

The gurus speak: Complexity and organizations

A Panel Discussion at the Second International Conference on Complex Systems. October 30, 1998

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The last day of the Second International Conference on Complex Systems hosted a rather unique event. Seven management gurus were brought together under the same roof to discuss the role of complexity science in management theory. Rather than treat the occasion as merely another monologue between panel members and the audience, the scene was set for a more interactive process. Some in attendance even agreed with the phrasing of Micklethwait and Wooldridge, the authors of *Witch Doctors*: “American managers are fond of the word guru because they aren’t sure how to pronounce charlatan.” The resultant emergent behavior gave rise to some interesting and possibly controversial debate. The following extract from the transcript of the event gives some flavor of what happened...

The Panel

Bill McKelvey, the Director of Strategy and Organization Science at the Anderson School at UCLA.

Henry Mintzberg, Professor of Management at McGill and the author of many seminal books, the most recent and perhaps important of which is *The Rise and Fall of Strategic Planning*.

Tom Petzinger, writer of “The Front Lines,” a weekly column in the *Wall Street Street Journal*, and author of *The New Pioneers*.

Larry Prusack, managing principal in the IBM consulting group, director of its Knowledge Management Institute, and editor of *Knowledge in Organizations*.

Peter Senge, founder of the Center for Organization Learning at MIT and author of *The Fifth Discipline*.

Ron Shultz, a writer, speaker, broadcast producer and Director of Publishing at Sendelaney Leadership Consulting in Santa Fe, and the co-author, with Howard Sherman, of *Open Boundaries*.

With comments from:

Yaneer Bar-Yam, president of the New England Complex Systems Institute, and author of *The Dynamics of Complex Systems*.

Dean Lebaron, founder, Battery March Financial.

Petzinger: Anyone recognize this woman? She is Mary Parker Follett. Mary Parker Follett was a management theorist back when there really was no such thing. This is pre cyberneticists, pre Norbert Weiner, pre general systems theory. “No one can understand the labor movement, the farmer movement, or international situations unless he is watching the internal stimuli, and the responses to the environment.” This writing is vintage 1920. She called this a circular response: “We cannot watch the strikers, and then the mill owners. Trade unionism today is not a response to capitalism, it is a response to the relation between itself and capitalism. What about authority? Where does it emanate from? It is not something from the top. It comes from the intermingling of all. Of my work fitting into yours, and yours into mine, and from that intermingling of forces a power is created which will control these forces. Authority is a self-generating process.”

The Austrians were not complexifiers, per se. But they used the very language that we now take as recent. The emphasis in this quote is in the original, the emergence of new patterns as a result of this increase in the number of elements means that this larger structure as a whole will possess certain general abstract features which recur independently of the particular values of the individual data.

Anyone recognize this fellow? This is Abraham Maslow, the great humanist psychologist best known for postulating the hierarchy of human motivations. Less well known is that Maslow also spent a sabbatical in an industrial plant in Southern California. He spent the summer walking around with a tape recorder in his hand, and having his thoughts transcribed; to my knowledge, the only time he was ever in a business or a firm-type setting. And he walked out with these kind of thoughts on such subjects as holistic business: “A business in which everything is related to everything else. Not like a chain of links of causes and effects, but rather a spiderweb, or geodesic dome, in which every part is related to every other part.” These writings, incidentally, are vintage 1962. As for creativity, he noted that it is correlated with the ability to withstand lack of structure, lack of predictability of control, the tolerance for ambiguity, for planlessness...

I'm going to pose a problem: in the course of naming something, or in explicitly linking so much deep thinking from across sciences, or many fields, or many intellectual traditions, you run the danger of oversimplifying it. And in oversimplifying it, you draw in the corrupters, the charlatans, people seeking pat solutions. This forces us to use the F word: Is this a management fad? Is it possible that the management folks will wreck this concept, even for the scientists perhaps? Just to contemplate this, I invite you to consider this quote from the business world: "In the world we enter, chaos is order. Evolution is revolution. Adaptation is survival. Order, truth, perhaps even beauty, will emerge from the constructive chaos of disruptive change." How many buzzwords in that sentence? We run the risk of wisdom becoming confused with word salad.

