Scripts for Interrupted Group Model Building: Lessons from Modeling the Emergence of Governance Structures for Information Integration Across Government Agencies [1]

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Abstract

The system dynamics group at Albany has been developing approaches to decision conferencing using a combination of group facilitation techniques linked to projected computer models in the room for more than 20 years. Over the years, the group has developed a series of pieces of small group processes to build system dynamics models with groups, i.e. scripts. The Group Model Building (GMB) process reported here has several characteristics that make it different from most other experiences in the group. While the common setting involves managers interested in tackling a specific problem, this work involves a research team interested in building theory about the complexity of intergovernmental information integration. Additionally, the reported GMB process took place in small sessions of two to three hours, while the common practice at

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Albany involves intensive one or two-day meetings. In this way, the paper will include general thoughts about the implications of these differences for the GMB process.

Key Words
Group Model Building, System Dynamics Modeling, Theory Building, Information Integration.

Introduction

Methods for Group Model Building (GMB) have been developed at the University at Albany to enable the integration of decision conferencing and system dynamics practices (Reagan-Cirincione *et al.*, 1991; Richardson and Andersen, 1995; Andersen and Richardson, 1997; Rohrbaugh, 2000; Zagonel, 2002). These methods employ decision conferences as a particular kind of group decision support activity in which groups create and refine system dynamics models. Instead of the computer-mediated collaboration typical of group decision support systems, however, these GMB methods employ face-to-face meetings in which "verbal and nonverbal communication takes a completely connected, 'each to all' pattern enhanced by the presence of a group facilitator" (Schuman and Rohrbaugh, 1991, p.148). These meetings use a combination of group facilitation techniques linked to projected computer models in the room to support the model development. (Mumpower *et al.*, 1988; Schuman and Rohrbaugh, 1991; Rohrbaugh, 1992). These methods and the related GMB research at Albany builds on the larger body of literature in GMB (Vennix, 1996; Rouwette *et al.*, 2000).

The particular GMB methods reported here were used to support theory building rather than managerial decision making. The purpose was not to guide a strategy or policy development but to create a dynamic theory of a complex interorganizational process: the social processes inside an interagency team with the task of creating a "framework" for Justice Integration in New York State. This interagency team, made up of government professionals, had the task of creating a governance framework to guide integration technology development. They worked with a research team that facilitated and studied the creative process. In a typical problem solving setting the group involved in the GMB sessions would be the interagency team, tackling a specific problem related to policy or strategy decisions. In this work, by contrast, the group consisted of the research team seeking to build a dynamic social science theory about the complexity of intergovernmental information integration. As described below, the research team was working as part of a larger theory-building project supported by the National Science Foundation (NSF). A significant amount of qualitative field research preceded the group modeling process and empirical research involving both focus groups and a survey followed the group modeling exercise.

Over the years, the Albany group has developed a series of scripts, i.e. "fairly sophisticated pieces of small group processes" (Andersen and Richardson, 1997, p. 107). This paper documents the scripts and products for the GMB effort using the approaches developed at Albany from November 2003 to May 2004. The theory building GMB process took place in small sessions of two to three hours, separated by one or more months. The previous common practice at Albany employed intensive one or two-day meetings. The paper describes the new GMB process in more detail and discusses the implications of these method differences for the GMB process in general.

The modeling group consists of the System Dynamics Group at Albany, and the action research team at the Center for Technology in Government[2] (CTG) who worked with representatives of the Criminal Justice Information Technology (CJIT) group of New York State (NYS). Their goal was to develop a governance framework as part of an initiative to create a "one-stop shopping" capability for users of criminal justice information. The actual model developed from these GMB sessions is described elsewhere in these proceedings (Luna-Reyes *et al.*, 2004).

Project Background: A NSF Funded Research Project

The GMB process was conducted as one of the several modeling approaches used in a basic research project funded by NSF and focusing on increasing the understanding of interorganizational information integration. See Figure 1 for project timeline and flow of research activities. The project aimed to develop and test models of information integration in multi-organizational government settings. Integrating and sharing information in these settings involves complex interactions among social and technological processes. Organizations must establish and maintain collaborative relationships in which knowledge sharing is critical to resolving issues of data definitions and meaning. The interagency team involved in the system design and development faced problems of multiple platforms, diverse database designs and data structures, highly variable data quality, and incompatible network infrastructure. These integration processes often involve new work processes and significant organizational change. Moreover, designing and implementing cross-agency information integration is a lengthy process, involving learning and evolving interorganizational relationships. Thus the processes appeared to involve important feedback effects, making it an appropriate focus for dynamic modeling.

