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Barry Richmond, System Dynamics and Public Policy

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Abstract
Barry Richmond left a rich legacy in many application areas of system dynamics, including the field of public policy. The paper identifies a key belief that motivated Barry's efforts in this arena. It draws out Barry's view of the relative value-added of various system dynamics activities, explaining Barry's bias toward simpler, smaller applications of the framework, tool and language. The paper then distills five principles which characterize Barry's work in public policy, illustrating each with a recent example. The paper concludes with a brief reflection on what it might mean to carry on Barry's legacy.

Introduction
Barry Richmond was one of those larger-than-life characters whom one seldom encounters in this world. His incisive intellect, his passion for building understanding, his gifts as a teacher and as a communicator, his boundless energy, his charisma, and his intellectual curiosity put him in a class by himself. For those of us who counted Barry as a colleague, collaborator, or friend, his passing in August of 2002 created a huge gap in our lives, a gap that will not soon be filled.

Barry's death created a gap in the field of system dynamics as well. At a memorial service shortly after Barry's death, several speakers—family, friends, and professional colleagues—commented on what Barry's life had meant to them. Toward the end of this service, Peter Senge spoke briefly. Peter stated that he was struck by both the importance and the incompleteness of Barry's work, noting that it was "up to us" to continue this important work.

Since Barry's death, I have spent a lot of time reflecting on his life and on his contribution to the field. I've been wrestling with a host of questions, including the following: What *was* the essence of Barry's work? Where *was* he "coming from" in his approach to system dynamics? Are there distillable sets of operating principles and learning strategies that guided Barry's work? What can mere mortals do to continue Barry's work if we so desire?

In this brief paper, I explore Barry's contribution to the use of system dynamics within the context of public policy. The paper is composed of two major parts. In Part 1, I sketch with broad brush a conceptual framework, in an effort to put Barry's work in a larger context. I identify the fundamental belief that I contend provided the motive force for virtually all of Barry's professional activity. Additionally, in Part 1 I outline how this belief played itself out, in terms of Barry's view of the relative value-added associated with various system dynamics oriented activities. Part 2 turns its attention to Barry's work in the arena of public policy. In Part 2, I distill five "operating principles" that I believe sculpted Barry's system dynamics work, illustrating these principles using Barry's public policy-oriented work. These five principles can be viewed as a set of guideposts or design criteria for adding value with system dynamics. While these principles are specifically applicable to work in public policy, they also have applicability in business, in education, and in other areas of inquiry. Finally, by way of summary, I offer a few thoughts about the nature of Barry's legacy in the realm of public policy, and about how one might build upon that legacy.

A Broad-Brush Conceptual Framework

To gain a deep understanding of Barry's work, it is first necessary to have some sense for where he was "coming from." What motivated his activities? What were his ideas regarding the real value of system dynamics?

Fortunately, Barry left a good paper trail that documents his thinking. For example, the STELLA and ithink user guides (HPS, 2003) do an excellent job of presenting Barry's view on how to "do" system dynamics. Various white papers available from Pegasus Communications develop Barry's thoughts about the key thinking skills behind the effective practice of systems thinking. These are great reference materials, and I would highly recommend them.

I contend that there was a fundamental belief that provided the motive force for these and other efforts. This belief is simple to state, and all-encompassing in its outlook. It gives a clear sense for where Barry was "coming from" in many of his professional endeavors. I like to phrase it this way:

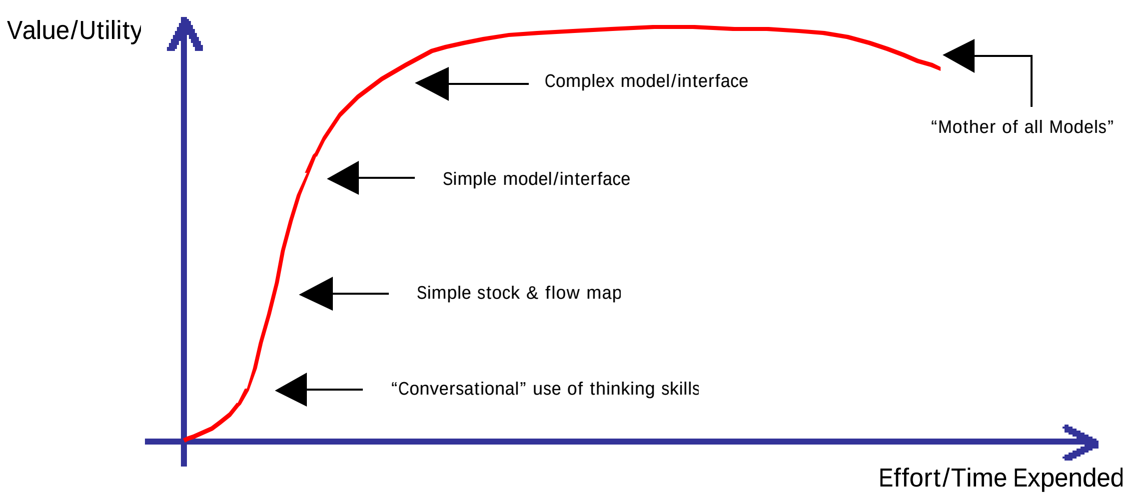
> "The framework, tools, and language of system dynamics should be accessible to all. *Anyone* can do this at some level, and *everyone* should try!"

