

■ Research Paper

Group Model-Building ‘Scripts’ as a Collaborative Planning Tool

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Group model building (GMB) is a participatory method for involving stakeholders in the process of developing system dynamics models. GMB has historically consisted of undocumented structured small-group exercises. This paper describes an effort to document GMB scripts called Scriptapedia, and how documented GMB scripts can be used to design more effective GMB sessions that address cultural and ideological barriers to collaboration. A case study of a project to develop a coordinated community response to domestic violence is used to illustrate the use of scripts for planning collaboration. The paper concludes with a discussion of potential limitations of scripts and implications for future research. Copyright © 2012 John Wiley & Sons, Ltd.

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INTRODUCTION

Developing effective collaborations often entails identifying and aligning the incentives specific to a given problem (Barrett, 2007). This can be especially challenging in dynamically complex systems where the incentives evolve over time. People typically invoke a set of mental models (e.g. Johnson-Laird, 1983; Doyle and Ford, 1998) to solve problems that consistently underestimate the effects of delays, accumulations, nonlinear

relationships and the interaction of feedback mechanisms (Dörner, 1997; Sterman, 2000). Formal models¹ help stakeholders improve their mental models by seeing and simulating the behavior of a system better. This allows stakeholders to develop collaborations by gaining system insights into a problem through the development and analysis of a common model.²

There are a variety of approaches for developing and simulating formal models of complex systems (for an overview, see Pidd, 1998; Gilbert and

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¹ Examples of formal models that allow stakeholders to see and simulate a system include discrete event simulation models, agent-based models and system dynamics models.

² A model is ‘common’ in the sense that it is objectively and independently *available* to all stakeholders. This does not imply that all stakeholders endorse a common model.

Troitzsch, 2005). However, concerns are sometimes raised about the use of formal models when seeking to develop effective collaborations including the lack of transparency and inability to evaluate the underlying assumptions behind a model, questions about appropriate conceptualization of the problem and system boundary and the difficulty of actually implementing the results from a formal model analysis when collaboration is required to implement the solutions. One approach to addressing these is to involve stakeholders in the process of developing and analysing the formal model using group model building (GMB).³

Over the past 15 years, since the development of icon-oriented software such as *i-Think*, *Vensim* and *Powersim*, GMB has emerged as one of several ways to construct policy-oriented system dynamics models working directly with client groups. We think of GMB as a form of group decision support that involves a group of stakeholders working with a modelling team to solve a focused problem within a complex system. The classic components of GMB include key aspects of the model-building and refinement process in public view of the client group, developing and testing scenarios and strategic options with the client group and facilitated discussion and analysis of results emanating from the system dynamics model. These group processes make extensive use of facilitation discussions and analysis with a diversified team of group facilitators and modelers typically present in the room.

Attempts to carefully define how to work with groups as part of the model-building process have been a key component of the overall GMB effort for a long time. Stenberg (1980) described approaches for working with policy reference groups before GMB came to be defined as a formal activity, and Roberts (1977) stressed the importance of interactions with client teams as a means to achieving effective implementation of model results. Richmond (1997) has described a strategic forum as a kind of small group whose purpose is to define and analyse a dynamic and complex problem around a formal system dynamics modelling effort. Vennix (1996) presented a

classic statement of the GMB method for system dynamics models. Soon thereafter, a special issue of the *System Dynamics Review* edited by Vennix *et al.* (1997) gave an overview of the then state-of-the-art of GMB. Eden and Ackermann (1998) have described formal procedures for using software tools such as Decision Explorer and Group Explorer to structure group processes around formal model-building activities, and Howick *et al.* (2006) have documented procedures for formally integrating strategic scenarios into system dynamics models while working in formal GMB sessions with client groups. More recently, Andersen *et al.* (2007) presented a more comprehensive review of current research in GMB using system dynamics.

A number of consistent themes have characterized recent work on GMB including the importance of teamwork (Richardson and Andersen, 1995), the identification of pre-defined sets of behavior in facilitating GMB sessions or 'scripts' (Andersen and Richardson, 1997), the sequencing of scripts in the design of GMB interventions (Ackermann *et al.*, 2010), evaluation of GMB effectiveness (Rouwette *et al.*, 2006) and the use of 'process maps' as visual tools for designing collaborations (Straus, 2002).

Scripts have historically remained undocumented and primarily transmitted verbally or through direct observation of group activities. Although the potential benefits of documenting GMB scripts has been recognized (Andersen and Richardson, 1997), no systematic framework existed prior to this work for recording scripts. Documentation of scripts increases transparency, replication and the transmission of effective practice. More important for this paper, documenting scripts helps the design of GMB sessions with diverse and frequently marginalized stakeholders and can thereby be an important tool for effective collaborative planning.

In particular, scripts allow community members and other stakeholders participating in the *design of GMB sessions* to visualize, adapt, tailor and create small-group exercises to address a variety of cultural and political barriers that undermine collaborations. The result of a better design using scripts is in having more effective GMB sessions that can handle a wider range of complex group

³ In this paper, we focus on the use of GMB to develop system dynamics models.

dynamics. Ultimately, we argue that this can lead to better models, analyses, 'buy in' and implementation of solutions.

This paper does the following: (1) describes a framework for documenting scripts, which we have organized as an online commons called *Scriptapedia* and (2) illustrates how scripts can be used as a collaborative planning tool to design and execute GMB sessions. A recurring theme throughout this paper is that as formal models are a tool for helping people visualize and solve problems in the design of complex systems, scripts are a tool for helping facilitation teams visualize and solve problems in the design of GMB sessions. GMB sessions are after all dynamically complex systems, and understanding how to address the conflicts that arise within a GMB session can provide an important bridge to understanding how to address the conflicts that arise in the larger system.

