technical summary • Difficulty of presenting technical data • Deficient EIA review policies and procedures • Difficulty in integrating multi-disciplinary work and teams 	<ul style="list-style-type: none"> • Convey technical arguments to lay people • Facilitate compilation of technical data • Facilitate presentation of technical data for multi-level audiences • Facilitate multi-disciplinary collaborative work 	High
CITIDEP and the Author	As presented in the chapter on "The Problem"	As presented in the chapter on "The Experiment Design"	High

5.4. The Experiment Models

Introduction; Experiment's Models of Expectations; Decision-making process model; Public participation process model; Data and knowledge representation model; Data and knowledge acquisition model; Information system user model; Scope and nature of the experiment models; Model implementation time frame.

5.4.1. Introduction

The approach I used for the Thesis experiment was to introduce a specific set of new IT in the EIA review process (my software prototype, plus Internet components, plus content), with suggested guidelines. To achieve a reliable and meaningful set of knowledge content for the system, I put together a multidisciplinary panel of experts. To keep a focus all through this complex research context, and using also the input from the expert panel, I compiled a set of models (decision making process; public participation process; knowledge representation; knowledge acquisition; IT user behavior and performance) according to precedent in traditional settings in past cases, and then built models of expectations, resulting of the introduction of my system (IT and guidelines). These models are therefore a kind of experiment test plan, derived from the overall methodology but defined in more fine detail, a kind of blueprint for implementing the experiment. This chapter describes such models and the specifics of the experiment methodology.

5.4.2. Experiment's Models of Expectations

The general methodology adopted, as described previously, was a case study centered in the EIA review process for a particular development (CTRSU S. João da Talha), in which we introduce a new information system with information technology (IS/IT) previously not in place or in use, and observe both the impact of the technology on the process and the performance / suitability of technology for such process.

Besides a good grasp of the case settings and a thorough understanding of the actors involved and their role, this implies building hypothetical models containing

a description of the process as-is (before introducing new IT), of the new IT and system to insert, and then mapping the expected results in what concerns the performance of the new IT and process improvements.

Naturally, such expectations are projected in a scenario where the institutional and regulatory frameworks are left untouched; therefore, any interference observed from these frameworks may affect the outcome and prove to be an impediment to the mapped expectations. In this case, the experiment models serve more like a “proof by absurd” concept, in what concerns this facet of my hypothesis.

Having this in mind, I found it useful to build the following inter-related models for hypothesis generation:

- 1) Decision-making process model
- 2) Public participation process model
- 3) Data and knowledge representation model
- 4) Data and knowledge acquisition model
- 5) Information system user model

5.4.3. Decision-making model

In terms of meta-methodology, the first model to define is the decision-making model, since all others depend and sometimes derive from it. In particular, this model defines the universe of IS/IT users targeted in the experiment, that is, the targeted audience.

The chosen approach here was to identify a synthesis of the current decision-making procedures in EIA review, and then to consider which aspects or parts of it could suffer changes deriving from the introduction of the proposed new IS/IT.

Briefly, the decision-making process in place at the time of this experiment consists on:

a) The developer / promoter of the work presents several printed copies of the EIA to the public administration agency / authority that has jurisdiction to process it. In this case, to the DGA (Direcção Geral do Ambiente), from the Ministry of Environment.

b) The public agency in charge verifies in a preliminary overview whether the EIA is in compliance with legal requirements, through a general, standard checklist (Does it include a non-technical summary? Does its scope correspond to the nature of the proposed development? Etc.). If not, the EIA report is sent back to the developer / promoter for further work.

c) The public agency in charge designates an EIA Review Committee with experts from areas related with the proposed development, whose composition is regulated by law and will depend on the nature of the EIA, and who will report to the Ministry of Environment its conclusions and recommendations. Once verified the EIA is in compliance with the preliminary checklist, this Committee begins its work.

d) At some point, it is scheduled the official period of public consultation, which is considered an official and mandatory component of the overall EIA review process; therefore, any (written) public input is a mandatory part of the final EIA Review Committee report.

e) Based on the EIA Review Committee report, but not necessarily in accordance with it (either in part or in the whole), the Ministry of Environment will condone or reject the proposed development / project, or will make approval dependent of a series of conditions, which may include requirements for further EIA studies, changes in the proposed development, minimization and/or mitigation measures, etc.

f) At the time of this experiment, the approval or rejection by the Ministry of Environment did not imply automatically the corresponding final Government decision. In other words, the Ministry of Environment did not have a veto power on developments / projects that failed to obtain the EIA Review approval (since then the law changed and reinforced considerably the weight of the EIA Review).