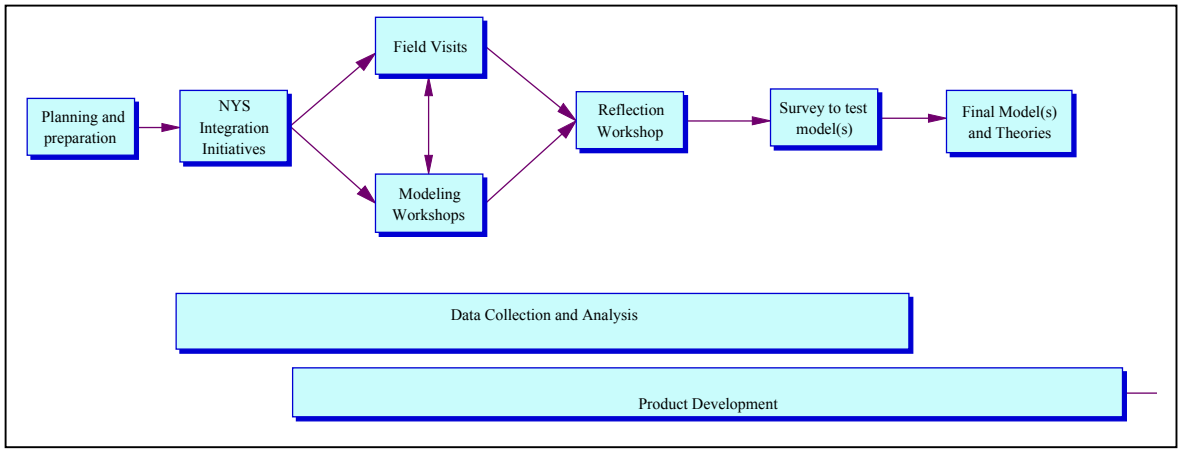

Figure 1. NSF funded project timeline

The goal of this group model building was an empirically grounded theory of the social and technical processes observed in the work of the interagency team. The plan was to develop

[2] The Center for Technology in Government at the University at Albany develops applied research and partnership projects to foster innovative ways to improve government services through the understanding of the management, policy, and technology dimensions of information use in the public sector (http://www.ctg.albany.edu).

that theory using the tools of system dynamics to represent the processes of interest, forming the basis for substantive theory. Therefore the group engaged in the model building had to bring together knowledge of what would constitute relevant theory with understanding of modeling and sufficient data about the process to be modeled. The data about the processes to be modeled was available in the notes, recording, and memories of the research team. Both the research team and the modeling team brought knowledge about relevant theory to the modeling. It was decided not to include members of the interagency team in the initial modeling sessions, since they were not equipped with relevant theory or modeling knowledge to participate. They would instead be asked to review and comment on the modeling work at later stages.

The NYS criminal justice information integration case provided the CTG researchers with an excellent opportunity to study how IT and social factors interact to influence the effectiveness of interorganizational information integration. Prior to their work with the CJIT group, the CTG researchers hypothesized that there was a structure to the social and technical processes of interaction for information integration. Drawing on preliminary research data from the team's work the CJIT group, the CTG researchers' approached the GMB effort with an interest in exploring this hypothesis further. Moreover, from the team's action research with the CJIT group, the CTG researchers had observed group interaction that was comprised of a set of social processes that formed and reformed technical artifacts. The research team further hypothesized that the effectiveness of interorganizational information integration hinged on the interaction of this set of social processes with the technical artifacts produced. Consequently, the CTG researchers and the modeling team agreed that a GMB effort involving the CTG research team focused on modeling these interactions was the appropriate approach.

Case Background: Integrated Criminal Justice Information for New York State

In April 2003, the Criminal Justice Information Technology (CJIT) group of New York State (NYS) was tasked with developing a framework to fulfill the goal of giving users of criminal justice data and information systems "one-stop shopping" access to the information needed to accomplish their mission.

Collaborating with the Center for Technology in Government for an 8-month period, the group specified the business problem, its context, and identified feasible solutions and alternatives. The vision for this project was for the "cop on the street" to be provided with quick, consolidated responses to support life-and-death decisions. Delays in retrieving data from multiple organizations cannot be tolerated. Systems must focus on ease of use, simplicity of administration, and functional relevancy to law enforcement personnel, correction officers, judges, and other justice system participants. Integrated systems must be central to the work and processes of the front line workers and not viewed as add-on, superfluous activities that require additional time and effort. In addition, these systems must also provide decision makers with access to summary, trend, geographic, and other strategic and tactical information that can be derived from operational information in near real-time.