BACKGROUND

Group model building has gained increased attention over the last several years. GMB is a part of a family of participatory systems modelling approaches and has variously been seen as a form of grounded theory, action research, implementation strategy, decision support and strategic planning. GMB holds significant promise for working with marginalized communities where the problem focus often has a greater emphasis on conflict, collaboration and empowerment combined with the system dynamics of incentives changing over time. Over the years, a number of important themes have emerged concerning how to design and conduct GMB sessions.

Teamwork in Group Model Building

Richardson and Andersen (1995) first defined their approach to using teams to support GMB. That early work concentrated on more clearly defining the various roles that must interact to create a smoothly functioning group modelling

team. Five distinct roles (not necessarily connected to five distinct persons in the room) include the following: (1) the facilitator/elicitor who leads the group discussion and keeps a constant eye on the group process in the room; (2) the modeller/reflector, the person or team in the room constantly paying attention to how the formal model is emerging from the group discussion, often providing critical model-based comments and insights to the client group; (3) a process coach who is responsible for the creation of the overall agenda for the day and for designing changes to this agenda 'on the fly' (often the role of the process coach is mostly performed before the GMB session begins and then handled by a person in one of the other roles during the meeting); (4) the recorder who makes a real-time record of all the discussions and decisions being made by the group; and (5) the gatekeeper, a member of the client team who serves as a bridge between the modelling team and the client team, often serving as a voice and support for the meeting owner, the primary sponsor of the overall activity within the client group.

Scripts as a Basic Unit of Behavior for Designing Group Model Building Interventions

A second theme of basing GMB practice on predefined sets of scripted behavior was first described by Andersen and Richardson (1997). The basic idea motivating scripts as an organizing framework for GMB activities was a need to be organized about interactions with a client team to make the best use of group time and to assure that the overall process moved forward in an organized fashion, ultimately culminating in useful products and insights for the client team. The group agenda for the full duration of the planned meetings was to be divided into small segments of 10 or 15 min each with detailed plans for what the group would be doing within each such scripted time block. Typically, the meeting would start with open-ended, problem-finding activities such as stakeholder mapping or group articulation of their 'hopes and fears' for the overall project or the formal introduction of simulation

tools via the use of small 'concept models' (Richardson, 2006; Ghaffarzadegen *et al.*, 2011).

Subsequent scripted activities included exercises designed to draw out reference modes by drawing graphs of variables over time or various approaches to eliciting system structure from the client group. Scripts for a second or third meeting of the group would include ways to review progress made at previous meetings as well as scripts designed to facilitate the client group's experimentation with a formal simulation model to discover policy conclusions constrained within the model's structure. Zagonel *et al.* (2004; Zagonel and Rohrbaugh, 2008) provided a detailed analysis of the genesis and practice of GMB activities within this school of work, and Luna-Reyes *et al.* (2006) published a 'soup-to-nuts' description of how teamwork and scripted facilitation actually played out in a specific intervention focused on providing homeless shelters in New York State.

Although the idea of using a script as a basic behavioral unit constituting GMB interventions had strong intuitive appeal, this same idea left open a number of conceptual and practical issues, which this current work on the *Scriptapedia* is designed to help remedy. Similar efforts, such as the work by Vreede *et al.* (2006), to define 'thinklets' as a basic unit of behavior of facilitated group meetings pay more detailed attention to specific and contingent behaviors by the facilitator under different kinds of group response. Should scripts include only behaviors in public view of the group or should they also include activities undertaken by the modelling team more in private? Should scripts be thought of as best practices with prescriptive power or more as descriptions of behavior waiting to be improved upon by subsequent practice? These and other questions are gaining greater precision in this project aimed at defining an online catalogue of scripts.

'ScriptsMap' as a Tool for Sequencing Individual Scripts into a Group Model-Building Plan

Another question left open by defining scripts as a basic unit of analysis is the many relationships

between a single script and a whole intervention. Should some scripts be performed first, whereas others wait until later? Are some scripts properly seen as prerequisites for others? In general, what guidance, if any, exists for practitioners who wish to assemble a series of scripts into a whole intervention plan that makes sense. Ackermann *et al.* (2010) proposed 'Scripts Map' as a tool for addressing just these questions. As a basic definition, they proposed that 'the ScriptsMap itself is a framework for effectively combining particular sequences of scripted activities, products, and deliverables into a formal network to enable facilitators to construct appropriate combinations for workshops'. Their initial work laid out a map that combines scripts from traditional GMB practice with Eden and Ackermann's (1998) approach to strategy development working directly with client groups. Eden *et al.* (2009) further elaborated on a number of practical and more theoretical dilemmas associated with attempts to integrate group modelling projects using diverse analytic methods whereas Andersen *et al.* (2006) proposed pedagogical approaches to teaching such a blended approach to group-oriented problem solving.

Evaluation of Group Model Building

In the last decade, evaluation of GMB has progressed beyond the systematic review of case studies described by Rouwette *et al.* (2002) in several ways. Rouwette *et al.* used the separation of context, mechanism and outcome elements common to evaluation research for describing differences between case studies. The first development in the last decade has been to group cases according to different contexts: public policy (Cockerill *et al.*, 2009), enterprise resource planning implementation (Rouwette and Vennix, 2009), criminal justice (Rouwette, 2011) and environmental modelling (Beall and Ford, 2010). The second development has been to use controlled settings to assess the impact of the modelling process (Dwyer and Stave, 2008; McCardle-Keurentjes *et al.*, 2008, 2009; Hoppenbrouwers *et al.*, 2011).

