

MODELING AND SIMULATING THE IMPACT OF SOCIAL ISSUES ON INFORMATION QUALITY: LITERATURE REVIEW

(Research in Progress)

(IQ Concepts and Models)

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Abstract

Information quality is generally defined in terms of fitness for use. Almost all agree that they prefer high-quality to low-quality information. And, while many organizations have made good progress, many find that setting up information quality programs and making improvements proves difficult. Further, most agree that the most critical difficulties stem from organizational, structural and political issues. As yet, there is no body of theory and practice to help leaders and organizations systematically understand and address these issues.

This research program aims to (begin to) build the body of needed theory. The basic idea is to employ systems dynamics and computer simulation to explore the ways hundreds of possible factors and managerial actions advance or hinder information quality efforts. More specifically then, the long-term goal of this research is to create and utilize a test bed (or simulator) to examine, in a systematic fashion, the impact of various social/cultural issues which influence the penetration and overall success of information quality in an organization. In particular, building on the work of Falleta⁽¹⁾, this research is a literature review of multiple organizational change models that can potentially be utilized for this modeling.

This paper reports on one aspect of this research, namely, the literature review. As one might suspect, there is much relevant work, from the fields of systems dynamics, organizational analyses, force-field analyses, and change management.

Keywords: organizational change, models, system dynamics, force field analysis, Leavitt, weisbord, six-box model, mckinsey, 7s framework, burke-litwin, Delphi method, organizational learning, cultural archetypes, change management

BACKGROUND ON THE MODELING AND SIMULATING SOCIAL ISSUES IN INFORMATION QUALITY RESEARCH PROGRAM

As Redman ⁽²⁾ reports, many organizations have made tremendous strides in managing and improving data quality. Some have made order-of-magnitude improvements, and so reduced cost, improved customer satisfaction, and made better, more confident decisions. And the importance of high-quality only grows as the concepts of “big data,” “manage data assets,” and the data-driven organization” gain favor.

Still, most organizations struggle with information quality. And most agree that it is not the inability to solve the technical problems of data quality that get in the way. Rather, it is a broad array of social, political, and organizational issues. There are hundreds of potential factors, from:

- The presence/lack of senior leadership (or even buy-in),
- Assigning information quality to the proper/wrong group,
- Getting too many/the right number/too few people engaged in the effort,
- Providing too much/just the right amount,/too little training, and
- Resolving/failing to resolve conflict with other priorities.

Similarly, there are hundreds of possible managerial actions, from:

- Leveraging an organizational crisis to create a sense of urgency,
- Focusing the effort on a very narrow problem,
- Leveraging outside expertise, and
- Insisting that everyone include improvement in their annual reviews.

Further, these factors and managerial actions almost certainly interact with one another in ways we simply do not understand.

Finally, there is no body of theory and practice to help those trying to lead information quality programs and their organizations to systematically understand the issues, sort through their options, and craft a plan to address them. This research program aims to (begin to) build the body of needed theory and practice.

Given the large number of potential factors and managerial actions, the approach selected is to employ systems dynamics and computer simulation to create a “test bed” or “laboratory” in which we can input various combinations of factors and managerial actions and “see what happens.” At the very least we hope to winnow the list of hundreds of possible factors and managerial actions to a more manageable number. More aggressively, we hope to understand which managerial actions yield the best results in the face of tough issues. Ultimately, we hope to identify the combinations of managerial actions that produce the fastest, strongest, longest lasting results. This is critical—practitioners also report that, at times, many information quality programs move incredibly quickly.

We’ll report on our successes and failures regularly.

INTRODUCTION TO THIS PAPER

An organizational model allows us to understand the dynamics of an organization more quickly than we would without it. According to Burke⁽³⁾, there are many ways in which a model is helpful:

1. Models help to enhance our understanding of organizational behavior.
2. Models help to categorize data about an organization.
3. Models help to interpret data about an organization.
4. Models help to provide a common, short-hand language.

We hope that the following overview of different models will help us to determine a path for successful modeling using System Dynamics techniques. For that reason, a review of System Dynamics modeling comes first. The other models are presented as they first appeared in published literature. We will be looking at these models as to how each model may help in understanding and identifying the social and cultural issues that we will ultimately attempt to model within a dynamic model using System Dynamics principles.

