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TAKING A SYSTEMS VIEW: A REFLECTION

By David W. Packer

Over many years of working with systems thinking as a student, manager, and consultant, I have developed an increasing respect for and fascination with the diversity of ways that people and organizations benefit from its application. Likewise, I have come to appreciate the power these concepts and tools can bring to issues that range from personal dilemmas to the biggest challenges confronting our world. Taking a systems view involves looking at how dysfunctional behaviors result from interactions among the parts of a system over time. It provides a way of examining the potential unintended consequences of proposed interventions and of recognizing the impact of time delays and feedback. As such, it can lead to better assessments and more effective actions than traditional linear thinking.

This long and broad view is in direct opposition to the "quick-fix" mentality that increasingly dominates our complex world. Perhaps the reliance on "band aids" results from our economic system, in which managers focus on short-term results to keep stock prices and option values high, and shareholders care more about quarterly returns than long-term corporate health (accentuated by technology that provides instant access to massive amounts of data). Perhaps it comes from our political system, in which politicians invest in symptomatic rather than fundamental solutions—which take longer to show results than the person's term in office—in order to ensure reelection. Or perhaps it is an outcome of our educational system, which fails to expose people to the basic ways in which feedback processes work in the world.

Whatever the reason, despite the promise of systems thinking, its impact has been surprisingly limited. But I fear that, unless a critical mass of people and organizations adopt a systems view, our organizations will continue to fall short of their potential. Even worse, the dire consequences of non-systemic approaches to issues such as global terrorism, the environment, and poverty will threaten the world for us, our children, and future generations. By offering the perspectives that follow, I hope to widen the circle of systems thinkers by attracting newcomers and convincing experts to stay the course.

The Systems Thinking Difference

Let me start with a personal story. As a student, I attended a lecture by Norbert Weiner, the famed mathematician. He discussed a key project in which scientists of the day were working—unsuccessfully— to get computers to translate text from one language to another. Weiner identified a possible breakthrough in the project: The goal should be to create a *system* for excellent translation by including a computer component to perform routine elements and a human component to handle the non-routine tasks. Together, they could elegantly and affordably achieve the overall goal. The fundamental idea of a *system* as an entity that was different from its components—and not merely the sum of the components—was, to me, original, new, and powerful.

Over the years, I have heard many people say that the simple act of thinking systems rather than components, the whole rather than the pieces, enables them to better understand why things behave as they do and take more effective actions. I have seen, for example,

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THIS ISSUE AT A GLANCE

Systems Citizens

This vision of Systems Citizens came out of the Essex conference in the summer of 2001. It never hurts to look it over again and see where it fits into the practicality of your classroom.

THE VISION

The Student

What are the skills, attitudes and behaviors that a citizen with a system dynamics education will possess?

- **Systems Thinking Skills[1] –** learned in the context of the current curriculum.
  - Dynamic Thinking – seeing patterns of change over time rather than focusing only on isolated events.
  - System as Cause Thinking – recognizing that problems, and their solutions are endogenous: they arise within a system, not from outside.
  - 10K Meters Thinking – being able to step back and see the big picture.
  - Operational Thinking – understanding how the structure of a system causes its behavior, and that the same basic structures apply to all systems. Understanding stocks and flows.
  - Closed-Loop Thinking – recognizing feedback: any action has consequences that can influence that action again.
  - Non-Linear Thinking – knowing that feedback loops interact to produce changing responses over time.
  - Quantitative Thinking – being able to consider and include all variables, even those that cannot be measured in standard units.
  - Scientific Thinking – recognizing that all models are working hypotheses to be rigorously built, tested and refined.

EDITORIAL

Welcome back to school! By now you have all welcomed your students, and probably their parents back to the school year and you have your classes going full swing. This year I encourage you to take time to look at the bigger picture of the school year and see where systems thinking and dynamic modeling fit in to your classrooms. How are we all working toward creating systems citizens? A list of the characteristics of systems citizens appears elsewhere on this page. Please take the time to read and review it, and envision your students developing the skills, attitudes and behaviors that a citizen with a system dynamics education will possess.

I hope your fall is productive and fun.

