Systems thinking: Theorists anchored in the real world

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Introduction

Engineers and engineering students are already familiar with systems thinking, since it is integrated into much of what they do. However, technical expertise without social expertise limits a person's effectiveness. In order to increase their proficiency as leaders and managers, engineers and engineering students can learn to apply systems thinking to organizations.

The Social Systems Model, or Social Model for short, integrates ideas and concepts from systems theory and applies them to the leadership of social organizations. Forrester, Ackoff and others pioneered social systems thinking, and their work has been continued by others including Senge, Deming, and Wheatley. These are theorists anchored in the real world, applying systems thinking to organizations where people work.

According to Deming[1], "a system is a network of interdependent components that work together to try to accomplish the aim of the system." Ackoff (1981) suggests that "[t]he performance of a system is not the sum of the performance of its parts taken separately, but the product of their interactions."[2]

Given this understanding, systems thinking is important for everyone in an organization to understand and be able to apply, but especially to leaders. Even though contemporary society has the tendency to divide the world into neat, arbitrary subdivisions, life comes to us whole and must be looked at through the systems lens.[3] Once understanding of the concept of systems thinking is established, those involved are better able to connect the dots and see the organization in its entirety and contribute to the optimization of the whole.

For organizations to be led effectively, leaders must think in terms of relationships between and among departments instead of thinking about them as independent components. The reality is, all departments and all people in an organization are *inter*dependent, not independent. The aim of these interdependent components should be to maximize their contribution to the performance of the organization as a whole. By doing this they optimize the performance of the whole, instead of individual departments within an organization, creating a win-win environment.

This presentation introduces systems thinking for social systems by identifying several key theorists, namely Jay W. Forrester, W. Edwards Deming, Russell Ackoff, Peter Senge, and Margaret Wheatley, and outlining some of the central lessons that would enable a person familiar with systems thinking to make a difference at an interpersonal, team, and organizational level.

Forrester

Known and credited for being the creator of the field of systems dynamics in the mid 1950's, Jay Forrester's ideas about the behavior of systems began to emerge long before. Born in Nebraska on July 14, 1918, Jay W. Forrester went on to received a B.S. degree in electrical engineering from the University of Nebraska in 1939 and his M.S. degree from MIT in 1945. He stayed on to become director of MIT's Lincoln Digital Computer Laboratory until he changed his focus to system dynamics and began teaching at MIT's Sloan School of Management. In 1957 he joined the board of Digital Equipment Corporation. He then went on to publish many works including, *Industrial Dynamics, Principles of Systems, Urban Dynamics, World Dynamic*s.

Today Forrester is Germeshausen Professor Emeritus and Senior Lecturer at Sloan. Awards he received include the Medal of Honor from the Institute of Electrical and Electronics Engineers and National Medal of Technology, and Induction into the National Inventors' Hall of Fame.

Deming

William Edwards Deming was born on October 14, 1900. He entered the University of Wyoming in 1917 and graduated in 1921, but remained a year longer for additional studies in mathematics. He received his master's degree in mathematics and physics at the University of Colorado and his Ph.D. in mathematical physics from Yale University in 1928.

Dr. Deming learned statistical process control at Bell Telephone Laboratories. Deming's claim to fame came when Japan requested his help with its post WW II census. He stayed longer and helped Japan rebuild its economy by teaching statistical methods. Upon returning, Deming appeared in a documentary titled "If Japan Can…Why Can't We?" Deming was 80 years old at the time. After its airing, Deming's four-day seminar was delivered to many organizations throughout the US. Dr. Deming worked up until the day he died, consulting and teaching organizations his basic tenets on quality. Dr. Deming died in November of 1993.

He was the author of many books and 171 articles. He started the American Society of Quality Control; now known as American Society of Quality. Deming also received numerous awards, prizes, and medals.

Ackoff

Russell L. Ackoff has been one of the key developers of the social systems model. He is currently the Anheuser Busch Professor Emeritus of Management Science, The Wharton School, University of Pennsylvania. Ackoff has been a vocal critic of many best-selling books on

management, and is renowned for advocating that organizational leaders need to reevaluate how they approach problem solving and innovation.

Ackoff received his Ph.D. in Philosophy of Science from the University of Pennsylvania in 1947. He was a member and former Chairman of the Social Systems Sciences Department and the Busch Center, which specializes in systems planning, research, and design - both within the Wharton School Center for Advanced Systems Practices at the University of Pennsylvania (2000). His work in research, consulting, and education has involved more than 350 corporations and 75 government agencies in the United States and abroad.