This belief is an assertion about the nature of the value of system dynamics. It's an assertion that the primary value of system dynamics consists in the *process* not the *products* of that process (although Barry would readily agree that products were important, too!). It's also an assertion about who should be doing this stuff. Barry's take: *Everyone* should be doing this to some degree. As more people use the framework, language, and tools to generate generating systemic insight—and act accordingly—the more likely we will be to solve the big problems facing the world today.

Over the time that I worked with Barry, this deeply-held assumption usually lay beneath the surface of conversations, forming the sub-text for our work together. But it was never very far out of sight. This assumption would often come to the surface in the context of a formal presentation, an essay, or a paper. Consider, for example, Barry's contribution to the 1985 System Dynamics conference held in Keystone, Colorado. This paper introduced the STELLA software to the world. It was entitled *STELLA: Software for Bringing System Dynamics to the Other 98%*. The title clearly reflects Barry's fundamental belief that everyone should be doing this. Or consider the paper Barry presented at the 1994 Conference in Sterling, Scotland. That paper carries the provocative title of *System Dynamics/Systems Thinking: Let's Just Get On With It.* Early in the paper, describing the spirit embodied in the STELLA software, Barry uses this characterization: "The feeling was: anyone can do this, and everyone should try. No few and privileged here!" Elsewhere in his paper, Barry asserts that we "have something…that is quite unique, quite powerful, and quite broadly useful as a way of thinking and or learning. It's also capable of being quite transparent—leveraging the way we learn biology, manage our businesses, or run our personal lives…"

It's important to ask how this belief played itself out in Barry's professional career. I would assert that huge part of Barry's life was devoted to turning his deeply-held belief into reality. Accordingly, over time this belief found its expression in a variety of products and services, including software, various learning environments, workshops, and specific client deliverables. The common theme in these efforts was one of increasing the base of people who could partake in the process of *gaining value by doing* system dynamics.

For me, a simple graphic below nicely captures our view of the nature of this value added, as it applies to "the other 98%". This graphic, adapted from one presented in workshops that Barry and I led for many years at HPS, gives a very clear picture of our perspective on the relationship between expending effort and deriving value.



This graphic relates effort or time expended to the value or utility that one can expect to derive from expending that effort. As the curve shows, there is significant value to be added from simple "conversational" uses of the fundamental thinking skills. Examples would include drawing a reference behavior pattern to cast a problem in dynamic terms, "elevating" from the specific players to characterize an issue in generic terms, or asking operational questions such as "how does this work?"

Another quantum increment in value/utility can come at relatively low cost from the creation, simulation (*mental* simulation), and communication of a simple stock & flow map. A third quantum increment in value can be added, again at relatively low cost in terms of time or effort, by transforming a map into a running simulation model, perhaps with a simple interface to facilitate controlled experimentation.

Note that once you move past simpler applications, diminishing returns can quickly begin to set in. As the complexity of the model increases, in our experience the amount of effort, skill, and time required to underwrite that complexity increases *disproportionately relative to the amount of value derived!* Out at the end of the curve, it may well be that adding complexity may result in *negative* returns.

If one puts together Barry's core belief with the more experientially-derived view of the nature of the value added from doing system dynamics, it's a bit easier to see the essence of Barry's vision for the use of system dynamics in pretty much any context. A very simple characterization of Barry's vision might include the following key points:

- Anyone *can* do this at some level
- Everyone *should be* doing this at some level
- There are many ways to add value. Specifically, one doesn't need to build large models (or even running models!) in order to gain value.

Five Principles: Guideposts for Barry's Public Policy Efforts

This section distills what I believe are key principles that guided Barry's public policy efforts. The principles fall into three broad categories, associated with the three activities that Barry viewed as fundamental to any modeling effort, as outlined below:

Building

1. The Principle of Operational Thinking
2. The Principle of Irreducible Essence

Simulating

3. The Principle of Controlled Experimentation

Communicating

4. The Principle of Mental Model Confrontation
5. The Principle of Controversial Topics

In the discussion which follows, I'll consider each principle in turn. For each, I will begin by providing a brief definition, highlighting the key implication of the principle—the "so what" associated with its use. And finally, I'll illustrate the principle by drawing from some of Barry's public policy work.

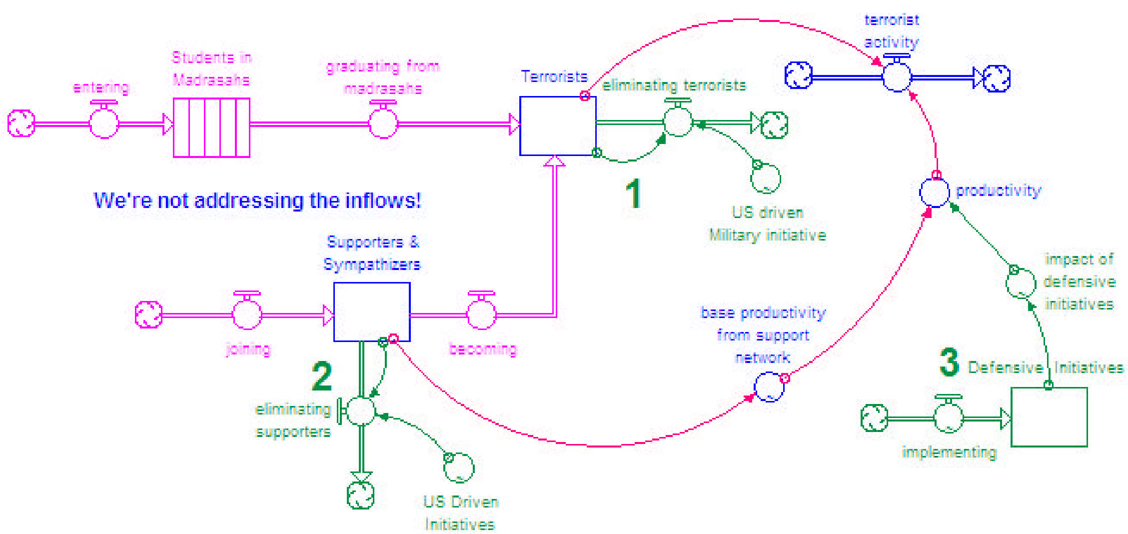
Principle 1. The Principle of Operational Thinking

