Volume 9, Issue 1 January, 2004

The F. M. Duffy REPORTS

A Change-Leader's Guide to Systems Thinking

Happy New Year, everyone! This edition of the **Reports** marks the 9th year of publication. Thank you for your continuing interest in receiving these **Reports**. I hope you have found the information provided to be helpful in your efforts to lead whole-district improvement in school districts.

Before presenting the main article, I have two quick pieces of information to share with you. First, the World Future Society has invited Dr. Thomas Houlihan, Executive Director of the Council of Chief State School Officers, Mr. John Horne, a consultant from Tempe, Arizona, and me to make a panel presentation at their upcoming annual conference in Washington, D.C. Our presentation is titled "How to Transform a School System: The Future in the Present Tense" and it's tentatively scheduled for Sunday August 1, 2004, 2:00 P.M.- 3:30 P.M.

Second, my 6th book is currently in production and should be ready for release in the spring, 2004. It's titled, *Moving upward together: Creating strategic alignment to sustain systemic school improvement*. William Cook, a nationally known strategic planner, wrote the foreword. It will be published by Scarecrow Education Press as part of their new *Leading Systemic School Improvement Series*.

A Change-Leader's Guide to Systems Thinking

Piecemeal change to improve schooling inside a school district is an approach that at its worst does more harm than good and at its best is limited to creating pockets of "good" within school districts. When it comes to improving schooling in a district, however, creating pockets of good isn't good enough. Whole school systems need to be improved.

To transform an entire school system, change-leaders in that system must know what a system is and how it functions; they must understand what it means to be a systems thinker; they must understand the dynamics of critical system archetypes; and they must be skillful in using a set of systems thinking tools. This article offers information about two elements of this competency set—the nature of a system and systems thinking. The next edition of the **Reports** will present information on system archetypes.

What a System is and How it Functions

The nature of systems has been described in great detail over the past 50 years, especially by von Bertalanffy (1950) and Katz and Kahn (1978). Another significant contributor to this literature is Russell Ackoff.

Ackoff (1999, pp 6-8) adds to our understanding of organizations as systems. He says a system is a whole entity consisting of several parts with the following properties, which were modified to fit school systems:

- The whole system [e.g., a whole school system] has one or more defining properties or functions; for example, a defining function [i.e., a system's main purpose] of a school district is to educate children and teenagers.

- Each part in the system [e.g., each school in a district] can affect the behavior or properties of the whole; for example, a couple of low performing schools in a district can drag a whole district into low performing status in the eyes of its state department of education.

- There is a subset of system parts that are essential for carrying out the main purpose of the whole but they cannot, by themselves, fulfill the main purpose of the system; e.g., teachers and classrooms in a single school building are essential parts of a school system and they are necessary for helping a school system fulfill its purpose, but these "parts" cannot and never will be able to do what the whole system does.

- There is also a subset of parts that are nonessential for fulfilling the system's main purpose, but are necessary for other minor purposes (e.g., in a school system these nonessential parts include school and community relations and other "parts" that are not part of the essential work of school systems—teaching and learning).

- If a system depends on its environment for the importation of "energy" (i.e., human, technical and financial resources), then that system is said to be an "open system." A school district is an open system. Its environment consists of its community, individuals and groups (collectively called stakeholders), the state and federal governments, and society in general.

- The way in which an essential part of a system affects the whole system depends on its interaction with at least one other essential part; e.g., the effect of a single school's performance has on the whole district depends on the interaction that school has with at least one other school or other essential part of the school system.

- The effect that a particular subset of essential parts has on the whole system depends on the behavior of at least one other subset of parts. For example, let's say that a school district is organized preKindergarten-12th grade. This means the work process for that district is 13 steps long (preK-12th grade).

  Now, let's say that district leaders are concerned about the performance of their high schools (which represent a subset of the system). These high schools contain grades 9-12. Then, let's say that the performance of those high schools is dragging down the overall performance of the district on state assessments.