SYSTEM DYNAMICS

In 1958, in the Harvard Business Review, Jay Forrester published the first paper that eventually led to the field of system dynamics.⁽⁴⁾ System dynamics has evolved to a computer-aided approach to policy analysis and design. It can be utilized for complex situations that frequently change. The approach begins with defining problems dynamically, proceeds through mapping and modeling stages, to steps for building confidence in the model and its policy implications. Mathematically, the basic structure of a formal system dynamics computer simulation model is a system of coupled, nonlinear, first-order differential (or integral) equations.⁽⁵⁾

System Dynamics has always emphasized the multi-loop, multi-state, nonlinear character of the world in which we live. It is a big-picture approach taking into account the dynamic complexities of human systems. Many different forces cause the complexity in these systems. The number of components in a system can certainly cause a system to be complex and dynamic. However, it is not so much the number of the components but the multitude of combinations involved and the desire to find the 'best' combination for a particular scenario that will result in combinatorial, or detail, complexity.⁽⁶⁾

Time delays between making a decision and seeing the results of a decision also increase the complexity of a scenario. The field of system dynamics considers that all decisions are made in the context of feedback loops. Learning is also considered to take place in this context. A simple model of this type of loop is shown here:⁽⁶⁾

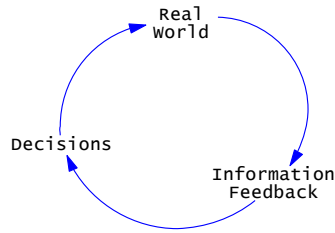


Figure 1: System Dynamics Feedback Loop

As we learn, we use the information available to us. It may not be perfect and is probably limited. As we learn more, we adjust our decisions to align with our goals in single-loop learning. In double-loop learning, we will also revise mental models and perhaps redesign the system.⁽⁶⁾

Systems dynamic modeling has been used for many different types of systems; including industrial systems, banking, healthcare, education, construction and policy-making.⁽⁷⁾ We believe that this model can be successfully used to dynamically model the policy-making and procedures that can help ensure the successful implementation of Information Quality processes in an organization.

FORCE FIELD ANALYSIS (1942)

Force field analysis is a management technique which was originally conceived by the psychologist Kurt Lewin for use in social situations. It displays and analyzes the forces driving movement toward a goal (helping or driving forces) or restraining movement toward the goal (hindering or restraining forces). While Lewin's theory does not look at isolated elements within the field (or the situation); the theory finds it advantageous to look at the situation as a whole and then undertake a more specific and more detailed analysis.⁽⁸⁾

Force field analysis is helpful in organizational situations when managing change or for decision support. It can be helpful for understanding the balance of power in a situation, identifying opponents and allies for a change and how each can be influenced. It is used as a tool in project management, for both change and quality management.

An example of a force field diagram follows:⁽⁹⁾



Figure 2: Force Field Diagram

While this model appears to be useful in evaluating an entire field or situation, it also appears to be worthwhile for modeling the current cultural characteristics of an organization that are both driving and restraining the concepts of information quality from taking root in an organization. However, we feel that this model will not be useful in quantifying these cultural characteristics or in pre-processing them for a Systems Dynamic model.

LIKERT SYSTEM ANALYSIS (1961)

While most people are most familiar with the Likert scale, developed in 1932 by Rensis Likert⁽¹⁰⁾, Likert also developed a model for organizational management.

In 1961, Rensis Likert published information on research, performed since 1947 and already partially disseminated, pertaining to a new system of organization and management.⁽¹¹⁾ The basic question of most of this research comes down to: Which characteristics of leadership and variables are related to the best and worst departments of an organization?

Likert interprets the results of this research as having answers that lie in the “principles of supportive relationships.” He believes that this means that any interaction an individual has with the organization should be considered by the individual to be supportive. He believes that the implementation of his principles will lead to better organizational effectiveness which he defines as productivity, costs, turnover, and job satisfaction.

Likert further discusses three principles for implementing his ideas⁽¹¹⁾:

1. That the leadership of an organization be employee-centered rather than job-centered;
2. That the organizational structure be focused on groups rather than individuals; and
3. That communication in an organization be transparent, in both upward and downward directions.

He also discusses what he calls intervening variables; those variables that are not easily measured and that reflect the current organizational state such as loyalty, skills and motivation.

