Chapter 2

Systems Thinking & the *ithink* Software

Better Mental Models, Simulated More Reliably

In Chapter 1, I began by reeling off data indicating that a wide variety of performance-improvement initiatives fail to achieve their intended impacts, and in many cases actually threw fuel on the fires they were seeking to extinguish. I then suggested the reason for this unfortunate state of affairs was that the quality of the mental models underlying the initiatives was not sufficiently high, and the simulations of these models were not reliable enough. The prescription I offered was to embrace a conceptual framework and tools capable of yielding both higher quality mental models *and* more reliable simulations. I claimed that Systems Thinking and the *ithink* software were one such framework and tool.

This Chapter is devoted to supporting these claims. It's not a "marketing" or "promotional" chapter. Rather it systematically revisits Chapter 1's "framework of shortcomings" associated with current frameworks (like Critical Success Factors Thinking) and tools (like regression analysis), discussing how Systems Thinking and the *ithink* software can address each shortcoming.

In the "framework of shortcomings," I took current mental models to task for their content, their representation of content, and for the process used (or rather *not* used!) for honing the quality of both. I also averred that our limited mental simulation capacity wasn't up to the challenges posed by the highly interdependent systems within which we must now operate. I will address each shortcoming in turn…

Improving the *Content* of Our Mental Models

The major issue with the *content* of our mental models has to do with the "filter" we employ to sift from reality the essential raw materials from which to construct our representations of that reality. As you may recall from Chapter 1, the "shortcoming" I identified was that our "filters" tend to be too narrow. As a result, our mental models end up being chockablock with narrowly-focused detail. We know a lot, about a little.

10,000 Meter Thinking

There really are *two* problems here: not enough breadth, too much depth. Systems Thinking offers "filter-oriented" thinking skills that address both. "10,000 Meter Thinking" inspires breadth while moderating depth. "System As Cause Thinking" primarily focuses on the former.

Imagine you're in a plane at 33,000 feet on a bright, clear day looking down at the earth beneath you. Look at all those cars lining the freeway…poor suckers! Say, what kind of car is that over there? Can't really tell the make, can you? Could be a Ford, might be a Mazda. Actually you can't even tell what color it is! All you can be sure of is that it's some kind of automobile…it could even be a light truck. That's the view from 10,000 meters. You get a big picture, but you lose the discriminations at the details level. You focus more on *categories* than on differences between individual members of a given category. It's "doctors," rather than the 43 varieties of medical specialties, or even further, Susan, the blonde cardiologist at thus-and-such medical center. Things take on a "generic" character. You can't afford to include all the detail because you are expanding the *breadth* of what you're taking in, and there's a limit to how much content you can structure into a useful mental model.

Figure 2-1 illustrates the difference in the nature of mental model content when a conventional, narrow filter is employed versus a "View from 10,000 Meters" perspective.

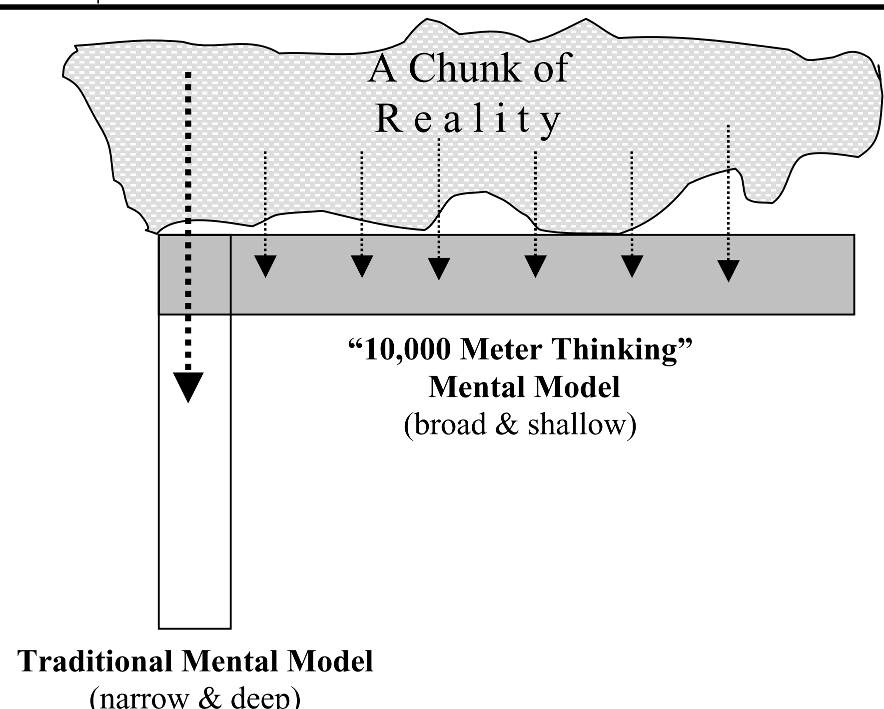

Figure 2-1.
The Content in a Traditional, versus a "10,000 Meter Thinking," Mental Model.

