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Norman L. Johnson

Sustainable Strategies in Fast-Changing Times

To get you all in the mood, I want you all to relax, take your pulse, feel your heartbeat, and then think about the fact that one day your heart will stop. Hopefully that adrenaline rush will last us through the next forty minutes!

I would like to open with two stories to set the stage for my discussion. For the last ten months since 9/11, I have been helping to develop a national counter-terrorism plan for bio-terror threats. It has been one of the hardest things I have ever done. It involved everything from local to national to international to technology to social dynamics and beyond. There are some investment opportunities in this area, but I have to look back on the last two years that I have spent in trying to understand the investment world. I have to conclude that bioterrorism is much easier than what you people do!

Second, I just came back from a conference in Switzerland on self organization and evolution in social behavior, and naturally this has totally changed the talk that I wanted to give here. What made it very interesting was that about two thirds of the people there were researchers in social systems of various types. This ranged from human systems, to upper primates with consciousness, to lower primates, to various social mammals and social insects. There was also a guy who studies slime molds.

So there we were sitting around the dinner table discussing the challenges associated with our various fields of study. The human researchers are clearly baffled. The upper primate researchers were clueless because there subjects are just as complex as humans. We went through all of these people until we got down to the social insects, where things were finally starting to get optimistic. The person that stole the show, however, was the guy that works on slime molds. He had been working on it for thirty years, and he knew slime molds better than anyone else ever had. None of these areas of study, however, combine all of the complexities of the investment world that you work in. Your world deals with all of these social complexities, on top of finance issues and all the rest.

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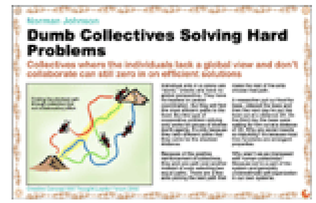
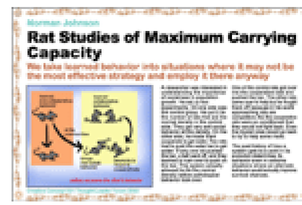
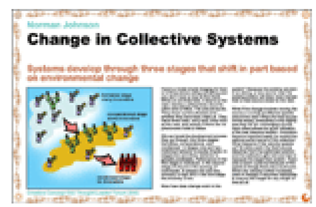
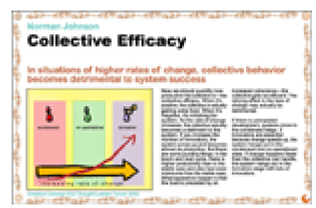
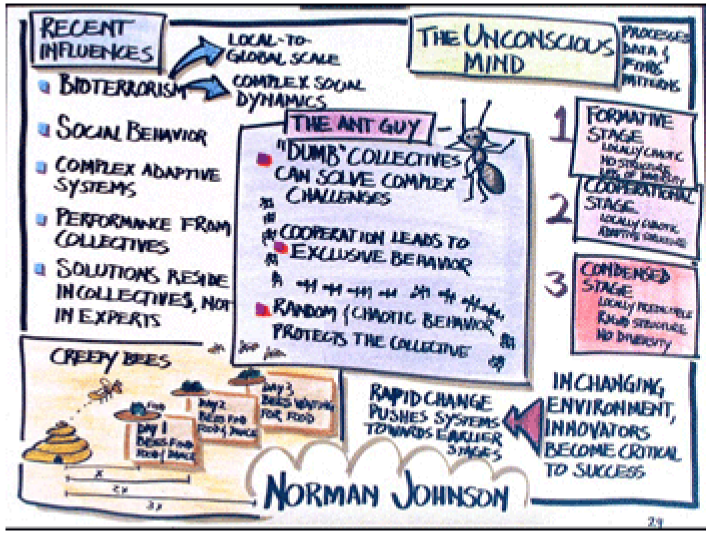
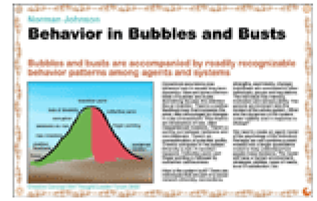












I would like to start with some highlights from my last talk at this conference. I am going to spend most of the time talking about Complex Adaptive Systems, and Michael has already given a very good introduction to that.