Likert uses the above principles, standard measurements and intervening variables to propose a system to build an effective organization. Likert calls this system the Interaction-Influence System. Based on multiple factors, this system categorizes an organization into four categories: Exploitative authoritative, Benevolent Authoritative, Consultative, and Participative Group. He considers Consultative to be both authoritative and participative.

In 1967, Likert expands on these ideas and refers to his system as System 4.⁽¹²⁾

While System 4 seems to be a worthwhile means of describing organizations and puts forth many characteristics of the different categories; it does not seem to be an ideal

system for determining the impact of social issues on Information Quality. However, we believe it would be worthwhile to consider some of Likert's characteristics of organizations as we move further down the path of our research.

DELPHI METHOD (1962)

The Delphi Method was conceived, at the RAND Corporation, in the early 1950s in a project sponsored by the Air Force. The objective behind the project was to "obtain the most reliable consensus of opinion of a group of experts... by a series of intensive questionnaires interspersed with controlled opinion feedback."⁽¹³⁾

In the introduction to a collection of articles on the Delphi method, the editors, Harold A. Linstone and Murray Turoff define the Delphi technique as

"Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem."⁽¹⁴⁾

The method involves gathering a group of experts and through structured (controlled or moderated) communication techniques eliciting opinions on a topic. The structure includes providing feedback to the group and allowing individuals to revise their opinion and views. The structure also allows for some or complete anonymity for responses.

The original study, which took place at RAND in early 1950s, was not published until 1962 due to security reasons. This study was designed "to apply expert opinion to the selection, from the viewpoint of a Soviet strategic planner, of an optimal U.S. industrial target system and to the estimation of the number of A-bombs required to reduce the munitions output by a prescribed amount."⁽¹³⁾

While the original studies of this method were related to defense, studies involving multiple types of forecasting were done in the early 1960s.⁽¹⁴⁾ These studies provided a foundation for experimentation with the Delphi Method in non-defense areas.

In a 1998 article, Mark Keil and his associates reported on a study where a modified Delphi method was used to both create a list of likely risks to a software development project and to rank those risks.⁽¹⁵⁾

Benefits of the Delphi method lie in its perceived ability to more accurately measure items that are considered largely subjective. In a discussion of exactness in the "exact" and "inexact" sciences, Olaf Helmer and Nicholas Rescher⁽¹⁶⁾ state that "what matters is not whether or to what extent inexactitudes in procedures and predictive capability can eventually be removed ... rather it is objectivity, i.e., the intersubjectivity of findings independent of any one person's intuitive judgment, which distinguishes science from intuitive guesswork however brilliant." In this same article, the authors proceed to apply statistical probability techniques to "expert judgment" which would include "relevant background knowledge" The Delphi technique "eliminates committee activity altogether, thus further reducing the influence of certain psychological factors, such as

specious persuasion, the unwillingness to abandon publicly expressed opinions, and the bandwagon effect of majority opinion.”

We believe that the Delphi method has the potential to assist with our endeavor to identify and model those social issues that have bearing on the progress of an information quality culture.

LEAVITT’S MODEL (1965)

In the mid 1960’s, Dr. Harold Leavitt developed another simple organizational model to look at the way organizations react during a change ⁽¹⁾. This model identifies four components: People, Tasks, Structure and Technology ⁽¹⁷⁾. Any change in any one of these components will affect all other components. The diamond shaped arrows emphasize the interdependence among four components. Let’s have a look at these four components:

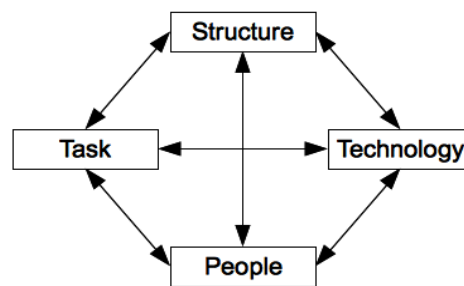


Figure 3: Leavitt's Diamond Model

The people are the human resources of the organization ⁽¹⁾. The task component refers to all the tasks and subtasks involved in providing products and services ⁽¹⁸⁾. Here we look at the qualitative aspects of tasks and subtasks rather than the actual tasks and subtasks ⁽¹⁾. The structure component refers to the authority systems, communication systems and work flow within the organization. Technology is that component of the organization which aids or facilitates the people to perform the tasks ⁽¹⁾. Computers, equipment etc. are all counted under technology.