Here, from one authority, are words of warning, which I take just a little bit personally: "As soon as one management fad disappears, another is waiting in the wings to replace it. What? You didn't catch on to quality circles? That's okay. The big guy read an article about chaos science in the *Wall Street Journal*, and wants to implement it throughout our North American operations right away." Before going to the first of our speakers, I'm going to boldly assert that we are in very little danger of creating a management fad for these reasons. Complexity describes the world as it is. It is not an idealization tool. It emphasizes removing behaviors over adding behaviors. It's not a program. It's not something you can start on Monday morning. It's behavior you have to stop doing on Friday. It rewards our humility over our conceits. It defies methodology in packaging. It has to be customized. It is the situation that complexity addresses. And lastly, it is science, rather than a fad.

McKelvey: When I was at MIT, I was a student of Warren Bennis, one of the leading gurus on leadership. I want to tell you that in 30 years this is the first time I've had a paper that had the L word in it. So this is a new venture for me.

Yaneer Bar-Yam said that when a single component controls a collective behavior, then the collective behavior of the system cannot be more complex than the individual behavior; i.e., there is no emergent complexity. So what that means is, if we don't have CEOs and leaders in the firm who can create complexity, there's no reason for any of you to exist.

Back to Bennis. He talks about visionary, heroic leadership, and he talks about this as herding cats. Now I don't know how many of you have cats—I live with a couple cats—cats are really dumb, and they have no network. There is no human capital, or social capital, involved in Bennis's statement. What this means is that his view of how you get organizations to work in firms is essentially irrelevant to the modern age. There's no capital, there's no labor, there's no human capital, and there's no social capital in that statement. It all depends on having this visionary leader. And if you have a visionary leader who can't get leadership down into the lower parts, you don't have any complexity. So we're dead if we follow Bennis.

What I think we ought to talk about, if we're in the complexity business, is: Do we have human capital in firms? How do we get it? Do we have social capital in firms? Do we have intelligence distributed or some combination between these two? That's the next thing. The disconnect is most of the work on leadership, and all of this talk in the guru books. The information gets us to the point where we have firms dealing in a rapidly changing environment, we have hypercompetition. And the only response we have is that the leaders should be visionary. How do you have a leader direct an emergent system? Because if the leader really leads, according to the current conception, he or she shuts down emergent structure.

How do we actually do leadership in a way that fosters emergent structure in a firm without the leader somehow creating a bunch of passive followers following some vision? And further, in a rapidly changing world, what chance is there that the leader has the right vision at the time, or at the right level of technology, and so forth? Very little chance.

That is when I turn to complexity theory for an idea. Think of the organizational context. We have a firm facing an energy differential. It's out of date, it's obsolete, it's not keeping up with the rapidly changing world. It's under a lot of adaptive tension. You see it with a lot of M&A activity. We buy a small firm in New England. We send in the MBA terrorists, we get rid of the management, we change the culture, we change the accounting system, we change the IS systems. And right away we just create a lot of chaos. And if we don't do all of that, if we just passively buy the firm and hope for the best, this little firm pretty much just stays the way it is, and not much of any good happens.

What we're trying to do is to get managers to set up strange attractors, so that you get relevant behavior without somehow identifying a point in advance where you want the system to go. Clearly, there's a lot of stress managing the agency problem. The owner is going to say: We're going to pay for these people to do whatever they want to do? How do we know it's for the good of the organization? How do we know it's for the good of the shareholders or the owners?