  It would be a mistake to focus improvement efforts only on those high schools because their performance is affected by at least two other subsets of schools (i.e., the elementary and middle schools that "feed" kids into those high schools). Since all essential parts of a school system interact either indirectly or directly, it would be reasonable and "systemic" to examine and determine how these parts are affecting the performance of the high schools. Focusing improvement only on the high schools would be a non-systemic and, therefore, piecemeal approach to improvement.

- A system is a whole entity that cannot be divided into individual parts without loss of its essential functions. For example, the dominant approach to school district improvement is school-based improvement. This approach has the consequence of dividing school systems into their aggregate parts—individual schools. These individual schools are then assumed to have the ability to fulfill the essential purpose of a school system; i.e., providing children with a total education. But individual schools do not and never will provide children with a total education; they only provide children with a partial education represented by the curriculum for the grades embedded in a particular school. When a school system is managed in this way—by disaggregating it into its individual parts—its effectiveness as a system deteriorates rapidly.

- Because a system derives its effectiveness from the interaction of its parts rather than from what the parts do independent of the system, when efforts are taken to improve the individual parts separate from the system (as in school-based improvement), the performance of the whole system, according to Ackoff (p. 9), deteriorates and the system involved may be destroyed. This is one reason why school-based improvement has generally failed to improve schooling throughout a district.

Systems Thinking

"Systems thinking" is a popular concept among change-leaders. It has many meanings. It can refer to a set of specific tools, it can describe a unique perspective on how organizations as systems function, or it can refer to a lexicon of terms of art for the field of systems dynamics. Here, I will talk about systems thinking tools that require practice and patience to develop and use.

Richmond (2000) presents an in-depth description of seven different mental skills that are collectively known as systems thinking skills. These skills complement each other, but are used at different times during a systemic change effort. These seven systems thinking skills collectively comprise a four-step systems thinking method.

Below, I briefly review the four-step method and the seven skills.

The Four-Step Systems Thinking Method

The systems thinking method has four steps: 1) describe the problem, 2) state hypotheses explaining the problem or develop a model to explain the problem, 3) test the hypotheses or model, and 4) implement high-leverage changes and communicate results, which, in turn, influences the future description of the problem.

The Seven Systems Thinking Skills

The seven systems thinking skills can be organized using the 4-step systems thinking model. The thinking skills of dynamic thinking, system-as-cause thinking and forest thinking are used in step one of the method. Operational thinking, closed-loop thinking and quantitative thinking are all used during step two of the method. Finally, scientific thinking is used during step three.

Dynamic thinking. Behavioral events in your district are often viewed in isolation—as disconnected events. One way to improve your response to these events is to observe them to see if they fall into patterns of behavior. Dynamic thinking skills are useful for helping you cluster troublesome events into patterns. For example, one troublesome event in school districts is the low performance of particular schools. If this low performance persists over time for the same schools, then this repetition is a pattern.

Static thinking, which is the opposite of dynamic thinking, leads change-leaders in school districts to focus only on the low performance of a school rather than thinking about how that low performance is part of a longer term flow of interconnected cause and effect relationships within the whole system. However, dynamic thinking skills help change-leaders to identify the underlying flow of cause and effect relationships (often called loops) that contribute to a school's low performance and then helps them identify ways to make changes that have a good chance of permanently improving a school's performance.

System-as-cause thinking. When you use dynamic thinking (described above), you begin to see your school system's problems organized into patterns of behavior rather than as isolated, disconnected events. Given those patterns, you now have to start thinking about why those patterns exist; in other words, you have to develop hypotheses to explain these patterns.

As an alternative to developing hypotheses to explain patterns of behavior, some systems thinkers develop models to "demonstrate" how these patterns emerged and the impact they have. When you develop a model of your system's performance that model must have boundaries, otherwise the model loses its explanatory power because it becomes too "big."

