

CONFERENCE PRESENTATION at the 19th Interational System Dynamics Society Conference, August 6-10, 2001, Atlanta, GA.

Part II: Testing the Use of a System Dynamics Model for Improving Public Participation

Sarah Williams Cloud¹

Krystyna A. Stave

Research Assistant and Assistant Professor; respectively
Department of Environmental Studies
University of Nevada Las Vegas
4505 Maryland Parkway, Las Vegas, NV 89154-4030
(¹corresponding author e-mail: cloudville@iwon.com)

Abstract

This paper discusses a study testing the potential of a system dynamics model to facilitate public participation in the management of the Las Vegas, NV water system. The Las Vegas water system serves one of the fastest growing metropolitan areas in the U.S., located in one of the country's most arid regions. Management challenges include communicating information about the dynamics of the interconnected urban and environmental system and enlisting public support to reach water conservation goals. In this study we developed a system dynamics model of the water system, scripted a workshop to present the model, and ran seven workshops for a total of 67 members of the Las Vegas community. Results of the workshop show that system dynamics models can provide a forum for analytic deliberation, in which scientific analyses are combined with structured discussion about values and objectives. Analysis of participant survey responses and facilitator observations shows the model improved group communication, technical knowledge and system insight, and promoted consensus among the participants. This paper presents the Las Vegas, Nevada water system case study, describes the workshop structure and content, and discusses findings from the research workshops.

Introduction

- Why is Public Participation in Resource Management Important?

An increasing number of citizens, resource managers, and policymakers have begun to recognize a need for a decision-making process that allows for genuine public dialogue about the issues and restores public confidence in the decision making process.

Researchers (Johnson 1993; Hale 1993) have found that, when given the opportunity to learn and evaluate resource problems and potential solutions, the public can contribute in a positive way to the deliberation process.

These contributions help decision makers to develop decisions that are more widely acceptable and less open to challenge, easier to implement, and more sustainable.

Obstacles to Public Involvement

- Lack of an Effectively Structured Forum
- Lack of Trust in the Process

Often, requests for public involvement in resource decisions are met with a sense of unease and distrust by both decision makers and citizens (Arnstein 1969; Hale 1993; Gott 1995).

Gregory (2000:35-36) says that in order to move beyond simple invitations to participate to meaningful involvement of all stakeholders in decision-making, a more structured forum for deliberation is needed. There needs to be a better forum, in which participants judge the process as fair and the decisions wise (Apostolakis and Pickett 1996).

In particular, there needs to be better communication of technical information, a mechanism for building a common understanding of how the system in question works, and a process which promotes learning and builds public trust through meaningful public involvement.

System Dynamics in Public Participation Forums

- System Dynamics Provides a Structured Forum for Discussion

System Dynamics modeling aids the deliberation process by helping to organize and unify information. Built in steps of increasing complexity, the models replicate the observed behavior of the system and help decision makers better understand the problem, the variables and relationships within the problem system, and the potential outcomes of intervention (Forrester 1995; Ford 1999; Sterman 2000).

Central to system dynamics models is the elicitation and incorporation of stakeholders' values. Preferences, and assumptions about the system. By integrating decisions with actions and results model simulation provide the key mechanism for determining the consequences of a given policy option. Model simulations give participants the opportunity to see their own ideas in action and the consequences. This provides stakeholders a sense of ownership of the decisions and improves their trust in the process. In these ways, system dynamics can be used to promote meaningful participation.

System Dynamics models can 1) promote greater awareness and understanding of a resource problem; 2) improve communication and the exchange of information between stakeholders; and 3) help determine the consequences of decisions.

Problem Statement

As noted in Stave 2000 (Part I) as water demand in Las Vegas Valley approaches supply, conservation becomes increasingly important. The Southern Nevada Water Authority has set a target of 25% reduction in Valley water use by 2010. To achieve this reduction, water managers are counting on individual behavior to change dramatically. So a key step in achieving their goal is to raise awareness and increase public support of the conservation policy. Could a system dynamics-based public forum help achieve the goals of improved public awareness and support?

Study Approach

This study tested the use of a system dynamics-based workshop for improving public understanding of, and participation in, the Las Vegas Valley conservation program to achieve their target goal.

Study hypotheses were developed from earlier studies on using modeling for stakeholder involvement (Akkermans and Vennix 1996; Costanza and Ruth 1996; Vennix 1996; Vennix and Rouwette 2000; Sterman 2000).

Hypotheses

System Dynamics-Based Workshops:

- H1 - Increase participant awareness of the problem
- H2 - Help facilitate the exchange of data and technical information among participants
- H3 - Enhances shared understanding among participants
- H4 - Lead to improved participant insight
- H5.1 - Provide a common language for participant discussions
- H5.2 - Promote discussions
- H5.3 - Promote participant comfort with communicating their ideas to each other during the deliberation process
- H6 - Improve participant perceived legitimacy of the decision- making process

Methods:

Research Workshops

We held research workshops between October 25, 2000 and December 14, 2000 with a total of 67 participants. Each workshop was 2-3 hours long. Participants were introduced to the water conservation issue and openly discussed the water management problem and the assumptions underlying it. Facilitators drew policy options from participant discussions. The options were tested using the system dynamics model described in Part I (Stave).

