

Insights from Two Concurrent System Dynamics Group Model Building Projects: Documenting Five Lessons Learned With Audiovisual Evidence

Michael Kenneth Lemke, Department of Environmental & Occupational Health Sciences, The University of Texas Health Science Center at Houston School of Public Health

Kyrah Brown, Department of Kinesiology, College of Nursing and Health Innovation, The University of Texas at Arlington

Saeideh Fallah-Fini, Industrial and Manufacturing Engineering Department, College of Engineering, California State Polytechnic University, Pomona

David Lounsbury, Department of Epidemiology & Population Health, Division of Health Behavior Research and Implementation Science, Albert Einstein College of Medicine

Tiffany Kindratt, Department of Kinesiology, College of Nursing and Health Innovation, The University of Texas at Arlington

Deneen Robinson, Truth Pregnancy Resource Center

Thanayi Lambert, Department of Undergraduate Nursing, College of Nursing and Health Innovation, The University of Texas at Arlington

Abstract

Introduction

Few studies have addressed maternal health outcomes from a complex systems perspective. To bridge this knowledge gap, two SD modeling projects that apply system dynamics group model building (SD GMB) are ongoing, with core SD GMB meetings with community participants having taken place within the same calendar month. The close timing of SD GMB activities provided a unique opportunity for rapid learning and adaptation by the research team.

Approach

Applying tenets of reflexivity, a manuscript was recently published in *System Dynamics Review* that described how SD GMB activities were conceptualized, planned, and implemented, offering reflections on the effectiveness of our approach. This paper augments the original publication by providing audiovisual documentation, drawn directly from SD GMB session recordings, to support these reflections.

Results

Drawing upon our own insights about successes, failures, and apparent enigmas in each project, these reflections and supporting audiovisual evidence are presented as five 'lessons'. These lessons summarize the challenging, yet rewarding, experience of having engaged in these closely-timed SD GMB activities.

Discussion

The five lessons derived from the two concurrent SD GMB activities may offer valuable insights for others engaging in the formative phase of SD GMB projects. By using audiovisual evidence, this paper may enhance understanding and increase uptake among researchers and practitioners who engage in SD GMB.

Key Words

group model building; stakeholder engagement; participatory activities; participatory learning; severe maternal morbidity

Introduction

High rates of maternal morbidity and mortality are persistent public health burdens in the United States (U.S.), where the maternal mortality rate has steadily increased and 80% of cases are preventable [1, 2]. Although decades of maternal health research has identified many causes of adverse maternal health outcomes and contributed to major clinical advancements [3, 4], there is growing consensus that maternal health outcomes are caused by the complex interaction of multilevel forces over time [5-8]. However, relatively few studies have addressed this problem from a complex systems perspective [e.g., 9, 10].

To generate novel, complex systems-grounded insights into maternal health outcomes and leverage these insights into actionable solutions, two community-based system dynamics group model building (SD GMB) projects ('Project 1' and 'Project 2') are currently underway, due to the demonstrated value of this approach for generating insights into systems and systems change and creating value for participants [11]. These projects emerged from two separate external grant proposals led by the same core investigator team that were submitted one year apart but coincidentally awarded three weeks apart. Although these two projects have key differences in their contexts, aims, and deliverables, the close timing of receiving awards, along with the focus on SD GMB during the first phase of both projects, led to similar initial project timelines. Accordingly, SD GMB participant meetings for both projects were conducted within one calendar month, and this close timing emerged as an opportunity for rapid learning by the research team and the adaptation of the specific SD GMB approaches employed across projects. Applying tenets of reflexivity [12], a paper was recently published in *System Dynamics Review* that described how SD GMB activities were conceptualized, planned, and implemented, offering reflections on the effectiveness of our approach by drawing upon our own insights about successes, failures, and apparent enigmas in each project, as five 'lessons' [13], which may be valuable for others engaging in the formative phase of SD GMB projects and help to bridge shortcomings in the literature by "add[ing] more science to the craft" of participatory modeling [14, 15]. This paper augments that original publication with audiovisual documentation drawn directly from SD GMB session recordings of the five lessons to enhance understanding and increase uptake among researchers and practitioners who engage in SD GMB