One of the main points from the last talk was about the performance of collectives. I did not appreciate at the time how relevant this might be to efficiency in markets. We are not really clear about where higher performance comes from. Some of us believe that it comes from selection - certain elements do better than others. We tend to forget, however, that this performance may also come from synergy. Having a very diverse group of investors out there may have a very synergistic effect.

The artists claim that I said that "Experts are phooey." What I would add to that is that if you compare all of the knowledge of speakers at this event to the collective knowledge of this group, there is much more knowledge out there than up here on the stage. By the end of this talk, I hope you will see that I believe the solutions for your biggest problems are not what you are hearing from this stage, but rather they are things that you can do.

Finally, in the last talk I discussed the theme of diversity and heterogeneity vs. structure.

What I did not talk about last time that I would like to add tonight are the themes of change and the behavior of the individual. At this conference in Switzerland, I learned of some research on behavior that I will share with you tonight.

Conventional Wisdoms

Do you agree or disagree with the following? Innovation changes the way the market operates. Progress is cumulative in science but cyclical in finance. Wall Street is an economic bellwether, early warning system. The market is the best long term investment. Buy on the dips. Don't fight the Fed. The average bear market lasts for 18 months. The current bear market is now into its 28th month. The recession ended in January, 2002. Creative destruction is taking place. Irrational pessimism has replaced irrational exuberance. We are in uncharted territory here. Bear markets are not supposed to hit new lows coming out of recession. The market is undervalued. The market is overvalued.

Dumb Collectives Solving Problems

Let's touch on some of topics that I covered last time. This first model is responsible for giving me the name "The Ant Guy". The subject is "Dumb Collectives Solving Problems." Ants and collectives can solve problems that lie far beyond the comprehension and perspectives of the individuals. Ants are dumb. They have no global perspective. When you give ants the challenge of multiple paths to a food source, they will always find the shortest path. They don't have GPS units telling them where to go. They find the path through their pheromone trails and the collective system. There are no central leaders - this is a totally distributed system.

The big insight, however, is that this approach only works for groups of diverse, dumb agents. If all of the ants took the exact same path, they could never find the shortest route. It is only because they take different paths that they can find the shortest solution. It turns out that slime molds also solve this shortest-path problem!

That is the positive side of collectives. There is also a negative side. Because of the positive reinforcement of collectives, they have a tendency to pick one path over another, even if the two paths are equidistant, and even if it would be more efficient to go up one path and down the other. This is caused by a few ants early on taking the one path, and all of the other ants following them. This is an example of global chaotic behavior based on individual chaotic behavior. There was a whole book called Butterfly Economics based on this concept.

The Bees

I had several people ask me whether or not I really talked about this next model. A researcher was looking into the language of bees. He put out some food and videoed the single bee coming back to the hive and doing the dance. The next day he put the food twice as far away from the hive, and he videoed the dance, and the whole swarm went out to get the food. On the third day, he went out to place the food at three times the original distance from the hive, and the entire swarm was waiting for him to arrive. At this point, the researcher gave up and went to have a beer and think about life.

Why was this behavior so disturbing? There is no was to argue that bees should have this capability or global perspective. Most of the functions of the hive are emergent properties - you cannot predict the global behavior by analyzing the individual bee. The problem is that we also have these global properties in human systems (like market efficiency), but we form part of that system as well. This is why it is so difficult for us to understand how important this capability is.

What Goes Wrong

Technology develops through three stages. It starts with some initial hype that helps to develop resources. It then moves into a utility stage, and finally into a transparency stage, where you don't even see the technology anymore. I would argue that we have seen a very rapid rise and collapse of the hype stage before the utility of these technologies could come into play. The internet is a good example of this. Things went online and offline so quickly that we were not able to develop utility and infrastructure. We broke the natural stages of technological development. There are other examples of this happening in the past as well Gene therapy experienced a lot of hype fifteen years ago, but it has only been recently that it has achieved any utility.