It's important to note that as you "push back" spatially from the reality you're examining, you also are able to take in a broader sweep of time. Compare the breadth of time inherent in the view from your airplane seat relative to your automobile seat. When you are actually down there in all that morning rush hour traffic, all you can perceive is *events* at points in time! A police car speeds by in the breakdown lane. An ambulance follows soon thereafter. Next, a fire truck. By contrast, from your seat at 10,000 meters, you can see the whole *pattern* of traffic backup in both directions, the overturned vehicle, the parade of emergency vehicles making their way to the scene of the accident. You get the big picture in time, as well as space—something vital to successfully anticipating the full ramifications of any initiative you may design.

System as Cause Thinking

The other "filtering" skill offered by Systems Thinking is called "Systems as Cause Thinking." We often use a simple physical demonstration to convey a useful sense of what this thinking skill really does for you. The demonstration involves supporting a slinky from underneath with one hand, while grasping the top couple of rings with the other, as illustrated in the first frame of Figure 2-2.

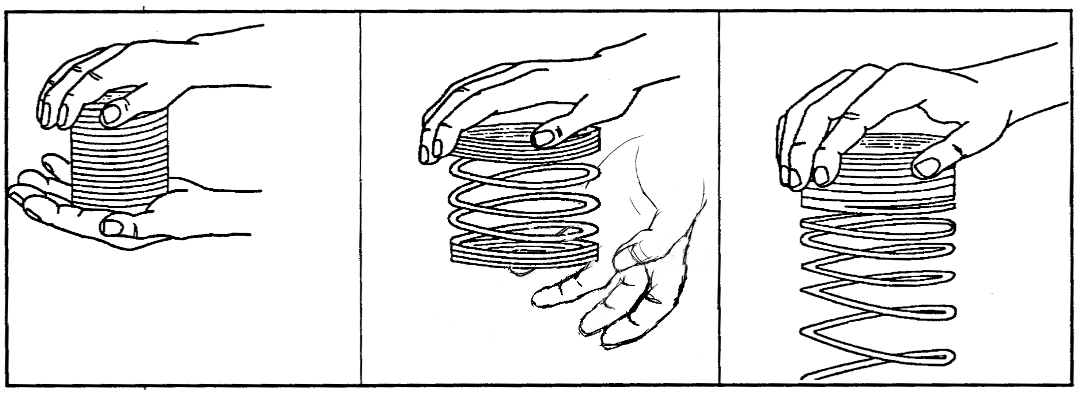

Figure 2-2.
The Slinky Demo.

Next, the supporting hand is withdrawn (the middle frame of Figure 2-2). The question then posed, is: *What is the cause of the resulting oscillating behavior?* Go ahead…take a shot at providing an answer…

Were you thinking removal of the supporting hand? Or, perhaps gravity? Well, congratulations if you were! Those are the two answers we've gotten from 90% of the people to whom we've put the question over the last 20 years or so.

Sure, it's true that had the supporting hand not been removed, the slinky *never* would have oscillated. And, it's also true that even if you *did* remove the hand, had there been no gravitational field, the slinky wouldn't have oscillated. *However*, suppose that the identical experiment were repeated, but this time with, say, a cup! No oscillation, huh? Same removal of the hand…same gravitational field…but no oscillation!

As the experiment makes clear, another way to look at why the slinky did what it did is to consider that its behavior is caused by its *internal structure*. Seen from this perspective, the slinky is an "oscillation waiting to happen." When the right stimulus comes along, the slinky will oscillate in response. It's in its nature to do so. Oscillation is "its thing." Not so for the cup.

It's important to note that we are not talking here about a "right" and a "wrong" way to view phenomena. We are talking about two *different* ways to view them. Each has implications for the amount and nature of content that is included in mental models. Briefly, if you embrace a "System as Cause" viewpoint, you tend to include only those things over which the actors *within the system* can exert some influence. In the slinky example, the slinky *is* the system. So, options for influence center on its design—perhaps we could increase its damping characteristics, make it less of an oscillator. Relatively little attention would be paid to the usually very much larger number of factors (such as removal of the hand and gravity, in the slinky example) over which *no* influence can be exerted. It's not that those embracing "System as Cause Thinking" would completely ignore such factors. But, rather than clutter the mental model with details about them, they'd be lumped into an undifferentiated category called "shocks," things that can "call forth" the dynamics inherent within a system. Little, if any, attention would be paid to their details.