Overview of System Dynamics Group Model Building Approach

Project 1 included 16 participants, and Project 2 included 17 participants, of whom 87% and 82% self-reported as non-Hispanic Black, 100% and 82% self-reported as women, and 31% and 35% self-reported as a person with lived experience, respectively. Each project consisted of two SD GMB sessions during March 2024, separated by two weeks, with the first session lasting one full day and one-half day (Friday and Saturday) and the second session lasting one full day (Friday). Project 1 took place first, during the first (the first session) and third (the second session) weeks of the month, while Project 2 took place during the second (the first session) and fourth (the second session) weeks of the month. This meant that the lessons learned from Project 1 activities were then used to adapt the approach for Project 2. Agendas and corresponding PowerPoints were adapted based on the flow of each activity in real-time

(e.g., to not prematurely end a rich discussion). At the conclusion of each session, the team met the same day and reflected on what went well and what did not.

The SD GMB approach was designed to be applied to both projects, with opportunities for deviation and adaptation planned for ahead of time and built into the agenda. Key SD GMB activities included: 1) discussing concerns and hopes; 2) eliciting key variables; 3) establishing a model boundary chart; 4) creating behavior-over-time graphs (BOTGs); 5) generating causal loop diagrams (CLDs); 6) identifying targets for action; and 7) producing a wall of evidence. The specific approach for each activity was based on existing scripts from Scriptapedia [22] when available, which were then subsequently modified based on considerations such as the size of the group of participants (e.g., causal loop diagramming was done in two small groups in each project). The agenda also included critical supporting activities, including biobreaks, as well as introductions at the beginning of each session and participant reflections and feedback to the research team at the end of each session. Finally, a detailed PowerPoint was created as a facilitation tool.

Insights Elicited from Group Model Building Processes: Five Lessons Learned

A complete overview of the context and methodology across the two projects can be found in the original manuscript [13], as well as two other manuscripts that describe the research findings that emerged from the SD GMB activities within each project [23, 24]. Overall, the SD GMB approach were considered successful in achieving the objectives set out during the initial conceptualization phase, as it led to: 1) a rich set of prioritized variables relevant to each problem; 2) insights into the dynamic characterization of each problem; 3) a novel understanding of how key factors and forces constitute system(s) with numerous embedded feedback loops; and 4) initial leverage points within the system(s) for preventive interventions. Further, the SD GMB activities contributed to objectives unique to each project (e.g., community capacity building in Project 1). However, some SD GMB activities were more challenging than others or were differentially effective across projects. Below we reflect on the five 'lessons learned' across the two projects.

Lesson 1: Measure Twice, Cut Once is a Valuable Philosophy

Planning for SD GMB activities has been described as “preparation of a theatrical performance” and consisting of rigorous scripting of planned activities [15, 25, 26]. Indeed, the scope of the SD GMB activities across both projects presented tremendous logistical challenges, and planning took place over months before the SD GMB, but these steps were essential and allowed the freedom to be more flexible during SD GMB activities – the “most artful” portion of this type of work [14]. For example, the unique insights elicited from the two projects were tied to identifying the right participants, which was enhanced by including a ‘community consultant’ (Figure 1) on the research team who served as a gatekeeper, confirming best practices reported elsewhere [25].



Figure 1.

Selected participants were then free to be fully engaged during the SD GMB activities because of the foresight to meet their needs on the day of each session, which likely contributed to the array of rich and insightful outputs that ultimately emerged (e.g., over 600 total variables elicited across the two projects). Among these needs that were met were adequate logistics for arrival (Figure 2) and support for those with infants/children (Figure 3).

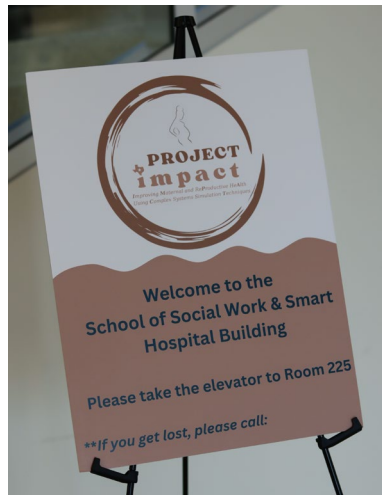


Figure 2.