Rat Studies

With this next model I will now be known as the "Rat Guy". This information actually comes from Michael Mauboussin's mother-in-law, who was at this conference in Switzerland. A researcher at the National Institute of Mental Health was interested in understanding the importance of social-ness in population growth. He set up two side-by-side experiments using rats. There is a natural group size that is comfortable for rats. Below that size, they are very warm and fuzzy. Above that size, they start fighting with each other.

The control system included 2.5 times the optimal population for the rats. If you overpopulate rats, they develop very antisocial behavior - killing each other, eating their young, etc. This is just like New Yorkers who lock themselves in their apartments to avoid too much social stimulation. When rats in this system were killed, he replaced them to keep the numbers up.

In the other system, he set up an incentive for the rats to cooperate. For any rat to get water, two rats had to push the water bar. If only one rat pushed the bar, then a little bell would ring. Very quickly, the rats learned to run over to help push the bar when they heard the bell. The neat thing that he discovered is that this system can tolerate up to eight times the optimal capacity before weird behaviors start manifesting. That is amazing!

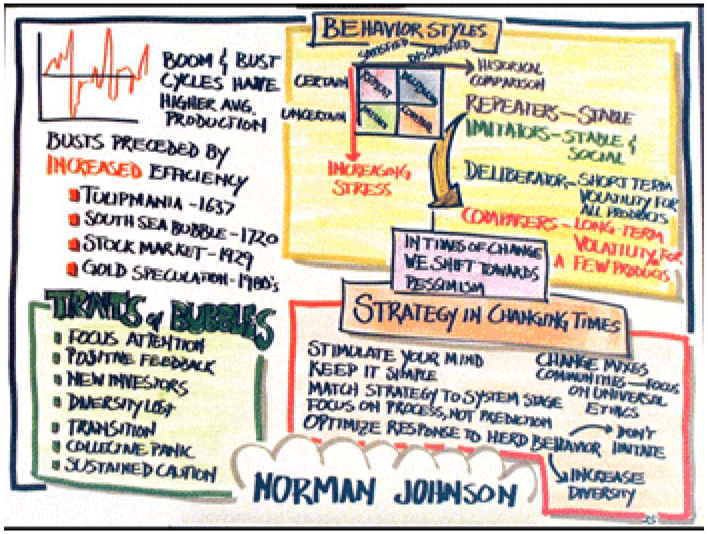
He developed lots of theories about how we are social creatures to help us deal with increasing populations. But this is not the most interesting part of this story.

The most important part of the story has to do with a mistake. One of the control rats got over into the cooperative rat cage. He pushed the bar for water, but since he was by himself, he did not get any water. That made him a little annoyed to begin with. All of the nearby rats, however, heard the bell and ran over to help. He, of course, fought them all because in his world approaching rats are competitors and threatening. It turned out that the cooperative rats were so conditioned that they would not fight back. In fact, they were so conditioned that even the ones that were injured would go back to help again, even to the degree that some of them died of multiple injuring.

Isn't that amazing? This is just rats! Then you start to think about humans and how we make sacrifices for various things. What it says to me is that even in these very simple social systems of rats, the past history of how you got to a point can totally determine your behavior, even in extreme situations.

So far we have seen the importance of collectives, the importance of history, and on a global level, how behavior might interrupt the normal behavior of a system. The question is how we might use these ideas in our work and lives. How do we take in these stories and make something magic happen?

Suppose I sat you down at a terminal, and asked you to click on an X every time it pops up on the screen. It appears, you click. It appears, you click. Slowly I speed it up and speed it up. That is all that I do. Eventually the experiment ends.



It turns out that in this experiment, the researcher had programmed a pattern in the times and locations that the X popped up on the screen. Before the X even appeared, the subject would start moving the cursor over toward the correct area. When you asked the subject about a pattern, they would tell you that they didn't see one. It turns out that they had figured out the pattern subconsciously but not consciously. This says that our unconscious mind processes data, sets goals, judges people, detects danger, formulates stereotypes, and infers causes, and it does all of this better than our conscious mind.