Systems thinkers identify two kinds of boundaries for their models. The first kind of boundary is an extensive boundary. An extensive boundary defines how broad your model is. Breadth, by analogy, is like the difference between having a map of a city versus a map of an entire state (a state map has more breadth). You need to have sufficient details in your model, but not too many.

The second kind of boundary is an intensive boundary. An intensive boundary defines the depth of your model. In other words, you define how far down into your system your model will attempt to go.

In the field of organization diagnosis (e.g., see Cummings & Worley, 2001), there are three levels of a system that can be used for constructing a system model: whole-system level, group-level, and individual. The depth of your model depends on the nature of the problems you are trying to diagnose.

When defining the extensive and intensive boundaries of your hypotheses or models, the operating principle is "...you should include only those variables that are under your control and that are capable of generating behavior you want to explain. The relevant question from this perspective is: 'In what ways are we 'doing it to ourselves'?" (Richmond, 2000, p. 6). In other words, you are focusing on variables and factors *inside* your district.

The opposite of system-as-cause thinking is system-as-effect thinking. This more common perspective entices change-leaders to look outside their districts to explain their problems as in "No Child Left Behind is doing this to us." The system-as-effect perspective results in too many variables for explaining and understanding a district's performance problems.

Because external variables are part of your district's external environment they are, by definition, beyond your control. So, there is little benefit to including them in your model. System-as-cause thinking, in contrast, "...places responsibility for the [troublesome performance problems] on those who manage the processes, policies, strategies, and structure of the system itself." (Richmond, 2000, p. 6).

If you want to develop your system-as-cause thinking skills try changing the diagnostic statement "It's their fault" (an external locus of control) to "How do we contribute to this problem?" (an internal locus of control). Certainly, those external pressures and requirements exist and have an effect on your system but you don't have the power to change them. Instead it is almost always possible and beneficial to ask, "What did we do as a school system to magnify or exacerbate these external pressures to make things worse for ourselves?"

Forest thinking. The old saw goes like this, "He couldn't see the forest for the trees." In other words, when people focus too intently on the details of a situation they loose sight of the big picture–the forest. This tree-by-tree thinking is the opposite of forest thinking.

If you create a model of your school district to examine performance problems using the tree-by-tree approach your models or hypotheses will be large and characterized by an obsession with "the details." Forest thinking, on the other hand, asks you to step back from the details to see the big picture. With this thinking skill, you organize details into broader categories so you can create an "on average" view of your system's performance problems. By analogy, tree-by-tree thinking creates a 90 minute movie while forest thinking gives you sets of snapshots.

To develop the forest thinking skill you need to get into the habit of creating categories of facts, data, events, and so on. For example, if you think your system's performance problems might be related to your faculty and staff's knowledge and skills instead of delineating each role (e.g., master teacher, teacher, beginning teacher, speech and language specialist, resource room specialist, reading specialist, and so on), clump these roles together into two categories–teaching staff and support staff.

Operational thinking. If you want to identify possible "causes" of your system's performance problems then you need to develop operational thinking skills. Operational thinking focuses on how performance emerges. The opposite of operational thinking is "correlational or factors thinking."

Factors thinking is characterized by lists of "factors" (as in Critical Success Factors) or "drivers" (as in what factors drive success in our district) assumed to cause behavior. Any time you create a list of factors purportedly explaining the causes of behavior you are using factors thinking.

The main problem with factors thinking is that it doesn't explain how each factor actually causes behavior. For example, you might develop a list of critical success factors for your district that you think will increase your district's effectiveness. But, *how* these factors increase effectiveness is left to your imagination. These critical success factors might influence performance but that doesn't mean that they cause performance. For example, job performance is influenced by three key factors: opportunity to perform, willingness to perform and ability to perform. But none of these factors explain how they work their magic.