Process Diagrams

Another emerging theme is an attempt to visually represent the temporal sequence of GMB sessions. For example, Zock (2004) used Luhmann's systemic theory of social systems to develop a standard intervention architecture for system-dynamics-based interventions. And, Straus (2002) used process maps as a way to design effective collaborations involving multiple stakeholder groups that has been used in the design of GMB sessions. Where process maps can help teams visualize and plan the overall sequence of GMB sessions across multiple stakeholder groups, scripts provide explicit descriptions of what is going to happen within any given session.

USING SCRIPTS TO IMPROVE PRACTICE

Modelling sessions are shaped by the interaction between a group of participants and a facilitation team. The facilitator has a crucial role in the interaction process, as he or she introduces key steps in the process to participants, provides guidance with regard to methods and techniques, summarizes intermediate results and proposes when to move on to another activity. This dependence on the facilitator is recognized in GMB as well as other forms of facilitated modelling (Franco and Montibeller, 2010). A fundamental reason for introducing scripts is the fact that much of facilitation remains an art rather than a science (Andersen *et al.*, 1997). Some practitioners go so far as to suggest that increased transparency is one of the key challenges for the field of facilitated modelling (Checkland, 2006; Eden and Ackermann, 2006; Westcombe *et al.*, 2006).

Scripts are one approach to elicit facilitator expertise and organize it into explicit and manageable chunks. These explicit descriptions can then be communicated, discussed and reused. This allows practitioners and researchers to document methods and techniques used by different facilitators and across different modelling disciplines. We feel that scripts have an advantage over existing modelling guidelines in handbooks, which rarely discuss the practical

choices a facilitator faces over the course of an intervention and in a particular session. This is problematic as the 'method in use' can be very different from the 'espoused method' featured in textbooks (Eden and Radford, 1990).

Dependence on the facilitator combined with a lack of concrete guidelines for facilitation makes life especially hard on novices that are trying to learn how to use GMB or other facilitated modelling approaches. Documenting scripts may increase the spread of GMB practice and its applicability for audiences that cannot enter into an apprenticeship with an experience modeller. Keys (2006) looked into differences between 'novice and expert users of facilitated modelling and the support needed to move from one stage to the other. A central element of such support is identifying the core tasks that experts carry out in a problem-structuring exercise and codifying these in some way. Codifying experiences in the form of scripts allows a greater spread of modelling practice and encourages its use in large-impact problems.

Scripts offer a standard approach to codifying experience, allow practitioners to compare facilitator approaches and increase our knowledge on what works best in particular circumstances. Scripts may be adapted and tailored to fit local circumstances and community contexts and even specific stakeholder groups.

Finally, being able for diverse stakeholders and those familiar with the local language and political context to engage in design of activities is an essential characteristic of using scripts to develop effective collaborations. In particular, scripts allow those involved in the planning process to understand not just the activities, but how they fit together and where the problems might arise, and negotiate design choices about how to convene a meeting that is more effective. Our experience in using the script template described here is that it facilitates greater understanding and participation in the design process by non-experts and thereby increases the diversity of people involved in the planning process.

Importantly, a significant benefit for facilitating collaboration also comes from *the process* of more effectively designing GMB sessions. For

example, by discussing and planning sessions explicitly using scripts, members of the planning team (which should include representatives or proxies from all stakeholder groups to be effective) become more exact in what should happen during the session, but also learn through this process the underlying values and criteria. This type of preparation process and investment thereby allows those in the planning process to understand where the flexibility lies during a session and defines what kinds of improvisation are permissible. It also allows potential design flaws that would exacerbate conflict and undermine collaboration to be identified and solved during the design phase and thus result in a session that is more culturally appropriate for participants. For example, culturally inappropriate language and activities can be identified and then adapted, tailored or replaced if necessary during the planning stage. Without some explicit definition of what should happen during a GMB session, it is all too easy to defer to the experts or most influential stakeholders in the room and not catch the design flaws until the actual GMB session is underway. Although strong and effective facilitation can often recover from these kinds of design flaws, the effort expended is a significant lost opportunity for building the kind of rapport and group cohesion needed to create a formal model.

This also places a significant emphasis on members of the team planning the GMB sessions recognizing the importance of the process. For example, if members representing or serving as proxies for a stakeholder group do not see their role in the review of scripts as helping the team develop appropriate scripts and understand the values and criteria that need to be recognized for the session to be successful, then it is likely that the resulting session will miss their perspective and input. Thus, failing to acknowledge the use of scripts as a tool for surfacing the values and criteria can also lead to an overly rigid GMB session that can create and reinforce conflict. It is therefore essential that all members of the planning team understand and take the use of scripts as a design tool seriously.

Learning and Reflection: Research into Modelling Effectiveness

In addition to practical advantages, explicitly capturing the modelling process in the form of scripts also offers advantages to research as well. Franco and Rouwette (2011) note that although the modelling session is central to facilitated modelling practice, as this is where the model is constructed and the benefits of directly involving participants are most evident, there is surprisingly little research on what actually happens in modelling sessions. Most research on modelling effectiveness takes the form of single-case studies, but these typically do not penetrate to the level of separate sessions. This is regrettable as small differences in the intervention process may lead to large differences in outcomes (Jarboe, 1996). Scripts offer a way to open up the 'black box' of modelling interventions, as they provide facilitators with a shared language to describe the intervention process, which is detailed enough to capture essentials. Before we can explain differences in modelling effectiveness between cases, we need to be able to adequately describe the context and process of our real-world applications (Rouwette *et al.*, 2002). In some cases, a seemingly identical modelling process can lead to different outcomes. Only by describing the process in adequate detail can we rule out that a subtle variation in the intervention caused the difference in outcomes. In doing so, we increase our knowledge on the fidelity and robustness of modelling methods and techniques. A central tenet of science is the ability to replicate results. In the case of a complicated intervention such as GMB, any increase in insight as to which elements of the process are more and less important for creating results is welcome.

