

**Choosing Our Destiny:
The Use of Systems Dynamics and Organizational
Learning in Community Planning
for a Sustainable Future**

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Abstract

This paper presents a framework for structuring community planning for a sustainable future and describes a process jointly developed and piloted by the author and The Boston Foundation, implementing the framework for the Greater Boston region. This novel framework, which draws from system dynamics modeling and organizational learning, builds on the community indicators movement and may have great potential to create the shared understanding and political will necessary to move communities powerfully and quickly towards sustainability.

Community Indicators and the Challenge of Change

The use of community indicators to help track the progress of communities, regions, and cities towards a sustainable future has been gaining momentum around the globe.¹ In brief, community indicators are measures of quality of life and sustainability that are tracked and published for use by stakeholders in the community to assess progress as well as craft policy. As the old adage says, what gets measured gets done. This movement arose out of a desire to move beyond overly simplistic unidimensional measures, like GDP growth, in order to better assess the true health of communities. Without measures of social and environmental health, it is too easy to sacrifice these things in order to produce economic health (i.e. growth), for which we do have measures. This movement democratized measurement by involving the community in articulating what things were worth tracking. For example, one indicator might be “racial disparities in health and education outcomes.” The goal was to first find out what mattered and then figure out how to measure it. Through this movement, we are finding it is possible to develop measures of things previously thought too subjective or nebulous to measure.²

But now that we have all these valuable new indicators and measures, we are faced with a new problem: How are these indicators related to each other and to overall sustainability? We cannot simply add or multiply together all of the measures in order to get a single measure of sustainability. To make such a measure, one would have to specify all the highly nonlinear relationships and interdependencies between the various measures. For example, how is child nutrition related to educational outcomes? They are certainly related, but the exact relationship is far from clear. In Boston, 70 indicators (and even more measures) have been articulated in 10 different categories. Creating a single measure of progress towards a sustainable future with a high quality of life is a daunting task, but may not be necessary.

And even having such a “super-indicator” is not enough, because it is not operational. In other words, having such an indicator does not provide any insight into how to generate the desired outcome. It does not describe what policy levers exist or how to manipulate them. Nor does it address the deeper systemic drivers of the various measures and indicators or how they influence each other dynamically over time. A “super-indicator” is

¹ For example, see <http://iisd1.iisd.ca/measure/compindex.asp> and <http://www.sustainablemeasures.com/>.

² For the sake of this paper, we assume that everything that people care about can be measured either directly, through surveys, or represented via proxies. This is certainly a debatable point but is beyond the scope of this paper.

not like a speedometer where we know to press the gas to go faster or the break to go slower. What then must be done?

Understanding the system

In order to create lasting, profound change, one must develop a model (whether mental or computational) that allows one to understand where “leverage” resides in a system.³ There is a wide range of actions that have low leverage⁴, waste resources and never achieve the desired outcome. Furthermore, unless all stakeholders are able to develop a shared “mental model” of the best pathway to change across the community, conflict will be unavoidable and people will be working at cross purposes. We use the term mental model in this paper to mean an individual’s *beliefs* about the system of cause and effect in the world relevant to a particular problem. It is important to note that these beliefs about the world can be correct, incorrect, or incomplete as well as conscious or subconscious. Harmonizing the mental models of an entire region is certainly an ambitious task, but it is a challenge well suited to SD and organizational learning, as we shall see. I will also argue that it is precisely this harmonization that is required for communities to be able to generate meaningful and speedy progress towards a sustainable future.

Unfortunately, human brains and our mental models are not good at representing how a group of interdependent factors and decisions behave and influence each other over time, in other words their *dynamic complexity*.⁵ Cause and effect not obviously connected in time or space at the level of daily experience is hard to recognize and understand. For example, people don’t make the connection between driving their car and the incidence of rainy weekends.⁶ Many people would consider this to be a negative “side effect” of driving. But what is a side effect if not simply an unanticipated effect? And why was it unanticipated? Almost by definition, the effect is unanticipated because it is not represented in the mental models of the drivers. As another example, an economic might recommend creating manufacturing jobs to improve the quality of life for local workers, but she may not understand or fail to take into account that manufacturing can cause pollution, which in turn detracts from quality of life. Even when someone understands the causal connections, they may undermine their analysis by choosing the wrong time frame. For example, a CEO may strive to maximize profit in the time frame of two years, but this is very likely to hurt his ability to maximize profit in the long term. These problems point to the importance of questioning and challenging our mental models in order to ensure our model boundary is large enough to include all of the relevant causal connections so that the system behavior can be described endogenously.

This is not to say we are not good at developing models of complex systems. In fact, I will argue that we are better than we think. To make this point we must distinguish the *structure* of the system, the component factors and causal connections between them,

³ By leverage we mean places where small interventions can create large benefits.

⁴ *Leverage Points: Places to Intervene in a System* by Donella Meadows, 1999. The Sustainability Institute, <http://sustainer.org/>.

⁵ For a discussion of this problem, see *Business Dynamics* by John Sterman, 2000.

⁶ Research done by Randall Cerveny and Robert Balling, Jr. as reported in *US News and World Report*, August 17, 1998.

from its *behavior*, how the factors change over time through their interrelationship. As discussed above, we have problems understanding dynamically complex behavior, but a *causal diagram* of the system, in other words a diagram of the various causal connections, can be developed iteratively by eliciting the mental models of people who have experience with the system and refining the model to include the causal connections that people believe to exist.

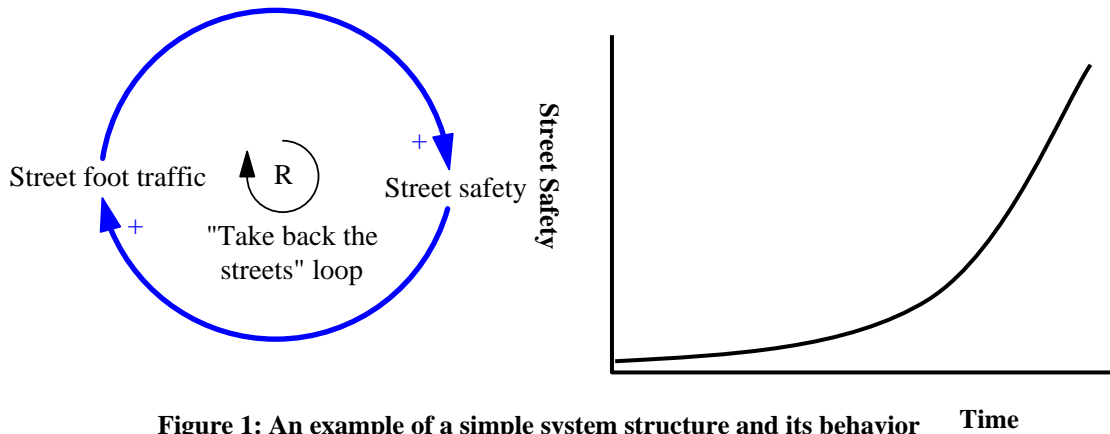


Figure 1: An example of a simple system structure and its behavior

We must always remember that the causal connections we include in a model are merely hypotheses about the real world. These hypotheses can be verified two ways: one is through computational simulation and the other is through corroboration by a number of people with different experiences with the same problem. As an example of the latter, if renters, landlords, homeowners, and policy makers all agree on the process one must go through to purchase a house, then we can be more confident in including it in our model.