Senge: I'm inclined to connect to one of the themes that Bill talked about and, since we already touched on the problems with heroic leadership, to come back to the whole business of knowledge. As I'm sure a lot of you know, all of you in business *certainly* know, knowledge management is what would qualify as a fad today. And it is remarkable to me how much time, and money, and all sorts of resources we can invest in something that people can't even define. There is a very strong tendency for us to define knowledge as information, or place it the other way around—for us to regard information as if it's knowledge.

I don't know what the world's greatest definition of knowledge is, I can only tell you what's been helpful for us in our work: knowhow. I've always found a really useful definition of knowledge to be "the capacity for effective action." Therefore learning in that sense is about the enhancement of capacity for effective action. While that's very simple, and undoubtedly has some limitations, it really gets you out of the confusion that knowledge is somehow information. Everybody is saying yes, knowledge isn't quite information, it's like really important information, or like really big information, there's something really different about it. But I think any of those definitions ultimately ends up not adding much of value. And I do think it is very challenging if you

think of knowledge as the capacity for effective action. It clearly has to do with highly complex, interdependent realities, and how people build knowledge; that is, not get ideas, not even build better theory—although I think theory is essential—but actually develop enhanced capacities for effective action.

Most of what's talked about in a conference like this is dynamic complexity. I'm not sure how well-defined, or consensually defined, dynamic complexity would be in this community; but by dynamic complexity I do mean things like emergence. I mean situations where cause and effect are not close in time and space, where in the behavior of a complex, non-linear system, the areas of most significance are very often very distant from the symptoms of the problems. So managers in organizations are—for all kinds of reasons—not only interested in the way the organization is organized and structured, but in the patterns of or the habits of our thought, e.g., if we're losing market share we ought to crank up a marketing intervention. Or if product development is somehow not up to snuff, we ought to reorganize the product development organization. Very often these are symptoms of the interactions of the enterprise as a whole, and the greatest leverage might lie in very distant parts of the organization.

The theory that I was most interested in, or became most interested in, was a theory constructed by the practitioners. To talk about theory in the world of business is usually a way to have yourself shown to the door—but I think that the best practitioners are theorists. They are thinking: What are my assumptions behind these actions? Why does one strategy make more sense than another, in terms of the world view that it is based on? And in so doing, if they're really good, they are quite reflective about their assumptions about that world view. So they know that they're just constructing a view on which their decisions are based, and ultimately the continual inquiry into that view is critical to their work.

In a human world, that means you have to deal with human complexity. You have to deal with the fact that people are different. They see the world differently. They construct different realities. They have very different assumptions, and oftentimes even different values. So in a sense, what we've been trying to do is pose the question: How do you make progress in this domain, in this space? Because there are a lot of tools for generating insight about complex systems which don't necessarily enable the human actors in those systems to become more effective. There are a lot of tools and methods for helping people listen to one another, appreciate one another, slow down enough so that we can start to see that the person who appears crazy, may not be crazy. And if I really could hear the process they have gone through to come to their view, I might learn something about the reality that I'm facing. And so in a funny, simple way, everything we have been doing has been trying to integrate tools and theories from these different dimensions.

The thing that's kind of interesting about this to me is it's always dangerous when you pick a little tiny piece of an example. You get a thread, but you don't get the weave. There is a weave here. People are spending a lot of time talking about why they don't get things done on time, and conceptualizing the kind of interdependent world they live in. Why is it that nobody will tell people they're behind? Because they're afraid of telling people things they're not good at, because of all the left-hand column stuff that nobody ever talks about. Most engineers, and most engineering cultures, will love to talk to

their peers about problems they have solved. But often—in some organizations I've found this to be really extreme—they really do not want to talk about problems they don't understand.

One of the things that's a huge limitation in our thinking, and taking more effective action, in this whole area is we've got to give up this notion that leader is boss, and boss is leader. It's everywhere, it's in our language: we use leader as a synonym for boss. And I would suggest to you if we do that, we are actually saying two things which we probably don't intend; but we're saying them very clearly. The first is, obviously, other people aren't leaders; and the second is we have no definition of leadership.

