Applying system dynamics modeling for learning to a messy problem in the public sector

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Extended Abstract:
The use of indicators and measures to help communities monitor their progress towards a sustainable future has been spreading rapidly.[1] In the Boston, Massachusetts metropolitan region, the Boston Foundation's Indicators Project has been spearheading this effort. Through a broad community process, indicators of quality of life and sustainability were articulated and synthesized into a collection of 70 indicators group into ten categories published in 2000 to local and national acclaim.

But important questions remain. Perhaps most fundamental is how these indicators drive change, especially given the complexity of the social, economic, natural and political systems that must be influenced. Attempting to improve the individual indicators in isolation is likely to fail given the interdependencies. What is needed is a model of problem that can be used for learning and to develop robust policy strategies.

If we consider the problem being modeled to be uneven progress in improving quality of life and sustainability as measured by the indicators, how can we understand the system that generates this behavior? Clearly, to make progress on improving *all* of the indicators would require understanding the system well enough to find points of leverage. But this is a quintessentially "messy problem" for group modeling.[2] In particular, several characteristics are important to note:

1. All participants are volunteers. The process itself must remain interesting and work around their commitments and limited availability.
2. No small group of individuals can be found whose knowledge of the system would be sufficient to model it. Furthermore, many conflicting explanations for the structure driving certain behavior exist.
3. The power distance between participants may be large. Experts and average citizens will need to work side by side if all perspectives are to be represented.
4. The modeling process will take a very long time to complete. Participants are not likely to participate consistently over the entire process.
5. Many participants are not technologically or scientifically savvy, creating feelings of alienation from, and distrust of, computer modeling. Likewise, participants have no inherent interest in the techniques of systems dynamics and

[1] See the Internation Institute for Sustainable Development's website for more information. http://iisd1.iisd.ca/measure/default.htm.
[2] See Vennix, *Group model-building: tackling messy problems.* System Dynamics Review, 15, pp. 379-401, (1999).

will not suffer through significant upfront training in system dynamics' tools willingly. The process must be very accessible, jargon-free, and its value immediately recognizable.

This paper describes a community modeling process for the Greater Boston region developed jointly by the author and the Boston Foundation that emphasized the modeling-as-learning approach and addressed the unique characteristics of this public sector situation. The process was successfully piloted this summer with 150 diverse stakeholders from the Greater Boston region, drawn from all sectors and demographic segments, in a series of eight three-hour workshops.

Although our initial plan was to use the standard model-building method, we quickly found the need to revise the process significantly to address the unique challenges of this situation. Through iterative revision based on participant feedback, we eventually settled on a process consisting of the following five interrelated activities. These activities essentially engage participants in Phase One, "Business Structure Analysis," of Lyneis' four-step approach[3] to modeling for strategy development, adapted for use under the public sector conditions described above. Attention was paid to what Marjolein van Asselt called narrowing the "metaphor gap" and communicating in plain, everyday language so that all participants would feel engaged and understand the process.[4]

1) **Provide context, set tone, and provide ground rules.** The long-term change process was outlined and participants were informed of their role within it, providing a sense of context and continuity. This was important given that many participants were there for the first time, or had not been engaged in several months. Significant attention was paid to creating a space for inquiry and open dialogue[5] to make double-loop learning possible in hopes of reconciling the various mental models that may be held by the participants. This was accomplished primarily by inspiring people with the possibility of creating a sustainable future and the use of concrete ground rules.
2) **Articulate a shared vision for the future.** Participants were asked to share their vision of what a sustainable Boston with high quality of life would look like in the year 2030 in as concrete and vivid terms as possible. This activity helped participants to gain some distance from their current circumstances to think more boldly and question what is possible. Articulating an ambitious vision of the possible creates something for the region to "grow into." Empirically, we have found that there is little conflict between the visions articulated. By encouraging participants to think "both/and" rather than "either/or" a shared vision emerges, which generates a sense of optimism, cooperation and commitment that corresponds to a shift in the participants' mental models from win/lose to win/win.

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[3] Lyneis, *System dynamics for business strategy: a phased approach*. System Dynamics Review, 15, 37-70, 1999.
[4] Marjolein van Asselt, *Globally Integrated Assessment Models as Policy Support Tools*. Doctoral dissertation at the University of Twente, Enschede. (DATE? DETAILS?)
[5] See William Isaacs, *Dialogue*, Doubleday, New York, 1999.

