An Assessment of Shared Vision Model Effectiveness In Water Resources Planning

Allison M. Keyes[1] Student Member, and Richard N. Palmer[2] Member, ASCE

Introduction

During the National Drought Study the US Army Corps of Engineers sponsored river basin planning efforts at six sites across the country (Institute for Water Resources 1994). These sites included the Cedar and Tolt River basins in Washington, the Green River basin in Washington, the James River basin in Virginia, the Kanawha River basin in West Virginia, the Marais des Cygnes-Osage River basin in Kansas and Missouri, and the Quabbin and Wachusetts River basins in Massachusetts. A common component of these efforts was the use of an object-oriented programming environment for simulation model construction. Two main goals were established for the modeling efforts: 1) To create models that could clearly be characterized as "Shared Vision" models, and 2) to effectively integrate these models into a seven- step paradigm for collaborative planning advocated by the Corps. Because the use of object-oriented programming to create Shared Vision models is relatively new to water planning, the effectiveness of this approach is of potential interest to water managers.

This paper outlines the approach used to assess if Shared Vision models were produced at each site and the process by which model effectiveness was evaluated. The outcomes at each site are described and influencing factors are noted. The implications of these findings for future planning efforts are also briefly discussed.

Evaluation Approach

It was initially hypothesized that use of object-oriented software would facilitate the creation of Shared Vision models, by allowing potential model users to play a more significant role in the model development process. Furthermore, it was believed that Shared Vision models would be more readily and effectively utilized throughout plan development than those which address a more singular perspective (Palmer et al 1993). To test these hypotheses, the evaluation effort focused on three activities: 1) Assessing the extent to which the object-oriented models could be characterized as Shared Vision models, 2) Assessing model usefulness in the planning activities advocated by the Corps, and 3) Identifying factors which contributed to the outcomes observed. Greater detail regarding these evaluation activities is provided below.

---

[1]Graduate Research Assistant, and [1]Professor of Civil Engineering, Department of Civil Engineering, University of Washington, Seattle, Washington 98195

Several sources of information were utilized for this assessment. Initial modeling objectives were examined. Models were reviewed and critiqued at different stages in the planning process on the basis of their technical merit, and appropriateness to the planning effort. Numerous planning workshops were attended to observe model applications in these settings. Questionnaires were administered to workshop participants and key members of the planning team were interviewed to assess their level of understanding, trust, and satisfaction with the model, as well as their views on the planning process. Model developers were interviewed to document the model development approach, ascertain their satisfaction with the model development and application, and gain insight regarding the perceived impacts of object oriented programming and other factors to these outcomes. The perspectives of numerous water resources professionals who were involved in the National Drought Study were also sought. Based on this information, case summaries were prepared for each study site.

Shared Vision Model Assessment

Unlike a structured and established analysis tool such as HEC-5, there is no firm prescription for Shared Vision model content, analysis capabilities or output. Rather, the unifying characteristics of Shared Vision models relate to their ability to represent a system in a way that is understood by participants, and to contain information that is relevant to their diverse perspectives. A Shared Vision model must be jointly endorsed by planning participants; a sufficient level of trust must be achieved so that it is viewed as an unbiased and valid source of information in a group decision making context. Finally, a Shared Vision model must be non-proprietary. It must be equally accessible to all groups represented in the planning effort, and a common level of proficiency in model use should be attained.

To assess the extent to which the goals of Shared Vision model development were achieved, the models produced at each site were characterized based on the above attributes. The elements of Shared Vision models that were most frequently attained were examined, as well as those that were most elusive.

Assessment of Model Effectiveness

Models utilized in a planning setting must be appropriate to the problems addressed, and be technically valid, not only from the perspective of planning participants, but also by peers in the field (Loucks 1992). Furthermore, they must be beneficial to the process and outcomes pursued. Site-specific planning objectives, approaches, and participants will help define these general model requirements.

The Corps envisioned that a similar planning process would be followed at five of the six sites. Like many water resources planning efforts, the planning approach advocated by the Corps provided numerous opportunities for model use in activities such as: joint fact-finding, problem identification, assumption and constraint clarification, group brainstorming, alternative screening, trade-off assessment, strategy refinement, communication, and plan maintenance. In general terms, each model’s effectiveness was gauged by its usefulness with respect to these tasks, as well as the versatility of support it provided.

To assess model usefulness, the following questions were posed at each site: 1) Was the model utilized in each of the planning activities listed above? 2) Did the model enhance each participant's ability to participate effectively in plan formulation, implementation and maintenance? 3) Did the model influence participants' perceptions regarding the quality of management decisions? 4) Did model use enhance the

support for planning decisions? Specific metrics were utilized whenever possible to clarify these outcomes.