I don't think there's a snowball's chance in hell of redefining leadership in this day and age. There are people who stick their necks out—there are people who step forward—there are people who initiate—and there are people who work to sustain significant forces for change; all of which is what I would consider the core work of leadership. It's not just initiating, because when you initiate you bring a lot of difficult stuff out of the closet. And many times people who initiate aren't very effective at dealing with that difficult stuff. The main point is that these people are all over the place.

What are their rules of thumb? I don't know. It's the kind of question that I have to tell you I'm not too used to thinking about. What comes to my mind first are all the things like timeless verities, commitment to the truth, which doesn't mean truth with a capital T. People as individuals do not create anything. Creation, or bringing something new into being, is always a product of human communities. I would say the closest and simplest word that comes to mind on this is love. The real appreciation of the other and the appreciation of the quality of our relationship. As far as I'm concerned, the quality of thinking in organizations is very, very strongly influenced by the quality of relationships. These are not very new or novel ideas; and I'm sure it's much too simple.

Prusak: I come as an emissary from Big Company Land. I specialize in knowledge. I think I invented the term “knowledge management.” *Mea culpa.* We did this because we're paid to invent terms. There is a real subject, in economics and sociology, of what people know, and what organizations know, and how it's manifested. This is a real thing, it has a lineage. It's in epistemology, and other subjects too. And I tried to study a great deal of that, and then did some writing on knowledge management. You can't manage knowledge, because you can't see it. This is a given.

American commercial society tends to take things and turn them into something I can sell to you on a disk. All the consulting

firms I know sell something called packaged enabled business transformation—something that makes no sense whatsoever if you look at the words, but they're making billions of dollars on this.

I work for IBM, a very big firm. They have big consulting and services type of practices. And they talk a lot around knowledge. They already beat out data, they did a lot of data. They work with information, which is sort of a message that's bounded by repositories. You know, Peter's exactly right, and I think Bill was right. Information and messages, me to you. *Guernica* is a message. Schubert's music is a message, so are Emily Dickinson's poems, and so are memos. Knowledge is what people know, and what groups of people know. It's the space between them, very often, rather than the people themselves.

And now IBM and all the other firms want to sell you something about knowledge. So they go to these large firms, and say we want to do something around knowledge in order for you to buy services, and software, and hardware. And I and people I work with get called in to say, let's do something about knowledge. It's an interesting job. You end up with large firms, talking to executives, people who have the budgets and the power to do something. They say: What are we going to do about knowledge?

Let me tell you how I try to answer that within the realm of trying to maintain some integrity, and still pay my mortgage. First thing I try to do is understand where is the knowledge in the organization. Is it in people? Is it in processes? Is it in routines? Is it in documents and databases? Is it in the social networks?

Once we begin to talk about that, with whoever wants to listen, we begin to say: What's a unit of analysis? What are you going to analyze? An event? A group? An individual? The entire enterprise? Its past history? A GM is interested in analyzing decisions. The decision is the unit of analysis. What's knowledge in input? Knowledge in output? Some firms use communities of practice, communities of knowers.

Not long ago the Ford Motor Company did a little experiment in this area, and found they had about 560 people across the firm who were passionate about the technology of brakes. This might not turn you on, or me. If you're Ford, it's big-time stuff. You have some 500 people across the world, across functions, across boundaries, across rank. What do you do with that? Do you give them money? Do you give them space and time? Do you acknowledge that they're really valuable to the firm because they share knowledge? They talk to each other, they take that extra step, they read something and send it to you, when it's not in their job description. That's a real issue. Is there an intervention you can make in an emerging group, a community, people who are not organized by the hierarchy, but have self-organized themselves around a passion? What do you do with those people? It's a legitimate question. You want to help them. You want to make an improvement. How do you improve their behavior? What do you do, if anything?