SCRIPTAPEDIA

Scriptapedia originated as an idea for documenting and sharing GMB scripts based on the work of Andersen and Richardson (1997). *Scriptapedia* is an online handbook that can easily be updated

and distributed. The cornerstone of standardizing and disseminating GMB practice in *Scriptapedia* is the script template (Table 1).

Comprised of 19 separate fields, the script template creates a *method for thinking about and documenting* the nuts and bolts of GMB. The script template has gone through multiple iterations to improve clarity and functionality. The goal was to create a template that would be easy to understand and use across different cultures and levels of GMB expertise. The script template provides what we believe to be the essential elements for completely defining a script. The script then becomes the definitive reference for what should happen during a given activity and how that activity relates to other activities. Scripts can then be used to create other tools including facilitation guides, training manuals and fidelity measures. Next, we elaborate on the 19 elements of the template shown in Table 1, focusing only on fields where important distinctions generated the most discussion and need for clarification in the creation and piloting of the script template.

A script's purpose distils its main goal into a few words. Multiple scripts may have the same purpose, essentially describing different ways to accomplish or build towards the same goal. Although a script may have more than one purpose, we have found that having too many purposes is often an indication that the script needs to be further divided into separate scripts.

Although the purpose defines the main goal in a few words, the primary nature of the group task comes from research on group tasks. Group tasks fall into one of four categories—divergent, convergent, evaluative and presentation—with most tasks being either divergent or convergent in nature. Divergent activities produce an array of different ideas and interpretations whereas convergent activities guide participants through clustering and categorizing ideas and interpretations. Evaluative and presentation are used less frequently. In evaluative activities, participants rank and choose between options and ideas. Lastly, there are times when the modelling team must explain system dynamics concepts or update the group on products and deliverables; such activities fall into the presentation category. Although a script may include different types of

group tasks, it should be defined as a small-group exercise that *has only one primary group task*. A group exercise that has a significant emphasis on both convergent and divergent activities, for example, is likely to involve two separate scripts, one that describes the convergent activity and another that describes the divergent activity.

Scripts are meant to build upon each other so that the end goal of the GMB project can be attained. Thus, inputs from other scripts represent the outputs of previously executed scripts or 'offline' work by facilitators and modellers that are needed before the current script can be implemented. It should be noted that some scripts might not require any inputs, particularly if it is very early in the GMB process. Scripts that do not require inputs and can be used to initiate a project are often called starter scripts. However, all scripts produce outputs. An output may be of interest solely to the modeller or it may be something that is shared with the entire group. In addition to listing the script's outputs, this field should also include a description of how each output is relevant to the overall project and how it will be used in the future. Outputs that are of interest to the client group are called deliverables, whereas outputs that are of primary interest to the modeller are products.

Although most scripts require all participants to be in the room along with the entire facilitation team, some scripts describe activities that may only involve a smaller set of stakeholders or a subset of the facilitation team. For example, the 'debriefing script' defines a standard process that the facilitation team can use to reflect on a session, and would only involve members of the facilitation team.

The steps field describes in detail who is doing what and is the essence of documenting a script. For example, 'Facilitator sets up task by asking *participants* to write short descriptions of resources available within the system.' Steps should be thorough so that anyone can follow them without needing additional explanation. If it is important to use specific language during the facilitation, it should be included in the steps. For example, the specific stem question posed to participants is often provided in this section. The planning team typically reviews and revises

Table 1 Script template

| Field | Description |
|--|--|
| Description | One- to two-sentence brief overview |
| Script status | Choose one and delete the bullets below that do not apply: <ul style="list-style-type: none"> • Best practice: this script has been used many times and in different settings and has consistently produced the intended outputs. • Promising practice: this script has been used a few times with good results but needs additional refinement and testing. • Under development: this script still needs to be refined and tested. |
| Context | When should this script be used? The context field specifies where in the GMB process this particular script fits. Because GMB projects are comprised of multiple scripts, the context explains whether the script should be used at the very beginning, after a particular script, to wrap a project up, etc. |
| Purpose(s) | Define the purpose of the script (delete those that do not apply): <ul style="list-style-type: none"> • Framing the problem • Initiating mapping • Eliciting variables • Deciding the reference modes for the study • Eliciting feedback loops • Eliciting stocks |
| Primary nature of group task | Identify the primary nature of the group task (delete the bullets below that do not apply and note that a group task should only have one primary purpose): <ul style="list-style-type: none"> • Divergent: activity designed to produced an array of different ideas and interpretations • Convergent: activity designed to clustering and categorizing ideas and interpretations • Evaluative: activity designed to rank and choose between options and idea • Presentation: activity designed to educate or update participants |
| Time | Preparation time: Time required to complete steps in script: Follow up time: |
| Materials needed to complete script | List the materials needed to successfully complete the script (e.g. markers, overhead projector, flip chart): <ul style="list-style-type: none"> • • |
| Inputs from other scripts | List the inputs from other scripts needed for this scrip (e.g. behavior-over-time graphs, concept model) or indicate 'none' if this is a starter script: <ul style="list-style-type: none"> • • |
| Outputs from this script | List specific products such as behavior-over-time graphs and system and how these products will be used in the context of the whole project. Distinguish deliverables from products, where deliverables are physical outputs such as an electronic file or hardcopy of a system map and products are interim outputs from a script that are of primary interest to the modeller. <ul style="list-style-type: none"> • • |
| Team roles required and expertise needed | List the team roles and minimum level of expertise required to complete the script (e.g. Facilitator—expert in SD): <ul style="list-style-type: none"> • • |
| Who is in the room? | List of people who should be in the room (e.g. 'gatekeeper', 'modeller', 'clients') during the exercise: <ul style="list-style-type: none"> • • |
| Steps | List the detailed 'how-to' sequence of actions in the script and who does them: <ol style="list-style-type: none"> 1. |

