
Thinking in Circles: A Method for Drawing System Dynamics Maps



System Dynamics is an approach that makes sense of complex interactions between people, organizations, natural resources – any thing or things whose actions are influenced by others, and which influence others in their turn. Originally developed as a way of understanding natural systems like cell biology or forest ecologies, System Dynamics found a place in management and leadership science 20 years ago, and has been put into use in a variety of private and public organizations.

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Introduction

The following article describes a step-by-step method for creating System Dynamics Maps, for making the leap from hearing a story in which one "smells a loop" to being able to visualize and create a fully formed map of that narrative. This essay assumes a basic understanding of reinforcing and balancing structures and that readers have struggled with trying to make System Dynamics Maps.

The method outlined in the pages that follow grew out of a mutual inquiry with EmcArts clients participating in a Systems Thinking Learning Group, who wanted to know how we "did it" – how we made maps from the stories they told us. Consequently, EmcArts embarked on a reflective process that exemplified the very best kind of Action Learning: watching our own work, developing a model of our own mapping process, and refining that model through several iterations of further observation and model making.

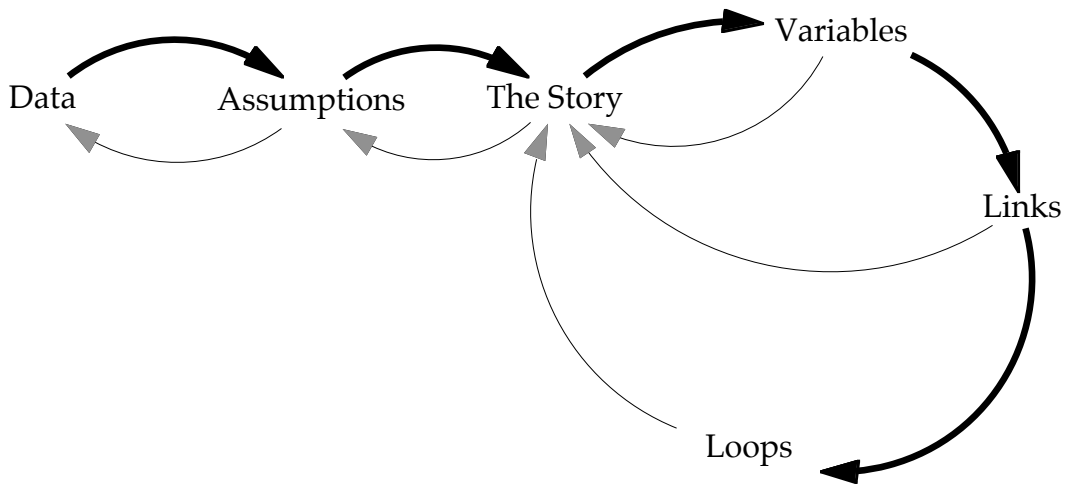
The basic steps to the map-making method are as follows:

- 1. Sense a story.**
- 2. Listen to the story.**
- 3. Listen to the story again, with "variable ears."**
- 4. Identify variables.**
- 5. Create links.**
- 6. See if the links make a loop.**

Two general rules also permeate the method:

Rule #1: As you move through the model, freely use what you learn to revisit and refine work done in earlier stages.

Rule #2: During it all, attend to the assumptions being made, and the way those assumptions are formed out of data.

