Putting systems thinking into practice

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The dynamic systems perspective illuminates some of the core challenges in organizational learning. If learning occurs through experience, there are good reasons why organizations often fail to learn. In particular, large organizations face a class of systemic decision-making situations in which learning is extremely unlikely. The systems perspective teaches us that cause and effect are often not close in time and space, that obvious interventions do not always produce obvious outcomes, and that long time delays, and systematic effects of actions can make it almost impossible to judge the effectiveness of those actions. This article presents a framework for organizational learning, outlines several breakdowns that thwart the learning process, and discusses how systems thinking can play an important role in helping organizations overcome the learning breakdowns through the design and implementation of managerial practice fields.

Diverse methodologies of systems thinking have been developed over the past 40 years. Yet, despite widespread recognition of the growing importance of understanding interdependency and change, there has been relatively little penetration of these methods into the mainstream of management practice. Managers talk about “the big picture,” yet there are no established tools to guard against myopic strategies and policies. Everyone acknowledges the sins of short-term profit maximization, yet planning continues to focus on simple, short-term goals for business performance rather than on high-leverage areas for systemwide redesign and significant improvement. Useful methodologies like system dynamics (Forrester 1961; Richardson and Pugh 1981; Richmond et al. 1987) and Ackoff’s (1981) idealized design planning have been in existence for 30–40 years and yet are still taught in only a small fraction of management schools.

Especially problematic is the inability to deal with dynamic complexity, when cause and effect are not closely related in time and space, and obvious changes do more harm than good (see Senge 1990, 71–72). Planning often recognizes detail complexity by taking into account multiple market segments and complex product lines. But dynamic complexity is more challenging because it requires us to think in terms of complex causal interdependencies involving multiple sources of delay and nonlinearity, and evolving patterns of change over time. Very often, recognizing dynamic complexity demands changes in prevailing mental models. Few organizations, in our experience, have the capability to build shared understanding of dynamic complexity—yet this is precisely what characterizes the most important policy and strategy issues.

Organizational learning dilemma

For the past ten years, we have found it helpful to view our efforts at MIT to foster the practice of systems thinking as part of a larger challenge, the challenge of organizational learning. By organizational learning we mean the development of new organizational capabilities. To learn, for an individual, group, or larger organization, is to enhance one’s capabilities in reliable and reproducible ways.

Thinking in terms of organizational learning illuminates why so little headway has been accomplished in getting systems thinking into practice. Methodologists have viewed their task as how to get their methodologies into use. This
puts the cart before the horse. The first rule of all learning is that the learner learns what the learner wants to learn. (Violation of this rule has been the bane of traditional schooling.) Managers are much more interested in improving product development, building more effective partnerships with customers, or reducing cycle time in complex supply chains than they are interested in learning systems thinking. Rather than focusing on the implementation of a set of tools and methods, it is necessary to focus on the aspirations, goals, and challenges faced by real managers.

This, of course, is precisely the perspective taken by consultants: consultants help managers in addressing practical problems. But consulting rarely results in learning for the client organization. While the consultants' clients may come to understand particular issues, they rarely develop significant new capabilities for understanding similar issues in the future. In fact, making their clients highly proficient in new skills and capabilities is often contrary to consultants' goals.

Herein lies the dilemma. Organizations are in great need of new learning capabilities if they are to thrive in an increasingly complex, interdependent, and changing world. Yet managers' attention is naturally focused on addressing their most important practical problems. Even when those problems are met successfully, there is little to guarantee that new capabilities have been developed to address similar problems more effectively in the future. We settle for fish rather than learning how to fish.