Since the research experiment had to fit in the current legal procedure, to build the new decision-making model I considered three basic aspects of the current decision-making process where introducing new IT could make a difference.

- The first aspect concerns the EIA structure and presentation (delivered by the promoter / developer).

- The second aspect concerns the nature of the non-technical summary and its relationship with the overall EIA.

- The third aspect concerns the "modus operandi" of the EIA Review Committee, in particular the work division between thematic areas (health, air, soil, etc.), the articulation between the technical review and the public consultation, and the evaluation of the public consultation itself.

Correspondingly, in the new decision-making model, I wanted to test:

- 1) In what concerns the first aspect, will the new IT allow the promoter / developer to present the EIA directly in digital form and media support and therefore:

- a) organize the EIA content and structure in such a way that there is a better articulation between the overall study and its non-technical summary;

- b) deliver all or part of the study through Internet and / or CD-ROM, thus providing a better format for EIA review and public consultation than current paper form.

- 2) In what concerns the second aspect, will the new IT allow one to re-think the nature, form and presentation of the non-technical summary, in such a way that instead of its current limitations (described in the chapters "The Problem" and "The Actors"), it will be possible to produce a digital version able to integrate multiple views, browsed at multiple levels of complexity and detail, according to the reviewer's motivation, concern and technical background.

- 3) In what concerns the third aspect, will the new IT/IS facilitate the cooperative working procedure of a multidisciplinary EIA Review Committee,

help to identify synergetic relationships between different impact domains, and provide a better way of relating public input with the review from the EIA Review Committee's experts.

5.4.4. Public participation model

Although public participation is part of the overall decision making process, I found useful to enlarge this subset and define it as a model itself. While the decision-making model denotes the process from the point of view of the Review Committee, the public participation model gives us the expectations from the view point of the public.

Expanding the public participation component of the described decision-making process, we have:

a) The public agency in charge of the EIA public consultation (in this case, IPAMB, Ministry of Environment) publishes a notice informing the public about the scheduled consultation and general procedure.

b) The EIA (printed copy) can be consulted in a few public offices, such as IPAMB itself and the local municipalities affected by the project.

c) It is also distributed the EIA non-technical summary, by tradition mailed to all relevant NGO and/or local "civil society" organizations (sport and cultural cooperatives, churches, etc.).

d) IPAMB usually promotes one or more public hearing sessions, even if it is not required by law in most cases (including the one in question, CTRSU).

e) During the period of public consultation, around one month, any citizen can ask questions and /or contribute with written opinions. In the end, the public entity in charge of the public consultation (IPAMB) compiles the public input from the hearings and written statements in a "public consultation report," incorporated in the final EIA Review Committee Report. This report is public.

Again, the research experiment had to fit in the current legal procedure for public consultation. To build the new public participation model, I wanted to test that:

1) New IT/IS, including Internet and CD-ROM delivery, will allow wider access to EIA data and promote participation in the public consultation process, translated in larger numbers of citizens involved and wider spectra of audiences, as compared with the usual few participants from the site location and NGO activists.

2) New IT/IS, including the IMS prototype, will allow for better understanding of the EIA issues in question, therefore better informed participation and more relevant questions and public input, mainly through the following advantages:

a) Easier and more detailed access to technical and political explanations and points of view from experts and institutional representatives of all actors involved (promoter, public administration, environmental NGOs, etc.), concerning the EIA and related issues;

b) Better use of the EIA non-technical summary as an entry to more technical material, instead of a frustrating superficial presentation of the EIA with a dead-end when more specific questions arise from the public at large, given the more flexible integration of this summary with the overall EIA, until now reserved for experts.

5.4.5. Data and knowledge representation model

Among the remaining models, the first to build is the one concerning the knowledge representation, since the models for knowledge acquisition and system use depend on the former.

To build this model I considered different representation paradigms that emerged from this field (as discussed in previous chapters), in a series of brainstorming and interviews with the panel of experts. Described in a specific chapter, given the relevance of this topic, I adopted as the main representation paradigm for the IMS knowledge content a "question-answer" model, derived from a common one known as FAQ (Frequently Asked Questions), in lieu of my first choice (in the

design stage), the rule-based representation. The choice, as discussed later, derived from factors such as suitability to the kind of knowledge in question, better responsiveness of the knowledge sources to the corresponding knowledge acquisition model, as well as feasibility, considering the short time available for implementation.