The formation of an Integrated Justice Advisory Board was seen as a critical first step in the establishment of the governance process necessary to achieve the goals of NYS Integrated Justice. In particular the team focused on the development of recommendations for a statewide

integrated justice governance body. The recommendations were submitted to the NYS Director of Criminal Justice in December 2003 with the first meeting of the recommended Criminal Justice CIO Council occurring in January 2004. The development of the governance framework is a "first of its kind" cross-agency decision process in support of a new initiative of the governor and the director of criminal justice. This work is critical to research as it provides foundational "street-level" knowledge of integration processes to inform the model development. Data collection for this action research effort includes transcripts and observations notes from over 120 meetings, workshops, debriefs, and interviews.

Scripts for Interrupted Group Model Building

The group modeling effort spanned a six-month period and consisted of five separate meetings held at the University at Albany's Center for Technology in Government (CTG). This paper includes a description of each of the five GMB sessions.[3]

Group Model Building Sessions		
1	November 26, 2003	Problem boundary and reference mode elicitation
2	December 10, 2003	Story-telling, reference mode clustering
3	March 2, 2004	Towards a dynamic hypothesis
4	May 4, 2004	Fishbowl with preliminary model
5	May 21, 2004	Revisiting model and exploring scenarios

The first three GMB sessions focused on developing reference modes from which the team began the model building and creation of a dynamic hypothesis. During the third meeting the modelers presented a series of dynamic models reflecting what they had heard over the previous four months as well as a first look at a dynamic hypothesis. The team spent the final meetings of the process experimenting with two versions of a "collaboration model" in order to elicit feedback for refinement. The fifth, and final meeting, concluded with a final draft that modeled the interactions between social and technical artifacts in this information integration project. Results of the theory construction process were shared with a panel of information professionals who were involved in system development at all six of the research sites. In addition, based on feedback at that meeting and on qualitative insights drawn from the larger project, CTG is presently engaged in a wide-scale survey effort to test and validate some of the theories proposed in the modeling projects.

Problem boundary and reference mode elicitation

One of the goals of the first meeting was to more fully familiarize the CTG research team with system dynamics modeling. After this the research team members were able to be more fully engaged in the model building process by using system thinking to provide modelers with information for model development. The first meeting also helped to probe the boundary of the

[3] See supplemental file for detailed agendas, meeting minutes, presentations, and group exercise products from all five GMB sessions.

model and to realize the expectations and desired outcomes of the CTG research team by using the system dynamics model building approach.

In the beginning of the first meeting, the modelers reviewed the core concepts of system dynamics, stocks and flows, with the CTG research team using a Concept Model as described in Andersen and Richardson (1997). The first group exercise was designed to have the research team work in pairs to identify Reference Modes of influential and significant variables. The exercise also included a short story telling section, which allowed each individual story to be verified or modified by the entire CTG research team. The story-telling section also helped the modelers to obtain a more comprehensive picture of the project and to gain important information about the overall system boundary. Figure 2 illustrates one Reference Mode example created during the first meeting.

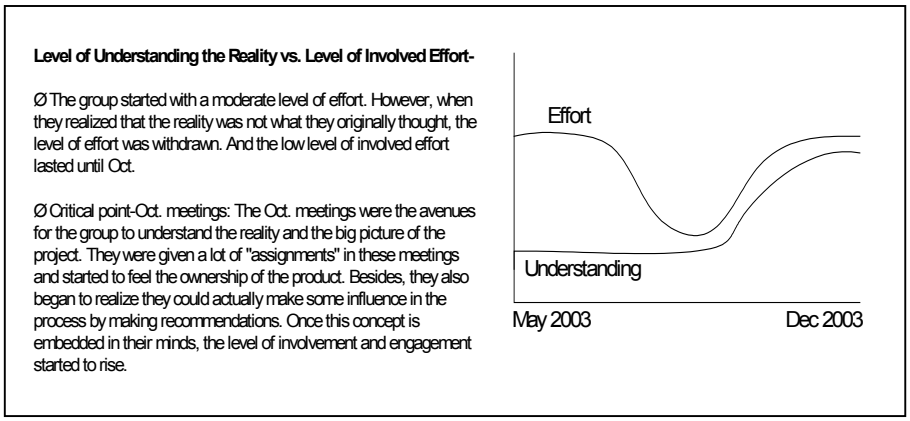

Figure 2. Example of results from the reference modes exercise

The dialogue between modelers and the CTG research team in the first meeting were extremely valuable in terms of identifying and eliciting some key variables in the research. This also leaded to an effective first attempt of building a dynamic hypothesis.