Take care,
Lees (Lees Stuntz, *stuntzln@clexchange.org*)

- **Systems Thinking Attitudes and Behaviors –** developed in the process of learning and practicing the principles of system dynamics within the curriculum.
  - The ability to work together to solve real world problems.
  - The willingness to examine and change one's own assumptions and conclusions. Meta-cognition.
  - Openness to the mental models of others. A tolerance for productive disagreement.
  - Patience and persistence in problem solving. Using systems thinking skills to dig deeper and keep learning.
  - The willingness to be wrong and learn from mistakes. An ability to take considered risks.
  - An acceptance that often there is no one right answer.
  - An expanded sense of self. Seeing oneself as an integral part of a larger system with a shared responsibility for the common good.
  - Empowerment. Using an understanding of a system to act upon its problems with courage, confidence and hope.
  - An extended time horizon. A suspicion of the short-term easy solution based on an understanding that short-term policies are detrimental in the long run, and vice versa.
  - An ability to relate the past to the present and the present to the future. An ability to read across the present and recognize patterns.
  - An internalization of all these principles that informs actions and interactions with others.

[1] Richmond, Barry, “The ‘Thinking’ in Systems Thinking: How Can We Make It Easier to Master?” The Systems Thinker, Vol. 8, No.2, Pegasus Communications, March 1997

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executives who are dealing with a critical product issue come to the realization that the answer is not in making marketing *or* manufacturing work better, but in improving the quality of interaction and influence *between* the two functions. The notion of recognizing the interactions among component parts as critical to the system's performance leads people to accept the system as the major determinant of the behaviors and events that occur.

Once we can see the whole (the system) as something different from its parts (the components), it isn't too far a leap to accept Deming's observation that optimizing a system *requires* sub-optimizing its components. This idea is profoundly paradoxical. It says that functional excellence will not guarantee overall success and that working "across the stovepipes" provides the greatest possibility for superior performance. Bridging the gap between functions requires compromises from each department for the benefit of the firm as a whole. My observation is that once people "get" the concept of systems, they become sensitive to the harm the stovepipe mentality can bring, and they open themselves to seeing linkages among the pieces that may be important, even in areas beyond their control.

Because talking across stovepipes is not easy, the mastery of dialogue, skillful conversation, and concepts such as the ladder of inference—all part of today's organizational learning focus—are essential to fundamental and sustainable performance improvement. A dozen years ago, I scoffed at such things as too soft and fuzzy. Now I am convinced that these tools play a critical role in improving systems. (Of course, Peter Senge already understood this point in 1990 when he popularized systems thinking and integrated it with team learning and other skills in his surprise best-selling management book, *The Fifth Discipline: The Art and Practice of the Learning Organization*!)

The ability to visually represent the interrelationships among the components of a system through different kinds of diagrams represents another benefit of systems thinking. These "maps" reveal the cause and effect linkages thought to underlie behaviors by depicting the "system behind the story." Causal loop diagrams are especially effective in displaying the feedback processes at play. By recognizing the behaviors associated with each of the two kinds of loops (balancing and reinforcing) and through the process of collaborating on creating the diagrams, people are able to reach important and sometimes profound insights.

> All approaches that stem from a fundamental understanding of systems—whether broad or deep—can add value by offering insights far beyond traditional linear thinking.

Stock and flow diagrams are especially effective in displaying the dynamics among accumulations or stocks (such as backlog, inventory, or morale) and the flows (such as orders, shipments, and successes) that increase or decrease them. By identifying stocks and flows, we gain knowledge about a system's behavior and take a step toward building simulation models. We know that the "map is not the terrain," but maps of structure predictably add insight to our ability to better know the real terrain by giving us a shared view of its complexity.

System archetypes also provide a strong basis for learning about systems. Archetypes are a set of relatively simple structures that have been observed to occur again and again in social systems. These structures typically consist of two or three causal loops and have names like "Fixes That Fail" (the story of unintended consequences),"Shifting the Burden" (the story of addiction), "Limits to Growth" (the story of resource depletion), and "Escalation" (the story of violence and war).

It has been interesting to see the rapidity with which relative newcomers can relate to an archetype and apply it to their own experiences. In workshops, the energy and insights that emerge from archetype examples are often startling. More than once, I have heard someone say that the understanding of a single archetype changed his or her life!