This dilemma is especially vexing when the capabilities in question, like systems thinking, take years rather than weeks to master. This renders any sort of typical training and development process to develop these new skills impractical. Recently an engineering manager in one of our working sessions at the MIT Learning Center said:

It has taken me a long time to begin to get what this new worldview is all about. I'm beginning to feel like I felt in my freshman calculus class. After months of confusion, I began to get it. Within a year, I had begun to develop some competence. Within four years, the basic tools and way of thinking were an integrated part of my professional skills. . . . The problem is, if calculus were invented today, our organizations could never learn it. We would send everyone off to the three-day crash course and then tell them to go off and apply it. After three months we'd check if it was working. Since little would have been achieved, we'd conclude that there really wasn't much there, and we'd move on to the next program.

We believe that there is another way for getting systems thinking into practice, which is neither traditional consulting nor training and development. This approach is based on the concept of managerial practice fields, settings where teams who need to take action together can learn together. In practice
fields, organizational teams, like their counterparts in sports or the performing arts, experiment, rehearse, and reflect. They not only envision new possibilities, they try them out. They can, as learning theorist Donald Schon observes, speed up or slow down time, simplify complexity, and make what is irreversible in real life reversible (see Schon 1987, 75–76). Most of all, they can make lots of mistakes, which is just what no one would ever do intentionally in a real managerial setting. Over time, they eventually develop new capabilities, not because they are being trained, but as a by-product of how they are learning. Systems thinking gets into practice through practice.

Developing and implementing successful managerial practice fields will, we believe, represent a basic innovation in management practice. Our own efforts over the past two years at the MIT Learning Center are just beginning to scratch the surface of what is possible. In this article, we discuss the basic sources of breakdown in organizational learning and share how this understanding is helping in the creation of first-generation managerial practice fields, which are beginning to demonstrate significant effects.

**Breakdowns in organizational learning: incomplete learning cycles**

Organizations, like individuals, learn through experience, through taking actions and, as a result of those actions, developing new insights and behaviors that enable more effective future actions. The problem is that taking action is no guarantee of learning, either for individuals or organizations (March and Olsen 1975).

**Organizational learning cycle**

Kim (1993b) presents an integrated framework of organizational learning where individual learning is linked to organizational learning through the concept of mental models as the transfer mechanism. By mental models, we mean internalized maps (Bostrom et al. 1992), schemas (Fiske and Taylor 1984), beliefs and assumptions, stories (Pennington and Hastie 1991), scripts (Schank and Abelson 1977), and routines (Argyris 1990) that influence perception and action. Mental models are held by individuals, but they can also be shared. Often they are tacit, and even at odds with what people say about their assumptions or beliefs. For example, a manager may say that he believes in collaborative decision making yet consistently make decisions unilaterally. Figure 1 presents this framework of organizational learning, in which six potential learning breakdowns are identified.
Individual learning is a necessary but not sufficient element of organizational learning. In Figure 1, the process of individual learning is represented through the OADI cycle of observation, assessment, design, and implementation (Kofman 1992). Like many other characterizations of the learning process, the OADI cycle directs our attention to the fact that all learning occurs over time, as we move between a domain of reflection (assess and design) and action (implement and observe consequences of our actions) (Kolb 1984). The process of individual learning is embedded in a larger feedback process whereby individual learning interacts with individual mental models. What data we as individuals see and how we make sense of our observations are conditioned by our cognitive frames (Fiske and Taylor 1984; Schank and Abelson 1977). The actions we take are shaped by our internalized behavioral routines (Argyris 1990; Argyris et al. 1985). Potentially, these mental models can change, although there is much evidence that this often does not occur. When mental models do change, there is a more complex learning process, which has often been termed second-order learning or double-loop learning (Argyris and Schón 1978; Kim 1993b).

Individual mental models are often strongly influenced by shared mental models. Individuals with assumptions and behaviors that are at odds with their larger social milieu experience many forms of pressure to conform. In turn, it is possible that changes in individual mental models may lead to changes in
shared mental models—indeed, this is the only way that shared mental models ever change.