In modeling complex systems is easy to develop irreconcilable conflict if we try to represent only the “most important” causal connections. One person may say that the current housing scarcity in Boston was caused by a burdensome permitting processes. Another will say that the scarcity is caused by the decrease in the size of the average household, which increased the need for housing. Yet another will say it is that the local universities have not done their part to house students, and so on. It is very likely that the scarcity is caused by *all* of these factors, and more, to greater and lesser extents. Thus it is important for us to think “both/and” rather than “either/or” in modeling the system. And fortunately, system dynamic models are designed explicitly to be able to represent all of these hypotheses in one model, thus sidestepping fruitless discussions of what are the “most important” connections. We must expand the boundary of the model to include all plausible hypotheses before we can determine which are the most important.

This may initially feel like a waste of time, but it exhibits a pattern found in many common group problem-solving approaches. For example, we are all familiar with the process of brainstorming in which a group lists all possible factors influencing a problem without discussion or evaluation. This brainstorming is then followed by a more critical evaluation phase through which priorities are chosen. Good modeling of complex social problems requires the same discipline, especially given the wide range of perspectives

and the power differences between stakeholders that can suppress open and complete inquiry.

In general, the modeling process and methods for understanding the system should be conceived of as iterative. For example, as the model is slowly built and tested, a desire to reframe the problem may arise. Or upon implementing policies derived from the model, unanticipated effects may be noticed that will then be incorporated into the model. In this way, the model becomes a “virtual world” that is constantly used to evaluate policies, help educate the public, and it is continually updated to include new information as needed.⁷ The day may come when such models will be as common and frequently used in government administrations as yearly budgets are now. Thought of in this way, budgets are simply models whose purpose is to yield insight and direction into the problem of fiscal health.

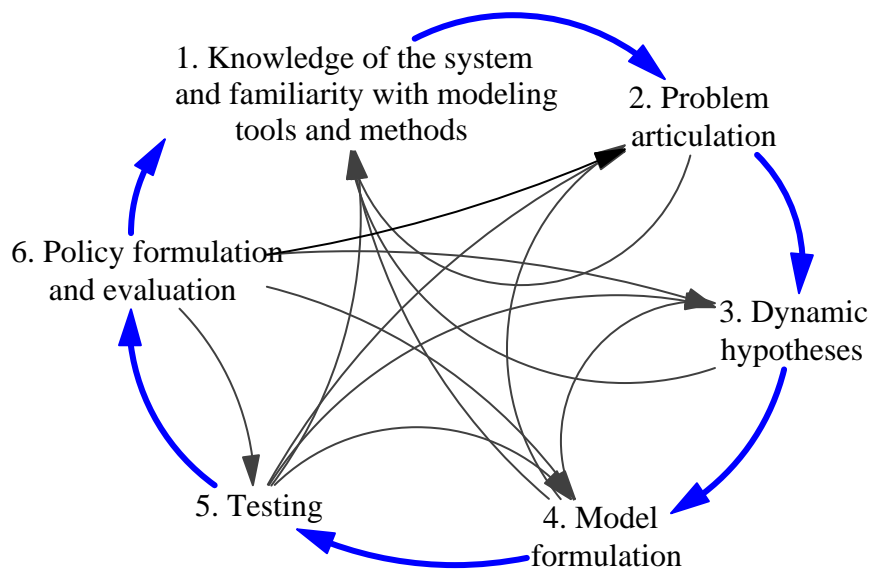


Figure 2: Modeling and system understanding are iterative processes
(Adapted from *Business Dynamics* by John Sterman, 2000.)

Thus, the process of modeling is an essential part of the process to understand the complex social, environmental and economic system that must be influenced to move us towards a sustainable future and in identifying promising strategies.⁸ People often resist

⁷ For more on the use of virtual worlds, see *Business Dynamics* by John Sterman, 2000.

⁸ See also “A system dynamics approach to sustainable cities” by Michael Radzicki, Worcester Polytechnic Institute (mjradzi@wpi.edu), June 1995. First published on pages 191-210 of the Proceedings of the 1995 International System Dynamics Conference, held July 30 - August 4, 1995, at Gakushuin University, Tokyo, Japan.

the use of computational models when they do not appreciate how they are built upon and support human intuition. This is a topic that will be discussed in a later section. But regardless of whether computational models are used or not, mental modeling cannot be avoided in any problem solving process.

Note also that the modeling process itself supports learning and improves the intuition of the stakeholders involved.⁹ Learning happens on several levels. First, people will come away with a broader appreciation for the range of hypotheses about the functioning of the system, which fosters an openness and spirit of inquiry that is very helpful in future cooperation. Furthermore, the testing of these hypotheses in a rigorous way results in a more accurate sense of how the system really works and the causal pathways that are truly the most important. In this way, what may have been previously poorly understood or counterintuitive becomes intuitive. For example, the stakeholders may come to understand that building affordable housing can sometimes further impoverish a community if what is needed is really more industrial space to provide more jobs.¹⁰

A successful modeling and problem-solving process will require surfacing and stating our subconscious assumptions about the world, then testing all of them. This is by definition difficult, because these assumptions are subconscious. But these subconscious assumptions are just as important, or perhaps more important, than our conscious beliefs about causality in the world because they influence our decisions and actions without our awareness. They are what we don't know we don't know.

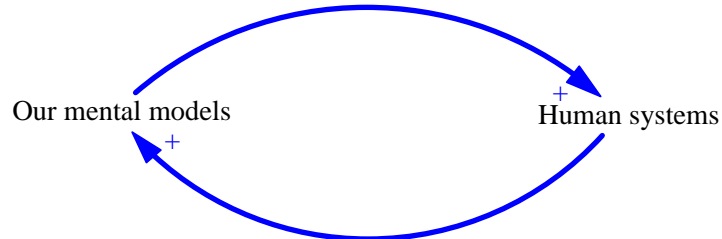


Figure 3: Our mental models generate and are generated by human systems

For example, many people in the United State assume that some level of homelessness is normal, because that is what their experience has taught them. Or that landlords should be able to charge whatever the market will bear. Or that people of different ethnicities have more differences than commonalities. But these are just assumptions that some people take as unquestioned givens. What makes it especially hard to recognize them as assumptions is that they are self-fulfilling prophecies. But it is essential to recognize that they are self-fulfilling only until we are able to step outside of them, see how they work, and understand what our role in them has been. Then we have a choice to continue to

⁹ There is a large body of literature on modeling for learning. For example, see *Modeling for Learning Organizations*, edited by John Morecroft and John Sterman, 1994.