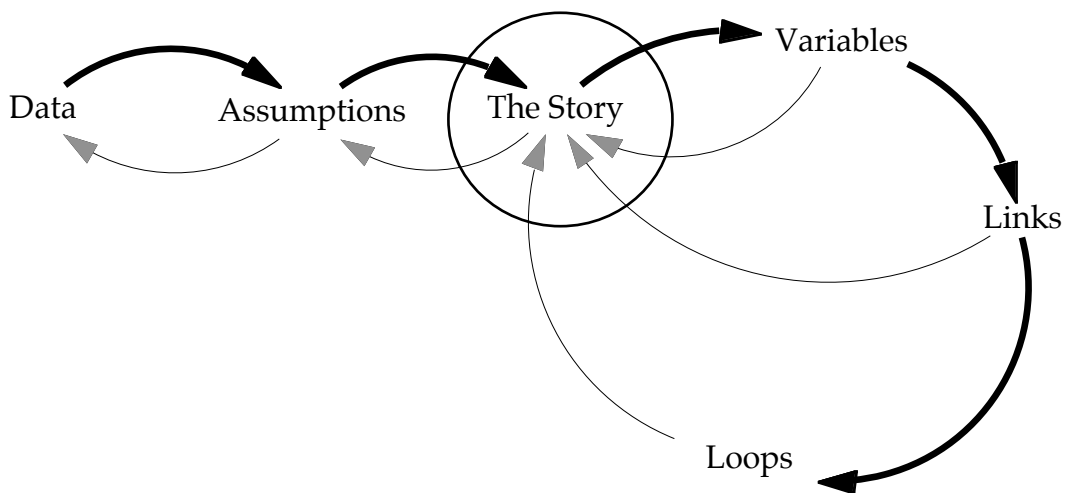


In the diagram above, the arrows with heavy lines connecting the six main steps illustrate the primary path forward toward a finished System Dynamic Map. The arrows with the thinner lines illustrate that the process is iterative (Rule #1), and requires constant attention to the assumption-making process (Rule #2).

The rest of this article explains each step in more detail.

The Method in Detail

The first three steps of this process are all about the story, as illustrated in the diagram below:



STEP 1: Sense a story.

The first step in creating a System Dynamic Map is to recognize patterns that might warrant creating one in the first place.

Everyday, all of us hear dozens of stories that could potentially be described using maps. The ability to "sense" when a systemic structure may be driving the results in a given story is one quality of a developed systems thinker. We call this capacity "system sensing" because more often than not, the realization that a loop may be hiding beneath the surface of

a story usually is not so much a conscious thought ("Oh, I bet there's a loop here.") as an intuition. This gentle tickle somewhere in your consciousness, if attended to, will lead to the thought, "Oh, I bet there's a loop here."

This "system sensibility" is probably the hardest task for the beginning system thinker to understand, let alone develop. It is not entirely clear how one develops this skill other by repeated practice – by drawing System Dynamic Maps over and over again. Honing this skill is a little like learning to be a jazz musician: the best jazz musicians have a musical "sense" of what will work, but that sense usually develops only after many years of scale work and practice.

That said, people do become better at sensing the "system-thinking tickle" during narratives, first, by simply knowing that feeling is there, and second, by listening for it.

STEP 2: Listen to the story.

Once you sense that a story can be mapped visually, listen to the story. Just listen. Listen without trying to find the archetype or the map or anything else. Just listen. This step is crucial for two reasons:

1. Listening closely without other aims or distractions is good discipline. Most people want to leap into action, to pursue insights immediately, the way a dog runs after a bone. The consequence can be that we end up hearing and drawing a narrative we are telling ourselves instead of the actual story that is being told.
2. Drawing loops is a rational process informed by intuition, which requires the involvement of the unconscious. The unconscious is a necessary partner to the rational, but will often not participate unless invited. By hearing the story once with a blank mind, we invite our unconscious to become involved.

STEP 3: Listen to the story again, with "variable ears."

After hearing the story once without looking for archetypes, have the storyteller tell the story again. This time, listen with your attention particularly attuned to **variables**, those elements in the story that change, that are increasing or decreasing over time, trending in one direction or the other or perhaps both at different times. A reliable and accurate map must be built on reliable variables.

For example, consider the following story:

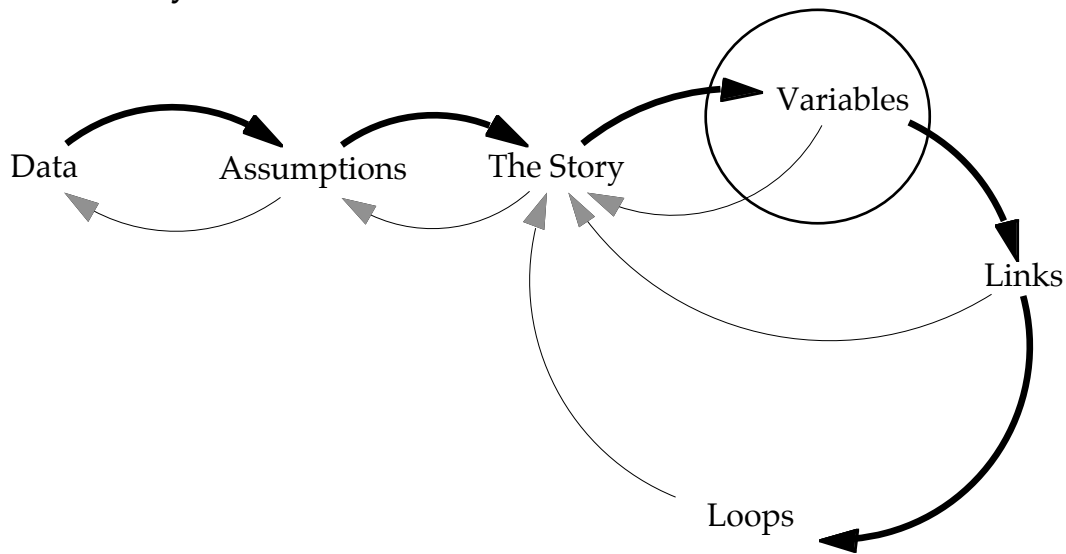
"This stock market is really something, eh? Stock prices are high, so people feel really optimistic, and so they buy more, which drives stock prices even higher. That makes people even more optimistic, so they buy even more stock, driving prices higher again."

