

# Supporting the Strategic Objectives of Participative Water Resources Management; an Evaluation of the Performance of Four ICT Tools

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Article 14 of the Water Framework Directive promotes a social learning model of participative planning and creates a broader stakeholder and public constituency for water management. Such natural resource management processes are key testing grounds for the development of new Information and Communication Technology (ICT) tools designed to support wider citizen participation in local and regional governance. Several types of purpose designed ICT tool are available, but there is a distinct lack of empirical research into their design and effectiveness. Strategic objectives performance take the central role in the work reported here. Six strategic objectives of the use of ICT tools were identified; learning, trust in the institution (the developers of the tool), trust in the computer tool (and the information contained within), trust in the decisions made (during a post interaction scenario), motivation and inclusion. A number of pre-existing software platforms, each specifically designed to either educate or support decision making in the area of water management, were selected and formally evaluated under controlled conditions with small groups of evaluators. Results from the evaluation sessions were analysed using statistical analysis techniques. The discussion focus is primarily on the performance of each evaluated tool with respect to achieving the strategic objectives.

**Keywords:** Public participation; ICT tools; Design; Evaluation

## 1. INTRODUCTION

### 1.1 The need for citizen inclusion

Implementation of the Water Framework Directive, specifically Article 14 saw the first steps towards initiating a two way flow of information and decision making with regards to water management. According to the European Commission, this pan-European piece of legislation was proposed due to pressure from environmental organisations and citizens for cleaner water resources. Therefore the EC took upon itself to make the remediation of polluted water bodies and the safeguarding of such areas a priority (European Union, 2000). The involvement of organisations and citizen groups was considered to be essential to ensure that the EC would achieve these objectives.

Following initial ideas on public participation as presented in Agenda 21 (UNCED, 1992), the Aarhus convention (CEC, 2003) and the Water Framework Directive (European Union, 2000),

the European Commission (EC) proposed via a White Paper the 'opening up' of the policy making process, whereby the involvement of members of the public in 'shaping and delivering' EU policy would take place (CEC, 2001a). Reforming European governance requires the commitment of European member states, regional and local authorities and citizens. To determine good governance, five political principles were devised which included Openness (in terms of communicating information to citizens), Participation (involving citizens would increase confidence in any final decisions reached by the EC), Accountability (Member states take responsibility for their actions), effectiveness (of policies) and coherence (of policies and actions).

## 1.2 Bridging the knowledge gap

It is outlined in the legislation (European Union, 2000) that in future, organisations will have to involve members of the public in decision making regarding the environment. Perhaps understandably organisations may be a little reluctant to involve members of the public in decision making regarding issues for which they have no expert training or prior knowledge of. Therefore it is imperative that the correct level of decision making power and the most suitable participative fora are selected based on the environmental issue to be discussed. A number of papers (House, 1999; Konisky and Beierle, 2001; Aldred and Jacobs, 2000,) have dealt with the level of decision making power afforded to the public in a decision a making situation, but Arnstein was the first to develop a ladder of citizen participation (Figure 1, Arnstein, 1969).

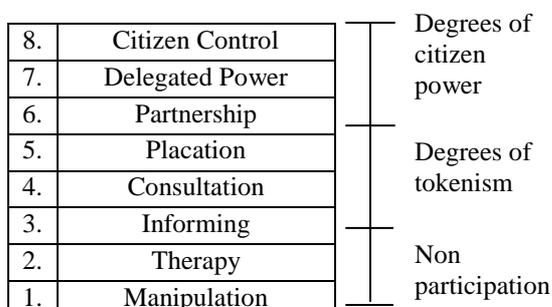


Figure 1 – Arnstein’s ladder of citizen participation

When considering Arnstein’s ladder with respect to the Water Framework Directive, the degree of citizen participation stated is unclear. However, the wording contained within Article 14 of the Water Framework Directive (European Union, 2000) implies that the level of public participation (according to Arnstein’s ladder) will manifest itself either in the form of a partnership or delegated power. It is unlikely that the level of citizen power implied in the article is meant to exist in the realms of tokenism, although there is a possibility that a subsequent decline to this level may occur. It is equally unlikely that the article is actually stating that the public involved should have complete control, as this could lead to citizens making ill-informed decisions with regard to water resource management. In their 2002 paper, Moorhouse and Ellif addressed the benefits of involving members of the public in decision making, reasoning that inclusion would reduce uneasiness between experts and non experts.