If you perform the same experiment and tell them to look for the pattern consciously, it doesn't work very well. They have to study the problem very hard, and they still have difficulty finding the pattern. This background processing might be called intuition. This might be what happens when investment professionals look at certain market results and get a feel for what it happening. The interesting thing is that there is also research that says that as you expose your brain to different things, your neurons actually begin to connect differently. You can teach an old dog new tricks!

Dumb Collective Simulations
Based upon that idea, I would like to show you some simulations. The whole idea behind these simulations is to get your intuition going. I want to stimulate that mental simulation model about change in collective systems. You can think of this as an ant foraging model, if you like. Or you can look at this as a consumer model. In the center of the simulation is the "hive" or "housing complex". Around the outside of the screen are "food sources" or perhaps "stores" that sell the same thing. In the retail model, you have to go out of the housing complex to find these stores, but you don't have a map of where the stores are. You initially have to wander randomly to find the stores, and then you can start to tell other people where the store is. Ultimately, the collective begins to take advantage of the "store" resource to use up the consumer goods.

These are pheromone clouds and represent social or collective information that we tell one another. You can see that the pheromone clouds evaporate over time, diffusing. The agents in this simulation are really dumb. There are only two pieces of information that they know about. One is their location and the other is whether or not they have food.

The agents have three rules. If they have food, they carry it to the nest. If they are at the nest they drop the food, turn 180 degrees and go searching. If they are searching, they follow pheromone trails if they exist. If there is no trail, they randomly search. The agents that have food are red. The ones that have had food and are headed back to the food source are purple. Individuals not associated with the collective are white. They wander around until they hit a pheromone trail or a food source. That's the collective structure. Again, the collective, as I'm using the term, comprises the red and the purple-the agents who have food or have had food and are on their way back to get more.

Here is a simpler version of the simulation. In the center is the "nest" and just south of the nest is a single, stationary food source. Think of a community that has a single store that everyone goes to. The store has been there forever, and it has a very efficient supply system, so the food available is essentially infinite. Over time, the agents that are out there searching eventually run across the pheromone trail and end up going back and forth between the nest and the food. In other words, over time, almost everyone finds the store.

Three Stages of System Development
Next, let's break the process down into three pieces. I presented these stages of development two years ago. There are three stages: formative, co-operational and condensed. In the formative stage, the agents are just

beginning to find the food sources. In the co-operational stage, more agents have found the sources and in the condensed stage the system is at its optimum performance. In the formative and co-operational stages the behavior of the individual agents is very chaotic. Most everyone is still running around trying to figure out how to solve the problem. In other words, there are lots of white colored agents in the picture. Once everyone ends up going to the same "shopping mall" in the condensed stage, the behavior of the agents is locally predictable.

The global behavior, though-the food production-is very predictable in the co-operational and condensed stage, but not in the formative stage. In the formative stage, production is still very dependent upon the individual. With respect to system structure, or pheromone trail has little structure in the formative stage. In the co-operational stage, the structure is a robust collective network. In the condensed stage, the structure is unchanging and it dominates everything in the problem.

Performance in the formative stage is based upon individuals doing well. In the co-operational stage, it's based upon synergy between the collective and individuals. In the condensed stage performance is based upon the collective alone, since it's completely optimized.

Finally, look at diversity, or the space. In an organization, diversity may be thought of as the number of different market areas people look at or the number of approaches and strategies for investment. In the formative and co-operational stage, there is high diversity because no single physical features stand out or dominate. Individuals are still trying out lots of strategies and approaches to the problem. In the condensed stage, everyone is doing the same thing: only the boss can alter diversity. There are very few individuals outside of the coherent solution.

System States in Various Types of Change

Now let's add some change to the system. I'll put the nest in the center and a finite food source at the northwest corner of the space. After the agents find the food source, I'll add more sources. Two of them are much closer to the nest but are southeast of it, in the opposite direction of the first food source. A third source added at the same time is again northwest of the nest, close to the original food source, but farther away from the nest than the other two new food sources positioned in the southeast. An interesting phenomenon occurs. Even though two of the new food sources are closer to the nest than the third new source, the agents find and exploit the third, more distant source first. This is a very inefficient global solution, but the key is that the prior optimized solution prevents the system from being further optimized by discovering the two closer food sources. The system is blind to the better solutions right at its doorstep. I call this the Loonie-Twonie effect. In Canada they have a coin called the Loonie. Then they came out with the two-dollar coin that they would never have called a Twonie if they hadn't have called the first coin a Loonie.