Improving Content, In Summary

"10,000 Meters Thinking" and "Systems as Cause Thinking" work in determining the content that "makes it through the filter" to become the raw materials for constructing your mental models. Embracing these "filtering perspectives" will help to ensure that the mental models you construct will be sufficiently broad in scope, and that their detail will focus on relationships over which you can exert some influence. These thinking skills "get you in the ball park." How well you do, once inside, depends upon mastery of the content-representation skills…

Improving the Representation of Content Within Our Mental Models

Thinking back to Chapter 1, I asserted that the quality of the representation of content within our mental models depends upon the set of "meta assumptions" we choose to employ. I identified the four most important of these, currently in widespread use, as: (1) causal factors act independently, (2) causality runs one-way, (3) impacts are felt instantaneously, and (4) impacts are linear. Systems Thinking offers a diametric alternative to each.

Causal Factors Act Inter-dependently and Causality Runs Both Ways

I've combined the first two "meta assumptions" because they really are two sides of the same coin. That "coin" is *interdependency.* The relevant Systems Thinking skill here is called "Closed-Loop Thinking."

In Chapter 1, using the example of three key factors driving an organization's success, I hope I dispelled the notion that causal factors act *independently*, and that "outcomes" are not also "drivers." The viewpoint offered by Systems Thinking is essentially that "everything is connected, in some way, to everything else." Not that it's prudent to try to represent all the linkages in a mental model, but "drivers" tend either to conspire or work at cross-purposes. They rarely, if ever, work as independent agents. And, "outcomes" virtually *always* feed back to influence "drivers." As such, it makes no sense to even recognize such a distinction! Rather than a list of independent "causes" running down the left-hand side of the page, with arrows—all of which point to an "effect"—on the right, we instead see a picture that looks like Figure 2-3.

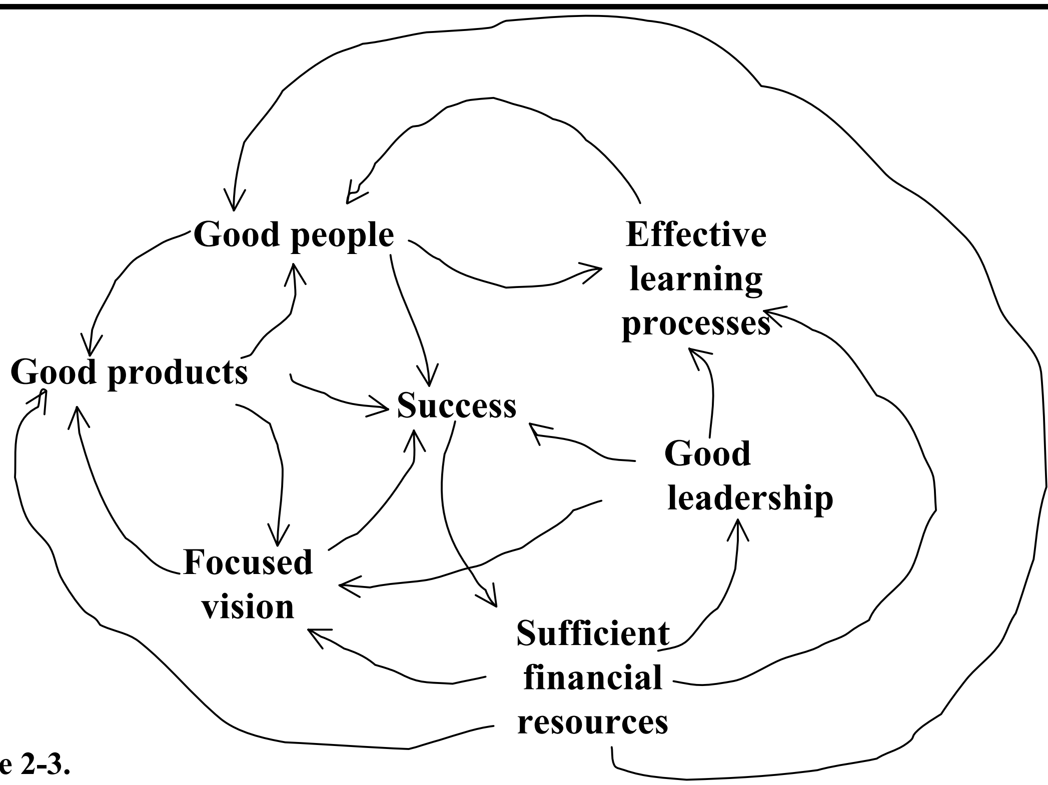

Figure 2-3.
A Reciprocal-Causality View.