This principle was at the bedrock core of Barry's work in system dynamics. Barry himself viewed operational thinking as *the* key thinking skill required for the effective application of system dynamics.

Operational thinking entails getting to the essence of how a process works. It involves asking questions about key accumulations and flows in the system. It requires careful thought about the physical relationships that generate flow processes. The effort is one of building understanding of *how it works* rather than simply listing the *factors that influence* the process.

The "so what" of operational thinking is this: it facilitates the identification of levers for changing system performance. If you understand how a process works at a fundamental, physical level, you are in a solid position systematically to walk through the policy space, asking focused questions about alternate proposed policy interventions and more accurately thinking through the implications of a proposed initiative. If, on the other hand, your thinking consists of simply a laundry list of factors that influence the process, your efforts to identify levers for actually *changing* the process may well be limited.

An excellent illustration of operational thinking can be found within Barry's presentation at the 2001 Systems Thinking in Action Conference. This conference took place a shortly after the September 11 airplane hijackings. Issues associated with international terrorism were very much on the minds of participants at the conference. Here's one part of a storytelling progression within Barry's presentation:



This little stock/flow map very nicely captures the essence of the process. Note the salient features of the map:

- Terrorist activity is represented operationally as a flow—generated by terrorists, each with an associated "productivity" term. From this map, you can identify two fundamental ways to reduce terrorist activity: either reduce the number of terrorists, or make terrorists less productive.
- The policy space for directly attacking the problem is clearly mapped (eliminating terrorists, eliminating supporters, and implementing defensive initiatives).

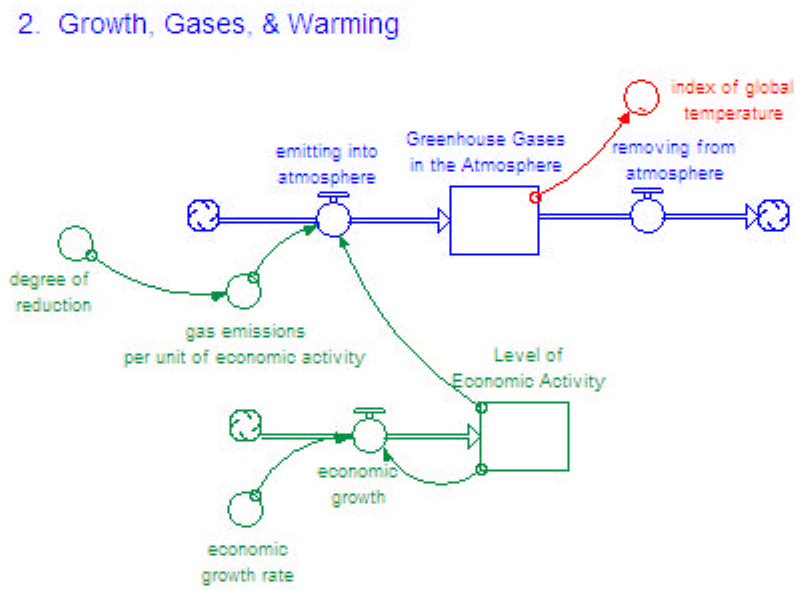
- The diagram captures both the outflows *and the inflows* to the terrorist stock. In so doing, it identifies the levers for *long-term* improvement in the performance of the system

Principle 2: The Principle of Irreducible Essence
This principle is simply a variation of the old KISS principle. Another way to state the principle is to use Einstein' maxim: A good explanation is one that is as simple as possible, but not simpler. Or, to use Occam's razor: A simple explanation is to be favored over a more complex one. Following the Principle of Irreducible Essence, one recognizes that simplification is necessary in order to make sense of the world—it's impossible to hold *all* the relationships in your head. The challenge is one of preserving the relevant essence of that part of the world upon which one wishes to act.

The "so what" of this principle is twofold. First, it enforces a mental discipline that can lead to greatly increased clarity of explanation. Second, it *greatly* increases the set of people who can derive value from the effort.

In a public policy context, Barry's "Stories of the Month" (HPS, 2001-2003) provided multiple opportunities to view the principle of irreducible essence in practice. These stories typically used a simple stock/flow map or a small simulation model to provide a systems perspective on current events in the news. An excellent example of this principle at work can be found in the story that Barry was working on at the time of his death. This story, entitled "Hot Air and Greenhouse Gases" was motivated by some dynamically sloppy statements about global warming, coming out of the White House in the summer of 2002. Among other things, there were statements to the effect that the president had a plan that would reduce greenhouse emissions while sustaining economic growth. Apparently, implicitly this was to result in a reversal in global warming trends.