Another question people ask is: If we can identify networks and communities, what can you do about them? The most valuable thing you can do if you want to optimize what an organization knows is to make it more visible, so others can use what others know. In a very raw sense, what we're talking about is that knowledge, what people and groups of people know, is local, contextual, and sticky, and that there needs to be respect for the localness of knowledge. People talk about knowledge transfer; they used to use the term technology transfer. It's very, very difficult to transfer knowledge in organizations, because the knowledge is embedded in social capital and social networks.

Knowledge is not Cartesian. It's not out there. It's not an individual. It's embedded, embodied in groups of people who share common goals, common ideas, common emotions. And that's a very elusive subject. What do you do when knowledge is embedded in social capital? It's the space between people. What can you do? What's an interventionist stance towards that? Professor Nonaka, who also writes about knowledge, talks about the need for *space*, and this is something I have come to agree with.

A lot of firms are run with mechanical models. The model they have in mind is a lean machine. This is just ridiculous, but it's still very current—the way people think. Machines don't need knowledge, they just need energy and direction. If you think of an organization as a machine, you're not going to make much progress. And I have to fight, we fight against this.

Nothing happens without reflection, and there's no reflection without space—cognitive space, social space. I'll give you a real example. Again, I hate speaking in abstractions without stories. People only learn through stories anyway.

If you don't have space to learn, what do we mean by space? Physical space, cognitive space. You can get all the technology you want. You can get money for technology. It pays off my debts, it will pay off yours. Sell all—you can't get space, and you can't get attention. The two things that are most valuable for doing knowledge stuff, or learning stuff in organizations, are space and attention, and you can't get them. They're becoming a scarcer and scarcer commodity.

I would then that add another key thing to do, along with space, is trust. Ken Arrow wrote a book 20 or 30 years ago, *Limits of Organization*, where he talked about trust being the most efficient economic tool, because you don't need to negotiate when you have trust. You don't have to barter or bargain. If you trust someone, you trust them. And trust is anticipated reciprocity. It's an options model. I will help you, with the understanding, tacit or covert, that you will help me in time, and that you have something that I would want to have help with. It's a long way of saying that it makes a tremendous difference.

There are things that can be done to enhance trust in organizations. Charles Sable at MIT wrote a very interesting paper on how if nations could recreate their myths, you'd have less wars. Companies can sometimes change stories. That's why I like that

learning history stuff. Sometimes if you change stories about the past, it will help engender trust.

IBM owns Lotus. We didn't merge with Lotus, we bought Lotus, and we're eating it. The Lotus-eaters. One of the things we're doing is changing the way they tell stories about IBM, which of course are not dissimilar to the stories I heard from my parents about Germans in the 1940s. But we're changing the stories, and it changes the legends, the myths, the way people understand; and it will help build trust.

The third very important element, which again is not science so much as heuristics, is perceived equity, which is a form of trust. If you sense in an organization that you're not getting your due, that there's wealth being created that is not being accrued by you, not only financial wealth, social wealth, intellectual wealth—a sense of a proportion of equity is not coming your way, however you define equity. You're going to underoptimize, you're going to underperform, and it kills trust. So perceived equity is a key ingredient in social capital. Networks will occur, but within these social networks that we're talking about, within the growth of social capital, it creates a tremendous constraint if you have a sense that someone is going to misuse what you have or give. Again, they'll be thrown out of the network. Not formally, but slowly their calls don't get answered. But if the whole firm has a sense of this, it's deadly.

If you can get across in these organizations a sense that there are interventions that enable cooperation, so knowledge can be moved, can be generated. People in firms know how to do things. And what they know how to do can sometimes be made more valuable if more people knew who knew what, if some of them had a little time, a little space, a little money, a little technology, a little pat on the back. With the diffusion of technology, you have a sense that knowledge gets more visible in organizations. As it becomes more visible, because of intranets and web sites, people get a sense of who knows what. And there's a real disparity in organizations between who knows, and who has the money, and who has the power. This guy helps me, but that person has the budget, and has the power. It's a very interesting sense of social stress. Knowledge isn't free, it isn't cheap, it's expensive, and it takes interventions.