In that picture, it's virtually impossible to distinguish "factors" from "outcomes." And given the reciprocal-causality, or *feedback loop* view, represented in the picture, it's not clear why doing so would be important! Representing the content within mental models as existing within a network of feedback loops casts that content in a *dynamic* perspective. Feedback loops, as you'll learn more about in Chapter 6, *self-generate* dynamics! Kick a feedback loop into motion, and like a slinky, it will take care of the rest! It is being able to divine how a web of loops is likely to perform that will help us to identify high-leverage initiatives capable of achieving intended outcomes with minimal resource expenditure.

Impacts Are Delayed, and "Impact" Should Become "Cause"

Notice here that I have added something to the description of the *Impacts Are Delayed, and "Impact" Should Become "Cause:"* "meta assumption." The addition ("Impact" should become "Cause") is important and necessary because the conventional "meta assumption" that "impacts are instantaneous" belies a much broader assumption about the nature of relationships—an assumption that Systems Thinking disputes. That assumption is that it's okay to think in terms of "impacts" or "influences." A more direct way to say this is that, mental models based on *correlational* relationships are okay.

Most Systems Thinkers would say correlational relationships are *not* okay, when the purpose to which you will put your mental model is *improving performance*. A soon-to-be immortal Systems Thinking jingle succinctly expresses the counter notion: "When improving performance is your aim, *causation* must be your game!" Let's look at a simple example that will help to solidify the argument…

Many years ago, while toiling as an economist, I came across an article in a prestigious economic journal that described a model whose aim was to predict milk production in the United States. The model was of the standard "regression analysis" form, expressed mathematically as…

$$\boldsymbol{Y = (a_1X_1 + a_2X_2 + a_3X_3 + \ldots)}$$

milk production = *f* (GNP, feed prices, interest rates, …)

In plain English, the model posited that milk production in any given year was "impacted" by a set of macroeconomic variables. Specifically, it held that milk production could be predicted by movements in variables like GNP, feed prices, interest rates, and so forth. For economists, the proof was in the pudding! The model did an extremely good job of "tracking history"—"goodness of fit" being the traditional way such models are "validated."

Later in life, having abandoned the reckless ways of my youth, I returned to reflect on this model, asking myself, and now you, a commonsensical question. Is there a variable, which is left out of consideration when focusing on macroeconomic factors, that's absolutely essential to milk production? By "absolutely essential," I mean in the absence of which there would be NO milk production? Not a single drop!

If you said, perhaps somewhat sheepishly, "Cows"… first, keep your animals straight… and second, welcome to the world of *Operational Thinking*! Operational Thinking and Closed-Loop Thinking are the two most important Systems Thinking skills associated with *representing* *content* in mental models. Chapters 3-5 of this Guide are devoted exclusively to Operational Thinking. Only one other thinking skill gets even *one* full chapter's attention (and that's Closed-Loop Thinking, Chapter 6). In short, Operational Thinking is a big deal! It's a big deal because, like Closed-Loop Thinking, it has to do with the how you structure the relationships between the various chunks of content you include in your mental models. Specifically, Operational Thinking says that neither "correlation," nor "impact," nor "influence" is good enough for describing how things are related. Only *causation* will do!

In our milk production example, *cows* would be the very first variable included in a model guided by operational thinking. No cows, no milk produced…as simple as that! But why *isn't* correlation good enough, especially since models based on it often seem to produce quite accurate forecasts of the future?

Correlation *is* good enough if your purpose is forecasting…and you're lucky (meaning that the relationships that have existed in the past, and from which the correlations have been derived, continue to exist). But, when your purpose is to *change* performance, you are explicitly seeking to *alter* relationships that have prevailed in the past, and to create new relationships in their place. You are trying to identify levers that you can pull to effect change. For this, you must understand the associated *causality*!

Let's continue with the milk production example to make these points more concrete.