In response to these statements, Barry could have developed an elaborate model of greenhouse gases, or he could have pointed people to large, detailed models produced by others on this topic. Instead, Barry began working on a very simple model and story. Here's a diagram taken from the story.



This diagram is stark in its simplicity. It provides just enough of the relevant essence of the issue to get at the dynamics of the greenhouse effect in a simple and compelling way. It includes just enough structure to facilitate investigation of the relationship between reduction in greenhouse emissions in a productivity sense, and the increase in economic activity that is serving as the base for generating greenhouse emissions.

Principle 3. The Principle of Controlled Experimentation

The principle of controlled experimentation is a simple yet powerful one. It entails making one-at-a-time structural or parametric changes in the model to facilitate simulation experiments.

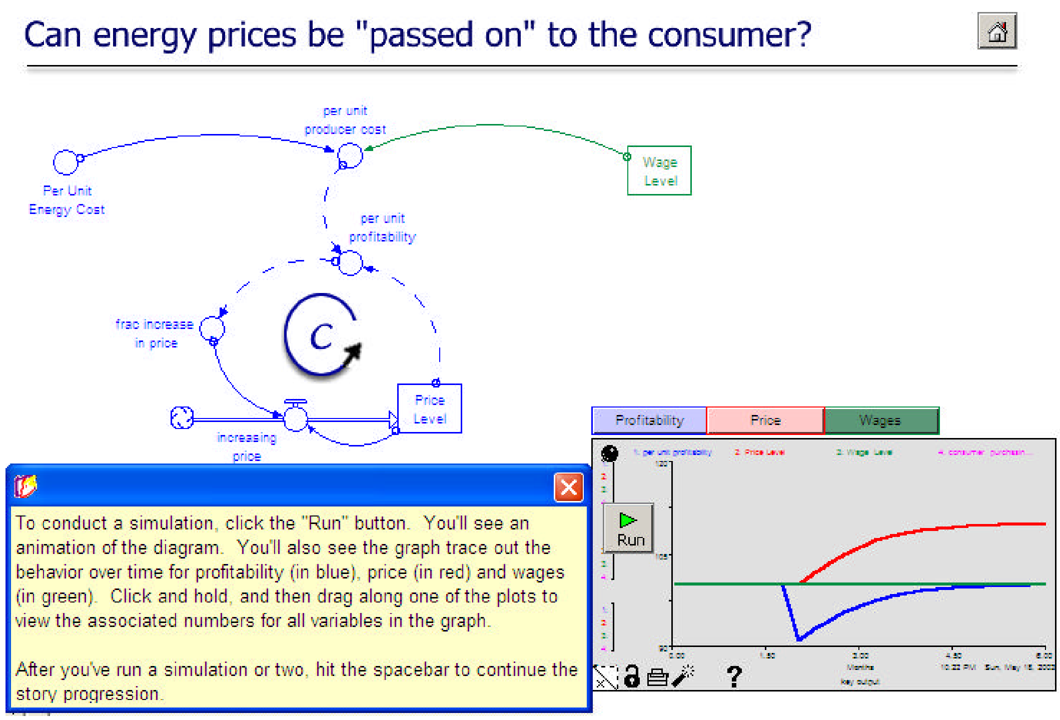
The "so what" of this principle is both rich in its implications. Controlled experiments add value directly, by building understanding. They add value indirectly, by building capability. The obvious direct value added of controlled experimentation is the role that it plays in building individual understanding. By making a one-at-a-time parameter or structural change, one has a clear basis for learning why a model behaves in a particular way. Mental simulations can be compared against computer simulations, with any gaps between the two providing the impetus for modifying one's mental model of the situation. By designing a set of controlled experiments that operate cumulatively (in which a small structural addition provides the basis for a simulation experiment, which provides the basis for the next structural addition, and so on), it's possible to bootstrap ones knowledge in a systematic and efficient manner.

A second result is that simple, controlled experiments can create the activity basis for building a *shared* understanding. A sequence of controlled experiments can yield extremely productive conversations, particularly when the results of experiments are compared against the results of mental simulations. Differences of opinion can be discussed; commonalities of thought can be identified; tacit assumptions can be surfaced.

Less directly, controlled experiments simulation are like aerobic exercise or strength training, building an individual's capacity to accurately trace dynamics and to make structural/behavioral connections. Barry was a firm believer that humans simply weren't very good at doing mental simulations of anything except the simplest of systems. Nevertheless, he believed that people could build their mental simulation capacity through sustained practice. Indeed, this was one of the methodological motivations behind the Story of the Month concept.