In an organizational setting, individual action is distinct from organizational action, both of which are influenced by mental models. Individual mental models shape individual actions through individual learning. In addition, organizational actions are directly influenced by shared mental models. This happens most often through standard operating procedures and operating policies, established ways of making decisions in organizations (Forrester 1961). Like individual mental models, shared mental models and operating policies may be tacit and unrecognized, even by the people whose actions are being influenced by them. The preceding framework recognizes that both individual action and organizational action may lead to an environmental response.

Tracing around the outer loop in Figure 1, we see the most basic loop of organizational learning: individual actions lead to organizational action, which in turn produces an environmental response, leading to individual learning and new individual actions.\(^1\) If the environmental response is static and unchanging, individual beliefs, actions, and therefore organizational actions will also remain unchanged. If there are changes in the environment, there are two basic learning possibilities: individuals adjust their actions based on new information, with no adjustment in underlying mental models (single-loop learning), or there is an adjustment in mental models and actions (double-loop learning). If changes in individual mental models occur, this may also lead to changes in shared mental models, which could then lead to further changes in organizational actions. This would represent organizational double-loop learning.

**Breakdowns in the learning cycle**

Of course, there is also the possibility that no learning will occur. In fact, there are multiple points of potential breakdown in organizational learning. March and Olsen (1975) identify three breakdowns that can produce incomplete learning cycles. Role-constrained learning occurs when an individual is unable to take actions she sees as necessary because she is not permitted to do so within the organization. In other words, changes in individual observations or assessments have no effect on individual action because of constraints imposed by the individual’s role. Audience learning occurs when the individual affects organizational action in an ambiguous way.

A third breakdown is superstitious learning, where individuals are unable to make valid sense of environmental response. Thus, actions are taken, responses are observed, inferences are drawn, and “learning” takes place, but there is no real basis for the connections made between organizational action and environ-
mental response. For example, sales may increase after a new marketing program is implemented, which leads to the conclusion that the program was effective when, in fact, sales would have increased without the marketing program because of other changes, such as declining availability of a competitor's products.

Superstitious learning is especially likely in situations where there is dynamic complexity. The reason is the growing evidence that human beings have great difficulty making valid causal inferences when cause and effect are not close in time and space. For example, Sterman (1989) has generated substantial experimental evidence of "misperceptions of feedback," which suggests that decision makers consistently misperceive the consequences of their own decisions in situations where there are significant delays and more than one or two feedback loops. When undesired results occur, "most subjects," according to Sterman, "attribute the dynamics to external variables which they believe to be closely correlated in time and space with the (problematic) phenomenon to be explained."

In addition, Kim (1993b) identifies three additional types of incomplete learning cycles that affect organizational learning: superficial, fragmented, and opportunistic. An individual encounters a problem, improvises on the spot and solves the problem, and moves on to the next task. Superficial learning occurs when there are adjustments in behavior without any corresponding adjustment in mental model. The resulting single-loop learning may be perfectly appropriate in many situations—in fact, most learning is single-loop because our prevailing mental models serve well in most situations. Superficial learning is a special case of single-loop learning where changes in mental models are called for but do not occur. An example would be an interpersonal situation where an individual is stuck in a behavior that is ineffective but is unable or unwilling to bring about a deeper change in assumptions, beliefs, or frame needed to become unstuck. Another example of superficial learning occurs when there is an effective change in behavior that should lead to change in the person's mental models but does not. So the learning has no long-term impact. Such situational learning may occur because of lack of reflection or because the individual sees the situation in question as idiosyncratic, as not being relevant to other similar situations. Since the individual's mental model is not changed, the organization does not have a way of absorbing the learning either. Many examples of superficial learning fall under the broad category of crisis management, where each problem encountered is solved, but no learning is carried over to the next case.