In the narrative above, three things changes over time (all increasing): stock prices, market optimism, and buying. Those changing elements are the variables in the story.

If you let the storyteller know that you are paying attention to the variables in a story, you may find that he or she starts to retell it with a "variable tongue," using such phrases as "this goes up" or "this goes down." In other words, the teller's own understanding of the story will begin to shape itself into the raw material of a map.

Note that at this point in the process, you are still *only* listening. In fact, you may be hearing the same story for the third time. That's okay. It sometimes takes three iterations before people can quiet the noise in their own heads enough to really understand the story the way that the teller does.

STEP 4: Identify variables.



Once you have heard the story again, move to identifying the variables that might be in play. Again, variables are those components in the story that change with time, the elements that increase or decrease.

The drive to identify the variables accurately inevitably causes us to return to the story itself and deepen our understanding of it. For this reason, the picture above has a light arrow path leading from “Variables” back to “The Story.”

In reality, two separate steps are at work in identifying variables:

1. The first step is getting potential variables public. For a first pass, simply record the variables without worrying about how well they function as variables. Our recommendation is to brainstorm by writing variables on large Post-its and stick them to a flip-chart easel; this method makes it very easy to move the variables around once they are listed and saves a lot of re-writing time.

Below is a brainstorming list identifying variables in the stock-market example. If we were brainstorming variables for that story, we would write the variables listed in the right-hand column below on Post-its and stick those to a flip-chart easel:

The Story

"This stock market is really something eh? **Stock prices** are high, so people feel really **optimistic**, and so **they buy** more which drives **stock prices** even higher. That makes people even more **optimistic**, so **they buy** even more stock, driving prices higher again.

The Variables

Stock Prices
Buyer Optimism
Buying

2. The second step is to clarify our thinking by becoming increasingly precise about what each variable represents. Several challenges are associated with identifying variables precisely:

Being "tight": Variables should be measurable. Ideally, you should be able to create a trend chart of the values described in the variables. In the stock-market story, for example, each variable – stock prices, buyer optimism and buying – could be measured.

Being "right": The variable needs to describe the thing that actually changes. This requirement can prove more challenging than it sounds. Often, people need help to think carefully about what exactly increases or decreases.

For example, in the stock-market story, what precisely does the “buying variable” refer to? Does the storyteller mean the market volume, the number of investors, or the ratio of buying to selling? Each option may be a legitimate variable, but the storyteller can only mean one of those possibilities.

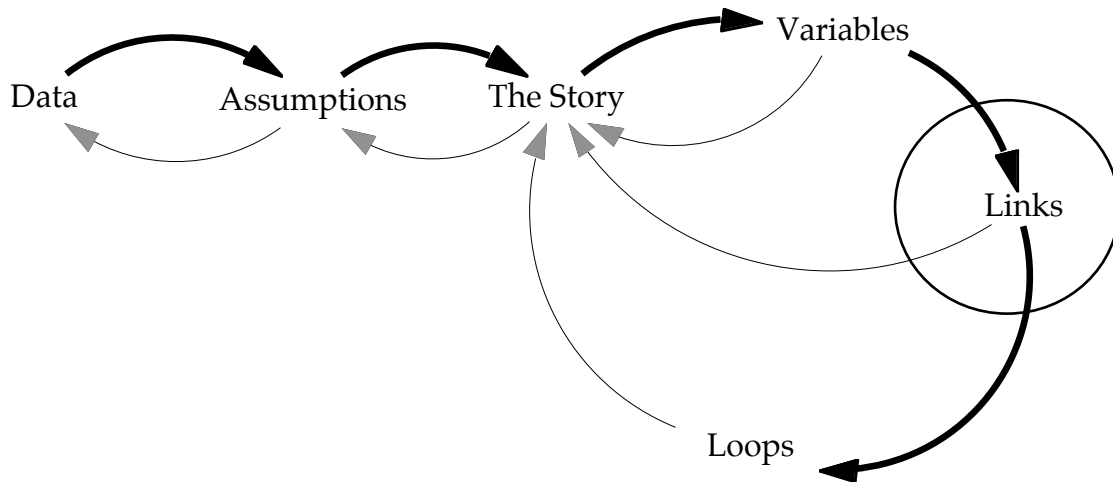
Being prolific: Often, at this stage in developing a map, people see a great many potential variables, far more than will be practical to create an elegant, descriptive map. Still, it is most useful to err on the side of inclusion at this early phase and narrow the scope later on.