Figure 2-4, on the next page, shows a simple *ithink* map that paints an operational picture of milk production…

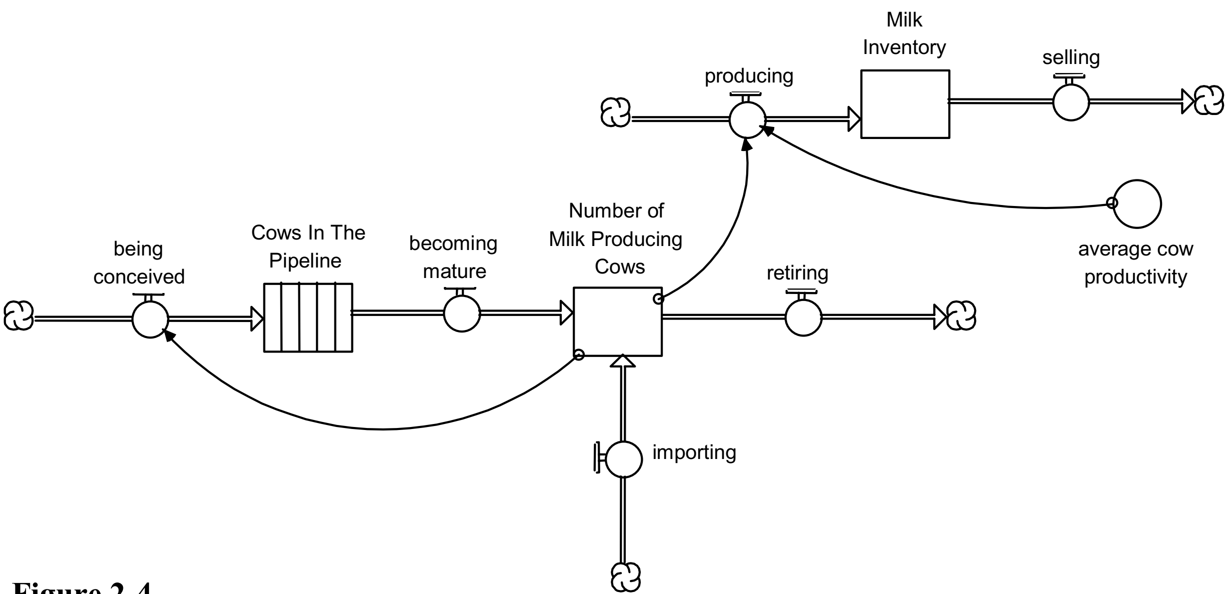

Figure 2-4.
An Operational Picture of Milk Production.

Briefly, the nouns and verbs in the *ithink* language, as you'll discover in Chapter 3, are represented as rectangles and directed pipes with regulators, respectively. The rectangles, two varieties of which are shown in the Figure, represent things that "accumulate." The directed pipes represent activities. The results of activities *flow* into and out of accumulations, changing their magnitudes. So, for example, as the volume of milk producing increases, milk inventory will fill—unless the volume of selling activity exceeds the producing volume. The two cow-related accumulations, Cows in the Pipeline and Number of Milk-Producing Cows, are depicted as "conveyors" (think of them as like moving sidewalks) to convey the notion "aging" or "time delay." That is, it takes awhile after being conceived for calves to become mature enough to join the milk-producing herd. And, after they do, they remain productive for some average amount of time before "retiring."

Given such a picture, we can now "get operational" about levers we can pull for seeking to increase milk production. I'd begin by looking at the "producing" flow because it is the volume of this flow that we wish to increase. "Producing" is *caused* by a combination of the number of cows that are producing milk, and how much milk, on average, each of these cows produces in a given period of time (i.e., "average cow productivity"). I did not develop the logic underlying cow productivity for this example. Instead, I focused on making explicit the levers for change on the "number of cows" front. There are four such levers shown in the diagram. Take a moment to see if you can identify them.

Time's up! OK, so you probably identified "importing." To boost producing we must boost the producing herd size. One straight-ahead way to do this is to import mature dairy cows from somewhere outside the US. The diagram does not show all of the "non-instantaneous" transactions that would have to occur in order to bring this about, but you can be pretty sure there would be several. You likely also "got" the "being conceived" lever. That's right, cow aphrodisiacs and fertility drugs! Want more milk-producing cows? Engineer more cow conceptions! But note that even if you were to succeed in doing so, you would have to endure a gestation delay while embryos developed, and then a maturation delay for calves to reach lactating age. Voila a classic *non-instantaneous* impact! Pull the lever…wait several years.

The other two levers are a bit less obvious. The first of these is to accelerate maturation (i.e., shorten the length of time calves spend in the Cows in the Pipeline conveyor). Not being a cow boy, I'm not sure how possible it is to exercise this lever. But in concept, if you *could* reduce the maturation delay, other things equal, you'd have a larger milk-producing cow population. The final lever, for many people, is all but invisible. It is to *reduce* the volume of the retiring flow! In practice, this would mean increasing the average number of years an average cow remained "on line" producing milk. Exercising this lever is analogous to seeking to grow your customer base by reducing "churn," as opposed to, say, increasing the inflow of *new* customers. Many companies have found this outflow-based lever to be an extremely useful one to pull. However, growing an accumulation by *reducing* its outflow, as opposed to *increasing* its inflow, continues to remain a counterintuitive notion to many people (*especially* Americans!).