There are many instances where individuals learn deeply, but the organization as a whole does not. When the link between individual mental models and shared mental models is broken, fragmented learning occurs. Organizational
learning is fragmented among isolated individuals (or groups). One consequence is that loss of the individuals from the organization means loss of the learning as well. Universities are a classic example of fragmented learning. Professors within each department may be the world’s leading experts on management, finance, operations, and marketing, but the university as an institution cannot apply their learning to the running of its own affairs. Very decentralized organizations that do not have the requisite networking capabilities to keep the various parts connected are also susceptible to fragmented learning. Individual mental models are changing, but those changes are not reflected in the organization’s memory, and thus there is no cohesive picture of what is occurring at the individual level.

Not all disconnects are bad. There are times when organizations purposely bypass standard organizational procedures and succeed in producing collective actions that might work. Such opportunistic learning is characterized by new organizational actions that deviate from prevailing shared mental models (i.e., traditional values and beliefs or standard operating procedures). For example, “skunkworks” are examples where groups deviate from established ways of doing things because they think there is a better way. Sometimes such experiments are sanctioned by senior management, often out of frustration with established procedures. Such experiments can be very exciting. But even when they succeed, there is little guarantee of longer-term change. The use of “skunkworks” to develop the IBM personal computer is a good example. Consciously bypassing normal bureaucratic structure and creating an entirely separate dedicated team led to developing the PC in record time, but there is little evidence that the PC team had much impact on IBM, just as is the case today with General Motors’ Saturn, an entire “skunkworks division.” The same problem of broader learning occurs even with famous, extraordinarily successful “skunkworks.” Much of this opportunistic learning remains as fragmented learning among the individuals, leaving the organizationally shared mental models unchanged.

Such cases of successful opportunistic learning are among the most puzzling and important breakdowns in organizational learning. They are testimony to the failure of the “better mousetrap” theory of innovation. Even when new experiments are successful, that is no guarantee that new insights and practices will spread. Often there is a complete absence of any mechanisms to reflect on and transfer new, better ways of doing things. Action-oriented managers are often too busy moving on to the next project to clearly articulate what established norms and procedures they violated and why. Even if they did, this would be little guarantee of change in shared mental models. After all, just because the daring experiment worked does not necessarily mean that those involved understand fully why it worked, or that the conditions for its success
can be replicated. Clearly, transcending opportunistic learning would require a systematic process of articulating emerging new theories for improvement and designing further experiments to test those theories. The absence of such a learning process is an indictment of results-oriented senior management.

Understanding the breakdowns

These multiple breakdowns suggest theoretical reasons why deep organizational learning is difficult. If there is doubt that these theoretical concerns matter, one need only consider the conclusion of the Royal Dutch Shell study, which found the life expectancy of large successful corporations to be roughly 30–40 years, that is, half the life expectancy of individuals in those organizations (de Geus 1988). In concert, the theoretical and empirical evidence leads to a humbling sense of the prospects for genuine organizational learning.

Another way to look at these ideas is that enabling learning will require a multifaceted effort and management commitment. Compelling speeches and increased training budgets will not work. There will need to be a serious, sustained commitment (on our part as well) to changes in culture, infrastructure, and people. As one CEO involved in the Learning Center put it, "When I understood the problem, I saw that it was me." Understanding the sources of the breakdowns in learning can be an important step in focusing that commitment.

In our work, we have found three bodies of theory especially relevant for understanding why the learning breakdowns occur and what can be done about them. All three play a major part in present research projects at the Center, while we concurrently explore additional theoretical lenses. The first has already been cited—the dynamic systems perspective, which suggests that little learning is likely to occur when facing systemic decision-making situations in which the consequences of decisions are distant in time and space. This helps in understanding causes of superstitious learning, and can help in overcoming fragmented learning by providing tools for capturing and transferring particular insights.