The FAQ model presumed the support from the case actors to supply both questions and answers, and implied a special attention to potential built-in biases in both, thus requiring an active, intervening effort from a moderator (myself) to achieve a balanced representation of all different points of view and agendas.

The kind of model adopted was more properly an "Intelligent Multimedia FAQ," since the question-answer template form was not restricted to text, but expandable (on the "answer" component) to other texts hyperlinked between them (including bibliography and contact business cards), sound recordings, digital video, pictures, "data trails," etc., linked and structured in such a way as to benefit from object-oriented properties (class types, inheritance, etc.). In this aspect, it remained very close to the defined in the design section.

I hypothesized that this "Intelligent Multimedia FAQ" model would be able to:

- 1) Anticipate the kind of questions that will be raised during the EIA review, either by the EIA Review experts or by citizens with different levels of concern and technical background. In fact, I was building an FAQ without knowing the "F" (frequency) parameter, therefore in itself it represented a working hypothesis.

- 2) Enable a richer understanding of technical complexities by non-experts, translated into more sensible and consistent questions and opinions from public participants, given its form, the multimedia facet and the flexibility derived from its "intelligent" representation.

5.4.6. Data and knowledge acquisition model

Derived from the knowledge representation model adapted ("intelligent multimedia FAQ"), data and knowledge acquisition had to be based on a process

of compiling both questions and answers through some structured process, adapted both the representation model and the kind of sources available. Hence the need for a "Data and knowledge acquisition model."

The basic expectation was the feasibility of collecting directly from the sources (mainly experts or administrative and political representatives) answers in some standard FAQ-compatible form, consisting of a written or videotaped summary plus units of information to fill-in a *metadata descriptor* or header, relating the summary with all other associated multimedia documentation each source would provide (other written documents, photographs, etc.), plus contact information.

To start-up the acquisition process, I planned to ask a panel of experts cooperating with the IMS project to compile an early set of vocabulary and questions and structure them using some kind of taxonomy (concepts developed in other chapter). This set was to be used as a seed in the first round of iterations of interviews (or written requests for answers) with external sources.

Consequently, I built the "data and knowledge acquisition model" in the following fashion:

a) A panel of experts would build a seed structure for the FAQ:

- i) Compiling an initial set of related vocabulary;
- ii) Defining a taxonomy;
- iii) Compiling an initial "question" set, attached to the taxonomy;
- iv) Compiling an initial body of knowledge, with answers to the initial question set ("seed") and keywords attached to the taxonomy.

b) Data and knowledge acquisition would then proceed with structured interviews with external sources, where the guideline was:

- i) The initial "question set" seed, structured according with the taxonomy;
- ii) A standard "multimedia metadata descriptor" form, designed by me in accordance with the knowledge representation model.

c) The acquisition process would consist in several iterations of these interviews (and a few written requests to some sources, such as municipalities and waste-related businesses), where each source would be asked:

- i) To suggest more questions to add to the question set;
- ii) To suggest rectification's to either question formulations or to the question set structure (taxonomy);
- iii) To provide answers to as many questions they would be willing to,
- iv) To provide other related multimedia documentation, together with information for their corresponding metadata descriptors.

This model has some built-in assumptions that I wanted to test:

1) All sources from the different actors will be able to agree on a common structure (taxonomy) for the question-answer set;

2) At the end of a few iterations, the acquired knowledge units (question-answer set) will have a balanced representation of all major points of view from the main actors involved, once incorporated all input, including criticism and suggestions from the sources concerning possible bias;

3) It will be possible to acquire a minimal "critical mass" of data and knowledge, enough to allow "real-world" conditions to test the use of the IT/IS introduced (IMS software prototype plus www), within the short period of time available for the EIA review and in particular for public consultation.

Naturally, all these hypotheses (in all models) are in the context of an unchanged decision-making institutional framework. In fact, they serve also as a test whether this current framework allows such improvements.

5.4.7. Information system user model

Building a simple user model was important to set up the interface conditions in order to, on one hand, enable the implementation and test of the public participation model and, on the other hand, allow for some kind of measure of user interaction with the technology and the IMS prototype.

Since the expectations concerning user participation and interaction with the IT/IS varied considerably from actor to actor, I chose to focus more on "tracing" devices

to observe and record user action rather than on setting up tests for some specific hypothesis of user behavior.