Story-telling, reference mode clustering

The second meeting was designed to pursue a dynamic hypothesis to work toward the entire model development. This was a process of lining up all the significant variables to address the overall picture of the project.

The second meeting grouped the CTG researchers into three teams and gave each team all the stories and graphs produced in the first meeting. In this assignment, modelers asked the teams to cluster the variables into different groups by naming them with core concepts (such as social factors, technical factors, intra-organizational, inter-organizational). Each team presented the story by illustrating the interactions among grouped variables. Figure 3 illustrates one team working during the clustering exercise.

Figure 3. Clustering exercise

The assignment helped the researchers and modelers to review the process of the information integration project, and to identify the challenges and obstacles to it. The assignment introduced the physics of the system (such as workload accumulation) and the perceptions of the system (such as work pressure). In addition, the second meeting moved the overall group toward a more comprehensive dynamic hypothesis and allowed modelers to identify specific critical stocks and flows in the model development.

Towards a dynamic hypothesis

In the third meeting, the modelers moved forward the conclusions of the three teams from the second meeting by specifying some of the casual structures that might generate the reference mode behavior within a dynamic model. Prior to the third meeting the modeling team had met and proposed a stock-and-flow image consisting of an aging chain of three technical artifacts surrounding by four social accumulations, two of which involved individual understanding and commitment to the project and two of which represented group understanding and engagement. The group spent considerable time understanding and agreeing upon this backbone structure.

The reflections and interactions between modelers and CTG research team in the third meeting allowed the modelers to modify the first draft hypothesis and models in the preparation of the actual running simulating model for the next meeting. Figure 4 illustrates one of the dynamic models proposed by the modeling team.

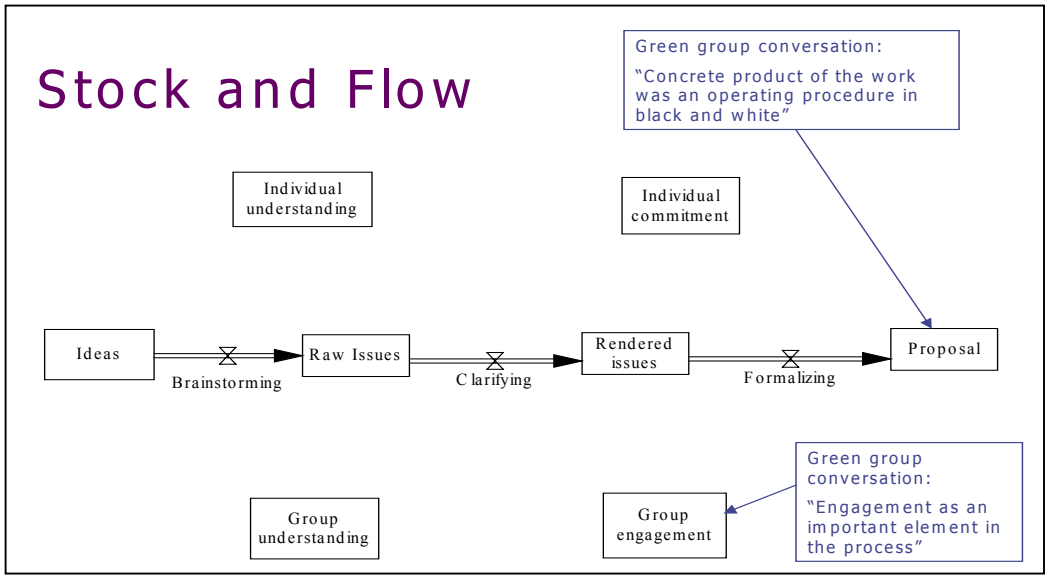

Figure 4. Dynamic model example

Fishbowl with preliminary model

The purpose of the fourth meeting was to reflect and comment on the meetings that had been conducted to date through a fishbowl exercise[4], and then to present the running model to the group for questions and suggestions.

The meeting raised a number of issues related to concept clarification and terminology usage between modelers and CTG research team. The first running model was also employed to show the behaviors of the model and to confirm whether the behaviors seemed logical according to the researchers' experience on working with the information integration project. If the simulating behaviors were shown differently from research team members' past experiences, the modelers would explain the feedback loops in the model, and then confirmed and comprehended the logic with the research team.

The fourth meeting granted the modelers the opportunity to check the first running model and brought the thread of exploring possible contingency implications in the information integration project.