¹⁰ See *Urban Dynamics*, by Jay Forrester, 1969.

behave as we have, or invent a new pattern of action and interaction that may yield more desirable outcomes.¹¹

For example, someone who assumes that human nature is inherently competitive may never realize this is an assumption because there is a very real way in which having this assumption can lead to creating a world around oneself that *is* entirely competitive. If I expect you to cheat me, I will not trust you and the foundation of a cooperative relationship cannot be established. Everything you say will be filtered through a screen of distrust. It's a form of confirmation bias well studied in the field of negotiation.¹² As another example, the field of economic development as commonly practiced assumes that economic development and environmental preservation are inherently at odds. It should be clear that this would be a self-fulfilling prophecy as well, because no effort would be put into developing creative ways to transcend the apparent conflict.

In this way we limit what is possible without realizing it, letting past experience dictate our behavior without our awareness or consent, thus ensuring our future experience will match the past. What we fail to recognize is that we have the ability to *choose* to make our future experience different from our past experience. I can choose to trust you, find you are trustworthy and thus develop a cooperative relationship with you. We can choose to search for ways to create sustainable economic development and we will find them in time. We can choose to consider homelessness to be unacceptable and it will disappear with our effort.

But how do we surface and test these assumptions if we cannot see them? This is where the processes of group dialogue and organizational learning play a key role. By dialogue I mean a very particular pattern of interaction with identifiable ground rules and characteristics. William Isaacs has described dialogue as a sustained collective inquiry into the processes, assumptions and certainties that compose everyday experience.¹³ Dialogue makes it possible engage in what Chris Argyris calls “double-loop” learning, which is essentially learning about our mental models themselves, not just their content (i.e. single-loop learning).¹⁴

¹¹ See the work of the Landmark Education Corporation, www.landmarkeducation.com or *The Art of Possibility* by Benjamin Zander, 2000 or the field of organizational learning for more information.

¹² For example, see *Errors in Social Judgment: Implications for Negotiation and Conflict Resolution*, Harvard Business School Case Study #N2-897-103, 1998.

¹³ *Dialogue and the Art of Thinking Together* by William Isaacs, 1999.

¹⁴ See *Theory in Practice: Increasing Professional Effectiveness* by Chris Argyris and Donald Schon, 1974. or their more recent work.

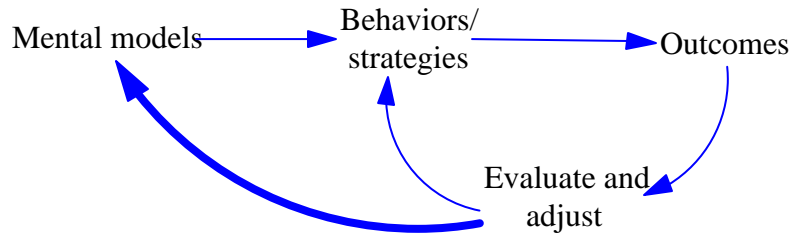


Figure 4: Double-loop learning

Double loop learning is distinguished from single-loop learning by its ability to surface and test tacit and subconscious assumptions through a process of inter-subjectivity. When people are ready to accept the possibility that what they believe to be objectively true about the world may actually only be a subjective assumption that is a product of their unique experience, dialogue allows them to compare assumptions and discover their roots in past experience. For dialogue to generate double-loop learning, it must involve people whose experiences, assumptions, and mental models differ in substantive ways. Thus the diversity of the participants, along all dimensions, is a very valuable asset and significant attention should be paid to ensuring the greatest diversity possible is represented in any community planning process. This diversity becomes easy to manage when space for genuine dialogue among the participants is created.

Organizational learning is very similar to dialogue except that it deals with the unit of the group rather than the individual. Every organization and group has unstated assumptions embedded in its culture just as individuals have unstated assumptions in their mental models. These assumptions limit what is possible for that organization or group until they are surfaced and tested. Outside perspectives make it possible for the organization to “see” these assumptions more clearly and test them, which creates the possibility for new and more effective avenues of action.

For these reasons, organizational learning and dialogue are essential ingredients in community planning processes striving for greater sustainability and a higher quality of life. The problem will be challenging enough without limiting ourselves to the small subset of possible interventions defined by our past experience. The successful interventions are very likely going to lie in one of the “blindspots” at the intersection of our unknown or untested assumptions.

Political consensus and effective action

The previous section described some of the key challenges in understanding the social, economic, and environmental systems that determine a community’s sustainability and quality of life, and suggested some ways to address those challenges. But even when problems are well understood, a large gap between understanding and action is very common. This is especially true in situations where the action required is highly dispersed among a large population, for example non-point-source pollution and global warming. Since it is high-leverage action to generate significant, enduring improvements that is our goal, we must be clear how understanding and action are related. Another way to frame this challenge is to accurately represent how change occurs in our mental and

computational models.¹⁵ There are reinforcing feedback processes that should be harnessed and balancing feedback processes to manage. Change and implementation must be made *endogenous*. For example, how do good ideas diffuse throughout a community? How do people recognize them as good ideas in the first place? Why do people resist change and how can their resistance be reduced? Too often strategy and implementation are thought to be separate processes, but successful change exhibits powerful interaction between strategy and implementation in a highly iterative fashion. In the for-profit sector there is a growing interest in this interaction, which is generally called “emergent” strategy.¹⁶

An implication of linking strategy and implementation is that the people whose cooperation will be required to generate the desired change should be involved in the modeling and strategy development process. We have already seen that the participation of a wide diversity of stakeholders is an asset in developing a rich and accurate model of a system. In addition to this benefit, their participation has two other important effects. First, by participating in a process of dialogue together, their mental models slowly begin to be harmonized. Previously held assumptions are challenged and the perspectives and experiences of others are added to their mental model. It is very important to note that this harmonization is not reductive, pushing towards the lowest common denominator, but instead is transcendent, seeking explanations that reconcile and subsume the various different perspectives of the participants. As this harmonization continues, the scope of agreement expands until what is essentially a fully shared mental model of the system emerges.