Consequently, I defined the IT/IS user model the following way:

- a) Citizens will interact with the new IT/IS,
 - a.1) by visiting web-based information, or
 - a.2) using the IMS prototype installed in several computers in several sites open to public access;
- b) Citizen input sent through the new IT/IS made available by the thesis experiment can take the form of

- b.1) email messages sent to the public agency in charge of EIA review,
 - b.2) filling and sending a web-based questionnaire / survey form, or
 - b.3) typing comments / opinions within the IMS software prototype.

This input would be made public within the same media, meaning email messages would be published on the web, IMS typed messages could be consulted in the IMS itself;

- c) Web based information (at least part of the EIA FAQ set) will be organized in such a way as to facilitate consultation at different depths of technical knowledge, and with "visit counters" in all knowledge units (web pages);
- d) IMS software prototype will present the user with alternative paths to access content, and incorporate a "trace" function, recording user steps (such as sections and FAQ visited, time spent on each step, etc.).

Again, this model contains some built-in general assumptions, corresponding to loosely hypothesize that different kinds of users will make different use of the available alternate paths to access information, and that tracing user interaction will show some meaningful patterns. Given the non-existence of a specific hypothesis on user categories and user behavior classes, the intention was more to compile potentially useful data rather than test a specific expectation, as referred already above.

5.4.8. Scope and nature of the experiment models

It is important to note that at first, with my earlier hypothesis formulation, these models of expectations were simply a kind of more detailed hypothesis, concerning the performance of each new IT introduced and the improvements at each step or facet of the decision-making process. After my preliminary findings, which pointed to significant constraints imposed by the current decision-making institutional framework, the experiment models were set with a different perspective.

Since the experiment settings do not change the institutional and regulatory framework, the interesting evidence from the experiment is the one that will point, for each of the models of expectations defined here, to one of the following possible outcomes:

a) The new IT failed to perform as expected **and** / **or** did not bring any significant improvement to the decision-making process; in either case, with no relevant institutional or regulatory constraints observed. In this outcome, my hypothesis is not proven true and may eventually be proven false.

b) The new IT performed as expected and brought the expected improvements to the process, despite institutional and regulatory constraints. In this outcome, part of my hypothesis, on the role of the new IT, is proven true, but another part of my hypothesis is proven false, since there is evidence we don't need a new decision-making institutional framework in order to profit from the new IT.

c) The new IT performed as expected and there is evidence that expected process improvements were likely to occur if it wasn't for the institutional and regulatory context. In this outcome, my hypothesis is proven true.

Naturally, real world processes are never clear-cut, so it is always possible more complex outcomes, with a combination of these three and other less conclusive ones. This is why the experiment was designed having in mind to focus more on understanding the factors in play, rather than trying to prove rigorous and detailed

settings. These models of expectations must be seen in this light. They are essentially a tool to facilitate observation, providing some structure to it.

5.4.9. Model implementation time frame

With these models explicit, and keeping in mind their scope and nature, it is useful to acquire a view of the “ensemble,” or synoptic view of the whole experiment, with a time frame of the implementation. The simplest approach for that purpose is to build the relevant timelines, based on the case chronology records, as presented in the next chapter.

5.5. The Chronology

Introduction; Preliminary work; Experiment phases; Chronology table; Timelines

5.5.1. Introduction

In the past chapters, I set the stage concerning this case study, providing the background for the description and analysis of thesis experiment. This included the overview of the case, of the actors involved and of their expectations. Before delving into the details of the experiment itself, it is useful to present a chronology of its main events and actions, establishing a timeline to facilitate integrating the multiple facets of the experiment.

5.5.2. Preliminary work

As already discussed in the chapters on the design of the experiment, an important part of it was the preliminary work, first to characterize candidate case studies, then to select the most adequate, and finally to create the conditions for the feasibility of the case -- from institutional support and funding to the availability of human and technical resources. It was also during this phase that most of the IMS software prototype functions were programmed and tested.

5.5.3. Experiment phases

The feasibility of the selected case established, beginning therefore the thesis experiment as such, we can identify 3 distinctive phases, all of which critical for the understanding of the results: the preparatory period, the period of EIA review, and the period post-EIA review.

In the preparatory period, with the input from the expert panel, plus ad-hoc collaborators, I discussed and defined the knowledge representation and acquisition model, the structure of the knowledge base and of the multimedia data base; compiled a questionnaire (anticipated Frequently Asked Questions - FAQ) and several hundred answers to it; developed collaborative tools to help the acquisition and integration of independent collaboration; collected data and multimedia material; digitized and inserted data into the system (both IMS and on the Web), including a major part of the EIA itself. But, not less important and

relevant, I also had to negotiate the terms and support from all the different actors and stake holders (the government agencies, the developers, the EIA consultants, the local municipalities, the environmental NGOs, etc.).