We need, again, a big element of social capital. Children need it, adults need it. You need to be recognized. You need a sense of identity. And identity, for better or worse, is often wrapped up in where you work, and what you do. We live in a society—and I've never heard it said better than by C.B. McPherson—that is possessively individualistic. You're not different when you enter a firm's door. It's possessive, and people want to possess something. It's not enough to know things. It's enough to know, and be recognized for what you know, and be rewarded for what you know.

Mintzberg: One of the things I discovered here is I guess I've been a complexity theorist for a long time, probably before anybody even used the word "complexity theory." I went out to observe managers, and I discovered that all kinds of funny things were going on in the office, and they were being interrupted all the time. They were doing short things. Their job was all oral, there was very little written. And a journalist described managerial work as calculated chaos, which I kind of like.

And it occurs to me that managers have to act. That's what management is about. It seems to me that because managers have to act, or intervene, or change things, they have to simplify. So no matter how complicated the world is, managers have to act. The worst thing a manager can possibly do is not act. Saying no, doing nothing, is far worse for a manager than doing something, no matter what it is. The best thing is to do the right thing, the worst thing is to do nothing, and the second best thing, or middle thing, is to do something, even if it's the wrong thing. Because at least you can correct it.

I think that leads to something I called emergent strategy. You don't make a strategy as some kind of Moses-like process where you walk down from the mountain, and present the tablets, and everybody else runs around implementing—you make a strategy by trying something, and testing, and changing. There's a threepart process to what management does. There are initiatives that people take, and those can happen anywhere in an organization; often down on the ground, where people know what's going on. There's a kind of championing or promoting role, which is somebody who recognizes the initiative for more than it looks to the person who started it, and promulgates it, to some extent. And then there's a kind of acceptance role. But part of the promoting role is to seek some kind of convergence in the initiatives. And I think strategy becomes simply the consistency or pattern that develops in behaviors. So management is really about that.

I just did an article called "Managing quietly." And what managing quietly is about is that the hype really gets in the way, and the big sort of initiatives get in the way, these big turnarounds where people come in, doing dramatic things to organizations, and driving everybody nuts, because they don't know what's going on. Managing quietly basically means building up the system—quietly, and slowly, and low key—by which other people take initiatives and by which you encourage people to take initiatives.

You act, in order to think. And it seems to me that the more complex something becomes, the more you have to act first, and the less thinking is actually useful, at least initially, as a starting point. I don't know how many of you are familiar with the "garbage can" view of decision making, organized anarchy. Is this the complexity of the process we're talking about, or is this the inability of the observer to understand what's going on? Because anything we don't understand is, by definition, chaotic.

For example, there's a lot of talk about turbulence. I hate that word. I think it applies well to hurricanes, literally, but I don't think it applies well to anything in management. Claims about turbulence are just an effort to pat ourselves on the back, and to say we're really important because big things are happening now. I see very little turbulence anywhere. If you want, take turbulence to be something like the siege of Leningrad. I grant you that was turbulent for the people who lived through it. I don't mean to be

callous, but the use of the word is absolute and utter nonsense most of the time.

I accept the notion of complexity, and complex systems. But how much of the complexity we supposedly see around us is real complexity, and how much is simpl that we're confused by things because we just don't have the right theories, or approaches to understand things, which may in fact be a lot simpler than we think? How much of the complexity is the unexplained variance, and how much is real, true complexity?

Shultz: I have the unenviable task here of trying to summarize what

has gone before. Peter began with this idea that knowledge is the capacity for effective action. And what that is really saying to me, on one level, is that our ideas are shaping our behaviors, so that what we think shapes what we do.