It is important to note that this process can take significant time and is far from easy. Just imagine how much openness and time it would take for a 21-year-old raised on welfare in the inner-city and a corporate CEO from a background of privilege in the suburbs to agree on the nature of the system out of which their lives emerged. One of the first assumptions that they will need to struggle to understand is the “American Dream.” To what extent is there really a uniform distribution of opportunity? Such a dialogue will strike at the heart of their experiences and identities, forcing them to destroy some of the pillars on which their view of reality rests. It will be very personally challenging. The 21-year-old may find himself examining the extent to which he has limited his own success as his resentment towards the CEO diminishes. The CEO may question the nature of her privilege and perhaps develop a new sense of responsibility and compassion for the plight of the 21-year-old. This is where the cognitive and emotional merge. There will come a moment in which the experience of one is finally understood, appreciated, and allowed to be incorporated in the mental model of the other, and vice versa. Thus, this process of harmonizing mental models will necessarily co-occur with the creation or strengthening of relationships, particularly across lines of great perceived difference.

¹⁵ For excellent treatment of the dynamics of change, see *The Dance of Change* by Peter Senge, 1999.

¹⁶ For example, see “Crafting Strategy” by Henry Mintzberg. *Harvard Business Review*, July-Aug 1987, #87407.

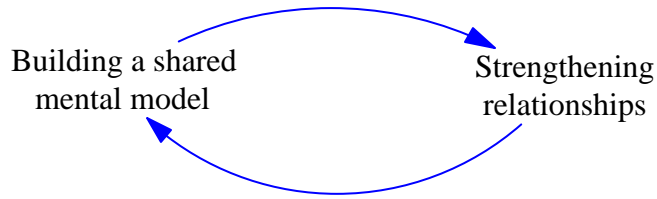


Figure 5: Building a shared mental model strengthens relationships and vice versa

This moment has been called “Crossing the Threshold”¹⁷ Once this threshold has been crossed, cooperative action becomes almost effortless. With a shared mental model about the nature of the system, action is not only easily coordinated because everyone knows how the system works and their role within it, action is nearly emergent and self-organizing. This is especially valuable when one is dealing with a highly dispersed and heterogeneous population as you would find in a metropolitan region where close coordination would be difficult.

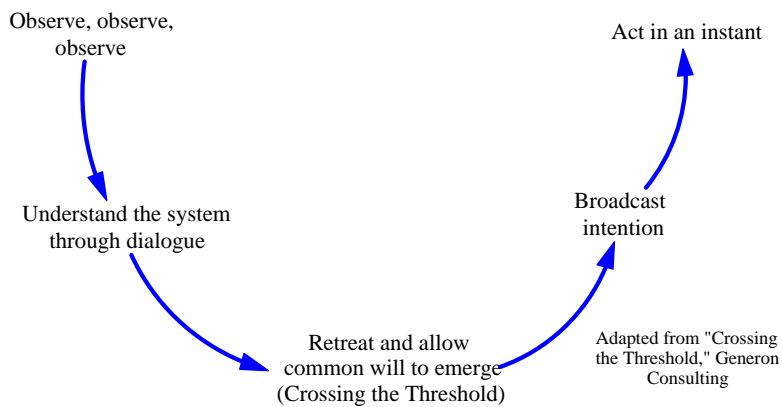


Figure 6: "Crossing the Threshold"

As an analogy, consider a large sailing ship. On such a ship, the crew will certainly coordinate their actions via explicit communications, but much of the ship’s overall behavior (here considering the ship as a system) is emergent, the function of the individual crew members’ actions as they respond to cues around them. For example, one person will know to lower the sails when the wind picks up. Another will know to turn the steering wheel when the compass indicates they are off course. Thus, the behavior of the system is emergent (i.e. self-organizing, self-regulating, or stigmergic¹⁸) with respect to the purpose of the system, which in this case is sailing to a particular destination.

¹⁷ “Crossing the Threshold: The Report of the 1999 Forum on Institutional Renewal,” edited by Janet Coleman, at Generon Consulting.

http://www.generonconsulting.com/Publications/Crossing_the_Threshold.pdf.

¹⁸ See *Being There: Putting Brain, Body and World Together Again* by Andy Clark, 1998 for a discussion of stigmergic algorithms and the complete sailing ship example.

Returning to the system that concerns us, the social-economic-environmental system, and our purpose, sustainability and quality of life, I would argue the same degree of self-regulation could emerge from a shared mental model. The beauty of this approach is that once the system as a whole is understood by the modelers, individuals need only remember their role and the small subset of the system that directly influences them and that they directly influence. The dynamics may be very complex, but their individual behavioral strategies will be simple. This is true of bird flocking behavior, which has seems very complex but has been modeled as an emergent system based on three simple rules that each bird follows.¹⁹ The desired goal of sustainability will emerge automatically.

In addition to the power of the shared mental model, cooperation and coordination will be greatly facilitated by the strengthened relationships that this process will produce. (This corresponds to “Broadcast intentions” and “Act in an instant” in the above diagram.) And as people work together productively on their problem of mutual concern, this will only further strengthen their relationships in a virtuous cycle. This increased “social capital” can be mobilized to create powerful and immediate action. An important consequence of this process and its use of dialogue is its ability to create strong relationships across divides of great perceived difference. It transcends what is commonly framed as a central dilemma of social capital: to build strong intra-group “bonding” social capital or create weak inter-group “bridging” social capital.²⁰ This process has the potential to create *strong inter-group* ties by creating for people a common understanding and emotional connection.

Note that the framing of this community planning process is strongly win-win, encouraging participation that is centered around solving a common problem rather than on negotiating competing interests. Another definition of dialogue is a conversation with a center, not sides.²¹ Thus we can think of this entire process as a form of rigorous, ongoing dialogue. This framing is very appropriate because the nature of the “game” of sustainability is inherently non-zero-sum: we all win together or we all lose together. Treating it as a win-lose game will only create a vicious cycle that will destroy net value for everyone. Given the high degree of interdependence, it is less and less possible for all but the most powerful to avoid the negative consequences of failure to solve the problem of sustainability (e.g. poisoned or depleted water supplies). In addition, this process has the potential to transform the sentiment and understanding of the participants such that they shift from win-lose thinking to win-win thinking, or at least develop a more enlightened sense of self-interest.

¹⁹Reynolds, C. W. (1987) Flocks, Herds, and Schools: A Distributed Behavioral Model, in Computer Graphics, 21(4) (SIGGRAPH '87 Conference Proceedings) pages 25-34.
<http://www.red3d.com/cwr/papers/1987/boids.html>.

²⁰ See *Bowling Alone* by Robert Putnam, 2000. Chapter 22.

²¹ *Dialogue and the Art of Thinking Together*, William Isaacs, 1999.

Putting it all together: A framework for effective community planning and change
 Synthesizing the lessons from the previous sections, a framework for understanding community planning and change can be articulated.