Now let's get quantitative about the change that takes place. I'll move the food source in a circle with the nest at the center of the circle. Let's see what happens. First the rate of movement will be very slow. Productivity for this scenario is only slightly less than it was in the previous, stationary example. The herd effect allows quick utilization of the new resource location. In this case, the optimization on the prior position of the food source actually helps because some agents as they return to the old food location will run across the new position of the food-it's moving that slowly. Unlike in the condensed stationary case, the innovators become important again and stay important. They're the ones who stray a bit from the trail and happen upon the food source at its new location. Their pheromone trail is closest to the real, current solution. In the condensed stationary case I described earlier, once the collective locked in on a solution, the innovators became very unimportant and actually a nuisance to the system. But this is not the case if the food is a moving target. They are now essential. And it's not always the same agents who are the innovators.

Now I'll speed the food source up by a third. Initially the behavior looks similar, but at some point the food source detaches from the collective pheromone cloud, or the collective solution. Basically, the collective got lost. Remember that the pheromone cloud is a lagging indicator of where the food source was, not a predictor of where the food source will be. Because the traffic pattern of agents between the food and the nest is non-uniform, there will be times when the system will lose its collective. This simulates a boom or productive cycle, followed by a bust cycle where the optimized solution failed to reacquire the target. In this case, there's an equal importance of the herd effect and innovators. You need the herd effect to bring the food back home, but you need the innovators to continually reacquire the source.

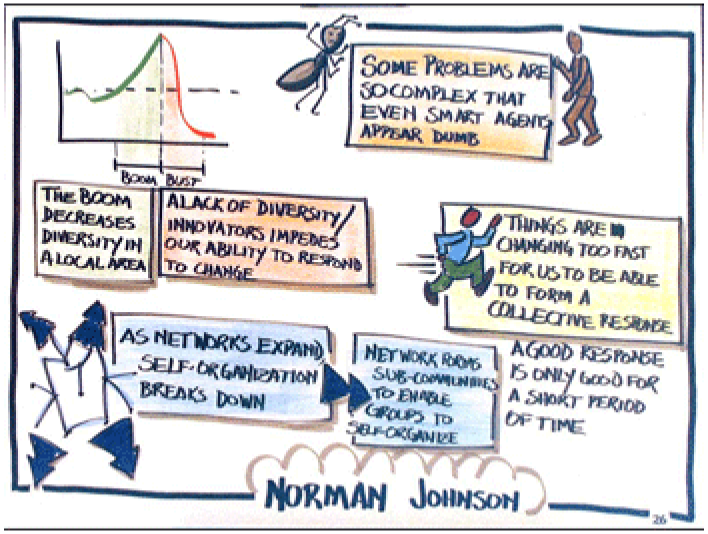
Now, I'll double the speed of the food source as it rotates around the nest. The system really wastes its time. It would be like going to Wal-Mart but the store has moved. So you give up and try again. Next time you find out where it is, it's moved again. Your collective information that's trying to help you is always behind the times. In this situation, almost all productivity is from the innovators. The highly productive condensed stage is never reached. The herd effect can actually degrade the performance.

Productivity and Structural Efficiency During Change
Here's a graph of rate of food production vs. speed of the food source (or environmental change). Interestingly, as environmental change increases, individual production stays about the same. But collective production decreases rapidly. The increasing rate of change in the environment has the effect of pushing the system back to earlier and earlier stages of development. A condensed stage system can be pushed back to a formative stage by a high rate of environmental change.