Breadth and Depth

The most rigorous end of this spectrum is computer simulation, which stems from the breakthrough work of Jay W. Forrester at MIT in the 1950s. He brought the first application of engineering control theory to social systems, taking advantage of advances in computer technology for simulating non-linear systems. His 1963 book, *Industrial Dynamics*, provided the initial codification of the ideas, tools, and learnings of the nascent field and remains a classic today. (It was, by the way, my privilege to be a research assistant in Forrester's group during the early phase of the field. That was how I was hooked!) Simulation enables users to view the system's behavior in action and to experiment with various scenarios. These are very powerful capabilities.

Efforts involving simulation models around specific organizational issues have had a positive impact on corporate decisions and strategy assessment in a number of cases. However, building such simulations takes enormous time, money, and expertise. In addition, decision-makers who don't fully understand the model may be uncomfortable changing policies based on its outcomes.

A broader or at least more visible source of impact, I think, has come from "models for learning" developed in academic and other non-corporate environments around major social issues and generic problem behaviors. *Limits to*

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Growth (by Donella Meadows et al.) and *World Dynamics* (by Jay Forrester) were based on simulations that explore the extent to which our planer's resources can support the rapid growth of human population and industrial activity. Forrester's *Urban Dynamics* deals with the system structure underlying the growth and decay of cities. These bodies of work have created a widespread awareness—with significant controversy—of the critical environmental and social issues facing humankind by demonstrating the potentially catastrophic trends that can result from certain systemic structures.

As another example, my own work on the dynamics of corporate growth (a master's thesis also published as a monograph) outlines how balance among functional decisions in a growing company can be more important than specific functional expertise. The study used computer simulations to show how a company, by its own actions and with inadequate understanding of its systemic structure, could easily fail even though its market was virtually infinite. It demonstrated how an enormous range of behaviors, from wildly successful growth to stagnation to collapse, depended *solely on the firm's internal decisions!* As the cartoon character Pogo said, "We found the enemy and it is us." I contend, though it is impossible to prove, that this work had a positive impact on the company that sponsored it (which was highly successful for more than 20 years afterward).

The very breadth of the systems arena has created some barriers that I believe have slowed acceptance of the field. From a systems perspective, the obstacles I have seen relate to our own stovepipes, represented by different approaches such as simulation, causal loop analysis, stock and flow diagrams and the like. When practitioners in particular areas imply that their approach is the only valid one, the credibility of the whole spectrum of activities suffers. Here, I have tried to convey that all approaches that stem from a fundamental understanding of systems—whether broad or deep—can add value by offering insights far beyond traditional linear thinking. As in most systems, the right balance among the components is the path to a stronger whole.

Looking Ahead

In closing, my objective in this article has been to present my observations of the compelling potential for creating a better world through applying systems concepts and tools to our own circumstances and issues. Thinking systemically can change lives, improve businesses, help economies, and maybe even save the planet. Equally important, the broad range of approaches for application provides great accessibility. Opportunities for demonstrating the impact of systems thinking should be embraced, wherever they happen, and the diversity of approaches should be used to full advantage! I hope I have provided some incentive for doing just that.

David W. Packer is a founding member of the Systems Thinking Collaborative (www.stcollab.com), bringing extensive business experience and systems thinking capability to its membership. He holds a master's degree in management from MIT, where he was a member of the system dynamics group at the Sloan School, and is a graduate of the executive program of the Darden School at the University of Virginia. David participated for many years in the growth of Digital Equipment Corporation and now serves on the board of directors of several organizations, including Pegasus Communications, the Home for Little Wanderers, and the Policy Council of the System Dynamics Society.

ESI PREP Project

By Ben Johnson, Program Manager

The summer Prefreshman Engineering Program (PREP) and the College of Earth and Environmental Sciences at the University of Texas at San Antonio (UTSA) are hoping to team up with NASA Earth Science Enterprise to integrate NASA Earth Systems Science into PREP's already academically rigorous junior high and high school science and math curriculum and to prepare more secondary teachers to teach earth systems science, NASA style. The ESI PREP Project will be taking current data from NASA Earth Systems Science programs and helping the students to make working earth systems models with modeling tools like STELLA®, while at the same time helping them learn environmental science, statistics, math, physics, and career preparation in interdisciplinary approaches.