(Continues)

Table 1 (Continued)

| Field | Description |
|------------------------------|--|
| Evaluation criteria | 2. 3. Describe the criteria for knowing whether or not the script is successful, that is, how would someone who had not seen this script used before know whether or not they did the script correctly? |
| Author(s) | Identify the authors of the script. It is important to note that a script is a unit of behavior, and the documentation of that behavior is separate. The author of the script is the person or collective that created the behavior, and this should be acknowledged by identifying the individual or collective as the author. If the author of a script is not known, simply write 'unknown'. For individuals or collectives with an email address, provide email contact information. Also include the date (if known) that the script was created. |
| History and basis for script | Describe the history and basis for creating this script including both the motivation (e.g. a specific need that arose during a project) and prior work that the script is based on (e.g. other scripts, journal articles, traditions within an organization or community). |
| Revisions | Provide a list of revision changes and who made them. The description of the script itself should be the most recent version of the script and reflect the best use of this activity. |
| References | List any publications or references to additional documentation using this script and cited in the history of the script. For example, if this script is based on another script that was described in a journal, then mention this under the 'History' field with an author/year citation and provide the full reference here in the references field. |

the specific language for introducing an exercise and defining terms. This process of reviewing and revising the language for a script helps the facilitation team design for collaboration as implicit values and criteria surface.

The evaluation criteria field should outline indicators of a successful script implementation. That is, how would someone using this script for the first time know if they have done the script correctly? The evaluation criteria are often linked to the intended outputs and can also include behavioral changes in participants or the attainment of certain learning objectives. It is not uncommon that members of the planning team for the GMB session have vague or conflicting expectations about what a successful session would look like. Being explicit about the evaluation criteria during the planning process helps the team understand and negotiate what should be happening during the session.

The author field refers to the individuals who *created* the script, not the person filling in the script template. This field gives credit to those individuals who came up with the ideas and activities captured in the script. Authors can be individual or collectives but should be identified

with a name, contact information, etc. Scripts that are in common use or without a known author have this field entered as 'author unknown'.

A script that is being documented can also be part of widespread community tradition. In such cases, the community should be acknowledged along with the known status of the script within the community's culture. This is especially important because during the creation of a GMB exercise with a community, it is not uncommon for community members to nominate activities that are culturally specific and more appropriate for the intended set of participants. However, a script being documented in this way did not originate with a project or even the individual nominating the activity but exists as part of a cultural tradition. Proper acknowledgement of a community tradition is essential.

Along similar lines, scripts often have an intellectual history as GMB practitioners often draw upon previous scripts, articles, other types of small-group exercises, etc. when developing a new script. This field should capture the motivation and development process. As a script is revised or adapted, it is also important to retain the entire history of origin. For example, if the

authors were motivated to create the script from a community ritual, this should be clearly stated within the field.

CASE EXAMPLE

To illustrate the use of *Scriptapedia* and scripts, we provide a case example where scripts were used to design and facilitate a series of GMB sessions. The purpose of the GMB sessions was to develop a community prevention strategy for violence among military, veterans and families affected by trauma. It is important to note that the intent of sharing this example is illustrative, not evaluative. A thorough empirical evaluation of the use of scripts as a collaborative planning tool is outside the scope of this paper.

The project was initially motivated by a growing concern in the community about the number of US soldiers returning from wars in Iraq and Afghanistan with trauma, including post-traumatic stress disorders and traumatic brain injuries, and the perceived risk they posed for their families in terms of violent behavior and criminal justice response to family violence. The project was conceived as part of a research project to apply system dynamics modelling (Forrester, 1990, 1999; Sterman, 2000) to help develop a coordinated community response (CCR), or more precisely, a coordinated community prevention strategy because the goal was primary prevention of violence over the next 20 years instead (as opposed to responding to current violence). Addressing the issue requires involving a number of different stakeholders with diverse perspectives and conflicting goals including mental health professionals; soldiers, veterans and their families; law enforcement, courts and probation; sexual assault and domestic violence service providers and advocates; and victim/survivors of family violence.

Developing CCR to domestic violence has historically been very challenging. Not only are the usual barriers to collaboration present, but many stakeholders in CCR efforts also have strong ideological and political reasons for wanting to protect their perspective of the problem

as they did in this study. For example, domestic violence advocates and the judicial system have often been in conflict on such issues as mandatory arrest policies (requiring a police officer to make an arrest of a batterer), which have led to an alarming increase in the number of women arrested for domestic violence and controversy (Hovmand and Ford, 2009; Hovmand *et al.*, 2009). In such situations, the goals of various stakeholders may be in conflict. For example, the goal of increasing victim safety (what advocates want) may conflict with the goal of increasing accountability for batterers (what the criminal justice system is focused on). In some cases, such conflicts can lead to chronic coordination problems.

Specific to this study was the inherent conflict between different perspectives on the aetiology of violence among veterans with trauma and hence the appropriate institutional responses to that violence. Of particular importance was the fact that most criminal justice system responses including court mandated that batterer intervention programmes operate from a prevailing assumption that most violence is a consequence of the individual's choice and not his or her underlying mental health condition. Meanwhile, mental health professionals working with veterans would see trauma as a major contributor to anger, substance abuse and poor impulse control that leads to violent behavior. And, although some families would seek ways to help their veterans gain the support they need, others found the use of government resources to treat abusers at the expense of supporting victims objectionable. Adding to the complexity of the problem was the fact that a number of stakeholders had a history of adversarial relationships. These types of conflicts extended to conflicts within some stakeholder groups with specific types of ideological and cultural conflicts that would need to be successfully navigated in a GMB session.