## 1.3 The Need for ICT Tools to support participative processes

So that members of the public are able to interact successfully and make meaningful decisions regarding water environment issues, certain tools have been identified which facilitate the decision making process. Other than the availability of obvious reference aids such as books or television, these include ICT (Information and communication technology) tools which can be designed for use to allow citizens to fill a knowledge gap, or in the form of decision support tools, which present the user with options concerning a specific problem or environmental issue (e.g. Water Ware, Jamieson and Fedra, 1996). Other suggested tools include the use of metaphors (Cronje, 2001) and scenarios (Van Nottes et al, 2003).

In order to enable natural resource management processes to take place it is widely advocated that there is a need for the development of new Information and Communication Technology tools (ICT) specifically to support participative management tools (Guimãres Pereira, et al. 2003). Such tools exist, but there is a distinct lack of research into the design performance, effectiveness and intended use of such tools. As limited work has been carried out on the design and evaluation of tools specifically designed to facilitate decision making processes it is important to first define possible areas that can be evaluated within an ICT tool. Within this research, three main areas have been identified to focus on in terms of evaluation, which are elements of the Human Computer Interface (HCI), the deployment context and finally the presence of certain strategic objectives.

## 2 EVALUATION RESEARCH

Whilst the HCI and deployment context are clearly of influence and are important focuses for study, it is the strategic objectives that we are concerned with here. Our motive for focusing so clearly on the strategic objectives of ICT tools is that strategic objectives constitute the avowed utility or benefit of engaging stakeholders in the first place. Without demonstrable accomplishment of the strategic objectives of ICT tool deployment, the whole process becomes somewhat notional and speculative. Our challenge is therefore to identify a set of strategic outcomes which ICT tools designed to support participative processes should be achieving. What is the nature of the change or transition which users of the tool will undergo? How will their opinions,

perspectives, understandings, or knowledges be modified / enhanced?

These strategic functions are, in fact, described reasonably well in the literature. However, a first principles approach should start with a set of reasons why wider participation in natural resource planning and management is desirous. Table 1 provides a suggested set of such reasons.

From the strategic objectives listed in the second column of Table 1 we can list a preliminary set of aspirations for participative planning processes; Learning, Trust, Motivation, Inclusion, Consensus, Justice, and Openness. These strategic functions or objectives of participation constitute a set of objectives for not only the participation process, but also for tools and techniques designed to support such processes.

constituency being consulted creates wider ownership of the issue.	
Participative processes result in outcomes which are considered fairer or less discriminatory.	Justice
Wider participation provides opportunities for information and knowledge acquisition and for social learning.	Learning

Table 1: Derivation of strategic functions

### 3. EVALUATION METHODOLOGY

#### 3.1 Platform and Respondent Selection

As stated previously existing tools designed specifically to promote citizen participation or empowerment are extremely sparse and therefore limited work has been carried out to analyse the interactions between the user and interface and more importantly whether tools developed achieve certain strategic objectives. Early on in the investigation the decision was made to only include tools developed within the UK, as it was felt that it would be unfair to ask residents of the UK questions regarding unfamiliar locations. Therefore it was decided that the platforms to be used in the evaluation would be those that focus on locations in the UK, so therefore would be developed by organisations situated in the UK. It was also decided that the tools should specifically focus on water related environmental issues. The aforementioned factors warranted consideration as they would particularly effect the trust questions to be asked during the evaluations. Asking an individual whether they trust an organisation, or the content within a tool developed by an organisation requires that the respondents must at least have had the chance to find out about or hear of the company in question, for example the Environment Agency.

The platforms selected for the evaluation included the Riverside Explorer (Environment Agency), Ecopod (Environment Agency), The Water Aid Game (Water Aid) and the Personal Barometer (Cranfield University).

As most of the pre-existing tools mentioned above were designed for students aged between 10-16 years it was decided that this target audience should be involved in the testing of the platforms. To be able to carry out the evaluation with student respondents it was decided that contact should be made with different secondary

Strategic objectives of participative processes	Keywords
Better solutions and deployment strategies can be identified.	Efficiency
All interested parties are provided with opportunities to contribute and engage in debate.	Fairness
Collaboration supports elicitation of both expert and local knowledge.	Knowledge pooling
The bringing together of members of the public and experts can help dispel the general mistrust of science that non-experts might possess.	Trust
All parties are aware of the issues and the process by which decisions are made.	Transparency of process
Confidence in decisions is likely to be enhanced under conditions where inclusiveness and openness are promoted.	Trust / Fairness
Wider participation provides opportunities for broader agreement on diagnosis, prognosis, and solution selection.	Consensus
Wider participation meets the ambitions of governance principles based on extending democracy	Democracy
Broadening the	Inclusion

schools in the Bedfordshire area. As well as including both the developers and target audience in the evaluations, a further respondent group was involved. Postgraduates from Cranfield University were also asked to volunteer to take part in the evaluation work. Both groups (postgraduates and target audience) took part in the evaluation because designing future tools to aid participatory process would require that individuals of all ages and ability would need to be able to use the tools.