Leavitt hypothesized that a change in one variable will affect the other variables. For example, if you are planning to change how things are done (tasks), you will have to educate people to new methods and practices, change job roles according to their new skills, and give new systems to apply their learning.

The main drawback of this model is Leavitt does not address the role of the external environment in bringing about change in any of the components ⁽¹⁾.

WEISBORD'S SIX-BOX MODEL (1976)

Weisbord developed the Six-Box model to assess the way in which an organization is organized. The model represents a particular way of looking at organizational structure and design and gives attention to issues such as planning, incentives and rewards, the role of support functions, organizational control, and accountability and performance assessment. The Six-Box model is comprised of the six components (boxes) and each box is posed with diagnostic questions. Following are the components and diagnostic questions for each box:

1. Purposes: What 'businesses' are we in?
2. Structure: How do we divide up the work?
3. Relationships: How do we manage conflict (coordinate) among people? With our technologies?
4. Rewards: Is there an incentive for doing all that needs doing?
5. Leadership: Is someone keeping the boxes in balance?
6. Helpful mechanisms: Have we adequate coordinating technologies?

The main limitation of the model is that the Six-Box model puts focus only on some elements; other elements can be overlooked.⁽¹⁹⁾

MCKINSEY 7S FRAMEWORK (1981-82)

In early 1980s Tom Peters and Robert Waterman, two consultants working at McKinsey & Company consulting firm, developed a model to analyze how well an organization is ready to accomplish its vision.⁽²⁰⁾ This model can be applied to almost any organizational or team effectiveness issue. Moreover, it identifies some of the interdependent key elements, to reveal the inconsistencies within an organization or a team and then align them together to make sure they are all contributing to the shared goals and values. This model is useful to gauge the likely effects of future changes within a company, to define how effectively to implement a proposed strategy, to enhance the performance of a company and lastly to put together departments and processes during a merger or acquisition.

McKinsey 7S model focuses on seven interdependent elements which are categorized as:

Hard Elements	Soft Elements
Strategy	Shared Values
Structure	Skills
Systems	Style
	Staff

Hard Elements are the strategy statements easier to identify and which management can directly influence. On the other hand, the Soft Elements are more difficult to describe. They are less intangible and culturally more influential.

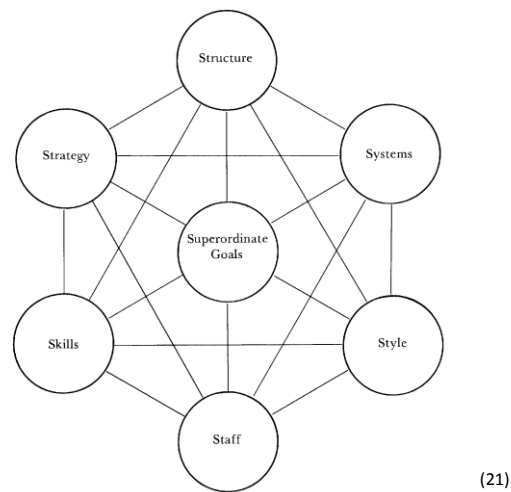


Figure 4: McKinsey 7S Model

Each element can be describes as follows:

- 1) **Strategy:** A plan of action to achieve a particular set of objectives.
- 2) **Structure:** A way how an organization is structured and its hierarchy.
- 3) **Shared Values:** These are the core values of the organization that are related to general work ethics and corporate culture.
- 4) **Style:** The manner of leadership adopted.
- 5) **Staff:** The workforce and their general capabilities.
- 6) **Skills:** The actual skill set and competencies of the employees working within the organization.

The main disadvantage of this model is that when one part is changed, all parts change because they are all interrelated.

HIGH-PERFORMANCE PROGRAMMING (1984)

The High Performance Programming Framework by Nelson and Burns' categorizes an organization system into four categories in order to plan intervention to transform the organization. Organization categories are based on the effectiveness of eleven variables. They call the organization categories as:

- The high performance organization (level 4) where leaders are fully invested in empowering organization members and the common focus is on organization excellence by having unrestricted communication and the organization as a whole guided by shared vision.

- The proactive organization (level 3) where focus is on future and organization is actively involved in planning and development strategies.
- The responsive organization (level 2) where the organization is more functional having achieved some clarity of purpose.
- The reactive organization (level 1) where the organization is badly in need of renewal and lacks shared focus.