This case serves as a good exemplar for the kinds of situations where system dynamics models, GMB, and scripts as a collaborative planning tool can be helpful. The problem is dynamic involving an increasing trend of trauma and violence over time, can be understood in terms

of multiple feedback loops interacting over time to change the incentives underlying the behavior of different stakeholders and involves stakeholders with a history of not collaborating. Moreover, the boundaries of the social groups and associated meanings (e.g. veterans, victims/survivors) are marginalized groups with members using a specific language to create identity, define an agenda and advocate for change. In practical terms, a misstep in the design of sessions or facilitation can easily reinforce the prevailing negative interactions groups experience in seeking to advocate for change and, as a consequence, reinforce conflict. So paying attention to language and the cultural appropriateness of activities is essential for developing rapport and effective collaboration during the GMB sessions.

To address the emerging concern of how to respond to the increase in veterans with trauma and perceived risk of domestic violence in the St. Louis community, the first author initiated a project to develop a community prevention strategy using GMB as part of a funded study. The core modelling team (CMT) included representatives from different stakeholder groups including providers from community-based organizations, the criminal justice system and the Department of Veterans Affairs. Central to this effort was the development of documented scripts and the design of a series of GMB sessions with different stakeholders. Approximately 70 people participated in the process in one or more sessions and represented a diverse set of stakeholders from the community including veterans, active members of the military, mental health providers, the Department of Veterans Affairs, domestic violence and sexual assault programmes, providers from homeless shelters, federal probations, state police, family members of veterans and researchers.

The CMT used process maps and scripts to design the GMB session. This started by having the experienced facilitators demonstrate an example of a GMB exercise and corresponding script. The CMT then reviewed the collection of scripts in *Scriptapedia* as potential activities for a GMB session, identified potential scripts and then developed the process map and scripts

for each session through an iterative process. The CMT then adapted and tailored scripts to each GMB session. For example, early discussions around the scripts raised questions about whether the focus was solely on veterans or included members of the military and what kind of specific language would be needed within the scripts to ensure that members of different branches would feel included.

Scripts were essential to this level of planning. In reviewing the scripts from previous projects, the CMT had a better sense of what kinds of activities might be used during the actual GMB session. The level of detail in the scripts provided explicit language that members of the CMT could critique and modify, and in turn, the discussion and validation of modification of scripts created a sense of the shared values and criteria within the CMT. For example, in discussing what the appropriate language should be when referring to veterans and members of the military, the CMT developed a shared sense of how important the use of these terms might be for participants and the potential of inappropriately signalling the exclusion of participants through their misuse. As a consequence, the CMT was able to collaboratively develop not only a set of scripts that were more culturally appropriate to the stakeholders but also a sense of the required 'facilitative attitude' (Vennix, 1996) needed to develop rapport with the participants during the GMB sessions.

Early on, the CMT also realized that there needed to be several additional activities that helped tie the content of the exercises back to the day-to-day lives of participants. Having already worked with existing scripts, the CMT was then able to design several new scripts that fit the specific needs of the project. For the CMT, creating a new script was relatively easy because the script template helped structure the discussion along a set of specific questions tied to defining a script. This led directly to the inclusion of exercises producing deliverables that were highly valued by participants in terms of both the process and outcomes.

The resulting GMB sessions consisted of a set of three small-group exercises focusing on different stakeholder groups and a large-group

meeting where the results were shared and used to develop a set of prioritized action steps. The level of collaboration at the end of the final session exceeded the CMT's expectations. We were able to have a productive discussion with a diverse stakeholder group with often opposing views on causes and appropriate responses to violence against women including domestic violence and military sexual trauma, both of which can be highly sensitive topics. For example, some participants entered sessions with the view that military training and culture was a significant if not a root cause of domestic violence in a patriarchal society, whereas other participants as members of the military and veterans viewed such criticism as hostile to veterans. Yet by the end of the project, participants were having deep and nuanced discussions about the nature of military training and domestic violence and were able to begin organizing activities in the community that built upon a shared and more holistic view of the issues.

The use of scripts thus enabled the CMT to effectively adapt, tailor, create and facilitate sessions with diverse stakeholders. Important elements of success include the CMT being able to effectively visualize the GMB activities, identify potential sources of conflict, recognize underlying values that frame the problem, identify potential power dynamics that could suppress participation, define an appropriate scope of the problem and help members of the CMT prepare for the facilitation of GMB exercises.

It is also important to note some of the limitations. The process of reviewing, revising and developing scripts for this project was time intensive. Scripts alone were insufficient for members of the planning team to acquire a sense of what GMB is or how the activities would unfold, but including a demonstration exercise and sharing the corresponding script helped address this. Our experience has also been that the structure of scripts can convey a certain sense of rigidity in GMB that impedes the very adaption and tailoring that one might seek in using scripts.

In subsequent projects where we shared the facilitation manual using the scripts for this project, we found groups reluctant to use the scripts until they realized the following: (1) these were

only examples and (2) they would also need to engage in a process of critique and revision for the activities to be an effective means for facilitating collaboration. This type of issue can easily be addressed, however, by more effectively communicating the purpose of introducing scripts used from other projects, providing more context and highlighting the different adaptations and uses of scripts from multiple projects. Most recently, we found it important to stress that although scripts are the definitive reference for a specific activity, the instructions for facilitators leading the activity and fidelity instruments can take a different format.