Using neutral language to label the variable is also helpful. For example, the "stock prices" variable could be re-stated as the "increase in stock prices." However, the loop should be as easy to understand with the market increasing or decreasing, and it takes some mental gymnastics to figure out what a “decrease in the increase” is. It's much simpler to state the variable as "Stock prices" and have those prices decrease or increase.

In the stock-market story, let's assume that after working the variables through using the above process, we settle on the three below:

<u>Variable</u>	<u>Definition/Description</u>
Stock Prices	I would probably suggest that the "Dow Average" is what is being referred to here, and see if the storyteller agrees. If not, we would keep working until we identified the accurate variable because it is his/her story.
Buyer Optimism	This variable is tricky because there exists an Index of Consumer Confidence that can measure this. I would be inclined to leave the variable as it is, acknowledging that we have no exact measure of it, though we could create one if we had to.
Buying	This variable is trickier still. My sense of what the storyteller is really talking about here is the behavioral response to an increase (or decrease) in optimism. It seems to be about demand for stocks because increased demand is what drives prices upward. (Note that a decrease in demand for stocks would also decrease stock prices.) Let's settle on the variable "Demand for Stocks."

STEP 5: Create links.

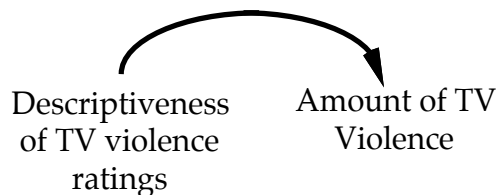


Once you have described key variables closely enough, you can begin to link the variables depicted. By this time, most people usually have an idea of where to start, and they put the relevant Post-it(s) on a new piece of flip-chart paper.

Two valuable questions that enable people to link variables are, "What does this lead to?", which gets the arrow moving forward, and "What leads to this?", which helps people identify the preceding variable.

When we add links between variables, we are making visible our assumption that a causal relationship exists between them, that one impacts the next. This process of clarifying different assumptions is one of the most useful results of a causal loop exercise.

For example, the link illustrated below asserts that a relationship exists between the descriptiveness of the TV violence rating system and the absolute amount of violence on TV:



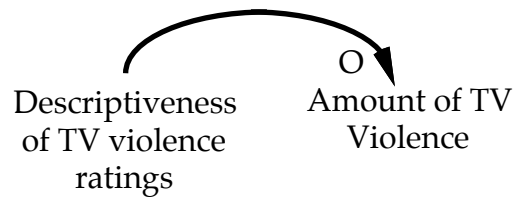
Translated into written English, the above link would be described as follows:

"A change in the descriptiveness of the TV violence rating system will cause a change in the amount of violence on TV."

However, different people will assume different things about this relationship, some claiming that the amount of violence on TV will increase as a result of the descriptiveness of the rating system, some claiming that it will decrease.

In causal-loop parlance, we say that one variable causes the next to change in either the same or the opposite manner. If the change is in the same direction, it gets labeled with an "S." If the change is in the opposite direction, then it gets labeled with an "O."

For example, if you believe that an increase in the descriptiveness of the TV violence rating system will lead to a decrease in the amount of TV violence, then put an O on the link, as in the graphic to the right:



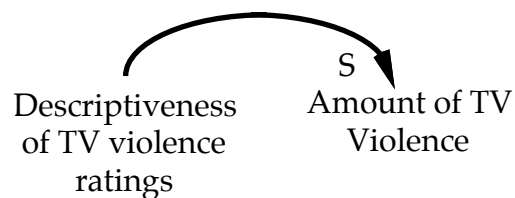
In written English, this illustrated link would read as follows:

“A change in the rating system will cause an **opposite (“O”)** change in TV violence.”