Figure 3.

Other details were found to be indispensable, such as the research team meeting the day before each session to set up the room, test the technology, and make sure the flip charts and painter's tape would stick to the wall (Figure 4) and window (Figure 5) surfaces. These plenary steps are known as critical success factors for SD GMB projects [25, 26].



Figure 4.

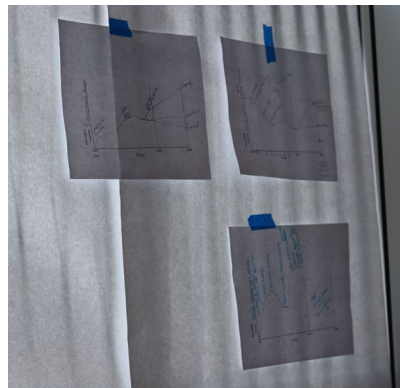


Figure 5.

However, in retrospect, two additional preparatory activities would have been valuable. First, key definitions (e.g., types of racism) should have been established and communicated with participants in advance, which corresponds with a known best practice in SD GMB: Establishing consistency in vocabulary [25]. Second, to resolve the potential of an emerging “role conflict” [27], members of the research team should have discussed guidelines for when to step in and intervene when group tensions arise (as described in Lesson 2 below). It is possible that these two changes would have led to differences in the quantity and quality of session outputs, such as closer correspondence between the CLDs that were developed in small groups in both projects.

Lesson 2: What Works in One Context May Not Work in Another – And That’s Okay

There were differences in how the participants responded to and engaged in specific SD GMB activities that were enigmatic. There were differences in how the participants responded to and engaged in specific SD GMB activities that were enigmatic, which confirms that these projects and collection of individuals involved are indeed complex systems themselves [14] and generate emergent and often surprising

phenomena. Many of these enigmas revolved around the initiation of “boundary objects” (e.g., CLDs), demonstrating the known potential of these objects for both discord and accord [28]. Given the context of the two projects, the research team’s approach to modeling centered on this boundary object approach, rather than a “micro-world” approach [29]. This may have contributed to greater variance across the two projects, as it led to a more bottom-up modeling process [29] that may have provided more opportunity for conflict among participants.

One clear example of this was the initial development of the CLDs – starting with one reinforcing and one balancing loop – that was done organically and in real-time with the entire group in both projects (prior to breaking out into the small groups for generating CLDs). This worked well during Project 1, resulting in a useful initial CLD for the small groups to build upon. However, when this same approach was then used for Project 2, disagreements immediately emerged that halted meaningful progress, which was captured in Figure 6 (and will be presented in audio format during the parallel session). Even though this dissension could be positively interpreted as reflecting of the capacity of groups to reject incorrect information [15], several team members sensed a ‘shift’ in the room characterized by tension and increasing disengagement among participants and redirected the discussion to the small group format instead. This experience was a manifestation of the potential of this process to lead to either virtuous (in Project 1) or vicious (in Project 2) cycles [28], perhaps driven by known cognitive biases among individuals that can emerge during SD GMB [30], and it affirms how decreasing communication may occur with larger group sizes [15]. While various approaches to using concept models have been proposed [e.g., 25, 31], this experience specifically demonstrated the value of having a back-up set of initial loops and a plan for conflict resolution prepared in advance.



Figure 6.

Another enigmatic difference across projects was in participants’ preferences for how the CLDs were generated, which is a critical consideration for the creation of boundary objects [28]. Specifically, within each project, one small group facilitated this activity on a whiteboard (Figure 7), while the other small group used Vensim [32] and a projector (Figure 8). However, one small group expressed a strong preference the whiteboard approach so they could more easily walk around and look at the CLD, which has been suggested as the preferable approach among other SD GMB practitioners as well [25].



Figure 7.

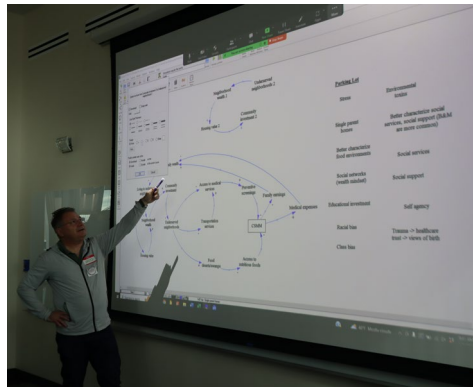


Figure 8.