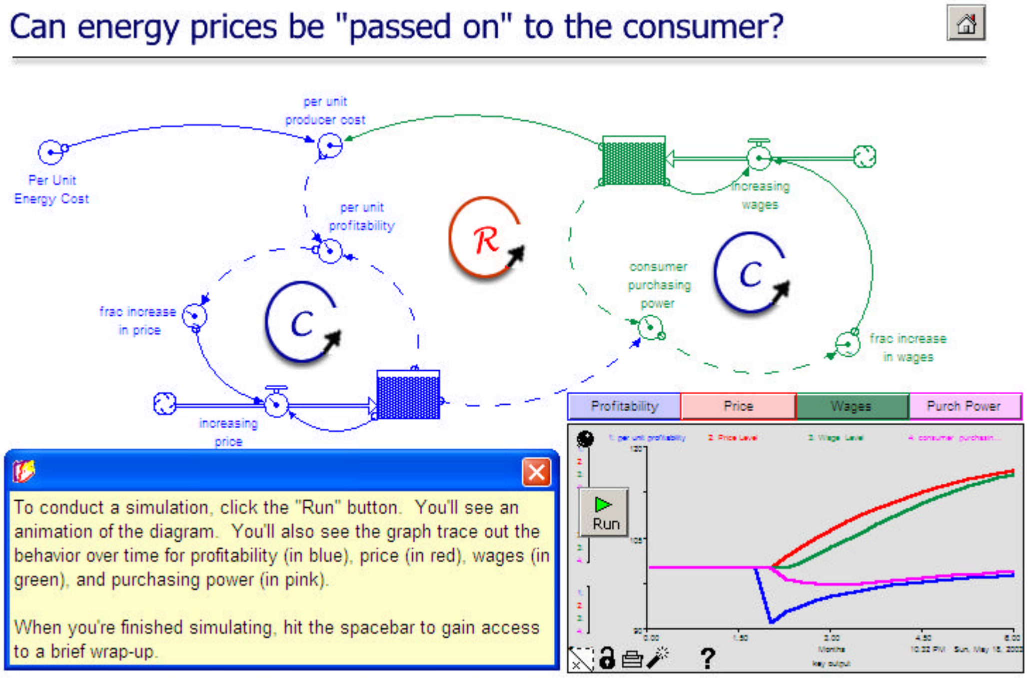
Many of the stories reflected this principle. An interesting one to consider is the very first Story of the Month produced by HPS. The context for this story was the pre-Enron-debacle run-up in energy prices in California and elsewhere in April of 2001. Barry was in California at the time. Everywhere he went he read news articles about organizations that planned to simply "pass on" increased energy prices to consumers. This raised a very interesting systems question: Is it possible for *everyone* to pass on costs? Or is there some self-limiting process at work?

We developed a simple story to address the issue. The first part of the story looks at raising prices in response to step-increase in energy costs, as shown below:



As the graphic shows, there's a nice self-corrective process at work here that uses price as a mechanism to keep profitability at desired levels. A simple, controlled experiment!

The next step in this progression is to expand the model boundary just a little bit, adding some structure that relates increasing prices to decreasing purchasing power, and hence, to upward pressure on wages. Again, experimenting with a step-increase in energy costs we get some very interesting results:



By using controlled experiments in a simple progression, it's possible to build understanding, stimulate good conversations, and strengthen mental simulation muscles.

Principle 4. The Principle of Mental Model Confrontation

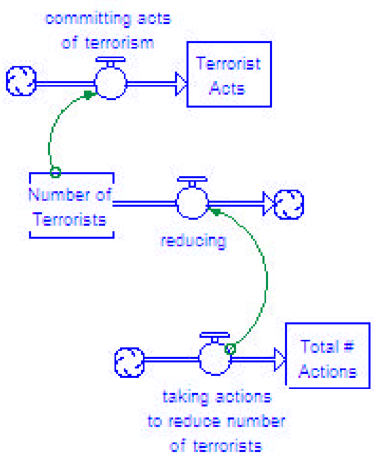
Like the principle of controlled experimentation, the principle of mental model confrontation is simple but powerful. Whenever possible, bring the prevailing mental model to the surface of the discussion. Explore the dynamic implications of that mental model. Then, provide an alternative mental model (often in the form of a stock/flow diagram) that offers benefits such as a better explanation, a more robust policy suite, or an improved insight into the issue at hand.

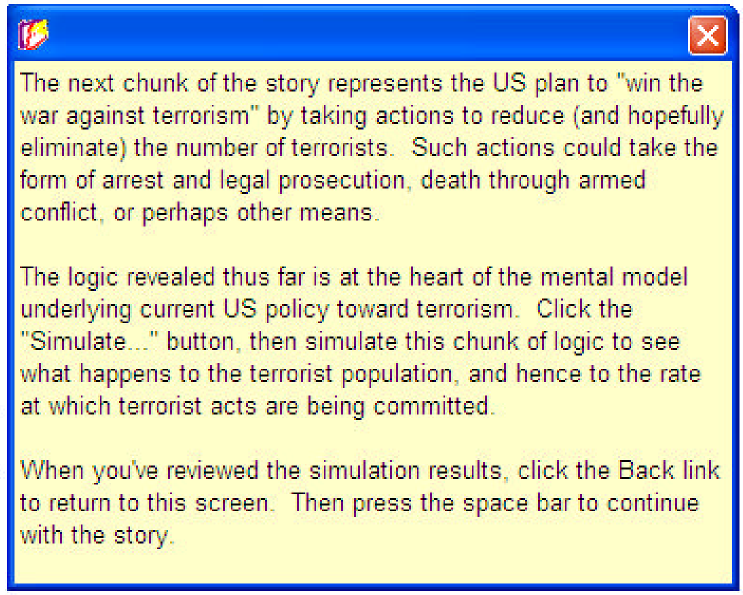
The process of confronting the prevailing mental model is a key part in creating a compelling case for changed behavior—often the desired outcome of work in public policy. Implicit assumptions can be surfaced and critically scrutinized. When there are multiple, conflicting mental models involved, the principle of mental model confrontation can be used to facilitate communication among key stakeholders. There's learning to be had when mental models are systematically compared, tested, and evaluated!