The above argument is based on the belief that TV shows will try to avoid more extreme ratings, the same way that studios avoid X ratings for movies because they drive away audiences.

The counter-argument is that violence and sex attract viewers, which will lead to high ratings, which, in turn, will lead to higher levels of violence as other shows strive to compete.

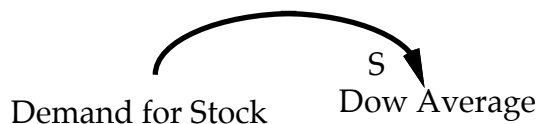
A link illustrating that counter-argument would be labeled as follows:



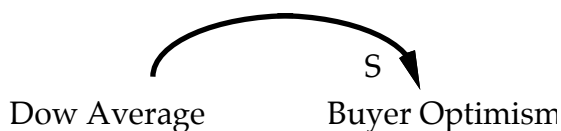
In written English, the above illustrated link of the counter-argument would read as follows:

“A change in the rating system will cause the **same (“S”)** type of change in the amount of violence on TV.”

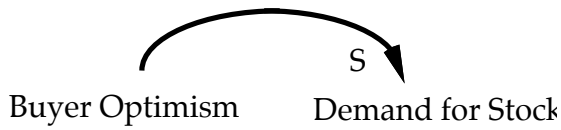
Using the stock-market story as a second example, the result would be the illustrated links and corresponding descriptions below:



A change in the demand for stock causes the **same (S)** kind of change in the Dow Average.



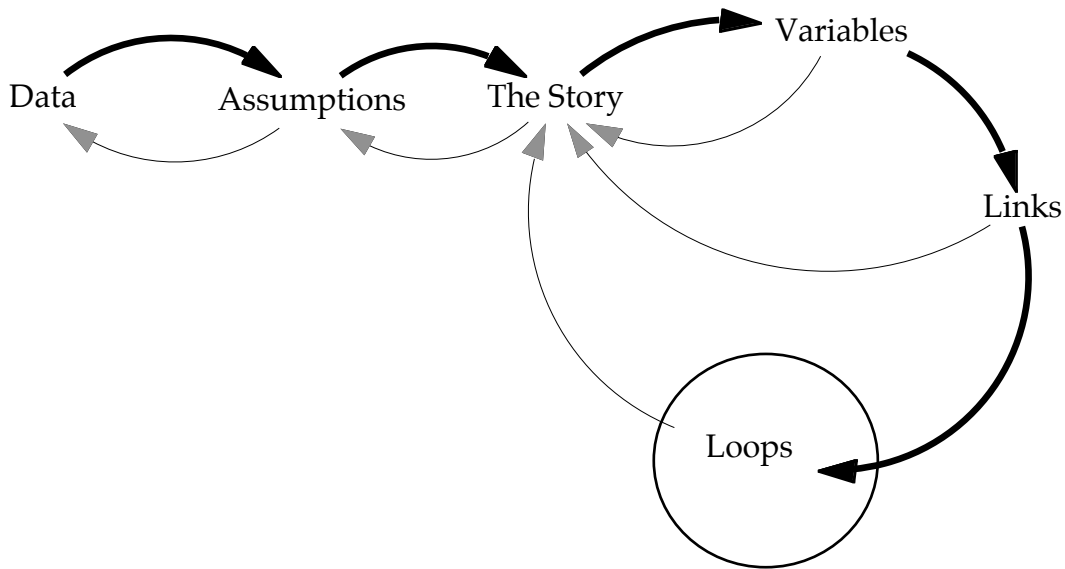
A change in the Dow Average causes the **same (S)** kind of change in Buyer Optimism.



A change in Buyer Optimism causes the **same (S)** kind of change in Demand for Stock.

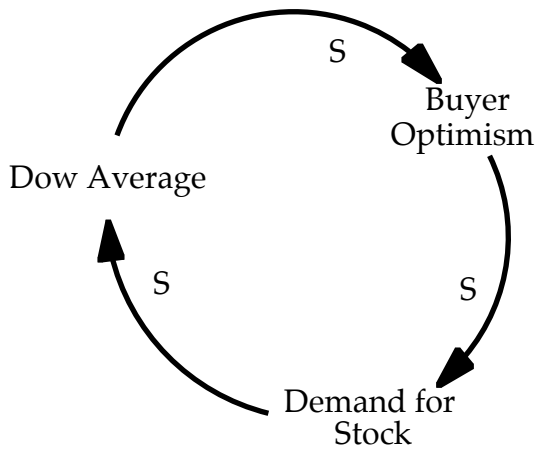
When building a map in real time, people inevitably make false starts and errors at this point in the process. Such obstacles are not an indication that something is "going wrong." Quite the contrary: understanding what is *not* going on in a given story is an important step toward building an accurate picture of what really is happening.