According to the HPC framework, the high-performing organizations are associated with empowering leadership; the proactive organizations are associated with purposing leadership; the responsive organizations are associated with coaching leadership and the reactive organizations are associated with enforcing leadership. ⁽²²⁾

THE BURKE-LITWIN MODEL OF ORGANIZATIONAL PERFORMANCE & CHANGE (1992)

Warner Burke and George Litwin published their organizational model in 1992. ⁽³⁾ In building their model, they explored two lines of thinking: how organizations function, and “how organizations might be deliberately changed.” The model evolved from both academic theory and practical consulting experience.

In their design, they considered, and distinguished between, climate and culture. Climate is defined by the perceptions of that people have about their work; how it is managed; and the day-to-day operations. Culture is more in the background and is related to beliefs and values.

The model is summarized in the following diagram: ⁽²³⁾

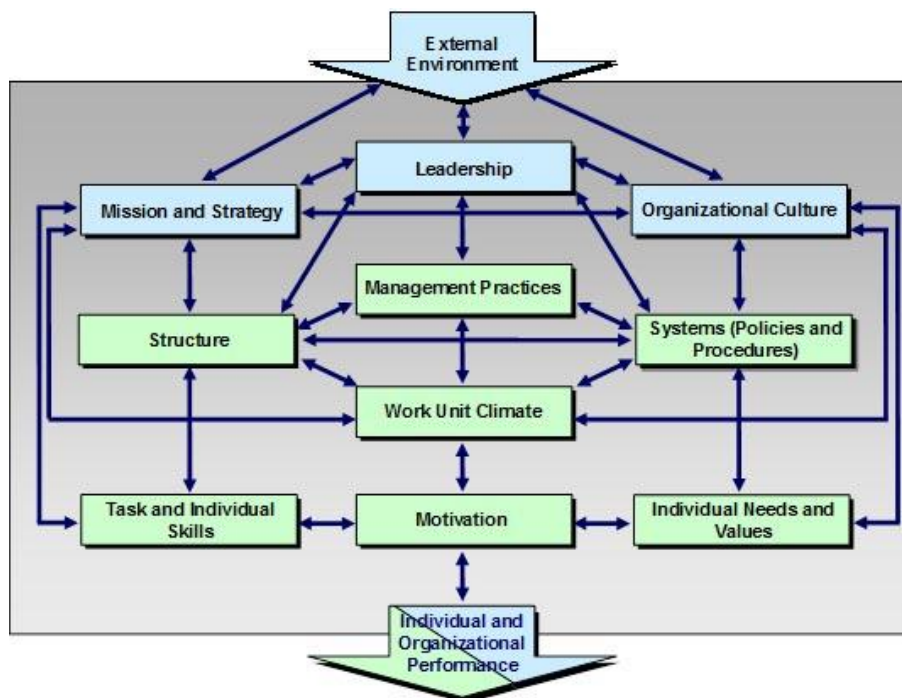


Figure 5: Burke-Litwin Model

The model is based on the factors that will drive change in an organization. In building this model, the authors state that they were influenced by others' thinking and that the model incorporates the 7Ss of McKinsey's model along with influence from Weisberg and Nadler and Tushman.⁽³⁾ (The McKinsey model and the Weisberg model are both discussed previously in this paper.)

The model includes both transformational factors and transactional factors. Transformational includes areas where organizational change comes about from interaction with internal and external environmental forces and where members of the organization will need to learn entirely new behaviors.

This model is complex and all the factors are inter-dependent. If one factor is changed, then all the others will be adjusted in some way.

We believe that these 12 factors or drivers for change should be strongly considered as we move forward in our research.

SENGE'S ORGANIZATIONAL LEARNING MODEL (1990)

In the 90's Peter Senge and his associates conducted some groundbreaking organizational change work documented in his book "The Dance of Change".⁽²⁴⁾ It starts with the premise that organizations are the products of the ways that people in them think and interact. Thus, to change organizations for the better, you must give people the opportunity to change the ways they think and interact. This cannot be done simply through increased training or through command-and-control management approaches. No one person, including a highly charismatic teacher or CEO, can train or command other people to alter their attitudes, beliefs, skills, capabilities, perceptions, or level of commitment. Instead, a better approach is to give people the training and tools for how to discover and study the ways that they think and interact and how this affects the behavior and performance of the system of which they are a part. This approach is called organizational learning.