3) **Brainstorm important current trends** that will shape the community's future.[6] Participants were encouraged to think not about what data currently exists, but instead what trends are most important, even if they are very qualitative. These trends were labeled either "positive" or "negative," meaning that they were currently moving towards or away from the vision articulated earlier. These trends are prioritized and three selected for further inquiry by small groups. This activity sometimes identified new indicators that would need to be monitored in the future. At this point in the process, the current reality and trend projections were contrasted with the shared vision from above, introducing a "creative tension" that motivates participants to take action and stay engaged in the process.
4) **Understand the drivers of the selected trends**, looking at the entire Greater Boston region as an integrated system. Facilitators guided this dialogue towards the places in the system where leverage is likely to reside. Although one can never know where leverage resides until a model can be simulated, Dana Meadows "Leverage Points: Places to Intervene in a System" provides a very valuable heuristic guide. Using such a heuristic was essential in order to keep participants interested and to accelerate discussion given the limited time available for each workshop. Participants were reminded that the leverage points identified were merely hypotheses that would be need to be tested in order to keep the ongoing inquiry open.
5) **Investigate possible high-leverage strategies for change.** Assumptions about what is likely to generate change were openly examined and challenged in a spirit of dialogue. These strategies were developed as possible ways to influence the drivers of the selected trends to ensure they will quickly and effectively move the community closer to the shared vision articulated earlier in the workshop.

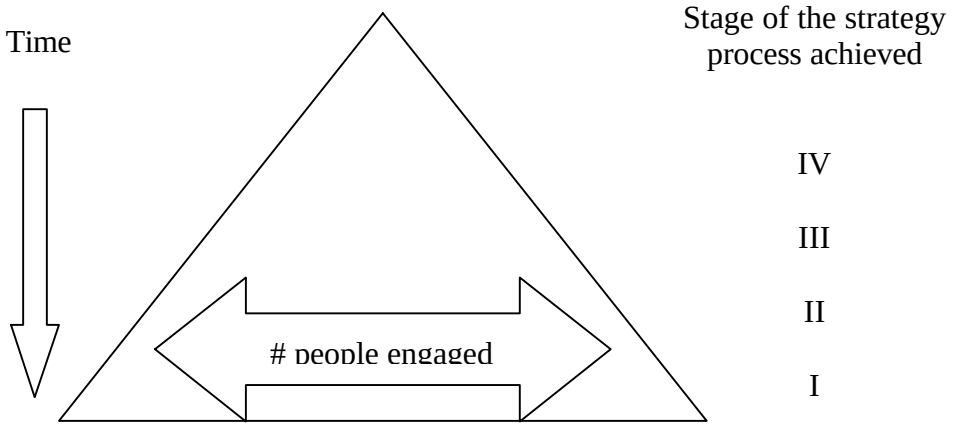
By repeating the workshop multiple times, we were able to develop greater confidence in the vision, trends, possible drivers, and recommended strategies as certain items would arise again and again. Formal feedback forms and informal questioning indicated that participants left the workshops energized by their new insight and hopeful that change was possible. They will be likely to participate in the future. And by creating an open dialogue, much of problems associated with perceived power imbalances and incomplete exploration of the system's dynamics could be overcome because all voices were explicitly equally valued, supported by vigilant process facilitation.

Over time, a process that involves more and more stakeholders in workshops like these, will begin to develop a consensus on a framework for action that will focus efforts where they will have the greatest leverage. Stakeholders will also be committed to the long-term change process because they will have a greatly enriched understanding of their role in the context of the dynamics of the entire system.

But this is just the beginning of long process that can be thought of as an expanding pyramid. The first participants in the process have new skills and understanding that ready them to engage in further, deeper investigation. Again referencing Lyneis' process,

[6] The term "trend" used in the community indicators process corresponds exactly with the notion of a "reference mode" in the systems dynamics modeling literature.

these participants, or some portion of them, will proceed to Phase Two. Meanwhile, more and more people can be involved in Phase One as the process is refined and more people are trained to give the workshops. In this way, the modeling process simultaneously probes deeper and deeper while engaging more and more people in learning about the systems that define the problem of sustainability and quality of life, generating latent support and political will for the strategy recommendations that will emerge from the process.



Subsequent stages of the process have yet to be developed but they will build on the work already done. For example, small groups of representative stakeholders could be engaged in causal mapping for various trends, which could then be useful in beginning to map out the causal relationships between the trends of greatest concern. One of the virtues of causal mapping as a tool for reconciling mental models is that multiple dynamic hypotheses can be considered simultaneously. Thus, the process can hold the complexity and multiple perspectives and explanations that will invariably surface as people articulate their mental models.

Computer modeling will eventually be necessary and valuable, but it need not be introduced for a quite a while, probably only in Phase Three, and then only for some representative subgroup of the total participants. There is much still to learn simply from engaging the various mental models represented in the process using the heuristics like the one discussed earlier. And the emphasis on learning-by-doing rather than learning-by-lecture or -presentation helps to ensure the process remains interesting and relevant for participants. Pushing computer modeling too early will alienate participants causing them to disengage, compromising the credibility of any model that is made as it reflects fewer and fewer of the diverse stakeholders' mental models.

Until a single indicator can be articulated that synthesizes all of the other indicators, this may be the closest we can come to modeling the "problem." In a very real way, the modeling process might even serve to assist in defining the problem itself more clearly as the systemic interrelations of the key trends are better understood and we gain confidence in our chosen model boundary.

The author:

Brendan Miller is a dual-degree student at the MIT Sloan School of Management and the Harvard Kennedy School of Government and the focusing on the application of systems dynamics and organizational learning to the development of socially, environmentally and economically sustainable communities.

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