Henry was talking about the mechanical perspective as well, and how we get locked in. But what happens when we get locked in? We limit our possibilities. And when we limit our possibilities to respond, we limit our ability to respond to unexpected occurrences. And when we limit our responses to strategies, we become vulnerable to catastrophic events. When we are vulnerable to catastrophes, an unexpected occurrence can wipe out the system. This in my estimation is why it's important for us to understand how ideas shape behaviors.

What I want to provide for you here is what I call a sustainable model for inconceivable development. The process is very simple, there are only three steps. It begins by understanding the system.

As soon as we have a new understanding of the system, as with complexity, it requires us to do something. It requires us to adjust our relationships according to that new understanding. So we go in, and we adjust all our relationships with people that we work with. And what happens? Something emerges out of that interaction of our understanding and that adjustment of relationship.

Now we have a new understanding because of what's emerged. So we have to go back in, and create a new understanding of how the system works. That means that we have to go back, and we have to adjust our relationships according to that new understanding. And when we do that, something new emerges, which means we have to go back in, and readjust our understanding of the system, and the system continues on down.

What happens when we do this in a organization? By the time you get three levels down in this process, what emerges would have been absolutely inconceivable. What usually happens is that by the time we get beyond the first emergence, we stop. We don't go back in, and readjust our understanding, and continue the process on down. The system then dies.

On one level, complexity is really an outcome, because it arises out of the very active organizing within an ever-changing environment. In business it comes out of our interactions with each other and with the environment. The interpretations of those interactions are all based on one common experience. And that one common experience is our thinking. Therefore, when we don't get stuck in our outmoded ways of thinking, we can greatly affect the way in which we operate. If our thinking is hectic, and overly busy, the way in which we operate is hectic, and overly busy. And if our thinking is quiet and calm, so too are our interactions.

Bar-Yam: I think it is very important to put the human back into the organization, also into the thinking about organizations in the context of complex systems. That is in contrast to the usual discussion of chaos, and the concept of edge of chaos, and so on, where people are being pushed to the limit, in order to be able to exist in a complex environment. And the discussion that is relevant here is a talk that Herb Simon gave at the banquet last year. He spoke about the concept of homeostasis, which was very important in the previous generation of complex systems thinking but is missing in much of the current thinking. And the idea is that there is a complexity that the organism exists in, in the context of the environment; but the parts of the organism are not in the complexity of the environment outside. This is because the organism is shielding and protecting its own components. Realizing that a complex system is protecting and shielding its components from the complexity that they otherwise would encounter is an important part of understanding how complex systems thinking should be applied in the context of human organizations.

One of the things that we have to recognize is that it is important to have both abstract, larger-scale models, and models that allow us to deal with the emotional or individual human content. In addition, we need to recognize that there are all those different levels of treating a system.

Lebaron: It's my observation, over an extraordinarily small sample size, that the floor or limitation in the description of what we're talking about of having a very nice emergent system is the individual. The individual does not want to live at the edge of chaos, or near to it. When you introduce a system which is periodically, or continuously, emergent and adaptive, nonforecastable in a linear or hierarchical sense, it appears to be out of control. The individual, wherever the individual is in the organization, will do whatever it can to freeze it up. Periodically you can get some pulses through. You can send through some shocks. That's what a merger or an acquisition is, it is a shock. Or you can change people around, shuffle them around. You can't do that very often, but they sort of restart the clock. But you can't keep it up continuously.

Petzinger: I'm going to close the session by returning to a thought. The aspect of complexity that is most in line with what I do is the realization that as valuable as living systems may be as metaphors for organizations, they are not nearly as valuable as the

knowledge that complexity teaches us—which is that human organizations are biological systems. We are biology. The organizations we create are just like the organizations that exist in the natural world. We aren't the natural world, but nevertheless, we operate according to, if not identically to, the laws of dynamics that scale from species to species—from organism to organization. There's a lot of science, including quantitative science, in the life sciences, and the physical sciences that we can learn a lot from. The question for us as managers is, "Do we dare? And do we care?" In our answer may rest our competitive position for the decade and century ahead...