One key area of adaptation across the two projects was in how the BOTG activities were implemented. During Project 1, participants were provided with instructions on how to create their BOTG, and they were then asked to engage in the activity. Participants were also asked to review the variables that were elicited and choose the outcome variable that they thought was most important to understand historically. However, this led to a more confusing and overwhelming process among participants, and the BOTGs that emerged were insightful but often lacked key attributes (e.g., future trends). In response, participants in Project 2 were led through the exercise step-by-step, creating one component of the BOTG at a time in between instructions, and they were also given the outcome variable “Severe maternal morbidity rates among Black women in Texas” to graph instead of choosing their own, as shown in Figure 9. This led to comparatively richer and more consistent BOTGs, which suggests the importance of providing ‘scaffolding’ when engaging in SD GMB activities that are especially demanding for participants. Further, because the BOTG were shared and voted on by participants in each project, this adaptation allowed for the creation of more robust boundary objects that supported subsequent SD GMB phases [28].



Figure 9.

Lesson 3: You Cannot Plan for Everything – Be Able to Go with the Flow

As is common for any research project, unexpected challenges are almost certain to arise during SD GMB activities. Some challenges that occurred are unlikely to happen again – such as an Uber mix-up that resulted in a participant ending up at the airport instead of his home. Others, such as repeatedly bad weather (as can be seen out the windows in Figure 10), cannot be well anticipated or planned for in advance.



Figure 10.

However, there were challenges that did fall within the research team's purview that had no obvious solutions and required flexibility – a valuable attribute of SD GMB facilitation [25, 27]. For example, there were a few participants who tended to dominate the conversation at times, and this occurred across both projects and within all the small group CLD processes and is a common occurrence in participatory modeling [33]. Despite advanced planning to address this possibility that are described in the literature (e.g., having a “parking lot”) [25], these efforts were not wholly sufficient, and the research team had several internal discussions about how to reconcile this. However, there were tradeoffs with any proposed strategy. On the one hand, participants were open to the research team being sterner in keeping conversations and SD GMB activities on track – saying to one facilitator, “Driver, keep driving the bus”. On the other hand, a research team member provided the following insight (Figure 11 extracted from

the *System Dynamics Review* publication but will be presented in audio format during the parallel session):

“We don’t account for the reality that most Black folk live lives where they are not heard. And so they’ve just been sitting on all this drama. And we committed to hearing them...so you have to balance them needing to feel heard with respecting them, and then, still moving on”.

Figure 11.

Related to the above point, it is also important for the research team to pay attention to the mental and emotional states of participants to ensure maximum engagement, especially when they have lived experiences that may be traumatic to discuss with others. More breaks and opportunities for reflection may need to be added spontaneously during a session, especially a full-day session – as one participant said to themselves, “Let me go get some coffee, because my brain wasn’t working”. Signs of stakeholder fatigue are shown in Figure 12. Such breaks are not only beneficial to participants, but also to fatigued facilitators, whose attitudes are critical to the SD GMB process [30]. At the same time, other participants noted the need to keep the meeting moving, such as getting the group together in a timely manner after lunch, indicating that balance must be found among participants’ dynamic needs and preferences. This also confirms the importance of not letting SD GMB activities and projects get “bogged down” [25], as this may compromise momentum and energy.



Figure 12.

Overall, Project 2 more closely followed the planned times that were delineated in the agenda, which was largely attributable to the prompter start times of the sessions at the start of each day compared to those of Project 1. This contributed to more robust session outputs from Project 2, including significantly more variables and targets for action that were elicited. Although the variations in start times were somewhat challenging, it was critical for the research team to maintain a positive attitude [30] (Figures 13 and 14) and to adjust the agenda accordingly to maximize the available

time. These two responses led to successful outcomes and meaningful session outputs across both projects.



Figure 13.