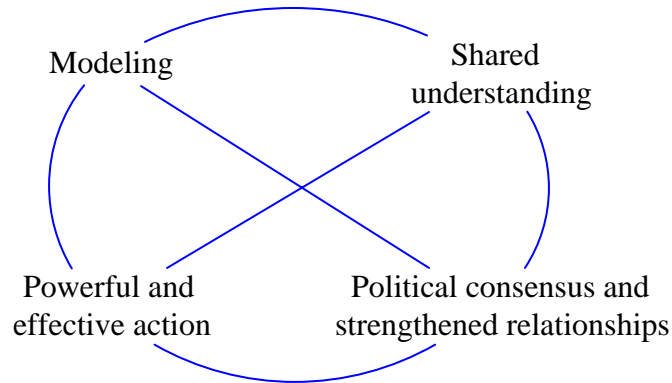


Figure 7: Modeling, understanding, consensus and action

In this framework, a process for system modeling facilitates building a shared understanding of the common challenges faced by the community and their interrelationship. This understanding is closely linked to the creation of new relationships, and these two factors together create a new political consensus on the most desirable, high leverage strategies for change. With this new consensus, power and effective action becomes possible, which will generate results more quickly than previously imagined possible. This positive change will create hope and enthusiasm, thus reinforcing the work being done until we reach a new dynamic equilibrium that we will know as sustainability.²²

Process structuring

In the previous sections we have seen that it is desirable to link system understanding, strategy development, and implementation, how logistically can this be done? Certainly not everyone in a region as large as Greater Boston could participate directly. How then should participation be structured?

I propose a process that can be thought of as an expanding wave of participation in which the diversity of the regional stakeholders is represented “fractally” at all points. Here fractally means that at any point in the process, examined at any level of granularity, the diversity of the stakeholders will be represented to the greatest extent possible without any form of systematic bias. A small, committed, insightful and carefully balanced group of stakeholders should serve as the vanguard of the process, pushing the modeling and system understanding deeper and deeper over time. If sufficient numbers of such people

²² “A system dynamics approach to sustainable cities” by Michael Radzicki, Worcester Polytechnic Institute (mjradzi@wpi.edu), June 1995.

can be found, it would be possible to establish a handful of groups to work in parallel, whose work could be compared and synthesized periodically to yield new insights and a more complete model. This circumvents the dangers of “groupthink.” Ideally these groups will be stable over time, thus saving time in building relationships and bringing new participants up to speed. However, the process would be effective even if a new group of people continued the work at each step, it would simply require more time to reconcile the mental models before new work could be begun. Fortunately, this is not wasted time because every step towards the harmonization of mental models is a step in the desired direction.

This first group will likely follow the general system dynamic modeling-for-strategy approach used by Pugh-Roberts Associates in the for-profit sector.²³ Although much will need to be adapted for a community process, the four phases of their process are clearly transferable. Unfortunately, there are no examples of the application of group system dynamics modeling to community problems so any process will need to be adapted from another context. Below are the four phases, with small changes made to match our community context.

- I. Analysis of the problem structure:** This phase is used to define the problem clearly, identify likely causes, possible constraints and performance indicators. Trend data is investigated and a conceptual model may be created and studied via “mental simulation.”
- II. Development of a small, insight-based model:** Phase II builds on Phase I to create a small computational model (approximately 20 to 400 equations) that can actually be simulated and analyzed to understand the system’s dynamic complexity more thoroughly. Much can be learned even from such a small model.
- III. Development of a detailed, calibrated model:** In this phase, a model that can robustly replicate past data, has been tested for sensitivity, and facilitates the evaluation various policy and strategy alternatives is developed.
- IV. Ongoing strategy management:** This phase continues indefinitely. The model is refined and updated as new learning and experience emerges from the ongoing dialogue and strategy implementation processes. Predictions of the model are tested against data as it becomes available. Strategies are adjusted as learning progresses, and implementation follows.

Depending on the intensity of work, I would expect Phase I to take approximately one year, Phase II one year and Phase III two years. Clearly this is a long-range process that will require stable and committed stewardship. There are few community institutions with the capacity or interest to undertake it, but community foundations seem to be the best home. Their endowments can provide continuity and independence from political and economic cycles, and their credibility as servants of the community will inspire trust and facilitate participation of a wide range of stakeholders. It would be a mistake to make this a government initiative or corporate-funded venture for these reasons.
give estimated time horizon

²³ “System dynamics for business strategy: A phased approach” by James Lyneis, *System Dynamics Review*, 15, pp. 37-70, 1999.

As the first group (or groups) pushes deeper and deeper, other groups can be involved. This second wave of participants benefits from the work of the first group because their dialogue can be focused more effectively on key sub-problems or on verifying and extending previous work. The temptation to present the work of the first group as a fait accompli or as “the truth” or as “the answer” should be resisted at all costs. If the temptation is not resisted the inquiry will end and nothing further will be learned, and it is very likely subsequent groups will reject the work as “wrong.” In this assessment they will be correct, because every model is inherently incomplete (and thus wrong). The key lesson here is that people do not resist change, but they resist *being* changed.²⁴ Thus, they must rediscover “the truth” for themselves to a large extent.

To avoid this trap it may be helpful to think of these groups as focus groups rather than audiences in order to keep the desired frame of inquiry. However, as more and groups progress through the process, they will have less and less new to add to the model, thus speeding the pace at which they can harmonize their mental models with the work of previous groups. The process remains the same, but its primary purpose shifts over time.

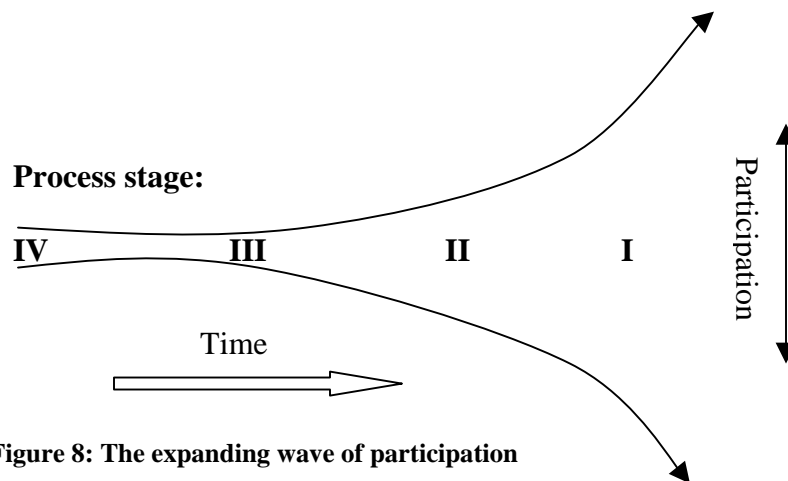


Figure 8: The expanding wave of participation

As more and more people experience the process, decentralizing becomes possible. With limited additional training and support, previous participants could become facilitators of subsequent groups. Although only a small fraction of people are likely to ever develop formal computational modeling expertise, this provides no limitation because so much of the learning relies on decidedly low-tech and simple process. Evidence of this is described in more detail in the section of this paper describing the work done by the section on Phase I below. Relinquishing control and decentralizing the process in this way unleashes an exponential growth processes, because each participant can reach 10 or 20 more. In this way, the work and learning diffuses organically and rapidly throughout the entire community over time.