Assessment of Influencing Factors

Many factors have been noted that can potentially influence the development and effectiveness of Shared Vision model in a planning process (McKinney 1990, Loucks et al. 1985). The factors examined in this study include the interactiveness, transparency, and flexibility of the models; model developer characteristics; the involvement of planning participants in model development; the accessibility of the platform; the types of model training provided; and several aspects of the planning environment. These attributes were characterized for each site. Cross-case comparisons were made to ascertain if there were observable relationships among these factors and study outcomes.

Summary of Model Outcomes and Influencing Factors

Shared Vision Models

The goal of creating a Shared Vision model was attained in each region to varying degrees. The most difficult and elusive goal was attaining a high level of model understanding and sufficient proficiency to allow models to be used by non-model developers. The level of understanding attained was positively correlated with the amount of stakeholder involvement in model development. However, it appears that additional training efforts, wider access to the modeling platform, and greater agency commitment to understand the model were needed.

Planning participants' acceptance of the models was more easily attained. Even though model details were often not well understood, it was nevertheless often trusted and perceived as both relevant and non-biased. The skills of model developers influenced this outcome, as it was common for model developers to assume the role of model translators in group planning activities. Their effectiveness in demonstrating model validity, completeness and relevance was a key prerequisite to model endorsement. The involvement of stakeholders in the model development process also enhanced the likelihood of model endorsement.

The use of object-oriented software greatly facilitated Shared Vision model development efforts. It enhanced the model developers' ability to communicate model content, and to readily incorporate new suggestions into the models. Also, given an appropriate setting, planning participants were able to effectively critique the models because of the transparency afforded by the object-oriented modeling environment.

Model Effectiveness

Model effectiveness varied from site to site. In the most successful case, the model was used in many contexts. In interagency settings it provided an effective means of demonstrating the impacts and trade-offs of different drought management strategies in terms that were relevant to participants. This information greatly facilitated group discussions and helped participants to focus on strategies that were perceived to be most effective and equitable. The model was useful in this role because it met many of the criterion of Shared Vision models: it was trusted by participants and relevant to the various interests represented.

In addition, the primary model users at this site reported that because of the model, a greater variety and number of alternatives were considered and a greater depth of analysis was achieved. The object-oriented environment was cited as the primary

source of these advantages, because it was felt to enhance model flexibility and allowed modifications to be easily made.

In three cases, models were developed to facilitate interagency water management activities other than the Corps-sponsored planning effort. Two of the sites were able to attain endorsement of the model for these purposes. Each model development team's ability to establish a shared sense of ownership in the model, to demonstrate model usefulness in relationship to other existing tools, and to identify potential applications for the model outside the Corps environment was extremely important to these successes. However, in one case, the model can not be utilized until a single, key management agency participates in its review.

In two basins, clear modeling objectives were never established, public participation was limited, and model development progress was sporadic. Planning efforts also suffered from a lack of focus and commitment to the process. As a result of these factors, viable models have not been produced.

Conclusions

The National Drought Study has shown that simulation models can enhance water planning efforts if they are appropriately integrated into the process. Adopting a modeling perspective that allows a Shared Vision model to be produced may enhance the likelihood that the model will benefit a collaborative planning effort. The features offered by object-oriented simulation software facilitate both Shared Vision model development and model application in a planning environment.

Development of a Shared Vision model requires extensive coordination, as well as a high level of commitment among model developers and model users. It calls for clearly articulated modeling objectives, a talented model development staff, and a strategy for effectively involving planning participants in model development. Training for both model developers and users may also be required.

The planning environment also plays a significant role in determining the prospects for model success. Shared Vision model development and effective model application in collaborative planning require a setting where mutual commitment to the process is high, planning objectives are well-defined, and each participant has a stake in planning outcomes. If these conditions are not met, the value of model development and use may be seriously undermined.

References

Institute for Water Resources (1994). *National Study of Water Management During Drought: Report to Congress*. U.S. Army Corps of Engineers, IWR Report 94-NDS- 13.

Loucks, D. P. (1992). "Water Resource Systems Models: Their Role in Planning". *Journal of Water Resources Planning and Management*, 118(3), 214-223.

Loucks, D. P., J. R. Stedinger, and U. Shamir (1985). "Modelling water resource systems: issues and experiences". *Civil Engineering Systems*, 2,223-231.

McKinney, M. J. (1990) State Water Planning: A Forum for Proactively Resolving Water Policy Disputes". *Water Resources Bulletin*, 26(2), 323-331.

Palmer, R. N., A. M. Keyes, and S. M. Fisher (1993). "Empowering Stakeholders through Simulation in Water Resources Planning". *Proceedings of the 20th Annual National Coflference. Water Resources Planning and Management*
Division of ASCE Seattle, Washington, 451-454.