In Late September, 2001, Barry put together a story of the month on terrorism. This story very nicely illustrates the principle of mental model confrontation. In it, Barry begins by…

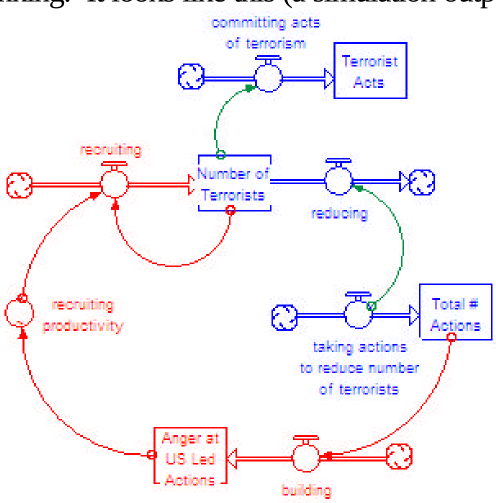
> "…surfacing the mental model underlying such rhetoric [the rhetoric of the Bush administration in response to the September 11 attacks, for example, 'leading the world to victory in a war against terrorism'] so you can critically examine its implicit assumptions."

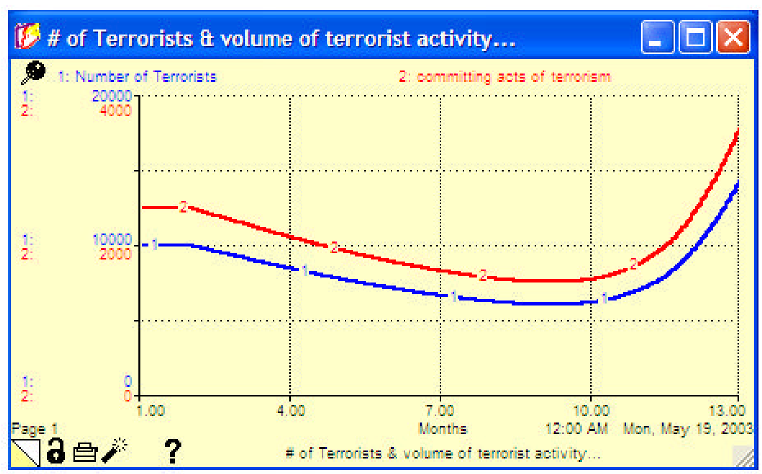
The resultant map, and Barry's characterization of it, looks like this:





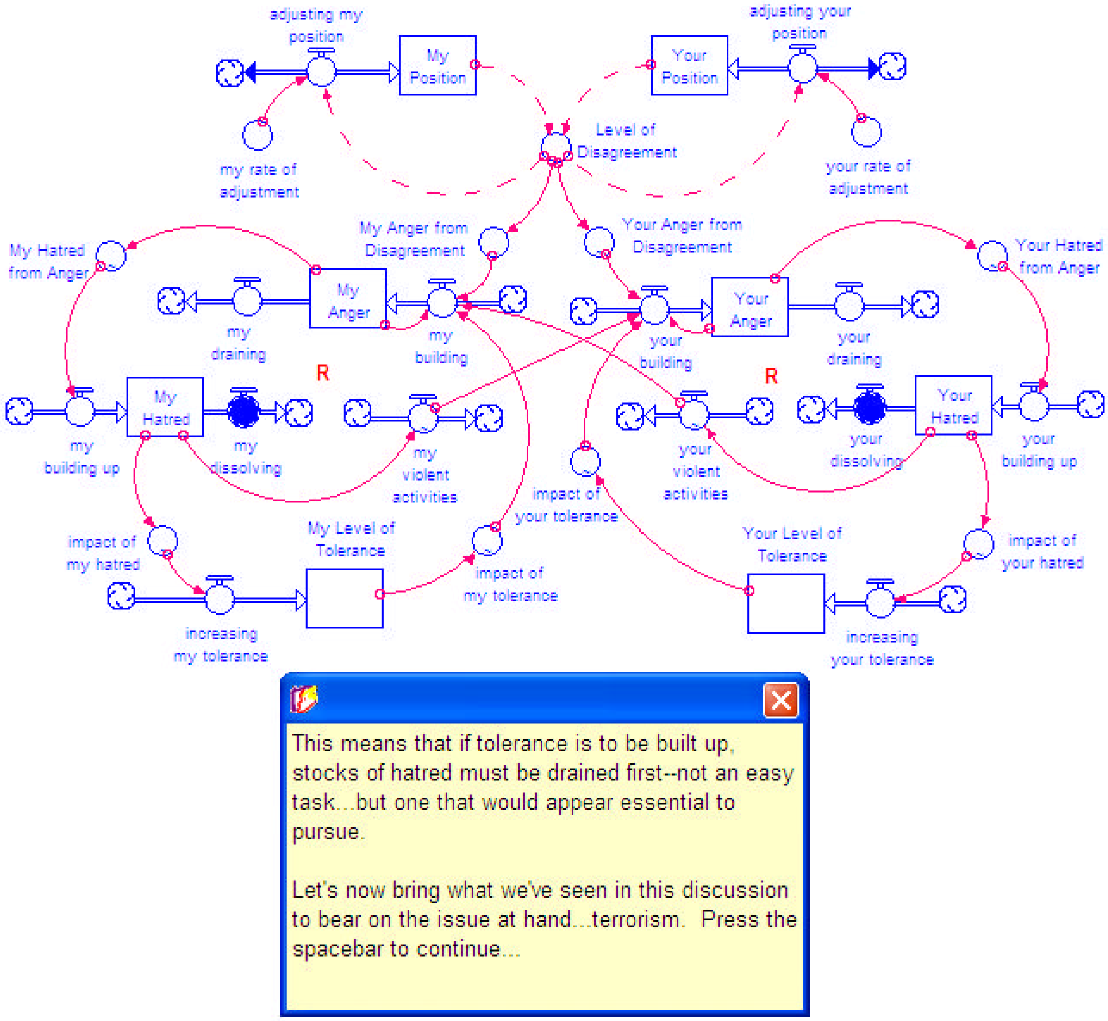
Next, Barry builds upon this simple mental model to offer a critique of the prevailing thinking. It looks like this (a simulation output graph is shown with the diagram:





As the graph shows, adding a bit more richness to the structure leads to longer-term difficulties for the "war" on terrorism. In the long term, the reinforcing loop associated with the recruiting process, as turbocharged by increasing anger at US-led actions, leads to a rapid growth in terrorists and to the committing of terrorist acts.

Later in this story, Barry offers a systems thinking based alternative to looking at the situation. The alternative consists of two components: a *defensive component* that minimizes current threat, and an *offensive* component that gets what Barry sees as the root cause of terrorism. Barry's map of the offensive component is rich in its use of qualitative concepts. Building it up a piece at a time, Barry ends up with a map that looks like what's shown below. This map has a lot in it! You should focus on the note text and on the highlighted flows that drain stocks of hatred, as these are key components of Barry's thinking about the locus of an effective policy.



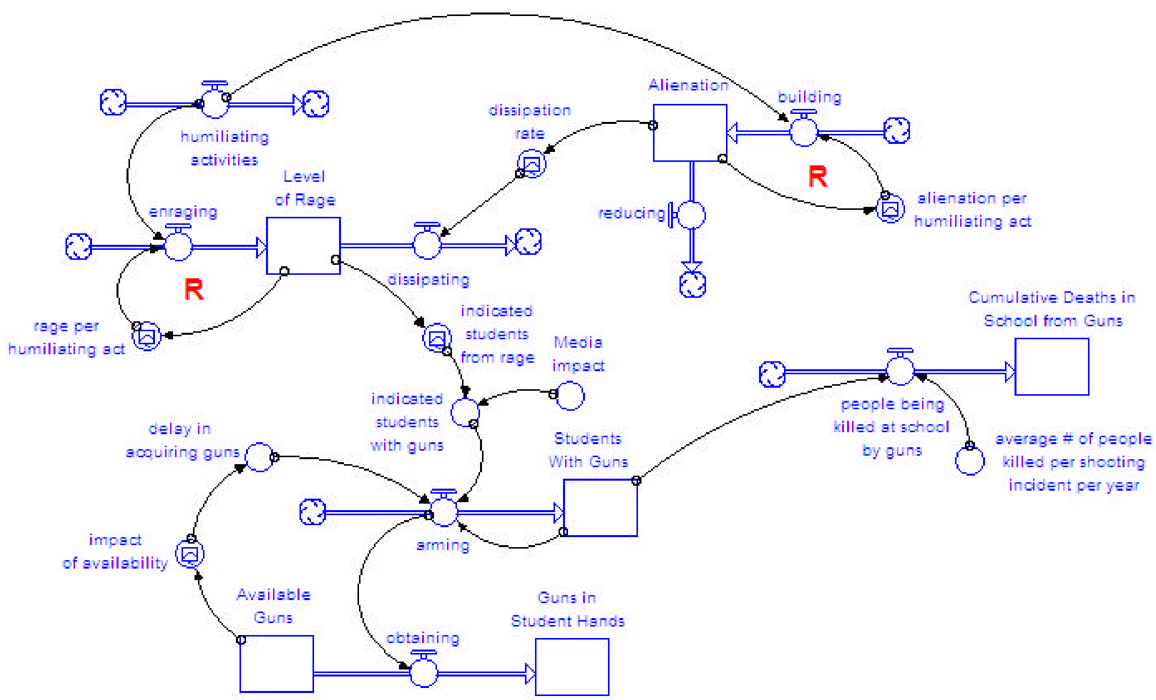
In this map, notice the refocusing of the issue from one of "winning the war" to one of building tolerance of another's viewpoint, managing anger, de-fusing hatred, and maybe even adjusting one's position. By initially confronting the mental model that appeared to be prevalent in the Bush administration, Barry sets us up to hear what he has to say in the way of a systems thinking-based alternative.

Principle 5. The Principle of Controversial Topics

This principle flows directly out of the Barry's deeply-held view that anyone could (and should be able to) use the language, framework, and tools of system dynamics in a productive way. He believed strongly that an informed layperson could generate insight into *any* topic of interest. For Barry, controversial or "hot" topics were especially important to pursue. Often they have the least clarity around them. They're often the most confusing or perplexing, and therefore the most potential for value-added through the use of system dynamics!