But I wanted to quantify how productive or unproductive the collective is. I came up with a variable called "structural efficiency." It really defines the collective efficacy. When it's positive, that means that the collective is allowing the system to get extra food. When it's negative it means that the collective is inhibiting the system. As the rate of environmental change increases, the presence of the collective actually becomes a detriment to the system and the structural efficiency goes negative. But what's interesting is that if you add a few more innovators (by making the pheromone trails diffuse faster), then a system in a higher rate of environmental change can become almost as productive as a system in a lower rate of environmental change. There's an edge of chaos feature that emerges that allows more productivity.

Something puzzling emerged from this work. I've plotted structural efficiency for the stable case and for the fast moving case. The case of the boom and bust cycle shows higher productivity in some times than you find in the stable case, but lower minimums as well. The boom and bust cycle shows greater maximums and minimums than the stable case- the case where the food source is not moving at all. This is fairly odd: how could the boom and bust model show higher productivity than a model where the food source is not moving at all? The bust is actually preceded by an increased coherence. The failure that happens is due in some way to the fact that the collective is getting more efficient. When we're in times of change, everyone's in denial: "we're not going to change; we're going to do what we did before!" The troops rally together until the system actually cracks.

So in summary, when there is no change in the environment, there is a very nice progression from formative to co-operational to condensed stage. Stable economic systems will move to a state of low diversity, high optimality, and high structure (rules and regulations). If change is slower than the collective response rate, the system tends to hang out in the condensed and co-operational state. If the change happens faster than the collective can form, the system tends to hang out in-between the formative and co-operational stages. If you really whack the system it hangs out at the formative or individual survival level.



Adding a Behavioral Component
I started the talk with the idea of a collective. Now if we add some model

for behavior, we can possibly get to an understanding of long-term dynamics. So now I'll talk about the behavioral component.

First, here are some historical bubbles and busts: The Netherlands' Tulipmania of 1637 (maybe not a real bubble); the salvage of sunken ships in1690 (England); the South Sea bubble of 1720. Sir Isaac Newton wrote, "I can predict the motion of heavenly bodies, but not the madness of crowds." He invested twice in the South Seas. The first time he made $300K and the second time, he lost $1M. He actually wrote the quote after he made the money on the first investment. Other bubbles include the Mississippi bubble (French), the US Stock Market crash of 1929, gold speculation in the 1980's and Kamikaze capitalism in 1990's Japan.

Here are some common traits of bubbles and busts. There's something that focuses attention initially. Next, there's a positive feedback loop that increases the price, often encouraged by changes in traditional rules in investment. The other common traits have more to do with behavior. Next we see the introduction of new, often inexperienced investors, who sort out between "believers" and "non-believer exploiters." There's an overestimation of the potential profits. Also, bubble/busts are characterized by corruption in the system, particularly in centralized regulation. Diversity is then lost: the elites are supported and the naysayers are neglected.

What happens next is a transition and the dynamics of the system change. Prices drop. I don't' really know what causes the transition. After the transition comes a period of collective panic, followed by blaming and then a sustained cautiousness after the fallout.

A Model Combining Individual Behavior and Global Dynamics

How can we combine what we saw about dynamics of the global system with individual behavior? Here is a model. It has some components. In the middle is a social-organization or information network, like Duncan Watts talked about. The network is characterized by diversity, a number of connections, asymmetry (for example communication may be one-way, as in a mass media model), strengths of connections, and change. Connected to the network is the component of the model that represents individuals in the network. They have three key characteristics: memory, motivation and some sensory apparatus. The individual is connected to other individuals, other groups and to regulations via the network. All of this resides inside an environment characterized by culture, economy, demography, technology and nature. It sets the context for the whole system.

We're interested in the dynamics of this system. Under stable conditions there are internal processes that go on, and we want to know what happens when change occurs. I went to a conference on Social Behavior in Switzerland. These two researchers put together an agent model of the psychology of the individual. They were looking at behavior in consumer systems, not in market systems, but the two are related. They looked at all the different psychological models and selected the ones that had been proven. They combined them into a single quantitative model that describes how people make decisions. It includes the human environment, strategies, abilities, needs, levels of satisfaction, and uncertainty. What it boils down to is a "state of the individual" box.