STEP 6: See if the links make a loop.



This step is not absolutely distinct from the previous one ("Create links."). As the illustration above reveals, loops grow out of the creation of a set of links that inevitably feeds back on itself to make a whole. In practical terms, if the first five steps of this process have been done well, the creation of a descriptive loop usually arises naturally and easily.

In the stock-market example, the picture below would be the result:



The Story

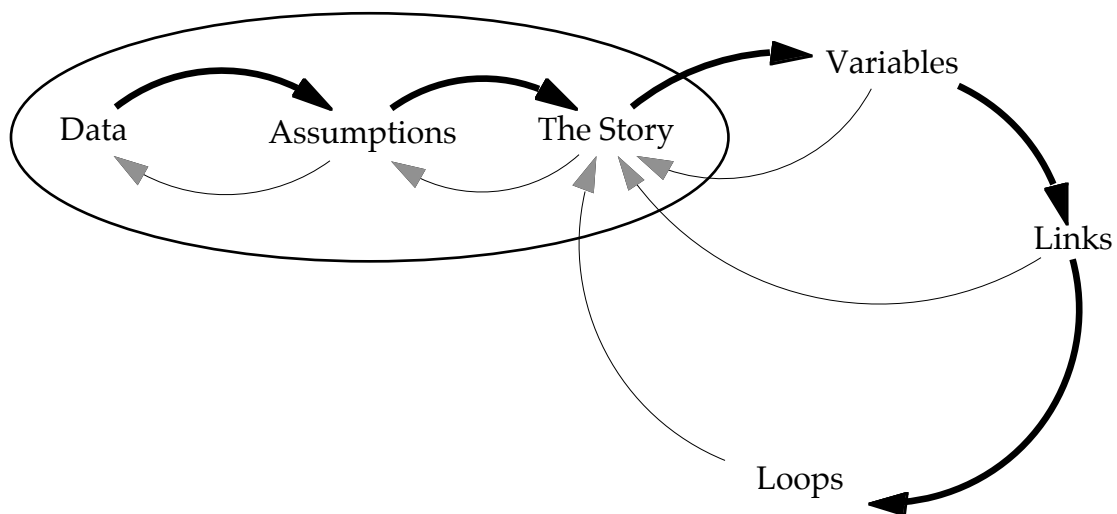
"A change in the demand for stock causes the same kind of change in the Dow Average. This, in turn, causes the same type of change in buyer optimism, which causes the same type of change in the demand for stock."

Notice that the above map will "work" in either a rising or falling market. That flexibility is one way to confirm you have drawn the map in a technically correct way.

After having drawn just such a loop, initially, some people find the results anti-climactic, thinking, "So what? Big deal. How does the loop help me?" Loops help you in two ways:

First, the process of getting to a loop that everyone in a group agrees on forces people to make explicit their assumptions. (That is the reason for Rule #2: "During it all, attend to the assumptions being made, and the way those assumptions are formed out of data.")

One's view of systemic dynamic reflects one's own mental models. As the process above is unfolding, one will stumble over these assumptions. The work of creating variables or links drives people back to clarify their story, and that work, in turn, forces people to make explicit the assumptions on which their story is based as well as the data that led them to those assumptions.



In the stock-market example, some people may feel strongly that hard economics drive the market far more than the mood of buyers, while others may see market behavior as far more social. The process of articulating the story, variables, and links make it possible to expose those differences rationally (in a way that leads to wondering how others see it differently and trying to understand those perspectives, rather than attempting to prove them wrong).

Second, the loop helps people understand the way that the elements in the system reinforce or balance one another. In the stock-market example, we can see that the three variables interact in a way that keeps them all increasing, or in a bear market, decreasing. Ultimately, once we know what is really happening, we can invent responses that have a better chance of succeeding.

Acknowledgments

We want to give special acknowledgment to the Columbia / St. Mary's Hospital Systems Thinking Study Group in Milwaukee, Wisconsin, and to Stephanie Speer for her passion about storytelling.