Ackoff is the author and co-author of twenty-five books, including *Redesigning the Future*, *The Art of Problem Solving, Creating the Corporate Future, Revitalizing Western Economies, Management in Small Doses, Ackoff's Fables, The Democratic Corporation*, *Re-Creating the Corporation* and *Ackoff's Best.* He has also published more than 250 articles in books and a wide variety of journals. He is currently working on his latest book, *Seven Faces of Leadership.*

Senge

Dr. Peter Senge (b. 1947) received his Bachelor of Science in engineering from Stanford University, a Master of Science degree in social systems modeling and a Ph.D. in management from the Massachusetts Institute of Technology. Senge is a senior lecturer at MIT. He is also the Chair and Co-Founder of the Society for Organizational Learning (S.O.L.), a global community of corporations, researchers and consultants dedicated to the "interdependent development of people and their institutions." He was named a "Strategist of the Century" by the *Journal of Business Strategy*, one of the twenty four men and women who have "had the greatest impact on the way we conduct business today."[4]

Dr. Senge studied how firms and organizations developed adaptive capabilities. Senge's book, *T*he *Fifth Discipline*: *The Art and Practice of the Learning Organization* that popularized the concept of the "learning organization." Peter Senge has also authored other books that discuss learning organizations and adaptive organizations including *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization*, *The Dance of Change: the Challenge to Sustain Momentum in Learning Organizations*, and *Schools that Learn*.

Wheatley

Margaret Wheatley earned an M.A. from New York University before completing her doctorate in Administration, Planning and Social Policy at Harvard University. She served as an associate professor at two institutions of higher education before her breakout publication in 1992 titled *Leadership and the New Science,* which was the management book of the year according to *Industry Week.*[5]

As her fame spread, Wheatley worked as a consultant with a variety of organizations, from the Girl Scouts to the U.S. Army, in the United States and increasingly abroad. Presently, she serves as president of a charitable leadership foundation, The Berkana Institute, from which she

coordinates her travels and writes further on issues directly applicable to organizational leadership.

Margaret Wheatley was not the first person to apply systems thinking to issues of leadership. In her bestseller *Leadership and the New Science*, she did connect systems thinking with a whole range of recent developments in the physical sciences, such as chaos theory, quantum mechanics, and evolutionary biology. She also updated the lessons from systems thinking, importing some of the latest work on self-organizing systems, for example, and finding direct applications to managerial practice.[5]

Common themes among these key theorists

1. Perhaps this goes without saying, but these theorists emphasized the importance of theory – not just for scholars or educators who study leadership, but everyone involved in leadership. The first step is to make implicit theories explicit. Forrester states in his book, *Principles of systems,* "A [theory] is essential if we are to effectively interrelate and interpret our observations in any field of knowledge. Without an integrating structure, information remains a hodge-podge of fragments."[6]

Deming concurs. He states that by having knowledge of theory, management is able to make predictions. He states that "rational prediction requires theory and builds knowledge through systematic revision and extension of theory based on comparison of prediction with observation."[1] He stresses this point when he talks about how Plane Euclidean geometry served the world well when the theory was that the world was flat. Based on this theory, it was tested and later revised when new learning emerged. Thus, without a theory in the first place, there would be nothing to revise, nothing to learn.[1] Deming cautions that information is not knowledge. Managers have immediate access to a plethora of information, but since information is not knowledge, that is not enough. Knowledge comes from theory. Without theory there is no way to use the information.[1]

Peter Senge took a similar position. He regarded leadership as a discipline, that is, a "body of practice, based on some underlying theory or understanding of the world, which suggests a path of development or education in its true sense of drawing out."[7] In other words, we operate according to mental models, which are "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action."[3] In organizations, mental models (theories) determine what individuals think can and cannot be done. Senge argues that leading learning organizations requires a new view of leadership, a new mental model. Traditional leaders set direction and make key decisions from an individualistic viewpoint. This leadership style is based on the assumption that subordinate individuals lack vision and that problems can be solved only by the leader. In learning organizations, however, leaders are responsible for building organizations which encourage individuals to expand their own capabilities, clarify their vision, and build shared mental models. For him, as for the others, that new mental model or theory is systems thinking.

2. What exactly is systems thinking? Deming is probably best known for *The System of Profound Knowledge*, which includes first and foremost an appreciation for systems thinking.

Deming defined a system as "a network of interdependent components that work together to try to accomplish the aim of the system."[1] Multiple elements are interrelated around a single purpose. A system must have an aim or goal or there is no system. That is critical.