During the official EIA review period, I continued to digitize and insert data into the system; interviewed and assisted users of the IMS prototype, including a group of workers from S. João da Talha, members of Environmental NGO's, staff from the Environmental Ministry and others; recorded the two public hearings and noted the questions raised, and performed a paper-based opinion survey during the said hearings, as well as collected answers from the web-based survey form; introduced several improvements on the prototype user interface, responding to user feedback; participated on a press conference promoted by the Environment Ministry concerning the tools made available to support public review, including a demonstration of the IMS prototype.

During the period post-EIA review, I collected more feedback from different intervening actors (Developer, Ministry, Experts, NGO's, groups of local citizens, etc.) concerning their perspective on the use of the prototype and Internet; produced a CD-ROM with the system and data; discussed with my panel of experts the preliminary results and the design of a controlled experiment with students concerning the IMS prototype; prepared a "knowledge test" for that controlled experiment and performed it, with two groups of students, one of Environmental Eng.. undergrads and the other of younger Psychology undergrads; and then reviewed and discussed the results from this controlled experiment, comparing them with informal use during the public consultation period.

Naturally, it followed a phase of analysis and discussion of the observations and collected evidence.

5.5.4. Chronology table

In table 5.5.4.-1 are listed the most relevant steps and milestones of the thesis experiment. This table was extracted from the "IMS Project Chronology Research Record", a field research document equivalent to laboratory notes.

Table 5.5.4.-1 - Thesis Experiment Main Steps and Milestones

DATE	EVENT	LEVEL
1994/01/01	Analysis of possible case studies (EXPO 98, New Tagus Bridge) Development of IMS prototype major functions Encouragement and offer of support from major NGO leaders to IMS Project.	Research&Development Political
1995/01/31	Analysis of a case study on the EIA of a dedicated incinerator for industrial/hazardous waste	Research&Development
1995/03/00	MEETING WITH ENVIRONMENTAL MINISTRY - APPROVAL IN PRINCIPLE OF SUPPORT TO IMS PROJECT , as a case study on the EIA of a dedicated incinerator for industrial/hazardous waste (Director of DGA present)	Political Institutional
1995/07/15	Document: Presentation of IMS project, with problem formulation and IMS prototype images, version 1	Research&Development
1995/08/10	First preliminary meeting towards foundation of CITIDEP IMS Project seen as a role model for CITIDEP	Institutional
1995/09/01	Document: Presentation of IMS project, final version (portuguese) (Ferraz de Abreu 1995a)	Research&Development
1995/10/10	NATIONAL ELECTIONS IN PORTUGAL CHANGE OF GOVERNMENT (PSD to PS)	Political
1995/10/16	THESIS PROPOSAL APPROVED at MIT	Research&Development
1995/11/02	MEETING CONSTITUTING IMS EXPERT PANEL	Expert
1995/12/19	Phone meeting w/ DCEA PROTOCOL DCEA-DGA on IMS SIGNED. DCEA says Ok to obtain Valorsul complementing funding for specific sub-project	Institutional
1996/02/01	FAQ VERSION 1	Research&Development
1996/02/14	BEGINNING OF OFFICIAL EIA REVIEW PROCESS (120 business days)	Institutional
1996/02/15	FAQ version 1.2	Research&Development
1996/02/26	IMS Expert Panel Meeting FAQ ANSWERS VERSION 1	Expert Research&Development
1996/03/17	Meeting with all EIA Review Committee, for formal presentation of IMS project, lead by the Director of DRARN-LVT (Silva Costa)	Political Institutional
1996/03/27	FORMAL IMS PROPOSAL presented at DRARN-LVT for IMS PROJECT GUIDELINES concerning Institutional cooperation and system use.	Institutional
	New IPAMB President: Antonio Guerreiro New DGA Director: Marques de Carvalho	Political
1996/04/15	FAQ version 2.8	Expert
1996/04/16	Meetings on IMS with Actors (DGA) Meeting IMS at DGA	Political Institutional
1996/04/16	RAISED CONCERNS ON SENSITIVITY of FAQ	Institutional
1996/04/17	Meetings on IMS with Actors (Min. of Environment/Secr. of state) CLEAR FAQ ISSUE and OBTAIN SUPPORT FROM MIN. of ENVIRONMENT TO PROPOSED GUIDELINES	Political
1996/04/18	CONTRACT SIGNED IMS/VALORSUL Project	Institutional
1996/04/19	Document: Guideline on installing and using IMS (version 1)	Research&Development
1996/05/17	Lunch w/ Mayor of Lisboa	Political