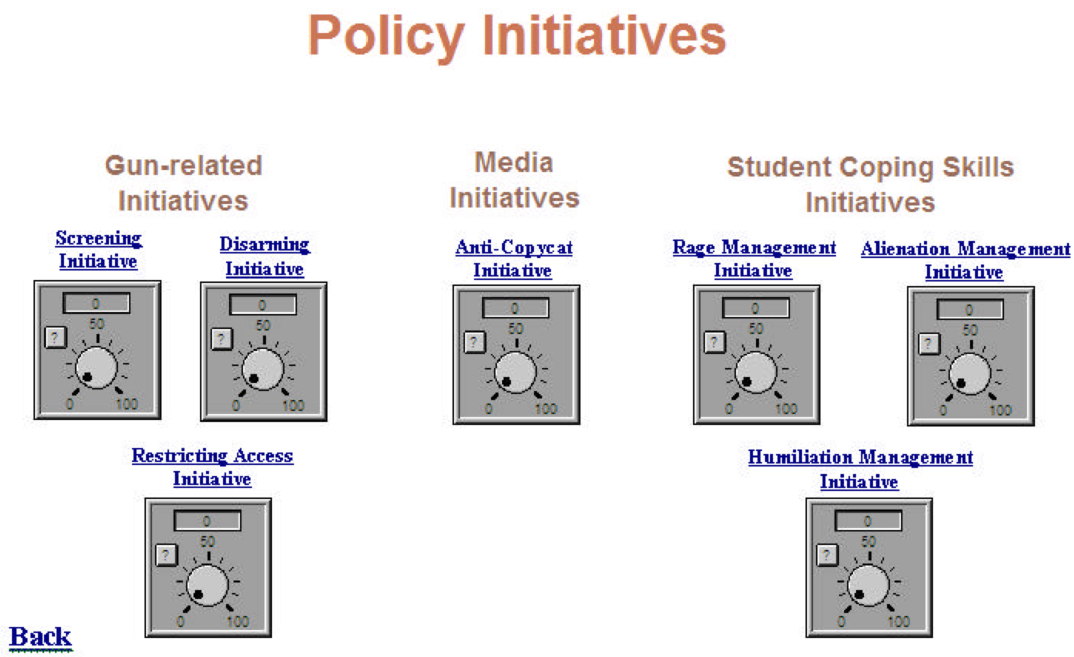
I've interspersed several of these controversial topics through this paper thus far. To make the point very clearly, I'll introduce one more controversial topic that Barry worked with in his story of the month series. In response to the tragedy at Columbine high school and at other schools in the United States, Barry put together the "Guns at School" story. Barry wrote, "Until we have a solid grip on the relationships responsible for producing and maintaining this scary phenomenon, we have scant hope of doing much to effectively address it." His story was an effort to come to grips with these relationships.

The story begins with a brief history of gun-related school violence, and then incrementally develops a stock/flow map that seeks to explain the phenomenon. The map is shown below:



This map depicts the progressive buildup of alienation, and rage, relating these to the acquisition and use of guns within a student population.

Against this model backdrop, Barry sets up a set of policy-based experiments. The "policy space" is shown below.



Readers are encouraged first to conduct one-at-a-time controlled experiments, Then, in a second round, they are encouraged to create a "policy cocktail" that is effective under a wide range of behavioral assumptions regarding the speed of buildup of rage, the rate of dissipation of alienation, etc. The intent of these experiments is the same as the intent behind the model structure: To provoke thought and to stimulate discussion as it promotes an exploration of the relationships that drive this pressing social issue. Is the topic controversial? Yes! Is the story helpful in shedding light? *Absolutely*!

Wrap-up: Barry's Legacy in the Application of System Dynamics in Public Policy
In the realm of public policy, Barry did not have a huge publication record. Most of his work was done in the context of client work, or more recently in the context of presentations or stories of the month. I do not think that Barry's work, by itself, is where his legacy resides. Rather, as befitting the teacher that he was, Barry's real legacy in public policy work resides in the mind-set that he brought to his work, along with the principles that he employed in doing this work.

The mind-set that Barry brought to his public policy efforts fueled his zeal, particularly in his stories of the month. *Anyone* can do this at some level, and *everyone* should try. In doing "this," there is significant value to be added with simple uses of the framework, tools and language. One doesn't need to develop a complex model in order to derive quantum improvements in insight.

In terms of principles that Barry employed, I've identified five that are particularly relevant in his public policy work. Operational thinking, irreducible essence, controlled experimentation, confrontation of mental models, and the effective use of controversy are key attributes of the typical Richmond effort in public policy. This package of attributes makes Barry's work easily identifiable in the world of system dynamics.

For those of us who wish to "carry on the work," I believe that there is much to glean from this legacy. For me, the primary lessons are as follows…

- Maybe not *everyone* can do this, but there are a *lot* of people who could do this at some level who currently are not. Those people need access to this stuff.
- Most people/organizations are on the steep part of the effort/value curve. They therefore can derive significant value from conversational uses of system dynamics, from simple stock/flow maps, and from simple models with interfaces.
- The five principles worked well for Barry. They aren't rocket science—although there is some art associated with their application! They ought to work well for me as well.

While it is beyond my ken to consider how one might replace someone like Barry, I believe that it is possible to carry on his work. It will require sustained effort and application, but it *can* be achievable.