An internet site and online community forums could greatly enhance this process by providing a repository for training manuals, documentation, as well as a place to share

²⁴ This comes from Richard Beckhard as quoted by Peter Senge in *The Dance of Change*, p. 14.

learning across groups and a collection point for the modelers to gather input. This has the desirable side effect of strengthening community and organically building a powerful communication network with broad reach that will prove invaluable when it comes time to “broadcast intention” and “act in an instant,” as described in the previous section. This process builds its own social infrastructure as it progresses.

The “fractal” diversity is very important to ensure the dialogue process can be effective in mapping the system, as described previously in this paper. However, attention should be paid not only to the diversity of interests, background, and experience, but also the diversity of social trust networks. This is important because the expansion of participation will occur organically as people involve those within their trust network in the process. If there is too much overlap of the networks of the participants large groups of stakeholders may never (or belatedly) be involved, which will create systematic “holes” in the model and political tensions, which could sabotage implementation later.

The participation structure described above requires that people have an incentive to participate willingly and openly. There are many incentives that are unlikely to work. For example, paying people would be prohibitively expensive and ineffective. Since participation will be essentially voluntary, the process must be rewarding in and of itself. People will not participate for long if they are not getting benefits from the process along the way. The desired outcome, sustainability and a high quality of life, has power to keep people engaged as well if participants actively *feel* it as a source of inspiration. This is best accomplished through a process of visioning in which participants articulate a shared and vivid vision that is invoked and recreated throughout the process.²⁵ A shared vision creates a source of “creative tension” between what is today with what is possible that is a powerful motivator.

The vision is also very important because actual, discernable progress is unlikely to appear for quite some time. It will help sustain momentum. This is a product of the need to “cross the threshold.” For a long period of time it will not appear that anything substantive is changing while the participants harmonize their mental models and build relationships. Another way to address this apparent lack of progress is to develop indicators of the extent of mental model harmonization and the new relationships built. Then this important work will be recognized and appreciated.

Some of the benefits of the process that can keep people engaged are new and satisfying relationships, new insight and learning that can help them in their lives, fun, and a sense of being involved in a positive movement larger than themselves. These benefits should be given serious consideration in order to ensure that every contact participants have with the process provides them in proportion to the commitment of time and energy required of the participants.

²⁵ See *The Fifth Discipline* by Peter Senge, 1990. Chapter 11.

Application of the framework (Phase I): The Boston Foundation, Summer 2001

This section of the paper provides an illustration of the application of the theory outlined above, specifically focused on Phase I of the process. Prior to the summer of 2001, a published collection of 70 community sustainability and quality of life indicators for the Greater Boston region had been articulated through a community process led by The Boston Foundation Indicators Project.²⁶ None of the interrelationships had been explored, and the Boston Foundation (TBF) was looking for ways to understand the underlying system and to identify high leverage strategies for change. This is what initiated my collaboration with TBF.

After initially piloting some group modeling with TBF staff, a project to develop a series of workshops for engaging a broader range of stakeholders was undertaken. This new workshop was first tested with a small, diverse group of stakeholders.²⁷ They were asked to provide feedback, which led to a complete reworking of the workshop format to make it more interactive and discovery-oriented rather than didactic. This workshop was then offered eight times to a total of nearly 150 stakeholders from across all segments of the region and revised iteratively based on the feedback solicited from each group. It is important to note that the theory presented above represents an attempt to explain and extend the lesson learned in this iterative process. Thus, the theory itself has also emerged organically and will continue to be refined and expanded based on future engagements. As a result, the process outlined here does not live up to the theory entirely in ways that will be explained below. Were we to offer the workshops again, some changes would certainly be made and are described below.

The final workshop format consisted of five reinforcing activities²⁸ that occurred during a span of three hours.

- 1) Create context and provide ground rules.** Participants are first given the overall context of the Indicators Project and their role within it. The importance of their contribution is reinforced, and ground rules to facilitate dialogue are explained and the consent of the group established. This ensures the group is mentally and emotionally present and open and ready to participate from a productive frame of mind.
- 2) Articulate a shared vision for the future.** This is accomplished by having each individual participant share his or her concrete and vivid vision for Greater Boston for the year 2030 and noting areas of compatibility and conflict across the

²⁶ This initiative was led by Charlotte Kahn and Geeta Pradhan. See <http://www.tbf.org/boston/indicators.html> for an electronic version of the report.

²⁷ Participants included Bob Consalvo, Research Director of the Boston Redevelopment Authority, David Cortiella, Executive Director of Inquilinos Boricuas En Accion (IBA), Anne Gelbspan, Project Manager with the Women's Institute for Housing and Economic Development, Ron Homer, CEO Access Capital Strategies, Marianne Hughes, Executive Director of The Interaction Institute for Social Change, Ted Landsmark, Executive Director of the Boston Architectural Center, and Meressa Pendermon, Grants Analyst with the Mass Community Development Finance Assoc.

²⁸ A complete workshop script is available from the author and can be downloaded from www.brendanmiller.com.

group. Empirically, we found that the visions were nearly always compatible. If they were found to be conflict, time could be spent to try to transcend the differences by thinking win-win. The conflicts that did arise came primarily from people not really thinking far enough into the future. Focusing on the year 2030 has the benefit of encouraging people to think big and giving up some of the short-term positional objectives that may have been preoccupying them. Concrete and vivid visions provide room for creativity of implementation because they do not focus on the “how,” only on the “what.” This cultivates stakeholder commitment, clarifies the long-term desired goal of the community, creates an openness and win-win framing that prepares people to participate in the subsequent dialogue feeling like a team rather than competing individuals.