Deming explained that shared vision unites individuals around a common goal. Shared vision is "the capacity to hold a shared picture of the future we seek to create."[3] A vision causes individuals to do things because they *want* to do them, not because they *have* to do them. Vision can allow people to focus on the long term.

Ackoff agreed and took this one step further. The organization serves the purposes of both its parts and the system of which it is a part. Each person has a purpose, and the people working together have a purpose.[2] Thus, he suggested that an organization conceived on the systems model serves the purposes of both its employees and the systems of which it is a part. Toward this end, an organization would be sensitive to the individual purposes of members, encouraging and facilitating their development.[8] Systems must take into account the purposes and well-being of individual participants, so that they are motivated and equipped to contribute where they are. The organization as a whole is seen as having an obligation to its stakeholders -- as well as they having an obligation to it.[2]

3. Deming insisted that a human system must be managed, since it cannot manage itself.[1] Not every theorist goes that far. Wheatley, for example, tends to doubt the importance of management.[5] Nonetheless, to the extent that managers lead an organization *toward* systems thinking, they will have at least a transitional role.

Presently, leaders have blind spots. For instance, leaders tend to neglect seeing the system as a whole, or holistically. They are too selective in their observations and measures. Senge writes about management's fixation on events, rather than on the underlying patterns that lead to events. There is also the so-called parable of the boiled frog, in which leaders fail to respond to a threat that builds gradually, because they don't notice the water keeps getting slowly hotter. Leaders are oblivious to incremental threats.

This problem of blind spots arises when leaders deal with variation of outcomes. Deming stated that variation will always be there, between people, in output, in service, in product.[1] The question that Deming wanted to impress upon leaders is what variation really means. Two mistakes are frequently made in attempts to improve results:

> a. To react to an outcome as if it came from a special cause, when actually it came from common causes of variation.
> b. To treat an outcome as if it came from common causes of variation, when actually it came from a special cause.[9]

He stated that both mistakes are costly. Leaders have such limited knowledge of variation that they spend an inordinate amount of time managing a data point. For example, leaders spend time assessing data on a monthly report, comparing percentage increases and decreases from one month to the next, from one quarter to the next, from one year to the next, and so forth. Leaders are under the false impression that they can make an intelligent assessment of the data by only

using limited data (percent increase and percent decrease) without understanding what the data is actually telling them.

Another way that leaders overlook systems thinking has to do with extrinsic motivation and the breeding of competition within a system. Deming cited the importance of understanding the interactions between people and their environment, i.e. all interactions that take place in a work setting. He cautioned that people are born intrinsically motivated, yet current management practices kill this intrinsic motivation and replace it with extrinsic motivation. Management practices that led to the demise of intrinsic motivation are forced ranking, employee of the month, bonus systems, and so on. All of these breed competition among employees which contradicts Deming's first point of a *System of Profound Knowledge*, appreciation of them together as a system or systems thinking. By pitting employees against each other and creating a zero-sum environment, they create an atmosphere of competition instead of cooperation.

In other words, systems represent **synergy**. Together, employees and the organization form a synergy through which each is enabled to accomplish things that neither could accomplish on its own. Senge also makes this point. Systems thinking teaches how to see things as a whole. It focuses on how parts interact with other parts of the system. This is the cornerstone of learning organizations, which he considers the epitome of systems thinking, as we shall explain. In traditional organizations, management focuses on specific problems rather than expanding its view to take into account how individual actions affect the whole organization.

4. Everyone ought to share a unifying purpose. Too often, members take a different approach. They have, what Senge calls, an "I am the position" model, which means their identity is tied up in their individual role, title, perks, and powers. This gets in the way of thinking of the entire system and its unifying purpose.

Consistent with the idea of a shared purpose is shared ownership. Thus, systems depend on democratic or participatory structures. As Ackoff pointed out, the organization has an obligation to encourage and facilitate the development of its stakeholders, and this can be realized only in a completely democratic system.[2] Employees of such organizations are empowered to participate in meaningful decision making and the selection of both the ends and the means that are relevant to them. They participate in the purpose, so they participate in the work.

Which means leaders have to give up control. Decision-making has to become decentralized.[8] Senge makes a similar point. He focuses on the decentralization of the role of leadership in order to enhance the capacity of all to work productively toward common goals. For example, he refers to the myth of the management team, in which leaders censor disagreement to keep the appearance of a cohesive team.

5. Forrester's writing and research took into account each and every element of a system, including things not normally considered at the time, such as age, culture, and economic factors. Often, managers fail to see these elements in the system, so they forget to consider their impact. Systems thinking expands the range of considerations.