A second body of theory concerns why individual mental models are unlikely to change in learning situations. In particular, the action science perspective developed by Argyris and his colleagues focuses on the reasons for nonreflectiveness within individuals and defensiveness in teams (Argyris 1990; Argyris et al. 1985), providing a powerful perspective on the causes of superficial learning. Last, an emerging theory and practice of dialogue is providing insight into fragmented learning by clarifying the subtle processes of collective thinking, whereby individual mental models might come into greater harmony
and shared mental models might evolve (Bohm 1990; Bohm and Edwards 1991; Isaacs 1993).

Most important, these bodies of theory carry with them methods that can be used to address the breakdowns in organizational learning. In systems thinking, there are a variety of tools, starting with reflectively simple methods of conceptualizing dynamic feedback processes up to complex computer simulation models and management flight simulators, which can foster shared understanding of dynamically complex policy and strategy issues (Kim 1992; Morecroft 1988; Richardson and Pugh 1981; Richmond et al. 1987; Senge 1990; Sterman 1988; Vennix 1990). Action science also incorporates a variety of methods for fostering greater awareness of how one's mental models operate and influence, and for developing skills in bringing mental models more into the open and for challenging them without invoking defensiveness (Argyris et al. 1985). Finally, several methods for nurturing a "container" wherein deep shared assumptions emerge and change are being developed in current research on dialogue (Isaacs 1993).

From theory to practice: the role of managerial practice fields

Managerial practice fields can play a vital role in helping to address these breakdowns in learning and, in certain situations, help accelerate the whole learning process. However, in order to find broad application they must be championed, designed, and facilitated by the managers who will benefit from their presence. This requires, first, a way of framing the role of practice fields in a managerial context. The diagram in Figure 2 simplifies the breakdowns presented in the preceding section and conveys the essential strategy represented by the practice field.

The outer loop shows the basic organizational learning loop, in which processes of dialogue, discussion, and debate eventually lead to changes in strategy, structure, and particular decisions, new consequences, which feed back to lead to improved mental models and improved decisions. Supposedly, learning occurs through observing and interpreting the consequences in the real world arising from those changes. The problem, however, is that this loop rarely functions effectively for all the reasons cited in the previous section.

The most important breakdowns to pay attention to in the design of practice fields are those that occur (1) because the consequences of changes in strategy, structure, and particular decisions are impossible to observe unambiguously in a world characterized by long delays and external confounding factors (superficial learning); (2) because common processes whereby individuals interpret
information and come together to debate alternatives do not bring underlying mental models into the open, to be examined and improved (superficial learning); and (3) because whatever changes in individual mental models do occur are rarely diffused broadly enough to affect shared mental models (fragmented learning).

Each of these breakdowns can be overcome in practice fields that

- Speed up time so that people can experience long-term, systemic consequences of decisions
- Slow down time so that people can observe and reflect more deeply on habitual ways of interacting
- Lead to explicit theories of the systemic causes of problem situations that represent shared mental models within the team

For example, a team at Ford is developing a “car product development learning laboratory” with the intention that it will eventually be used widely to augment the traditional car development process and to steadily improve that process. An interactive management flight simulator offers participants in initial sessions an opportunity to test their assumptions and to viscerally experience the consequences of their actions. Suddenly, long-term consequences become real. Working in pairs, participants are encouraged to make explicit the reasoning behind their decisions, the mental models driving their decision making. Typically, they discover, for example, that their assumptions about the right pace of staffing and coordination between product and process engineering lead to missing all three targets: cost, quality, and timing. This sows the seeds for questioning well established but superstitious learnings.

Interactions with the simulator are just one facet of the practice field sessions. There is considerable work on examining in depth what happens intra-
personally and interpersonally when team members interact in ways that compromise learning. For example, using an action science tool called the left-hand column case, team members in an early session discovered that there were two very different sets of assumptions between finance and program management. The unspoken assumptions made it difficult for each to see and appreciate the other's view. By stepping off-line on the practice field, these assumptions were surfaced and acknowledged in a way that would not have happened in the day-to-day performance field.