Revisiting model and exploring scenarios

The fifth meeting was held to revisit the system dynamics model which had been modified after the first running model check in the fourth meeting and to test more contingency scenarios to better understand project and model behaviors.

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[4] During a fishbowl exercise, the modeling team sits in front of the group and talk about alternative ways to conduct the meeting, choosing one of those alternatives.

Modelers picked several core variables in the project and laid out a scenario matrix in order to test different applications and discover the leverage/tipping point of each variable. Through this exercise, the project and model behaviors were realized in a system thinking approach that helped the CTG research team to obtain another comprehensive picture for research and to acknowledge the feedback effects in the project. Figure 5 illustrates one of the experiments shared with the GMB team.

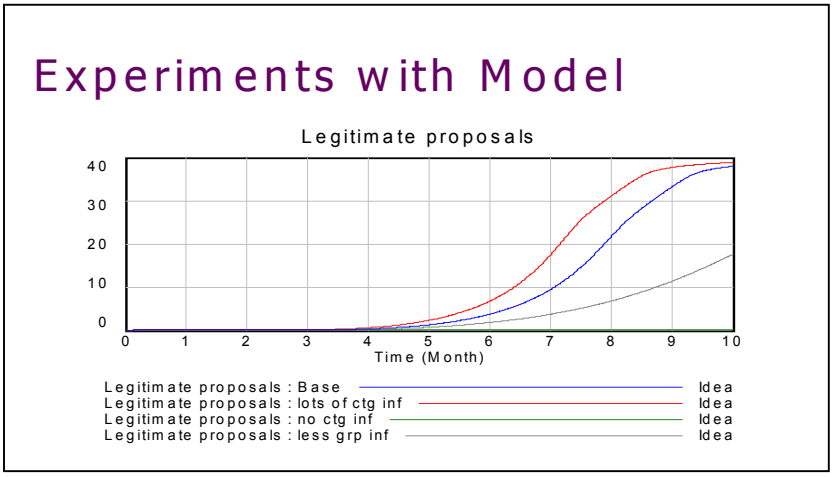

Figure 5. Model Exercise Example

In other words, as long as the variable leverage points were recognized, it is easier for the research team to locate the critical parameters and to understand the problem of information integration.

Discussion

Using System dynamics as one of the theory-building methodologies delivered a number of benefits in the project. First, the group had an opportunity to observe and express the project-related issues through a dynamic analytical lens, capturing the story at a different level of analysis. Prior to the GMB sessions, the CTG team had developed a set of propositions from their preliminary research data. These propositions formed a foundation from which the CTG team and the modelers were able to explore the interaction of social processes and technical artifacts through a systems thinking approach. The graphical representations of the model proved useful to facilitate conversation and promote new insights into the already rich thinking of the CTG team.

Having a period of time between sessions also proved to be useful for theory-making purposes. It provided a unique opportunity for the CTG research team to reflect on the model building effort after each phase of the process. It allowed the researchers the time to review the large amount of data collected from the case after each GMB session in order to help them and the modelers continue building and refining dynamic models that most accurately captured, in terms of systems, thinking the team's experiences and observations.

Formulating the diagrammed theory in mathematical terms also brought some advantages. The mathematical formulation of every relationship and feedback process eliminates

any ambiguity associated with them, facilitating conversations about their nature, and the appropriateness of each of them. During one of the sessions, a member of the group commented "apparently all depends on the math in this model", and effectively that is true. The group needs then to decide if the math represents appropriately the observed phenomenon or if it needs to be reformulated in a way more consistent to their observations.

Conclusion

Although the GMB approach proved to be effective to facilitate conversation and generation of insight in the theory-building process by providing a graphical and mathematical language to promote critical reflection, system dynamicists need to reflect about the appropriateness of our current validation techniques to the theory –building process. That is to say, our current validation techniques are oriented to build confidence in a model to be used by a particular group to make decisions about either policy or strategy. However, the generalizability of the theory embedded in the model is not a concern of the group of managers involved in its development and use. Using the same tool to build general theories may need additional tests and process "safeguards." In this way we need to revisit the tests to build confidence in system dynamics models to assess its suitability to "build confidence" in the generalizability of a model (Forrester and Senge, 1980; Barlas, 1996). Work of social scientists developing theory through the use of qualitative techniques and case studies has the potential to contribute to this reflection process as well (Lee, 1989; Walsham, 1995; Strauss and Corbin, 1998; Eisenhardt, 2002; Lee and Baskerville, 2003).

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