To develop a deeper and richer understanding of your district's performance problems you could use operational thinking. With operational thinking you develop maps illustrating the flow of work processes in your system, processes that are literally rich interactions of individual and team knowledge and skills, sets of policies and procedures, and so on. All of these variables flow into dynamic cause and effect relationships that produce observable behavior.

Operational thinking skills are learned and refined by mapping the various activities associated with the entire teaching and learning process in your school system (or with any work process in your system; e.g., custodial services, bus services, pupil personnel services, administration and supervision, secretarial support services or cafeteria services). Then ask, "What actually causes effective teaching and learning in our district?" instead of asking, "What are all the factors that influence teaching and learning?"

Closed-loop thinking. Imagine you are in an in-service session discussing your district's performance. The facilitator divides you into small discussion groups and asks each group to discuss your district's performance. More than likely, each group would develop lists that include curriculum, instruction, classroom management, instructional methods, state and federal legislation affecting education, among others, and these would be discussed as if they were unrelated to each other. Then, you would probably rank these variables in terms of their importance as "drivers" of performance in your system.

Making a list like the one suggested above is an example of "straight-line thinking," which is the opposite of "closed-loop thinking." Straight-line thinking leads to the assumption that the listed factors caused your district's performance. If you were to list these factors on a piece of paper and illustrate how they are connected to your district's performance, there would be a straight line with one arrowhead on it pointing to your district's performance–one arrow for each factor.

Systems thinkers, however, know that system performance is not determined by factors operating in isolation of each other. Instead, performance is determined by a complex network of multiple cause and effect relationships. If you were to draw these relationships on a piece of paper you would have a set of closed loops, one for each factor, with arrowheads at each end, each leading to the other, and all leading to your system's performance.

Closed-loop thinking creates a more accurate picture of reality whereby observed "effects" feed into other variables to create "causes" that create additional effects that feed into other variables to create yet more causes, thereby creating an elaborate web of cause and effect relationships.

According to Richmond (2000), "Closed-Loop Thinking skills help you to see causality as an ongoing, interdependent process, rather than a one-time, one-directional event caused by independent factors" (p. 7). Developing closed-loop thinking skills requires you to take lists of variables and use them to map cause and effect relationships among them. Then, instead of ranking the variables as "drivers" of performance, discuss how the power of these variables to affect performance might change over time.

Quantitative thinking. In the world of systems thinkers, quantitative is not a synonym for measurable. This confuses people because both concepts involve numbers.

In school systems, the "data-based decision-making" movement seems to be founded on the premise that to know something you must be able to measure it and measuring requirements compel educators to seek the Holy Grail of measurement—perfectly accurate numerical data. Measurement thinking is the opposite of quantitative thinking.

Yet, despite the drive for measuring performance to acquire perfectly accurate numerical data, aren't there things in our lives and in our school systems that we can never measure accurately? Can you ever accurately measure motivation, attitude, beliefs, or resistance to change? Yet, these variables, sometimes called "soft variables," are important to individual, team and organizational performance. Do you agree with the premise that one's motivation has an important influence on his or her job performance? Do you agree that the overall level of resistance to change in your school system can make or break your district transformation effort? Yes, these are important variables, but they cannot and never will be measured accurately. But, if you ignore these variables when planning your district transformation because you can't measure them you are surrendering to the belief that because you don't have perfect numerical data about them that they are therefore unimportant. But they are important and they can be quantified, although not measured.

To quantify "soft," indeterminate variables you can create numerical scales, for example, the often used Likert Scale. Using a scale like this, you could say that a zero represents a total lack of motivation and a 10 equals highly motivated. You could then survey a sample of your faculty and staff with a set of questions related to motivation, compute an average score of all respondents, and then plot that average score on a scale of 0 to 10. This scale and the numbers on it are, of course, arbitrary, but they are not ambiguous. Given the average score on a motivation scale, you could include in your model of your system's performance a variable called "strength of motivation." All "soft" variables can be quantified in this way, even though they cannot be precisely measured.