Figure 14

Lesson 4: Record Everything You Can

The amount of information that was elicited across the two projects was voluminous, as is typical of SD GMB projects [26]. Although the research team was diligent in capturing as much of this information in real-time as possible, there were moments when it was extremely difficult to keep up with the conversation. Fortunately, sessions were audio recorded (Figure 15), which were then transcribed using a transcription service. These recordings continue to be indispensable – even the quotes included in this paper would not have been possible otherwise. Another especially valuable form of recording was note-taking by the facilitators (Figure 16) during the small group CLD sessions – as stated by one participant, “...had it not been for her notes, we wouldn’t have flushed out a few more loops”.



Figure 15

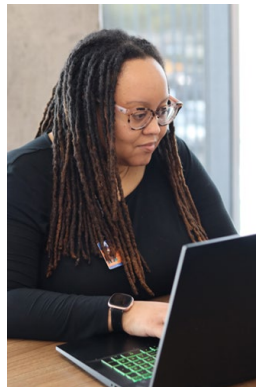


Figure 16

Additionally, as described by other SD GMB practitioners [25], providing the parking lot (Figure 17) was extremely helpful for keeping discussions on-track and enabling facilitators to refer back to this information across the multi-day projects, while also demonstrating to participants that their insights were valued.



Figure 17

Lesson 5: Enjoy the Work and Have Fun – and Appreciate the Opportunity

Although the SD GMB process was exhausting for both participants and research team members, it was often fun and created positive memories that brought everyone closer together. For example, one of the small groups for Project 1 created their own catchphrase during the small group CLD activity – “Close the loop!” – that reflected their

enthusiasm for the work (Figure 18) and shows an additional benefit of having a shared iconography [25]. This enthusiasm translated into a CLD that told a compelling story due to its powerful array of feedback loops and served as a “shared language” of the views of each small group [33, 34].



Figure 18

Providing the opportunity for each small group to present their final CLD to each other (Figure 19) corresponds with existing best practices [15] and bolstered group collaboration and excitement to provide a powerful “climax”[25]. The preparation that each small group undertook prior to these presentations provided an opportunity to critically review these diagrams (Figure 20), which cemented their relevance as boundary objects by confirming the shared understanding represented by these complex CLDs [28].



Figure 19



Figure 20

There were also many insightful conversations that were not directly related to any SD GMB activity that occurred during breaks and provided the opportunity to re-focus and energize during the grueling days (demonstrating the value of the good food and extra coffee shown in Figure 21).



Figure 21

Finally, the opportunity to engage in these closely-timed meetings provided richer boundary objects that led to novel insights that the research team may have missed otherwise (Figure 22), such as comparing CLDs across both small groups within projects (e.g., feedback loops that were present in one small group CLD but not the other). These insights are expected to be valuable in future stages of both projects, such as during the development of quantitative SD simulation models.

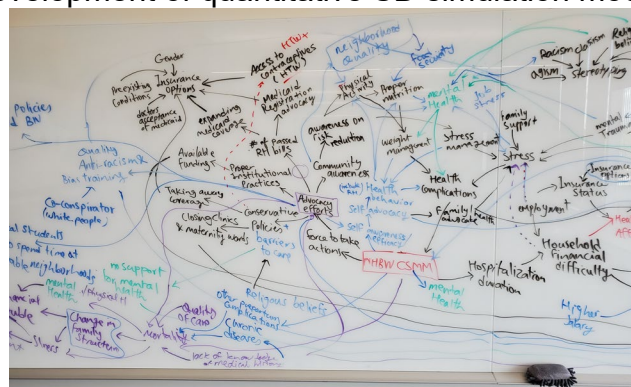


Figure 22

Conclusion

The close timing of SD GMB participant meetings across two projects related to maternal health provided a unique opportunity for rapid learning by the research team and the adaptation of the specific approaches employed across projects. This experience confirmed that SD GMB can be a challenging, but also rewarding and fun, process that can lead to novel, complex systems-grounded insights into problems that can be leveraged into preventive interventions. Although every SD GMB project is different, the five lessons described and depicted in this table talk, including successes, failures, and apparent enigmas, may provide valuable insights for others engaging in SD GMB work. By using audiovisual evidence to demonstrate these insights, this table talk may enhance understanding and increase uptake among researchers and practitioners who engage in SD GMB.

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