There is also considerable work on conceptualizing feedback interactions that operate in car product development. In initial learning lab sessions, conceptualization is aided by elementary system archetypes, as presented in Senge (1990) and Kim (1992). To illustrate, consider tragedy of the commons, an archetype with much insight for car development (Zeniuk 1993). In a tragedy-of-the-commons structure, each individual pursues actions that are individually beneficial but that over time result in a worse situation for everyone involved because the individuals are depleting a common resource that is limited. At Ford, individual component teams were competing for the limited amount of alternator power output in the designs they were creating. It made sense for each component team to draw as much power as it required to maximize the functionality of its part. The collective result was an impasse in the design process, since no team was willing to concede what benefited its own component. Individual attempts to resolve the issue were unproductive.

What happens in typical projects as a result of this dynamic is that teams continue to struggle among themselves for resources, until at some point the program timing is jeopardized and the program manager has to step in and dictate what each team can have from the common resource. This makes the teams unhappy because a decision is imposed on them and because some of them did not get what they wanted. The manager is not happy because he had to intervene when he had expected the teams to work more cooperatively on their own. Typically, people conclude that this was just an instance of poorly aligned teams or a heavy-handed manager. There is no general framework for them to learn from; superficial, fragmented learning is the inevitable result.

In this case, once the tragedy-of-the-commons structure was recognized and conceptualized by team members, they realized that they were stuck in a situation where none of them, acting individually, would likely solve the problem. Only a collective governing body or an individual with the authority to impose constraints on all the teams could resolve the situation. They elected to give the program manager all the component designs and ask him to make the decision on how much power to allocate to each of the components. Those who had to give up some functionality did not like it, but they understood why it was necessary—because the alternative of laissez faire individual decision
making made everyone lose. In subsequent sessions, team members looked at other common resources, such as available torque, and realized that they too fell into the tragedy-of-the-commons category. These examples provide a systemic explanation of why a program manager with wide authority over the entire car program makes sense and why most Japanese car programs are structured that way.

This example shows how making explicit a tacit understanding can lead to a new shared mental model and alternative collective action. This explicit dynamic theory would not have been possible without the right tools to express such a theory, such as the system archetype mapping method. Once this theory was articulated and understood by everyone, it was obvious that some new action was needed.

Moreover, the managers involved did not stop there. As they have begun to internalize the basic capabilities needed to do left-hand column cases and system archetypes, they have continued to apply and extend their learning. For example, team members have identified several other core dynamic structures that have traditionally undermined car development, such as how component teams ensconced in organizational “chimneys” create vicious cycles linking “shifting the burden” structures: where one component team’s quick fix exacerbates another’s basic problems, leading the second group to its own quick fix, which exacerbates the first group’s problems.

Prototype practice fields are also being developed in concert with the Federal Express global sales organization, Philips Display components (a division of Philips North America), National SemiConductor, and other Learning Center member companies. The specific issues may vary, but the underlying theory and basic methods are the same in each case. While it is too early to assess the overall effectiveness of these experiments, initial results are very encouraging.

Conclusions

Overcoming the multiple breakdowns in organizational learning will not be easy. It will require basic innovation in how organizations operate. We believe that managerial practice fields can be such an innovation. As a by-product, we are seeing that they go much further than traditional consulting or training in bringing systems thinking principles and tools into the mainstream of management practice.

In this article, we have tried to lay out the motivations for managerial practice fields in terms of the basic breakdowns in organizational learning. We have also summarized our basic strategy for positioning systems-oriented practice fields as part of an improved organizational learning process. In subsequent
publications, we will develop the design principles and practices for such practice fields in more depth.

**Notes**

1. This loop is similar to the basic model of organizational learning offered by March and Olsen (1975). The main difference here is that we distinguish individual learning from change in mental models in order to distinguish single-loop from double-loop learning.

2. Management flight simulators are interactive decision-making computer games based on a system dynamics model of a particular domain of interest, such as product development, service quality, and product life cycle.

**References**