To develop your quantitative thinking skills, the next time you have a set of data in front of you that were collected through measurements (e.g., student test scores on achievement tests), invite your colleagues to start thinking about key "soft" variables that might be affecting the test scores but were not included in the data set; e.g., student motivation to perform well on the tests. Then, think about what would happen if you started to factor these soft variables into your analysis of the data.

<u>Scientific thinking</u>. Scientific progress is made by discarding falsehoods, not by discovering truths. According to Richmond (2000), "The current prevailing wisdom [in the scientific world] is always regarded as merely an 'entertainable hypothesis,' just waiting to be thrown out the window" (p. 9).

Scientific thinking skills are most important for system thinkers who develop computer models to describe and explain the performance of their organization (system). Those who develop these models are often pressured to validate or "prove the truth" of their models. Instead of "proving" the validity of their models, model-builders strive to recognize when their models become increasingly inadequate for guiding decision-making. This focus on scientific thinking rather than proving-truth thinking is reflected in the words of W. Edwards Deming, a noted expert on quality, when he said (in Richmond, 2000, p. 9), "All models are wrong. Some models are useful."

Scientific thinking requires you to use avoid using complex numerical data to understand the performance of your system and focus instead on using numbers that are simple and understandable. And, you should be able to see and understand the relationship between and among these numbers. These relationships, rather than the numbers themselves, are very important for understanding your system's dynamics (please recall the discussion about closed-loop thinking and how your system is a complex web of cause and effect relationships).

Systems thinking is a hot topic in the practice of school improvement. Many people talk about the need for change-leaders in school districts to be systems thinkers. But, as you can imagine from reading the above descriptions of the seven systems thinking skills, applying systems thinking is not so easy.

Part of our challenge in striving to become systems thinkers is the dominant mental model embedded in our brains about how to identify and solve problems in organizations. This traditional mental model is found in the thinking skills that are the opposite of systems thinking skills. These opposites were identified when I described the systems thinking skills; e.g., static thinking (traditional skill) versus dynamic thinking (systems skill) and system-as-effect thinking (traditional skill) versus system-as-cause thinking (systems skill).

To learn systems thinking skills, you need to study more about them and then practice each set one at a time. Then, as you gain mastery over each set you can begin to combine them to create a powerful set of thinking skills to help you create and sustain systemic school improvement in your district.

Although systems thinking skills are important for the success of your efforts to transform your entire district, these skills are not the only systems tools you need to know, understand and apply. You also need to identify and understand underlying dynamic structures in your system that may be creating cause and effect relationships in your school system. It is at this deep structural level that you can find significant leverage for transforming your system.

A set of systems concepts used to identify and understand these structures is known as "system archetypes"–the dynamic phenomena that occur repeatedly, and invisibly, throughout your system. (Kim, 2000). System archetypes will be the focus of the next edition of these **Reports**, which will be published in April, 2004.

Epilogue

The need for large-scale approaches to improving entire school systems is significant. The piecemeal approaches of the past have not improved schooling. In response, school districts throughout the United States are beginning to use district-wide methodologies to improve their systems.

Michael Casserly, the Executive Director of the Council of Great City Schools, commented on the successes of urban districts engaged in whole-district change in "Fixing D.C.'s failing schools" (The Washington Post, December 26, 2003, p. A35).His comments were meant to expose the failings of the Washington D.C. Public Schools. He said,

"Many of the big-city school systems that are seeing signifycant gains do a number of things that the D.C. schools do not do. These districts are more likely to have a coherent vision of where they are going; measurable goals districtwide and school by school; an accountability system that holds people responsible for the results; a single and sometimes prescriptive curriculum in reading and math; a method for monitoring reforms at the school and classroom levels; data systems that allow schools to catch kids before they fall too far behind and a clear strategy to address the lowest-performing schools. The D.C. schools do just the opposite."

The D.C. school system is not the only one stuck in the old paradigm for improving schooling. Others are too. The time to break out of that paradigm is now!

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