Workshop Structure

Each workshop used a scripted structure that had the following four components:

- Information and communication of problem definition [15 min.]
Here we described the expected trends in water supply and demand as shown in reference mode of part I (Stave)
- Eliciting participant ideas and opinions [45 min.]
We facilitated participant brainstorming about how to extend the point at which demand is likely to exceed supply
- System and model introduction [20 min.]
We introduced participants to the water system, moving from a basin diagram (Fig 2, Part I), to a schematic diagram (Fig 3, Part I) to the model structure (Fig 6, Part I)
- Model simulation and discussion [45 min.]
Based on the results of the initial policy tests participants developed further policies for testing.

Workshop Participants

Figures 1 and 2 describe the ages and professions of the 67 workshop participants. Participants represented a broad demographic sampling of Las Vegas water system stakeholders. There was a wide range of ages, interests, education, experience, income, and residence time among participants.

Workshop Evaluation

To evaluate the effectiveness of the use of the system dynamics model in the workshops, we analyzed participant responses to pre- and post workshop surveys. The questionnaires contained a number of items designed to evaluate each of the hypotheses. An example of a question on common language (Hypotheses 5) is “The model helped participants communicate their ideas to each other.” Participants responded on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). In addition to questions on the hypotheses, participants were asked to rate, and comment on, the overall usefulness, efficiency, and success of the workshop and the modeling approach.

Research Results

Survey results most supported the following hypotheses:

- H1 - Increase participant awareness of the problem
- H3 - Enhances shared understanding among participants
- H5.2 - Promote discussions
- H5.3 - Promote participant comfort with communicating their ideas to each other during the deliberation process

Overall, awareness of the water problem was increased among participants. Several participants noted on the questionnaire that they had gained knowledge about the Las Vegas water system. One respondent from workshop 5 noted: “I [didn’t] know much about water in Las Vegas and now I do!”.

Survey responses also indicated an agreement among participants that the workshop(s) and model were useful for improving shared understanding of each others views and opinions. Several participants noted that hearing others’ opinions and points of view was interesting and useful. A participant from workshop 2 wrote: “I liked how all present had the opportunity to share [and see the outcomes] of their ideas.”

Communication among participants was candid and the forum of discussions was praised by several participants. Comments, in response to the open-ended questions, were often in the form of “...the forum encouraged [group] discussion,” to “[I liked best] the round table [style] of discussions”.

Overall, the workshop was found good for increasing awareness and enhanced communication and shared understanding among the participants.

Other hypotheses were not as strongly supported by the survey instrument:

- H2 - Help facilitate the exchange of data and technical information among participants
- H4 - Lead to improved participant insight
- H6 - Improve participant perceived legitimacy of the decision- making process

Upon reflection, survey items for these hypotheses were not effectively designed to specifically address these issues. However, these hypotheses were supported by facilitator observation and participant comments on open-ended questions in the questionnaire. We noted that technical information was much easier to relay with the model diagram and simulations. The simulations provided a great amount of insight for the participants. This was observed in the way participants would redevelop policy options in response simulation outcomes. Many participants noted that they liked “seeing” their input “put into action”. The experience generally left them feeling that they had actually participated in the process and that the outcomes were a result of their knowledge and ideas. Overall, the experience was positive for most participants and many expressed a desire to see the system dynamics-based approach used for other types of resource management decisions.

Additionally, 41 of the 67 participants indicated that they had prior (other) public participation experience. Table 9 summarizes participants comparison of the system dynamics-based approach with other experiences. These respondents ranked the system dynamics-based workshop as better than other types of workshops for helping to understand the issue, promoting better communication and shared understanding, and providing greater insight into the water problem.

Tables 1 - 9 summarize representative participant responses to selected survey items used to evaluate the hypotheses. The complete analysis used 5-8 items for each hypotheses.

H1 - System dynamics-based workshops increase participants awareness of the problem

Table 1 Participant response to survey items which measured changes in participant awareness of the water management problem

Survey Question	n	strongly agree/ agree	strongly disagree/ disagree
I know more about Las Vegas water issues than I did before this workshop	66	92%	5%
I think the model was useful for improving participant understanding about Las Vegas water issues	67	97%	0

H2 - System dynamics-based workshops help facilitate the exchange of data and technical information among participant

Table 2 Participant response to survey items which measured the use of the model for helping with the exchange of technical information among participants

Survey Questions	n	strongly agree/ agree	strongly disagree/ disagree
The workshop helped me better understand how the Las Vegas water system works	51	90%	4%
Using the model is a fast and easy way to learn about water management issues	66	92%	0

H3 - System dynamics-based workshops enhance shared understanding among participants

Table 3 Participant response to survey items which measured the use of the model for enhancing shared understanding among participants

Survey Question	n	strongly agree/ agree	strongly disagree/ disagree
The workshop helped me understand the opinions and ideas of other participants	66	94%	1%
The model simulations helped me understand the opinions and ideas of other participants	67	88%	2%