I hope this extended illustration has made clear both what Operational Thinking is, and why the associated "meta assumption" (impacts are non-instantaneous, and more broadly, relationships must be expressed *causally*) is important to embrace when deploying your mental models in service of performance improvement efforts. You will hear a lot more about Operational Thinking in subsequent chapters. Honing this skill is the key to mastering the practical application of Systems Thinking.

Impacts Are Non-linear

The final "meta assumption" identified in Chapter 1 is that impacts are "linear." This means that if a particular "input" is tweaked by, say, X%, we should expect to see a cX% impact on outcomes—where "c" is a *constant*. So, for example, one might assume that a 10% increase in spending on training will yield a 2.5% increase in productivity, or that a 25% increase in advertising will boost sales by 15%.

In reality, such linear relationships between inputs and resulting outcomes seldom exist! Markets saturate, customers acclimate to product discounts, technology advances, and top-of-mind awareness fades. As a result, sometimes a tweak of a given magnitude will be reciprocated in kind. Other times, it will take an enormous tug just to produce a muted whisper. And still other times, a small piece of straw will be enough to break a camel's back. In short, the "elasticity" of any particular linkage within a web of closed-loop causal relationships is highly dynamic! That's how feedback loops work! Their strength waxes and wanes. Thus, assuming such strengths remain constant, as "linear impact" mental models do, is very likely to earn you a "surprise." That's why Systems Thinkers have identified "Nonlinear Thinking" as one of the important thinking skills to be mastered. Much of Chapter 7 is devoted to developing this skill. And, as you'll discover in that Chapter, one of the real powers of the *ithink* software is that it will enable you to represent nonlinear relationships without the need for any complex mathematics!

In Summary, Improving the Representation of Content

How we represent what we decide to include in our mental models depends upon the "meta assumptions" we embrace. There are four such assumptions in widespread use today: (1) factors act independently, (2) causality runs one-way, (3) impacts are instantaneous (correlation is "good enough"), and (4) impacts are linear. Mental models that are structured using these assumptions are unfit for underwriting the design of effective performance-improvement initiatives. Systems Thinking offers four counter-assumptions: (1) factors act interdependently, (2) causality runs both ways (there are no "factors!"), (3) impacts are non-instantaneous (only causal relationships will do), and (4) impacts are non-linear. Embracing this set of assumptions results in models that stand a much greater chance of underwriting initiatives capable of achieving their intended impacts.

Improving the Process for Honing the Quality of Our Mental Models

In Chapter 1, I asserted that most organizations (and individuals, for that matter!) lack a process for systematically improving the quality of the content, and representation of content, of their mental models. I cited two reasons why this is the case. First, we don't have a *sharable language* for integrating "piece understanding" into a coherent picture of "the whole." And second, we don't have tools for testing the validity of that understanding. Systems Thinking, and the *ithink* software, can help in addressing both.

An important part of what makes "Operational Thinking" operational is having an icon-based language to create "here's how it works" portraits. The language consists of only four simple icons (each with a few variations), yet it has been used to represent everything from very tangible bottom-line variables (like Accounts Payable, Cash and Inventory) to the squishiest of the squishy (like Trust, Commitment, and Morale). The language truly constitutes an organizational *Esperanto*. And this has some very practical importance in terms of honing the quality of our mental models.

Having a language that everyone across the organization can "read" and understand means that "blind spots"—both in content, and representation of content—can be brought to light and discussed. "Oh, *now* I see what you are thinking. I like that part, but this piece over here doesn't square with my experience!" Such comments are typical of the kind generated when a well-written *ithink* map is circulated around an organization. That a possible "blind spot" has been identified, is obvious from the comment. Less obvious, is something that's very important for the process of honing mental model quality. Because the comment is directed *at the ithink map*, and *not* at the person who authored the map, it is much less likely to stimulate *defensive responses*. Such responses literally shut off learning. Thus, by serving as a "third-party object," an *ithink* map can facilitate discussions that enable everyone to share their "piece expertise," and, as a result, work together to *build shared understanding*—the holy grail of any good organizational learning process!

But, an *ithink* map is much more than just a "pretty picture" that facilitates cross-organizational discussion. These "pretty pictures" can be simulated on a computer to determine whether the relationships people agree are operating, can in fact generate the dynamics being exhibited! In other words, *ithink* models offer an opportunity to "sanity check" a group's thinking—in scientific terms, a way to test whether a model constitutes an "entertainable hypothesis." And, if a model cannot produce the dynamics being exhibited, there's much learning to be had in exploring what changes to content and/or representation of content must be made to enable it to do so? Updating the *ithink* model updates the mental models around the organization. Everyone learns together. The quality of mental model content and representation of content is systematically ratcheted upward.