- 3) **Brainstorm important current trends.** To begin to elicit the concerns and mental models of the participants, they were asked to brainstorm important trends, both encouraging and discouraging, that they believe influence the region’s ability to achieve their shared vision. Participants are not restricted to trends for which data exists so that their true concerns can be surfaced. Each trend is sketched qualitatively so that there is a shared understanding of what has occurred with respect to this trend in the past. These trends are prioritized using a voting procedure, and three selected for further inquiry by small groups. The group is asked to select the trends that will need the most attention and work to ensure they move towards the state described in their shared vision.²⁹ Note that this activity may identify new indicators for which measures will need to be developed and data collected in the future. This activity, in conjunction with the vision, produces a creative tension that motivates the participants to stay engaged in the work.
- 4) **Understand the drivers of the selected trends.** Participants are broken into three small groups and are then asked to consider what factors are driving these trends, looking at the whole region as a unified system. This begins to develop the systems-thinking ability of the participants. Many people are used to thinking linearly and do not have a good intuition for system dynamics. This activity pushes them gently in productive directions to consider interrelationships they may have overlooked before. Facilitators guide this dialogue towards the places in the system where leverage is known to reside, specifically to the role that mental models play.³⁰ (See Appendix A for a visual representation.) This helps them begin to grapple with their own assumptions about the system and challenges the region faces and harmonize their mental models. Time is allowed for the groups to reflect on the drivers they have identified and to look for common drivers across the three trends investigated in the workshop. Implications are considered.
- 5) **Investigate possible high-leverage civic strategies for change.** The three groups are then asked to brainstorm strategies that would ensure that the trends move toward their shared vision. Of course, the full system would need to be modeled

²⁹ The list of these prioritized trends for all eight workshops is included in Appendix B.

³⁰ *Leverage Points: Places to Intervene in a System* by Donella Meadows, 1999. The Sustainability Institute, <http://sustainer.org/>.

computationally in order to know precisely how to do this, but participants were asked to do “mental simulation” to imagine how their proposed strategies would affect the trend. They were reminded that any high-leverage strategy would necessarily need to influence the drivers they identified in the previous step. This activity further engages the system thinking skills of the participants and yields possible strategies that could later be tested on computational models.

Each workshop closed with a chance to provide feedback on the process, which was then incorporated into subsequent workshops. The full record of the contribution of the participants was saved on flipchart paper and will be used to inform future workshops.

Overall, feedback on the process was quite positive. Participants indicated that they enjoyed it, developed an appreciation for thinking systemically, and gained new insights in the system governing the problem of sustainability. However, this workshop failed to deepen relationships significantly, which was one of our desired outcomes. This is likely due to the short amount of time provided for each workshop and the shallowness of the dialogue that was achieved. In addition, although there was considerable diversity among the participants, certain stakeholders were notable in their absence. In particular, business leaders and youth were underrepresented.

A variety of other improvements can also be envisioned. For example, a distinction between exogenous and endogenous trends of concern could be made. This could help participants to recognize what trends the region must respond to (e.g. globalization), and which could be controlled or influenced (e.g. local housing prices). Also, participants could be asked to brainstorm possible future constraints that would prevent the trends from reaching the vision that may not yet be having an influence (e.g. the availability of clean water on population growth). Finally, it would be quite illuminating the look explicitly for drivers that affected *all* of the trends, or consider how the strategies developed for one trend would impact other trends. This would have highlighted their interdependence in a way that was only touched on in these workshops.

Future work with the participants who have been through this workshop could begin to involve some causal diagramming of the systems governing the trends they identified. These diagrams would further enrich their understanding and provide valuable information for the subsequent modeling phases.

Future work: Phases II to IV

As the results from these workshops are synthesized, Phase II modeling could be begun with people who had participated in Phase I. In time, Phase II and III could then be rolled out.

As I have described so far, computer modeling has been assumed to a valuable addition to this process. Is it really necessary? Can sufficient learning come simply from good group process and dialogue? We have already noted that the human brain has important limits in understanding how a system behaves over time (i.e. the system’s *dynamic complexity*). Fortunately, this is something that computer simulation can help with

tremendously. Much in the same way that spreadsheets and databases help us to manage *detail* complexity by storing data and allowing us to organize and look at it in ways not possible without a computer, there are software packages available to help us investigate dynamic complexity too. The package we used for this project, Vensim produced by Ventana Software³¹, makes it possible to create models of systems and then observe their simulated behavior over time.

Some may argue that computational models will never be able to capture the complexity of the social, economic, and environmental systems involved sufficiently to be useful in finding leverage points for action in the system. However, the field of system dynamic modeling has progressed tremendously since its founding, and more and more powerful simulation tools are available each year. In the for-profit sector, such seemingly intangible factors as employee morale and its impact on productivity have been modeled.³² In addition, complex environmental and urban problems have been analyzed using system dynamics.³³ Although these models are not uncontroversial, successes like these give us hope for the application of computational modeling to even more complex social problems.

A final danger is that computer models may be alienating to lay participants because models can be perceived as mysterious “black boxes.” However, if framed correctly, people will understand that computer models support human intuition and understanding, they do not replace them. There are ways to gradually familiarize participants with computer modeling over time to reduce their resistance and anxiety. And it should be noted that the first phase of this proposed process does not rely on the use of a computer at all.

Summary

This paper has presented a framework for structuring community planning for a sustainable future and described a process jointly developed and piloted by the author and The Boston Foundation, implementing the first phase of the framework for the Greater Boston region. This novel framework, which draws from system dynamics modeling and organizational learning, builds on the community indicators movement. We believe it has great potential to create the shared understanding and political will necessary to move Greater Boston, and other communities like it, powerfully towards sustainability.