H4 - System dynamics-based workshops lead to participant insight

Table 4 Participant response to survey items which measured the use of the model for improving participant insight

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
The workshop helped me see potential solutions to Las Vegas water problems that I hadn't considered before	66	82%	7%
The model simulations helped me evaluate the merits of different ideas	51	92%	7%

H5.1 - System dynamics-based workshops provide a common language for participant discussions

Table 5 Participant response to survey items which measured the use of the model for providing a common language for discussions

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
I referred to the model in discussing the pros and cons of possible solutions	65	72%	5%
The model helped me communicate my ideas to others	67	76%	2%

H5.2 - System dynamics-based workshops promote discussions

Table 6 Participant response to survey items which measured the use of the model for promoting discussions

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
I think this workshop was useful for improving discussion among participants about Las Vegas water management issues	66	97%	1.5%

H5.3 - System dynamics-based workshops promote participant comfort with communicating their ideas to each other during the deliberation process

Table 7 Participant response to survey items which measured the use of the model for promoting participant comfort with communicating their ideas to each other

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
The model helped participants communicate their ideas to each other	67	91%	2%

H6 - System dynamics-based workshops improve participants' perceived legitimacy of the decision making process

Table 8 Participant response to survey items which measured the use of the model for improving participants' perceived legitimacy of the process

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
The model simulations included my ideas	53	85%	2%
This kind of workshop is a good way to get more people to care about water issues	52	85%	4%
I would be interested in participating in other workshops like this one	67	73%	6%

System Dynamics-Based Workshop Compared With Other Workshops

Forty-one respondents indicated they had attended other types of workshops before. Of those respondents we asked them to compare the system dynamics-based workshop experience with other experiences. Table 9 summarizes those responses.

Table 9 Summary of responses comparing system dynamics-based workshops with other types of workshops

Survey Question	n	strongly agree/ agree	strongly disagree/disagree
Compared with similar discussions you have participated in, would you say this workshop...			
helped you understand the issues more quickly than other workshops?	41	66%	4%
resulted in better communication among participants?	41	78%	2%
developed shared understanding of the issues among the participants better than other workshops?	41	86%	2%
gave you more insight into the issues being discussed than other workshops?	41	78%	7%

Discussion

Participants in this study felt that the use of a system dynamics model in this kind of facilitated public workshop was an efficient way for raising their awareness and increasing their understanding of the Las Vegas water system problem. They felt the quality of communication and shared understanding, exchange of technical information, awareness, insight, and legitimacy was high using this system dynamics-based approach.

Participants reported that they felt they had actually participated in the process and that the outcomes were a result of their knowledge and ideas. Overall, the experience was positive for most participants and many expressed a desire to see the system dynamics-based approach used for other types of resource management decisions. Seventy-three percent of survey respondents agreed that they would be interested in participating in other workshops like these.

Remaining Questions

The positive results of this study raise questions about how to extend the benefits of the system dynamics-based approach to a broader audience. Facilitated workshops like the ones in this study are limited. The size of the audience is limited by the format. The workshops take time and are labor intensive.

The question remains: How can we translate the benefits from this study to a larger scale? How do we reach people in an un-facilitated forum? The next step would be to provide users with an interactive forum that supports systemic learning and understanding about the Las Vegas water system and the consequences of potential management decisions when applied to the system.

References

- Akkermans, H.A. and J.A.M. Vennix. 1997. Clients' opinions on group model-building: an exploratory study. *System Dynamics Review* 13(1):3-31.
- Apostolakis, G.E. and S.E. Pickett. 1998. Deliberation: Integrating Analytical Results into Environmental Decisions Involving Multiple Stakeholders. *Risk Analysis* 18(5):621-634.
- Arnstein, S. R. 1969. A Ladder of Citizen Participation. *American Institute of Planners Journal*. July:216-224.
- Costanza, R. and M. Ruth. 1998. Using Dynamic Modeling to Scope Environmental Problems and Build Consensus. *Environmental Management* 22(2):183-195.
- Ford, A. 1999. *Modeling the Environment*. Washington, D.C.: Island Press, 401 pp.
- Forrester, J. W. 1995. *Counterintuitive Behavior of Social Systems*. Portland, OR: Productivity Press.
- Gott, N.C. 1995. *Environmental justice and participatory democracy: an emancipatory policy proposal*. Las Vegas, NV: University of Nevada.
- Gregory, R. 2000. Using Stakeholder Values to Make Smarter Environmental Decisions. *Environment* 42(5):34-44.
- Hale, E.O. 1993. Successful Public Involvement. *Journal of Environmental Health* January/February:17-19.
- Johnson P. 1993. How I Turned a Critical Public into Useful Consultants. *Harvard Business Review* January-February:56-66.
- Sternan, J. 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. McGraw-Hill.
- Vennix, J.A.M. 1996. *Group Model Building: Facilitating Team Learning Using System Dynamics*. Chichester: J. Wiley & Sons. 297 pages.
- Vennix, J.A.M. and E. Rouwette. 2000. Group Model Building: What Does The Client Think About It Now? *Proceedings of the 18th International System Dynamics Conference 2000*.