	Meetings on IMS with Actors (S.Joao da Talha Grassroots) Contact w/ "Comissão de acompanhamento" and "Comissão de luta S Joao da Talha"	Political Institutional
1996/05/27	BEGINNING OF PUBLIC CONSULTATION PERIOD	Institutional
1996/06/05	INAUGURATED FIRST INTERNET ACCESS to EIA Review, at IPAMB (with President of Republic, J. Sampaio)	Political
1996/06/09	IMS Expert Panel working session STABLE VERSION FAQ-IMS (2.9.5)	Expert
1996/06/10	Document: Guideline on installing and using IMS (final version)	Research&Development
1996/06/11	FAQ IMS - Valorsul ON-LINE (web)	Expert
1996/06/11	DEADLINE to deliver internal review statements within EIA Review Committee	Institutional
1996/06/25	PUBLIC HEARING at S. Joao da Talha (~ 150 present at beginning, lasted 6 hours) Available a written detailed description on my notes, my tape recording and an official report from IPAMB	Institutional
1996/06/27	PUBLIC HEARING at LNEC, Lisbon (~ 55 present, lasted 3 hours) Available a written detailed description on my notes, and an official report from IPAMB	Institutional
1996/07/08	INSTALLATION of "final" IMS at IPAMB, Environmental Ministry / Sec State, GEOTA; PUBLIC CONSULTATION SESSION USING IMS at IPAMB with my presence.	Expert
1996/07/09	PRESS CONFERENCE at Min. Environment	Political
1996/07/09	DEMONSTRATION OF IMS Prototype to "Comite Adhoc S. Joao da Talha" (blue collar workers), at IPAMB PUBLIC CONSULTATION SESSION USING IMS at IPAMB with my presence.	Expert
1996/07/10	PUBLIC CONSULTATION SESSION USING IMS at IPAMB with my presence.	Expert
1996/07/10	END OF PUBLIC CONSULTATION PERIOD	Institutional
1996/08/05	Environmental Ministry signs approval of EIA, with conditions	Institutional
1996/09/14	FOUNDATION OF CITIDEP	Institutional
1997/02/27	Tests IMS at Fac. Psychology (students)	Research&Development
1997/03/04	Tests IMS at DRARN-LVT (expert staff)	Research&Development
1997/03/10	Tests IMS at FCT-UNL (students)	Research&Development
1997/03/18	Tests IMS at DRARN-LVT (directors)	Research&Development
1997/06/15	Published article on IMS Project: Ferraz de Abreu, P., Chito, B. (1997), " <i>Current Challenges in Environmental Impact Assessment Evaluation in Portugal, and the Role of New Information Technologies: The Case of S. João da Talha's Incinerator for Solid Urban Waste</i> ", In Machado, J. Reis & Ahern, Jack (eds). 1997. Environmental Challenges in an Expanding Urban World: and the Role of Emerging Information Technologies. National Centre for Geographical Information (CNIG), Lisbon, Portugal. 538 pages, pp 1-11.	Research&Development
1997/06/15	FINAL clean VERSION of FAQ-IMS (3.0) 445 question-answer pairs	Research&Development
1997/12/31	IMS FINAL REPORT (Portuguese version)	Research&Development

5.5.5. Timelines

Based on the "IMS project chronology research record", summarized in table 5.5.4.-1, we can build timeline tables that provide a global overview of the experiment phases and milestones.

Table 5.5.5.-1 shows an aggregated timeline view of the case studies (considered, studied, prepared and finally the one implemented, with respective aggregated phases), against the background of the development of the information technologies used in the thesis experiment.

Tables 5.5.5.-2, 5.5.5.-3 and 5.5.5.-4 show a more desegregated view for CTRSU Case Study Timeline, respectively in 1995, 1996 and 1997.

From these time lines, it is clear that, besides the preparatory work in meetings with the main actors involved in the EIA review process, already described in the respective chapter, the other key step to launch the thesis experiment was to assemble a panel of experts to support the IMS project. I will then proceed to describe, in the next chapter, the expert panel and its work.