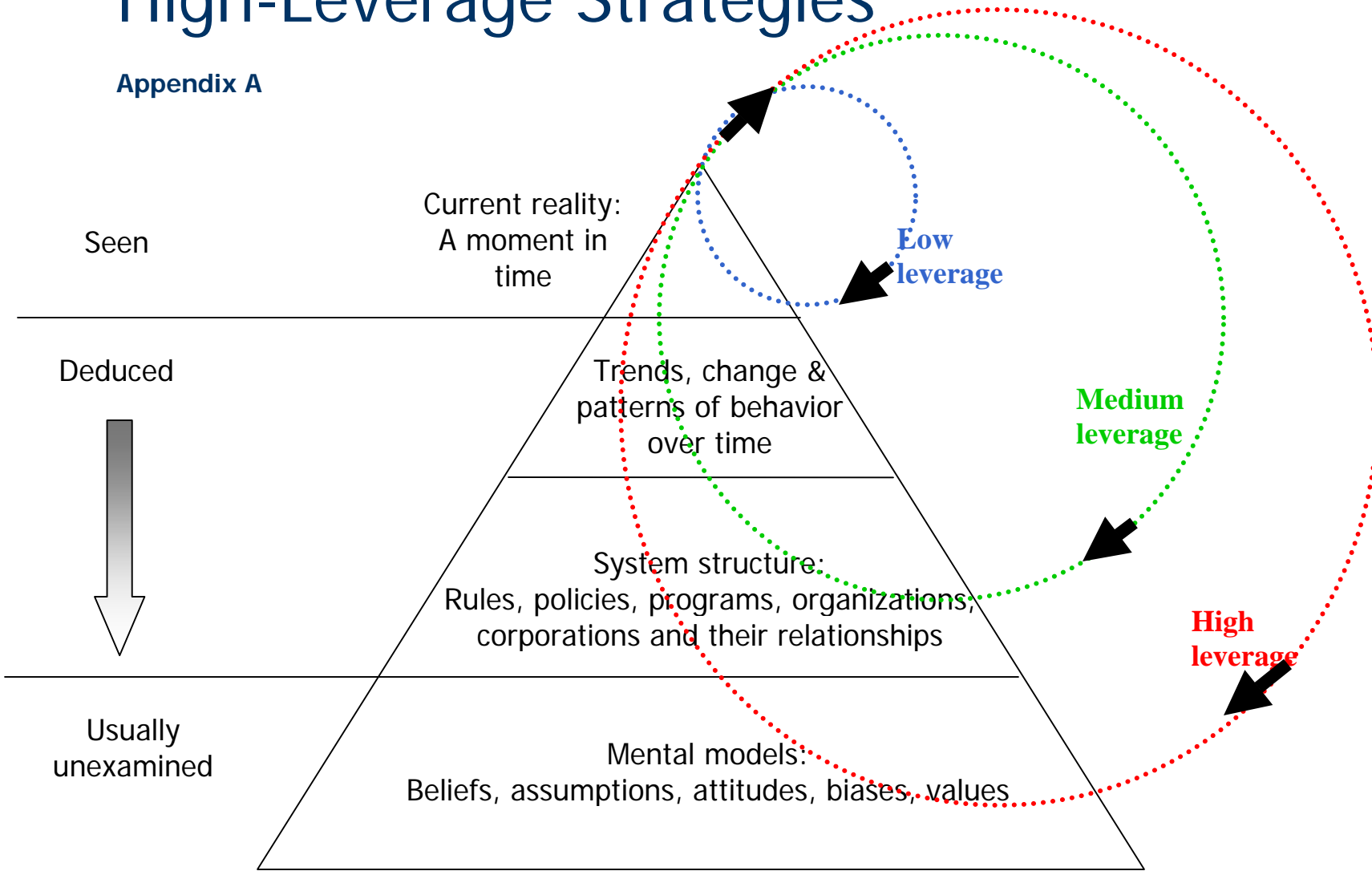
³¹ Visit the Vensim website at www.vensim.com. A free version of their software is available for academic use and demonstration use.

³² See *System Dynamics for Business Strategy* by John Sterman, 2000.

³³ See *The Limits to Growth* by Dennis Meadows, Donella Meadows, and Jorgen Randers, 1974 and *Urban Dynamics* by Jay Forrester, 1969 respectively.

High-Leverage Strategies

Appendix A



Adapted from Innovation Associates, Inc.

Appendix B: Prioritized trends and their drivers, from Summer 2001 Boston Foundation workshops

These key trends and their primary drivers (listed as bullets) were identified explicitly by workshop participants. There is some overlap of trends because this list includes the results from all eight workshops. The bold headings are one way that these trends could be grouped and categorized, but did not emerge from the group process directly. Everything else reflects the work of the participants.

Housing pressures

Trend: Competition for housing resources

- Slow political/public response to change
- Lack of regional focus
- Individualism
- Capitalistic/ free economy
- Growth expectations
- Investment vs. human right
- Who's at the table

Trend: Development pressures (caused by profit maximization)

- Too busy – no time/energy
- Development is so complicated takes deep pockets
- Stewardship vs. individual success/wealth (fragmentation, turf, competition)

Trend: Lack of affordable housing

- Free enterprise vs. community values
- Greater demand than supply
- Industry change: disparity in wages

Trend: Increasing housing costs

- Who is at the table in decision making

Inequality and fair system

Trend: Gap between the rich and the poor

- Attitudinal shift from consumerism and greed to civic/social responsibility and financial planning
- Education levels/system
- Employment opportunities

Trend: Racial disparities in health and education outcomes

- Income inequality
- Belief that people should take care of themselves
- Racism in the health care system
- The profit motive: the bottom line driving the system- health care under-resourced

Trend: Homogenous political representation for a diversifying population

- Status quo-favoring incumbents
- Campaign finance and lack of resources
- Lack of interest and desire to enter politics

Trend: Growing income disparity

- Education system failing
- Types of jobs: missing middle jobs, only high/low skill
- Lack of training/upward mobility: career ladders
- Value some kinds of work but not others (e.g. caregiving)
- Race/class issues: rich can go to private school
- ++ Education system expected to make up for other failings. Ed reform can't succeed where children don't come to school prepared/positioned for success.

Trend: Boston is becoming a polarized city and driving out long-term residents

- Homeownership rates
- Public education system denies residents opps to good jobs
- Capitalism: max profit
- Community org/empowerment

Community

Trend: Historical antagonisms across race, income, neighborhood - **look this up again**

- Parochialism within neighborhoods conflated with cultural survival
- Redlining and housing prices
- Unrepresentative people in power

Trend: Loss of community and connectedness

- Need for more than one income/job (living wage)
- Fewer community institutions
- Not as much time for community

Trend: Changing urban neighborhoods

- ++ Rapid population change
- Lack of affordable housing leads to polarization
- Loss of local employment base
- Lack of social capital, local leaders, and neighborhood identity

Trend: Loss of neighborhood communities

- Lack of community connection through activities/uses (schools, orgs, parks, comm. Centers) and support structures
- Changing family household structure and structures to support them and help manage change
- Corp, tech, and inst. Changes (TV, computers, autos) that affect lifestyle and create isolation

Trend: People taking responsibility for self, others, community

- TV watching process and content
- Consumerism/selfishness/wastefulness

Environmental quality and awareness

Trend: Environmental quality

- Lack of education
- Culture of immediate short term values

Trend: Growing environmental awareness

- Redefinition of environmental issues so that they are more relevant to Boston's diverse population
- Intense personal/shared experience (both + and -) and a taste of success that gives you a sense of possibility

Youth

Trend: Increased youth involvement in community service, development, and improvement

- Adults recognize need to provide youth w/ afterschool programs in response to long hours worked by adults and 2 income or single parent households
- Local champions/leaders
- Less time – need to work and go to school
- Rising youth volunteerism

Trend: 18-24 year olds checking out of political process

- Me first: materialism, individualism, focus on present, economic pressure
- Loss of community: Lack of role models, lack of peer involvement, high mobility, government isn't us (mistrust)
- Why bother? Belief that participation doesn't matter, issues are perceived not to address this age group

Education system

Trend: Standards based education

- Professionalization of many things that used to be the province of parents as "first educators": outsourcing parenting
- Weakening of civic capital in family unit drives many of these things: family can't because comm. Doesn't support it to do that