So far, we have been dealing with a static characterization, however. Systems are dynamic. They are comprised of processes and adapt to their environment. In the vanguard, Forrester emphasized a new management education based on the inherent, dynamic complexity of all the related parts of a corporation unified as a system.[10]

Wheatley came at this from a slightly different direction. She began from the desire of most leaders to control and stabilize their organizations. Not only would this disempower other members, it also inhibits adaptability. Here is her argument.

Among her findings is that dynamic systems evolve and grow during phases of disequilibrium. Equilibrium in a system suggests stability, as one can imagine. Disequilibrium suggests change. The system that tolerates change and makes adaptations is said to be resilient, rather than stable.[5] On the other side of disequilibrium, as it were, when it finally resolves itself, the system orders itself in a new way, usually a more adapted way. The system evolves and grows partly in order just to persist in a changing environment. By this reasoning, an organization must respond to changing times by risking disequilibrium.

Historically, leaders had felt obliged to stabilize systems in order to preserve them, so that they might withstand change. They tried to rigidify organizational structures. Wheatley argues that the greater obligation is to preserve systems by making them adaptive, fluid, even to the point of turbulence. This is an important point. Once leaders feel an obligation to adapt, they tend to prefer orderly methods of change, a predictable process intended to achieve a predicted end state. Such an approach would be better presumably than resisting change altogether, yet Wheatley believes that the kind of change that organizations require now is chaotic change. Leaders have to reduce their need for predictability and rely more on trust.

A system that learns to trust chaos re-orders itself in ways that no one could have expected. Chaos is an integral part of the creative process, and it requires that leaders give up control. Giving up control is counter-intuitive for leaders in moments of uncertainty. They are likely to worry that they are neglecting their essential function. When times become turbulent, people cry out for order. It takes a strong person in a position of authority to resist the pleas for order and instead convince people to participate in shaping something totally new.

Through an elaborate explanation of chaos theory and self-organizing systems in the physical world, Margaret Wheatley offers leaders a powerful metaphor. Leaders' perception of their task has changed accordingly, as they work to create systems that are known as *autopoietic*, which means that they retain their core identity throughout numerous transitions. (e.g. 1992, pp. 18 & 94) In fact, autopoiesis provides a firmer sense of identity.[5]

Systems have to be able to change and adapt. Change requires openness.

6. Since change has to take place in unpredictable ways, resulting temporarily in system instability and disequilibrium, members have to learn how to trust each other as a unit. After much study and observation, it became evident to Forrester that there lived a potential for an unstable system that was entirely internally determined. Even if all external factors disappeared,

instability could arise due to common internal factors.[8] That is not a bad thing. Change is inherent in organizations.

7. Leaders must create (and then trust) systems that respond to change in productive ways. Senge refers to this type of system as a learning organization. Learning organizations are:

> "…organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free and where people are continually learning to see the whole together."[3]

The basic rationale for creating learning organizations is an environment of rapid change requires organizations to be flexible and adaptive in order to excel. Organizations need to be able to "discover how to tap people's commitment and capacity to learn at *all* levels".[3]

In order to develop a learning organization, individual members must reach what he calls **Personal Mastery.** Personal Mastery is "the discipline of continually clarifying and deepening our personal vision, of focusing our energies, or patience, and of seeing reality objectively."[3] Organizations learn through individuals who learn. Personal mastery is more than competency and skills. Personal mastery is the skill of developing a personal vision.

In addition to personal mastery, achieved by individual members, Senge urged **Team Learning**, which is "the process of aligning and developing the capacities of a team to create the results its members truly desire."[3] When people learn together, the whole becomes smarter than the parts. Team learning includes talking together. Team learning requires that individuals overcome defensiveness that hinders learning. Leaders are ultimately responsible for this learning.

Conclusion

These key theorists have added a solid foundation for the understanding and application of systems thinking. While other theorists have researched the subject, Forrester, Deming, Ackoff, Senge, and Wheatley are still the theorists who have created the groundwork. Needless to say, there is still much work to be done in the area of application. This paper is a step toward identifying key theorists and dominant themes toward the practical use of systems thinking at the individual, group, and organizational levels. One must first understand a concept before actually applying it to everyday life. Incorporating systems thinking into all aspects of an organization and learning how to understand things according to the whole system is increasingly crucial for success. Simply put, to understand and exercise systems thinking has become a necessity. Academics, educators, engineers and other interested professionals looking for a place to begin doing their own study should begin with here.

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Biographies

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