Both time and monetary constraints limited the number of evaluation sessions that took place and therefore the number of participants that took part in the investigation. The length of time it took to plan the sessions reduced time to actually carry out the sessions. Also as a financial reward was offered to any postgraduate volunteers willing to take part in the session. This was a predetermined amount, therefore limiting the number of respondents who could take part.

### 3.2 Evaluation techniques

After much deliberation as to the best way to discover strategic objective presence in each tool, it was decided that questions related to each of the strategic objectives would be asked both before and after interaction with the specific platform. Both the pre and post interaction questions were exactly the same so that the respondent's prior knowledge and opinions could be gauged both before and following platform use. This would also enable a direct comparison between answers to the two sets of questions pre and post platform use.

A self complete questionnaire was designed to ask questions relating to the strategic objectives both before and after interaction. A platform specific scenario was also proposed to the group before and after interaction with the tool. The format of the evaluation sessions was as follows:

1. The administering of a pre interaction self complete questionnaire.
2. The discussion of a platform specific pre interaction scenario (to be taped).
3. Interaction with the tool
4. The administering of a post interaction self complete questionnaire (Same wording as pre interaction questionnaire).
5. The discussion of a platform specific post interaction scenario (to be taped).

## 4 RESULTS

Data collected from a total of 21 sessions (involving a total of 69 respondents) are from the evaluations involving the target audience (10-16 year olds) and postgraduate volunteers. This small sample therefore means that significance testing would not be very robust or meaningful. This combined data is represented in Figures 2-6. Figure 2 shows the total percentage strategic objectives achieved for each platform tested.

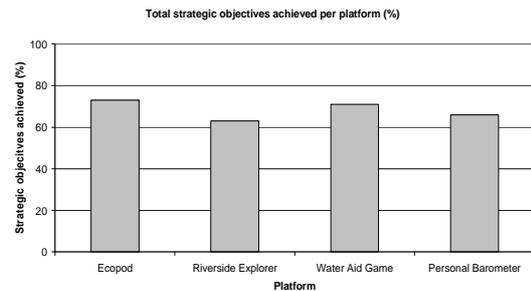


Figure 2 – Total percentage strategic objectives tested.

Through analysis of the individual strategic objectives achieved by each platform, the degree to which each strategic objective was achieved could be observed. Figures 3-6 present the strategic objectives achieved for each platform.

### Key

- TII – Trust in the institution
- TID – Trust in the decisions made
- TICT – Trust in the computer tool

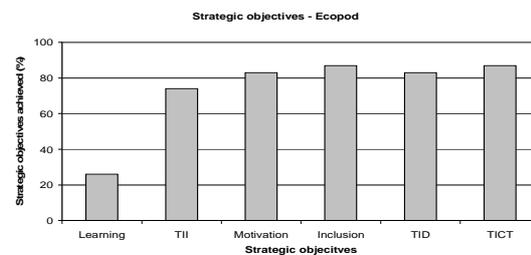


Figure 3 – Strategic objectives achieved by Ecopod (Environment Agency, 2002).

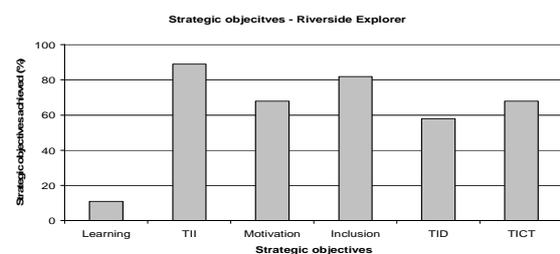


Figure 4 – Strategic Objectives achieved by The Riverside Explorer (Environment Agency, 2002)

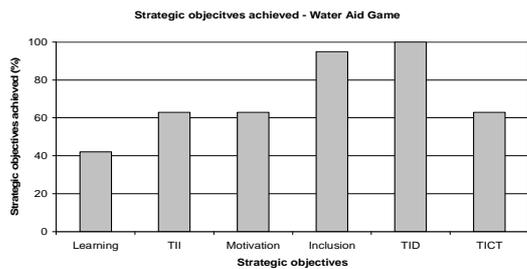


Figure 5 – Strategic Objectives achieved by the Water Aid Game (Water Aid, 1999)