Dr. Alyson Ponomarenko of the UTSA Earth and Environmental Science Department is teaming with Dr. Raul Reyna, Director of the PREP to write this joint grant from NASA's Earth Science Enterprise, Earth Explorers Program, and the Minority University Research and Education Program. The goal of the three-year ESI PREP Project is to create a replicable plan and curriculum that can be shared nationwide. Dr. Ponomarenko and Dr. Reyna believe that this project will not only help PREP in San Antonio but will have wide application throughout Texas and the rest of the United States. They are seeking projects to partner with that are doing similar things and would like to collaborate, thus focusing and uniting efforts to use wonderful NASA resources and promote systems thinking in students and teachers, nationwide.

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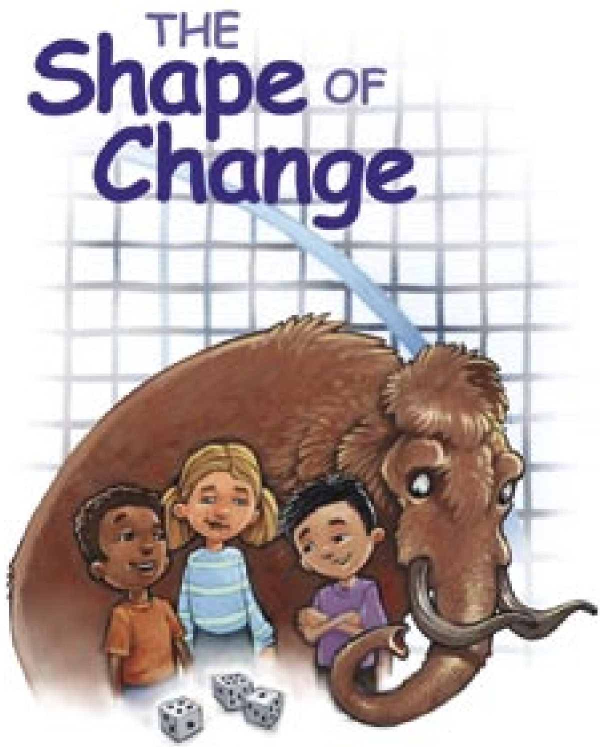

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Report on the Systems Thinking and Dynamic Modeling Conference at Skamania Lodge, June 30 - July 2, 2004

by Lees Stuntz

This year's conference was, once again, a wonderful opportunity for interaction with others who are deeply committed to K-12 education and system dynamics. Many faces were familiar, but newer ones were interspersed, showing the vitality of the K-12 systems thinking and dynamic modeling group across the country and internationally. We were again blessed with the participation of the most active educators and system dynamicists, who came with the motivation to mentor as well as to learn.

This conference always has been unique in its mixture of both K-12 educators and skilled, committed system dynamicists. Nowhere else in the K-12 community do the practitioners most prominent in the academic discipline give so freely of their time and expertise. And nowhere else, I venture to say, do they listen so intently to the creative and practical ideas bubbling forth from the K-12 community. It is a powerful combination. The lead in this has come from Jay Forrester, who has supported K-12 from the beginning and attends our conferences regularly.

In 2002, Barry Richmond, one of the best friends of K-12 in the system dynamics community, gave the ending keynote of the conference. That was his last public address. Fittingly, one of the prominent themes of the conference was his work and how others are going forward with his ideas and themes. George Richardson started the conference off with a discussion of the dialogue he had been having with Barry at the time of Barry's death. This dialogue centered on issues that had emerged out of mentoring the K-12 community. It was a learning and growing experience for both George and Barry, as well as those privileged to hear a recounting at the conference.

We also had a chance to view the video of Barry's keynote from the 2004 conference and discuss his message; and in the final keynote this year, Jeff Potash and John Heinbokel described their intellectual journey using Barry's concept of systems citizenship and their work integrating it into their own piece of K-12 education in Burlington, Vermont, at Vermont Commons School.

The Keynote speeches were rounded out by an inspiring and interesting talk by John Sterman from MIT who talked on "Why I want my Children to know System Dynamics." One can certainly understand why he consistently receives the highest teaching ratings at the Sloan School at MIT. It was a treat for all to have him and his son, David, join us at the conference. We look forward to seeing them both at future gatherings.

The parallel sessions sported a wide range of subjects, from a model for Systemic Planning and Decision Making through multiple curricula at all levels, as well as basic to advanced training sessions. Some of the most popular sessions were the elementary, middle and high school sessions describing the action research being supported by the Waters Foundation. Much exciting work is going on throughout the country!