Before implementing a performance-improvement initiative, the *ithink* software enables people from across the organization to literally "get onto the same page," as well as to ensure that the page everyone has gotten onto is indeed an "entertainable" one. Once this matter is settled, quickly adding an interface, transforms the *ithink* model into a "practice field." People can use a Dashboard to test-fly strategies, new process designs, merger & acquisition possibilities, alternative Balanced Scorecard metrics, and so forth. Organizations can build an understanding of what works, what doesn't, and why—thereby increasing the likelihood that when the real "flight" occurs, a crash-and-burn (or even an in-flight "turbulence") scenario can be avoided.

Thus far, I've discussed only *pre-implementation* honing of mental models. A huge honing opportunity exists in the post-implementation period as well! Unfortunately, it's an opportunity that too often goes completely untapped because mental models are not re-visited after reality has played itself out. One of the most important reasons re-visiting doesn't happen is that mental models are too often not made explicit. In cases where they are made explicit, frequently the job falls to a "back-room analyst." The resulting model is then usually highly complex—often enshrined in a large, multi-sheet spreadsheet. Frequently, such models place a premium on numerical precision, and as such, rarely include the rich set of *qualitative* assumptions contained in most mental models. The combination of single-person-authorship, analytical complexity, and the absence of qualitative richness, creates a low sense of across-the organization ownership for the model. This makes re-visiting an unattractive proposition. And without re-visiting, the enormous and systematic learning associated with correcting bad assumptions, filling in the missing, and deleting the excess, is completely lost!

By contrast, rendering mental models using the *ithink* software is a multi-author, across-the-organization activity. Resulting *ithink* maps are easily "readable" by anyone in the organization. In addition, the software elevates "qualitative" variables to full-citizen status, so the full richness of the assumption set can be captured. As a result, *ithink*-based models engender a sense of *collective* ownership. And, if the portfolio of various *ithink* models is maintained in an easy-access, on-line database, people from around the organization can "re-visit" at will to compare model-generated to actual outcomes. Anyone then can offer suggestions for improving the content, and/or the representation of content, within a model. Everyone can review the suggestions, posting their reactions to a Listserve, or other electronic forum. In this way, the collective understanding, as reflected in the current state of the *ithink*-based "library," can be systematically ratcheted upward over time. Anyone has instant access to that understanding. With such an *ithink*-based *organizational learning infrastructure* in place, everyone can contribute to helping everyone else get smarter.

It's also important to note that the previously-described organizational learning infrastructure is robust with respect to people movement. That is, when people leave the organization, they won't "take away" their understanding because it also exists within the collection of *ithink* models. And, when new people join the organization, they can visit the "Library" to quickly come up to speed on the best available current understanding within a range of arenas.

The *ithink* software can play an important role in the process of honing our mental models at both the level of the individual and the organization. The opportunity awaits!

Improving Our Inherent Simulation Capabilities

The final shortcoming (identified in Chapter 1), which undermines our efforts to design effective performance-improvement initiatives, is the inherent limitations of our mental simulation capabilities. There's not a lot anyone can do about the neurobiological portion of these limitations. But there is something Systems Thinking and the *ithink* software can do to help us realize more of the capability that we do have.

Systems Thinking, as argued throughout this Chapter, can help by improving the quality of the mental models you construct. Higher-quality mental models—broader spatial and temporal boundaries, just-what's-needed detail, and more realistic representation of content—yield more reliable mental simulations. In addition, used judiciously, the *ithink* software can help strengthen your mental simulation "muscles" by providing rigorous feedback on your mental simulations. To benefit from this feedback, it is essential that you make these predictions explicit *prior to* initiating a computer simulation! Then, by checking to see if you were right, and if so, for the right reason (or were you just lucky?), you can progressively hone your capacity for intuiting dynamics. Used in this manner, you can think of the software as kind of like an aerobics studio for the mind.

To illustrate how the *ithink* software can be used to hone our intuition for dynamics, let's return to the mental simulation exercise you did in Chapter 1. Recall you were asked to predict how a simple supply chain would respond to a "disturbance" by charting the pattern you thought would be traced over time by the level of a retailer's inventory. I've created an *ithink* map from the description provided in Chapter 1. I'll use it to rekindle your memory of that description. The map appears in Figure 2-5.