CONCLUSION

Group model-building sessions that engage communities on complex issues frequently involve diverse stakeholders where there is a significant risk of coordination issues and conflict, undermining efforts at developing and implementing solutions. Being able to effectively plan and execute sessions that are culturally appropriate, engage participants and manage conflict productively is essential for two reasons. First, solutions based on the insights and analysis of a model need to be implemented, and implementation oftentimes requires collaboration in a community setting. Without an effective means of designing sessions to manage conflict, one may end up with knowing what needs to happen, but not have a community that is ready to implement the solution. Second, GMB sessions are interventions, and interventions that fail to effectively identify and manage the conflicts are not neutral but actually harmful. The resistance to change in communities is often there for a good reason and based on a history of failed efforts to bring about solutions that ultimately made the situation worse in the long run. GMB sessions that are ineffective therefore contribute to this stock of resistance, making future identification and implementation of issues even more challenging.

We build and use models of complex systems because we believe that it is hard if not impossible to adequately understand systems without

the aid of a model, and our ability to find and implement solutions is intimately connected to how well we understand the system. Thus, we see models as design objects, that is, as things that we can see, interact with and manipulate to understand a complex system and find a solution. We involve stakeholders in the process of building such models through GMB techniques because we believe the process of being involved leads to a better model and increases stakeholders' understanding of the model and ability to implement necessary changes. What we have come to appreciate through our use of scripts is how they too function as design objects for planning effective collaborations.

The use of documented scripts as we have described here with *Scriptapedia* makes it possible to more effectively engage a wider and more diverse set of stakeholders where conflict and coordination issues may be major barriers to solving some problem in a system. This occurs through both better and more explicit planning of exercises by the team planning the sessions and also by having the facilitators negotiate and internalize the criteria and values underlying scripts.

When documented and used in *Scriptapedia*, scripts provide a tangible tool that teams can use to design and plan sessions bridging diverse and conflicting stakeholder perspectives. Using scripts in this way allows persons with little or no experience in system dynamics or GMB to actively engage in this design process and increases the diversity of the CMT and thereby the ability of a team to design effective collaboration.

As participatory methods for developing models gain more interest and are applied to a wider array of issues with more diverse stakeholders, it will become increasingly important to recognize and develop more tools that help the teams design effective collaborations. Such tools have the potential to not only improve the quality systems analysis but also increase democratic participation in the process, likelihood of having the results implemented, and ultimately expand the potential capacity of communities to solve a much wider array of complex system problems.

In this paper, we have focused on scripts as a collaborative planning tool for designing GMB

sessions where the goal of the sessions is to understand and solve a dynamically complex problem through the development and analysis of a system dynamics model. This focus has a specific set of assumptions from the outset about the nature of the problem and reasons why collaboration can be difficult, which we illustrated in the case example.

However, there are other reasons why collaborations can be difficult, and hence, other methods for solving them that do not involve the development of a system dynamics models, GMB or the use of scripts to plan GMB sessions collaboratively. Exploring which methods work best for which kinds of collaboration problems is an area for future research, but one that requires unpacking the complexity of the problems and methods. This paper is a step in that direction by providing an explicit protocol for the activities within a GMB session that will allow future research to rigorously test the relationship between various intervention elements on the collaboration as a process and outcome.

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REFERENCES

- Ackermann F, Andersen DF, Eden C, Richardson GP. 2010. ScriptsMap: a tool for designing multi-method policy-making workshops. *Omega* 39(4): 427–434.
- Andersen DF, Richardson GP. 1997. Scripts for group model building. *System Dynamics Review* 13(2): 107–129.