Some of the suggestions for 2006 include more in-depth training workshops and more concentration on how to get started, in detail. We will spend the next year thinking about the program for 2006, so feel free to e-mail with any suggestions (stuntzln@clexchange.org.) We are hoping to have the 2006 conference in another lovely place with good food, the New England Conference Center in Durham, New Hampshire.

Conference papers, handouts, outlines and PowerPoint presentations are available on the CLE website www.clexchange.org.

ESI PREP Project, *continued from page 4*

What the program directors need to know is who is doing something similar so they can share notes and verify results. For those groups or individuals that are already using systems dynamics in this way, or those who would like to, this is an opportunity to collaborate, share and duplicate efforts. If you have any questions about this NASA grant or PREP, you are welcome to contact Dr. Reyna or Dr. Ponomarenko at any time and they will be glad to share what they know.

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Dr. Alyson Ponomarenko (210) 458-5449
aponomarenko@utsa.edu

DynamiQUE*ST* 2005
March 4th, 9am—3pm
Campus Center, Worcester Polytechnic Institute, Worcester, MA

Come join us for the sixth annual DynamiQUE*ST*!

The what and why…

*Students (and teachers) are at various places along the road to developing proficiency with thinking systemically and employing System Dynamics/Systems Thinking (SD/ST) to address complex issues and increase understanding. We seek to encourage students and teachers to develop an understanding of the use of SD/ST tools. We also know that we need an environment, free from the "winner/loser" constraint, where kids can receive feedback from other kids as well as from teachers and professionals well versed in SD/ST. DynamiQUE**ST** creates a venue for both celebrating what has been done and providing encouragement for all to continue!*

In this spirit, DynamiQUE***ST*** was launched in 2000. DynamiQUE***ST*** 2005 will provide a venue for students in Grades 3-12 to showcase work in which they have employed the tools and method of system dynamics. This effort has several purposes:

- Provide a way for students to meet other students and see what they are doing
- Permit teachers from different schools to see evidence of student work in ST/SD
- Provide a venue for teachers and kids to network
- Have some fun and celebrate with your kids!

The how…

Simple! Have a place where students from around the country can bring their SD/ST work for others to see. Don't pit kids against each other, but hold their work accountable to a set of clearly defined standards (see DynamiQUE***ST*** 2005 Rubrics). Give them (and their teachers) a chance to see "where they are" and "where they can go from here."

But, but…

"My kids are at different stages in learning and understanding the tools and method of SD/ST. Why would we make the trip just to bring our BOTG's?"

Of course they are, and this is precisely why you should make the trip! The use of standards allows kids to see their work as a point in time along a learning continuum and see where they can go next. DynamiQUE***ST*** 2005 provides rubrics for any combination of SD/ST tools from a simple (but powerful) BOTG to a full-blown, dynamic model. The 5th grader's BOTG is as valid as the 11th grader's functional model! Both represent vital stages in the development of a systems thinker/dynamic modeler. Let's take some time to see this work, have kids see each other's work, and celebrate where we are and where we are going.

What now…

Look over the guidelines provided on the website. Begin planning, with your kids, what you will bring to DynamiQUE***ST*** 2005!

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THE K-12SD LISTSERVE

The K-12SD listserve is a wonderful way to make connections and find resources within the K-12 community. Share your experiences anad ask for help. If you are not yet a member, please join us.

To subscribe to the K-12SD listserve, send an email message to *listserv@sysdyn.clexchange.org* with the line "subscribe k-12sd first-name last-name" as the only thing in the message's body (no footer, no signature, etc.) The subject line is immaterial."First-name" and "last-name" should be your first and last names, for example, "subscribe k-12sd Lees Stuntz" if your are Lees Stuntz. Remember that the quotation marks are not to be included in your message, just the words.

The list is not an overwhelmingly active one, so it will not burden your in-basket, unless there is a lively discussion going on. Our most recent one centered on the conceptual difference in a stock and a flow and why these are important concepts for students to understand. Bring your ideas and questions! Where else can you get answers from both experienced teachers and world-class system dynamics experts?

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If you would like to invest in our effort here at *The Creative Learning Exchange*, your contribution would be appreciated. You may donate any amount you wish; perhaps $50.00 is a reasonable amount for a year. All contributions are tax-deductible.

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