The practice of organizational learning involves developing tangible activities: new governing ideas, innovations in infrastructure, and new management methods and tools for changing the way people conduct their work. Given the opportunity to take part in these new activities, people will develop an enduring capability for change. The process will pay back the organization with far greater levels of diversity, commitment, innovation and talent.

Systems thinking is one of the key disciplines for discovering and studying the ways that people think and interact and how this affects the behavior and performance of the system of which they are a part.

Systems thinking - taking a systems perspective - shows that there are multiple levels of explanation in any complex situation, as suggested by the diagram below: event explanations, pattern of behavior explanations and system structure explanations.

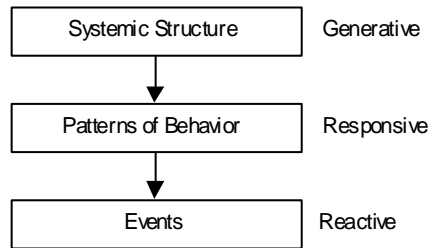


Figure 6: Systems Thinking

Levels of Explanation

Event explanations - "who did what to whom" - doom their holders to a reactive stance. Event explanations are the most common in contemporary culture, and that is exactly why reactive management is the prevailing form of management today.

Pattern of behavior explanations focus on seeing longer-term trends and assessing their implications. For example, a pattern of behavior explanation would be: "Production/distribution systems are inherently prone to cycles and instability, which become more severe the further you move from the retailer. Pattern of behavior explanations begin to break the grip of short-term reactivity. At least they suggest how, over a long term, we can respond to shifting trends.

The third level of explanation, the structural explanation, is the least common and most powerful. It focuses on answering the question, "What causes the patterns of behavior?" Though rare, structural explanations, when they are clear and widely understood, have considerable impact. The reason that structural explanations are so important is that they address the underlying causes of behavior at a level that patterns of behavior **can be changed**. Structure produces behavior, and changing underlying structures can produce different patterns of behavior. In this sense, structural explanations are inherently generative. Moreover, since structure in human systems includes the "operating policies" of the decision makers in the system, redesigning our own decision making redesigns the system structure.

The generic structure (also called an archetype) that is most applicable to the org change situation is called "Limits to Growth". In Limits to Growth situations, patterns of growth and limits come together in various combinations. Sometimes growth dominates; sometimes limits dominate. And often the degree of influence shifts back and forth between them.

In this structure, the growth process is usually shown as a virtuous reinforcing loop on the left. The limiting process is usually shown as a balancing loop on the right, which reacts to imbalances imposed on it by the growth loop. The balancing loop is also driven to move toward its own target – a limit or constraint on the whole system, difficult to see because it is so far removed from the growth process.