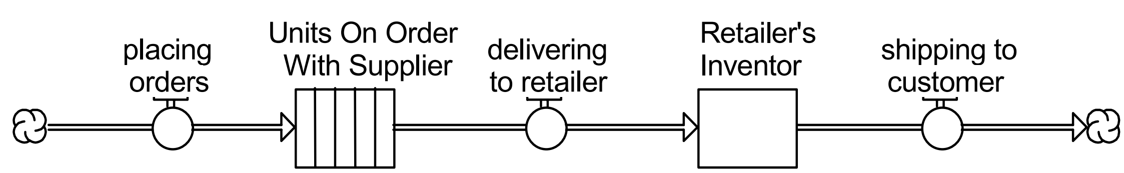

Figure 2-5.
An ithink Map of the Simple Supply Chain.

There are two general things to note about the diagram in Figure 2-5. First, several paragraphs of text have been replaced by a simple picture. An economy of communication has been realized. Second, the same set of icons that was used in Figure 2-4 to represent cows, and the associated milk production, is now being used to depict a supply chain. Holy *Esperanto*, Batman!

From the diagram, it should be clear that the retailer ships product out of inventory to customers, using information about the shipping volume to determine the ordering volume. The final salient detail in the diagram is the delay that exists between the time an order is placed, and its subsequent delivery to the retailer. With this brief description, let's now use the diagram to facilitate a mental simulation of this system…

The system as described is initially in "steady-state," a condition that's easy to visualize by looking at the map. It means, in this case, that the three *flows* in the chain are equal and constant, and hence the two *stocks* are unchanging in magnitude. Note that, in order for the delivering flow to equal the ordering flow, each of the six "slats" (one for each day of the delay) in the conveyor (only five "slats" are shown in the conveyor icon!) must contain an amount exactly equal in volume to the ordering flow. This will be the case because the system has been in "steady-state" for more than six days. Look at the diagram and make sure you can visualize this.

Suddenly, a step-increase occurs in the volume of shipping to customers. What happens? See if you can trace it through using the map. Because you are interested in the pattern traced by the retailer's inventory over time, focus your mental simulation on the inflow to, and outflow from, inventory…

Shipping, the outflow from Retailer Inventory, steps *up*. Does delivering, the inflow to Retailer Inventory, step up at the *same* instant? No! Ordering does, yes. But *not* delivering! Delivering will remain at its pre-step volume for six days, because that's how long it will take to empty the six "slats" carrying the *pre-step-increase* ordering volume. After six days, the new, stepped-up ordering volume will have made its way through the pipeline and begin being delivered into inventory! Hence, delivering will again equal shipping, and the retailer's inventory will again remain constant.

So, in summary: Inventory will continue to decline for six days by a daily amount equal to the difference between the new, higher shipping volume and the pre-step delivering volume. After six days, the delivering flow will step up to once again equal the shipping flow, and the system will be back in steady-state—but the retailer's inventory will be at a permanently *lower* level!

This example is intended to illustrate that *ithink* maps are useful for facilitating mental simulation, and can help in developing your capacity for intuiting dynamics. Computer simulation then can be used as a check on mental simulation, to ensure you were "thinking it through" correctly. If we simulated the supply chain system using the *ithink* software, and graphed the retailer's inventory level and the three flows in the system, we'd get something that looks like Figure 2-6. As predicted, the retailer's inventory traces a straight line downward for six time periods following the step increase in shipping that occurs at Day four. Note that ordering also steps up at exactly the same time. However, as the graph clearly shows, delivering does not follow suit until day ten—*six* days later! If the inflow volume to a "bathtub" is less, by a constant amount, than the outflow volume, the level of water in the tub will decline at a constant rate. The *ithink*-based simulation helps to concretize the intuition.

Figure 2-6.
A Graph of Key Supply Chain Variables.

Summary & What's Next

This Chapter seeks to support the claim that Systems Thinking and the *ithink* software offer a powerful combination for improving the quality of our mental models, and increasing the reliability of the simulation of these models. Without them, or some equally powerful alternative, we will continue to create poor quality mental models and to generate unreliable simulation results from these models. This means we will continue to risk missing the mark with our strategies, policies, processes, change efforts, and other performance improvement initiatives. By embracing Systems Thinking, and leveraging its application through judicious use of the *ithink* software, we have a much greater chance of *constructing* mental models that better reflect the reality whose performance we are seeking to improve, and *simulating* these models more reliably. The result of doing so is an increased likelihood of creating performance improvement initiatives capable of achieving their intended impacts.

In the Chapters that follow, you will build your Systems Thinking skills, and gain a thorough grounding in the language of the *ithink* software. You will learn how to use these thinking skills and language to render your (and others') mental models. *Congratulations* on your purchase of the software! You have taken an important step toward thinking more clearly, learning more productively, and communicating more effectively.