Four Behavioral States of Individuals
The box is a two-by-two matrix that shows four behavior styles, or states that a single individual may take. This matrix is not easy to understand. The horizontal axis deals with cognitive processing and the vertical axis deals with social processing. Along the cognitive processing axis, if your needs are satisfied, you don't think. You just keep going along as you have been. If your needs are dissatisfied, you may have to think a lot. For example, if you have a cup of coffee, your need for coffee is satisfied and you don't think about where you want to go to get a cup. If you don't have a cup of coffee and you want one, all of a sudden, you start going through scenarios about where to go to get it, what kind, when, and so on. Along the social processing axis, you're either certain about the future or uncertain about it. If you're uncertain, you tend to do more social processing-you tend to watch and rely more upon others. If you're certain, you tend to do more individual processing.

These two researchers did a small world model with 1000 consumers, each with the same behavioral propensities. In the first scenario, all of the consumers are Repeaters. The Repeater is satisfied and certain about the future. That scenario moves to a situation where there are few products with equal distribution, and the whole system is highly stable. In the second scenario, all consumers are Imitators. The Imitator is satisfied but uncertain about the future. In this situation, there are few products in the market, their distribution is unequal, and the system is highly stable. Because Imitators are socially active, the system performance converges on the stable state much faster than it does when there are all Repeaters. In the third scenario, all consumers are Deliberators. Deliberators are dissatisfied and uncertain about the future. There's some need that's not being met. This model is the closest to the rational agent model used in economics. The result is high volatility on all products. A lot of the economic models assume this. This may be why we see a lot of chaotic behavior. In the last scenario, the consumers are all Comparers. Comparers are dissatisfied and uncertain. They're both social and rational. Because of the social nature, the cycles are longer, but there is still a lot of volatility over a few products.

In summary, a Repeater system is highly stable with low diversity. An Imitator system is highly stable with moderate diversity. A Deliberator system shows short-term volatility on many products. A Comparer system shows long-term volatility on a few products. Individual behavior yields interesting global results. What we're missing in the model is the change in behavior due to feedback. How do people change from being Repeaters to Comparers, for example?

Putting the Two Models Together
Now we have a model for collective behavior and a model for individual behavior. In times of stability, the individual behavior tends to gravitate towards the Repeater, while the collective behavior moves to the condensed stage. If you whack the system, the collective behavior moves to the formative stage. The individual behavior tends to move towards the Deliberator or Comparer states. These two models can feed upon one another.

What are some sustainable strategies to use in fast changing times? First, the whole reason for showing the simulations to you today is to feed your mental simulation. Continue to feed it, and be deliberate about it. Second, keep strategies simple in times of fast change. I bought a real early chess program for my computer, in which I could set the level of how many moves ahead it would look. If I picked a level that matched my individual ability, it was a tough match. If I picked a level way beyond my individual ability, I looked like a random agent to the software and I could beat the pants off it. It thought I was a lot more complex than I really was. The new programs don't let you do that.

It's important to recognize stages and states in systems and individuals. Strategies should match stages. Enable diversity because diversity is best at recognizing the emerging herd trends. Next, focus on processes and not specific predictions. Drucker wrote a book about discontinuity in 1968 that predicted the information age. This was long before the personal computer. He made the prediction by examining the processes that would happen associated with an information revolution. Mark Twain wrote, "history does not repeat itself-it rhymes." That's why historical processes may be the same, but not the details. Strategic planning therefore is about developing process, not product.

Optimize your response to herd behavior. Learn to recognize herding by the loss of diversity. Otherwise there will be an over-coherence. Resist condensing your social network. Rely upon diverse communities. Become more flexible when your tendency is to become more rigid. There's a tendency in times of change to become more social, more imitative when we should be thinking more diversely.

Finally, in times of change, acceptable ethics in our communities may not be acceptable more broadly. We need to think about the broader, more universally acceptable ethics in times of change.

"Problems cannot be solved at the same level of awareness that created them."-Albert Einstein

"When we remember we are all mad, the mysteries disappear and life stands explained."-Mark Twain

"The whole problem with the world is that fools and fanatics are always so certain of themselves, but wiser people so full of doubts."-Bertrand Russell