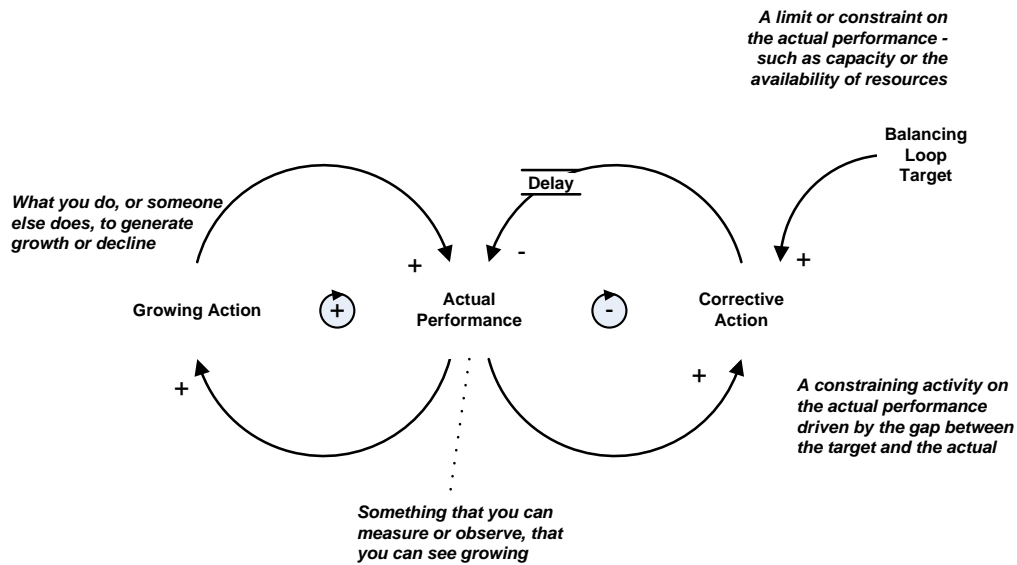


Figure 7: Growth Process with Balancing Loop

Limits to Growth Archetype

In the Dance of Change model there are a number of growth processes for profound change as well as challenges to profound change. The growth processes of profound change include: investment in change initiatives, development of learning capabilities, enhancing personal results, developing networks of committed people, and improving business results. The challenges to profound change fall into 3 categories: the challenges of initiating, the challenges of sustaining transformation, and the challenges of redesigning and rethinking. The challenges of initiating include: not enough time, no help (coaching and support), not relevant, and walking the talk. The challenges of sustaining include: fear and anxiety, assessment and measurement, and true believers and nonbelievers. The challenges of redesign and rethinking include: governance, diffusion, and strategy and purpose.

The Limits to Growth archetype helps us see how the balance between these elements shifts over time. It particularly helps us come to terms with the ways in which, by pushing hard to overcome the constraints on our lives, we make the effects of those constraints even worse than they otherwise would be. We can become aware of the symptoms that are expressions of the way that structure is driving behavior. We can understand the mental models that are behind the way that the organization typically reacts, and we can craft appropriate strategies that give us higher leverage control actions to address the situations that confront us.

CULTURAL ARCHETYPES

In the mid-1980's, after the divestiture of AT&T, work began at AT&T on initiating quality programs. As a quality manager in Network Systems, Marilyn Zuckerman was familiar with the work of Dr. Clotaire Rapaille, "a cultural anthropologist and psychoanalyst turned archetypologist™".⁽²⁵⁾ Dr. Rapaille specialized in exploring the details of different cultures and using those insights to explain and answer why procedures that worked in one country or culture did not work in another.

With Dr. Rapaille's assistance and using his research approach, Zuckerman was able to arrive at an archetype of quality for Americans. This concept of quality, to Americans, is a very strong, emotionally laden construct, "not to be taken lightly" and based on another American concept of second chances.

Americans believe perfection (or doing things right the first time) unattainable and those that achieve perfection are often ridiculed by their peers. Americans also believe that when perfection is achieved, there is nothing else that can be done and that, in a sense, this is death. Americans come out from defeat, or non-perfection, and do it right the second time.⁽²⁵⁾

Rapaille defines the American attitude towards quality as "It Works".⁽²⁶⁾ Americans don't expect perfection. Getting it good enough is good enough and moving beyond that tends to bore those tasked with the effort.⁽²⁵⁾

Christine Robinson, in 2010, reviews these studies⁽²⁷⁾, and later ones, in a discussion of how these archetypes can be used by organizational leaders to bring success to their organizations.

We believe that it will be important to take these archetypal ideas into our work with modeling successful cultures that will have the greatest impact on quality programs.

CONCLUSION

While we have covered almost a dozen different tools that can be used to model or predict organizational style and change, there are significant models that have been left out due to space constraints. These include Open Systems Theory (1966), Nadler and Tushman's Congruence Model for Organizational Analysis (1977), Tichy's Technical Political Cultural (TPC) Framework (1983), and Harrison's model for Diagnosing Individual and Group Behavior (1987).⁽¹⁾

The literature leads us to believe that the problem we've chosen to address is important. Systems dynamics appears to provide a terrific theoretical framework for building the test bed and a simulation engine. We're encouraged by this. There is rich literature on related organizational problems and approaches. So we are not starting from scratch.

However, the rich literature is both a curse and a blessing. We don't know what in the literature will prove most useful but will be moving forward with what we have learned from each model.

FUTURE WORK

We are pleased that the literature has revealed a significant number of organizational models that have potential for assisting us with our goal of identifying those social issues that will have the greatest impact on information quality programs. As we proceed with our research, we will continue to research literature for relevant models or other relevant topics. As mentioned earlier, our long-term goal is to create a simulation of how these issues interact with each other and with the goals of an information quality program. We believe that this literature review informed our research and has presented us with several new avenues of exploration.

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