- Andersen DF, Bryson JM, Richardson GP, Ackermann F, Eden C, Finn CB. 2006. Integrating modes of systems thinking into strategic planning education and practice: the thinking persons' institute approach. *Journal of Public Affairs Education* 60(1): 265–293.
- Andersen DF, Richardson GP, Vennix JAM. 1997. Group model building: adding more science to the craft. *System Dynamics Review* 13(2): 187–203.
- Andersen DF, Vennix JAM, Richardson GP, Rouwette E. 2007. Group model building: problem structuring, policy simulation and decision support. *Journal of the Operational Research Society* 58(5): 691–694.
- Barrett S. 2007. *Why Cooperate? The Incentive to Supply Global Public Goods*. Oxford University Press: New York.
- Beall A, Ford A. 2010. Reports from the field: assessing the art and science of participatory environmental modeling. *The International Journal of Information Systems and Social Change* 1(2): 72–89.
- Checkland P. 2006. Reply to Eden and Ackermann: any future for problem structuring methods? *Journal of the Operational Research Society* 57(7): 769–771.
- Cockerill K, Daniel L, Malczynski L, Tidwell V. 2009. A fresh look at a policy sciences methodology: collaborative modeling for more effective policy. *Policy Sciences* 42: 211–225.
- Dörner D. 1997. *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*. Basic Books: New York.
- Doyle JK, Ford DN. 1998. Mental models concepts for system dynamics research. *System Dynamics Review* 14: 3–29.
- Dwyer M, Stave K. 2008. Group model building wins: the results of a comparative analysis. Paper presented at the *System Dynamics Conference*, Athens.
- Eden C, Ackermann F. 1998. *Making Strategy: The Journey of Strategic Management*. Sage: London.
- Eden C, Ackermann F. 2006. Where next for problem structuring methods. *Journal of the Operational Research Society* 57(7): 766–768.
- Eden C, Radford J. 1990. *Tackling Strategic Problems: The Role of Group Decision Support*. Sage: London.
- Eden C, Ackermann F, Bryson JM, Richardson GP, Andersen DF, Finn CB. 2009. Integrating modes of policy analysis and strategic management practice: requisite elements and dilemmas. *Journal of the Operational Research Society* 60(1): 2–13.
- Forrester JW. 1990. *Principle of Systems*. Pegasus Communications, Inc.: Waltham.
- Forrester JW. 1999. *Industrial Dynamics*. Pegasus Communications, Inc.: Waltham.
- Franco LA, Montibeller G. 2010. Facilitated modelling in operational research. *European Journal of Operational Research* 205(3): 489–500.
- Franco LA, Rouwette EAJA. 2011. Decision development in facilitated modelling workshops. *European Journal of Operational Research* 212: 164–178.
- Ghaffarzadegen N, Lyneis JM, Richardson GP. 2011. How small system dynamics models can help the public policy process. *System Dynamics Review* 27(1): 22–44.
- Gilbert N, Troitzsch KG. 2005. *Simulation for the Social Scientist* (2nd edn.). Open University Press: New York.
- Hoppenbrouwers SJBA, Weigand H, Rouwette EAJA. 2011. Exploring dialogue games for collaborative modeling. In *E-Collaboration Technologies and Organizational Performance: Current and Future Trends*, Kock N (ed.). IGI Global: Hershey; 292–317.
- Hovmand PS, Ford DN. 2009. Sequence and timing of three community interventions to domestic violence. *American Journal of Community Psychology* 44(3–4): 261–272.
- Hovmand PS, Ford DN, Flom I, Kyriakakis S. 2009. Victims arrested for domestic violence: unintended consequences of arrest policies. *System Dynamics Review* 25(3): 161–181.
- Howick S, Ackermann F, Andersen DF. 2006. Linking event thinking with structural thinking: methods to improve client value in projects. *System Dynamics Review* 22(2): 113–140.
- Jarboe S. 1996. Procedures for enhancing group decision making. In *Communication and Group Decision Making* (2nd edn.). Hirokawa RY, Poole MS (eds.). Sage: London; 345–383.
- Johnson-Laird P. 1983. *Mental Models: Towards a Cognitive Science of Language, Inference and Consciousness*. Harvard University Press: Cambridge.
- Keys P. 2006. On becoming expert in the use of problem structuring methods. *Journal of the Operational Research Society* 57: 822–829.
- Luna-Reyes LF, Martinez-Moyano IJ, Pardo TA, Cresswell AM, Andersen DF, Richardson GP. 2006. Anatomy of a group model-building intervention: Building dynamic theory from case study research. *System Dynamics Review* 22(4): 291–320.
- McCardle-Keurentjes MHF, Rouwette EAJA, Vennix JAM. 2008. Effectiveness of group model building in discovering hidden profiles in strategic decision-making. Paper presented at the *System Dynamics Conference*, Athens.
- McCardle-Keurentjes M, Rouwette EAJA, Vennix JAM, Jacobs E. 2009. Is group model building worthwhile? Considering the effectiveness of GMB. Paper presented at the *International System Dynamics Conference*, Athens, Greece.
- Pidd M. 1998. *Computer Simulation in Management Science* (4th edn.). John Wiley & Sons, Ltd.: West Sussex.
- Richardson GP. 2006. Concept models. Paper presented at the *Proceedings of the 24th International Conference of the System Dynamics Society*.
- Richardson GP, Andersen DF. 1995. Teamwork in group model building. *System Dynamics Review* 11(2): 113–137.
- Richmond B. 1997. The strategic forum: aligning objective, strategy, and process. *System Dynamics Review* 13(2): 131–148.

- Roberts EB. 1977. Strategies for effective implementation of complex corporate models. *Interfaces* 8(1): 26–33.
- Rouwette E. 2011. Facilitated modelling in strategy development: measuring the impact on communication, consensus and commitment. *Journal of the Operational Research Society* 62: 879–887.
- Rouwette E, Vennix JAM. 2009. Improving operations management by synthesizing participant knowledge and system data. In *Strategisches und operatives Produktionsmanagement: Empirie und Simulation*, Strohhecker J, Größler A (eds.). Gabler: Wiesbaden; 267–282.
- Rouwette E, Vennix JAM, Mullekom T. 2006. Group model building effectiveness: a review of assessment studies. *System Dynamics Review* 18(1): 5–45.
- Rouwette E, Vennix JAM, Van Mullekom T. 2002. Group model building effectiveness. A review of assessment studies. *System Dynamics Review* 18(1): 5–45.
- Stenberg L. 1980. A modeling procedure for public policy. In *Elements of the System Dynamics Method*, Randers J (ed.). MIT Press: Cambridge; 292–312.
- Sterman JD. 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin/McGraw-Hill: Boston.
- Straus D. 2002. *How to Make Collaboration Work*. Berrett-Koehler Publishers, Inc.: San Francisco.
- Vennix JAM. 1996. *Group Model Building*. John Wiley & Sons: New York.
- Vennix JAM, Andersen DF, Richardson GP. 1997. Forward: group model building, art, and science. *System Dynamics Review* 13(2): 103–106.
- Vreede G, Briggs RO, Kolfshoten GL. 2006. Thinklets: a pattern language for facilitated practitioner-guided collaboration processes. *International Journal of Computer Applications in Technology* 25: 140–154.
- Westcombe M, Franco LA, Shaw D. 2006. Where next for PSMs—a grassroots revolution? *Journal of the Operational Research Society* 57(7): 776–778.
- Zagonel A, Rohrbaugh J. 2008. Using group model building to inform public policy making and implementation. In *Complex Decision Making*, Qudart-Ullah H, Spector JM, Davidsen PI (eds.). Springer-Verlag: New York; 113–138.
- Zagonel A, Rohrbaugh J, Richardson GP, Andersen DF. 2004. Using simulation models to address “what if” questions about welfare reform. *Journal of Policy Analysis and Management* 22(4): 890–901.
- Zock A. 2004. A critical review of the use of system dynamics for organizational consultation projects. Paper presented at the *International System Dynamics Conference*, Oxford, UK.