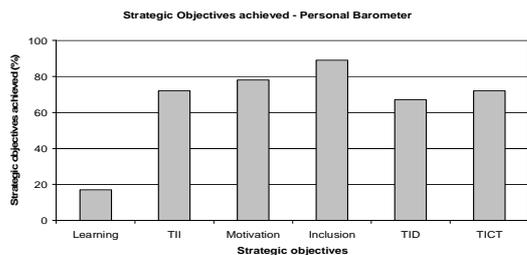


Figure 6 – Strategic Objectives achieved by the Personal Barometer (Cranfield University, 2003)

## 5 DISCUSSION

By looking at Figure 2 it can be seen that the Ecopod application achieved the highest overall percentage of strategic objectives, with a mean score of 73%. This was followed by the Water Aid game achieving a score of 71%, the Personal Barometer achieving a score of 66% and finally the Riverside Explorer achieving a score of 63%. Ecopod, designed by the Environment Agency gained the highest overall score during the evaluation, meaning that it achieved the total strategic objectives to the highest degree. However, from the results it can be seen that there is only a 10% difference between the highest and lowest scoring tools, so therefore it is necessary to consider the degree to which individual tools achieved strategic objectives.

With all tools, learning was the strategic objective that was achieved to the lowest degree, which suggests that particular attention needs to be focussed on this area when designing a generic evaluation methodology and in future tool design. The low score for learning for all tools implies that although they are designed for learning and even if they possess all of the relevant information regarding the subject area, the respondents have failed to answer questions regarding a major learning goal within the tool. This could be because of the way in which the information is presented within each tool, perhaps it was difficult for the user to navigate the tool. This finding has implications for the future design

of computer tools for learning, especially those used in a decision support context.

The results for the strategic objectives vary according to each tool evaluated. Beginning with Ecopod, the joint highest strategic objectives achieved were ‘inclusion’ and ‘trust in the computer tool’. The second highest jointly, were ‘motivation’ and ‘trust in the decisions made’. The strategic objective ‘trust in the institution’ scored poorly. When looking at the results from the Riverside Explorer, the strategic objective achieved to the highest degree was ‘trust in the institution’, followed by ‘inclusion’ and then jointly by ‘motivation’ and ‘trust in the computer tool’. Results suggest that the tool did not help the respondents gain confidence in the decision making scenario, therefore the strategic objective ‘trust in the decisions made’ received a low score. Adversely, ‘trust in the decision’ was the strategic objective to be achieved to the highest degree during the evaluation of the Water Aid Game tool, followed by ‘inclusion’. This tool achieved the strategic objectives ‘trust in the institution’, ‘motivation’ and ‘trust in the computer tool’ to the same degree. Finally, ‘inclusion’ was achieved to the highest degree when the Personal Barometer was evaluated, followed by ‘motivation’ and then jointly by ‘trust in the computer tool’ and ‘trust in the institution’. ‘Trust in the decisions made’ was the poorest scoring objective.

From the evaluation sessions it was found that ‘inclusion’ was the easiest objective to achieve overall. During the questionnaire the respondents were asked whether a certain environmental issue (for example, world drought) was a problem that they thought that they should be concerned with. It was found that following tool interaction most respondent’s opinions had changed and the tool demonstrated that it was important for them to consider the issue. When asked whether they would get involved in helping solve an environmental issue affecting their local area, most respondents answered in a positive way following tool use. However, the strategic objectives related to trust varied greatly, the respondents trusted the computer tool, but when asked if they trusted the institution that developed the tool, the responses depended on whether the respondents had heard of the institutions in the first place. This would therefore be affected by age (children would be less likely to be concerned with environmental matters) or duration of residency in the UK. Finally the most varied strategic objective score was trust in decisions made during the scenario section of the evaluation. It would seem that after using the tool

the respondents did not feel confident about the decision that they had made aided by the tool.

## 6 CONCLUSIONS

- Learning was the poorest strategic objective achieved and special attention needs to be focussed on this in future tool development.
- Inclusion was the highest strategic objective achieved.
- Respondents tended to be more motivated following tool use.
- The elements of trust were varied.

## 7 ACKNOWLEDGEMENTS

The work on which this paper is based was supported by the European Commission under the VIRTU@LIS project (IST-2000-28121). The authors would also like to thank the respondents who took part in the evaluation study.

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